

About the Souvenir / Abstract Book



The **Abstract/Proceedings Book** of the *9th International Conference on “Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development (ABCD–2025)”* stands as a scholarly testament to the spirit of innovation, collaboration, and scientific advancement that defines this global gathering. Hosted by the prestigious **Department of Studies in Botany, University of Mysore, Karnataka, India**, from **November 13–15, 2025**, this publication compiles a rich collection of abstracts and research contributions from eminent scientists, academicians, educators, research scholars, and professionals representing diverse disciplines and institutions from India and across the world. This volume reflects the collective endeavor to address contemporary challenges in agriculture, biology, and biodiversity conservation through knowledge exchange, technological innovation, and sustainable practices. It captures emerging perspectives and transformative ideas that contribute to building resilient ecosystems and promoting human well-being through health-oriented, sustainable agriculture. The **Organizing Committee** extends heartfelt appreciation to the **University of Mysore** for its continuous encouragement and institutional support, and to all distinguished participants, presenters, and contributors whose valuable efforts and academic excellence have enriched this international conference and made it a memorable and meaningful success.



**Rajarshi
Prakashan**
Maharashtra, India

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9th International Conference - ABCD 2025

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University of Mysore
Mysuru, Karnataka, India



ATDS, Ghaziabad
Uttar Pradesh, India

9th International Conference

Advances in Agricultural, Biological and Biodiversity Conservation
for Sustainable Development (ABCD - 2025)

Souvenir / Abstract Book

: Venue :

Conference Auditorium (Vijnana Bhavan)

University of Mysore, Manasagangotri
Mysuru, Karnataka, India



: EDITORS :

Dr. Joginder Singh
Prof. A. P. Garg
Dr. Anant Kumar
Dr. M. Murali

Prof. K. N. Amruthesh
Prof. H. S. Murthy
Dr. D. P. Singh
Dr. Kalpashree M. M.

Souvenir / Abstract Book

9th International Conference

Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development (ABCD - 2025)

◆ Editors ◆

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Rajarshi Prakashan

13-15 November, 2025

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First Edition

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9th International Conference**

Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development (ABCD - 2025)

Editors:

Dr. Joginder Singh, Prof. K. N. Amruthesh, Prof. A. P. Garg, Prof. H. S. Murthy,
Dr. Anant Kumar, Dr. D. P. Singh, Dr. M. Murali, Dr. Kalpashree M. M.

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Vice Chancellor's Message

It is with great pleasure that I extend a warm welcome to all delegates, distinguished speakers, and participants at the 09th International Conference on 'Advances in Agriculture, Biological and Biodiversity Conservation for Sustainable Development', to be held on 13th to 15th November 2025 at the University of Mysore.

The University of Mysore, established in 1916, takes immense pride in being the host for this important event. As one of the oldest and most respected educational institutions in the country, we are committed to fostering academic excellence and providing a platform for the exchange of knowledge that addresses some of the most pressing global challenges today. The pressing need to ensure sustainable development through advances in agriculture, biological sciences, and biodiversity conservation calls for immediate attention from scientists, researchers, and policymakers worldwide. This international conference provides a unique platform to bring together experts from diverse disciplines to share cutting-edge research, innovative technologies, and practical solutions aimed at enhancing agricultural productivity, conserving biodiversity, and promoting ecological balance.

I am confident that this conference will serve as a significant milestone in deepening our understanding of sustainable agricultural and conservation practices. It will also foster collaboration among scientists, industry professionals, environmentalists, farmers, and policymakers to collectively address global challenges and pave the way toward a resilient and sustainable future.

I wish you all a fruitful and inspiring conference and look forward to the valuable discussions and insights that will emerge from this gathering.

- Dr. N.K. Lokanath



Prof. A. Biju Kumar

Vice Chancellor



MESSAGE

It gives me immense pleasure to extend my warm greetings and best wishes to the organizers and participants of the 9th International Conference on “Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development (ABCD-2025)”, being held from 13-15 November 2025 at the University of Mysore.

This prestigious event represents a vital interdisciplinary platform that brings together scientists, academicians, industry leaders, policymakers, and practitioners from around the world to deliberate on the most pressing issues in agriculture, biological sciences, biodiversity conservation, and sustainability. The theme of the conference is both timely and significant, reflecting the growing global emphasis on integrating innovation with ecological responsibility.

In an era marked by rapid technological advancement and climate uncertainty, the need for sustainable, inclusive, and resilient systems in agriculture and natural resource management has never been greater. I am pleased to note that the conference will focus on a wide range of emerging and critical themes – from organic and climate-resilient farming systems to AI, IoT, and precision agriculture, and from ecosystem restoration and biodiversity protection to renewable energy and circular economy solutions.

Such interdisciplinary engagements are essential for translating research into actionable strategies and policy frameworks that directly contribute to achieving the United Nations Sustainable Development Goals (SDGs). They also serve to strengthen linkages between academia, industry, and governance – a collaboration that is key to realizing the vision of a sustainable and knowledge-driven future.

I sincerely appreciate the efforts of the Agricultural Technology Development Society (ATDS), Ghaziabad, and the University of Mysore for organizing this important conference, and KUFOS is pleased to be a partner organisation in this event. I am confident that the discussions and outcomes will inspire innovative collaborations, enhance scientific understanding, and contribute meaningfully to national and global sustainability efforts.

I wish the organizers and all participants a highly productive and enriching conference.

Prof. (Dr.) A. Biju Kumar

Vice Chancellor, KUFOS

Professor S. R. Niranjana

PDF (Denmark), FNASc, FNAAS, FNABS, FKSTA

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Vice Chairman's Message

The Agricultural Technology Development Society (ATDS), Gaziabad, Uttar Pradesh has consistently remained at the forefront of promoting excellence in agricultural research and innovation. By fostering interdisciplinary collaboration and advancing modern approaches in agricultural and biological sciences, ATDS has significantly contributed to strengthening global food security and environmental sustainability. Through its conferences, symposia, and outreach initiatives, the society continues to serve as a vital platform for scientists, academicians, and policymakers to exchange ideas, share research findings, and develop strategies for sustainable and eco-friendly agricultural practices.

This conference embodies that vision by bringing together experts from around the world to share knowledge, address emerging challenges, and explore innovative solutions in agricultural and biological sciences. It promises to play a pivotal role in shaping research directions, advancing sustainable agriculture, conserving biodiversity, and strengthening ecosystem resilience. I am delighted that the University of Mysore is hosting this significant international event, which aligns seamlessly with our commitment to tackling global agricultural and environmental challenges through scientific research and innovation.

I would like to express my deepest appreciation to the ATDS for choosing the University of Mysore as the venue for this International Conference, and I extend my sincere thanks to all the contributors, who have worked tirelessly to make this event a reality.



Dr. S. R. Niranjana

Professor A. H. Rajasab

MSc, PhD

Hon'ble Chairman

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KSTA Chairman's Message

The world today faces unprecedented challenges in agriculture and environmental conservation. Rapid population growth, climate change, soil degradation, emerging plant diseases, and the loss of biodiversity are placing immense pressure on food security and ecosystem sustainability. Addressing these interconnected issues requires urgent attention, innovative solutions, and the adoption of advanced scientific tools and technologies to safeguard crops, conserve biodiversity, and ensure the resilience of our ecosystems.

This international conference serves as a pivotal platform to address these pressing challenges by facilitating experts, researchers, and policymakers from across the globe for greater interaction and discussions. It fosters the exchange of cutting-edge research, innovative solutions, and best practices. By highlighting the application of modern technologies such as Artificial Intelligence, precision agriculture, Quantum technology and biotechnology, the event underscores their potential to boost agricultural productivity, enhance ecosystem resilience, and advance sustainable farming practices.

I commend the Agricultural Technology Development Society (ATDS) and the University of Mysore for hosting this prestigious conference and fostering interdisciplinary collaboration. I am confident that the deliberations and outcomes of this event will make a meaningful contribution to sustainable agriculture, biodiversity conservation, and global environmental stewardship.

- Dr. A.H. Rajasab



MESSAGE

Dr. V.K. Sharma
Senior Scientist

Italian National Agency for New Technologies,
Energy and Sustainable Economic Development

I am happy to know that Department of Studies in Botany, University of Mysore and the ATDS Society, Ghaziabad (U.P.), in association with several renowned institutions and organizations including the Zoological Survey of India (Kolkata), KUFOS (Kochi), UAS (Bangalore, Mandya & Dharwad), KSOU (Mysuru), HNB Garhwal University (Uttarakhand), and SWERI (Giza, Egypt), are jointly organizing 9th International Conference on “Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development (ABCD–2025)” at University of Mysore, Karnataka, India from November 13–15, 2025, The speakers from many countries both Asia and Europe are expected to present their papers during the conference

Increased awareness about the contribution that agriculture makes to sustainable development measured in part by the impacts on conservation of biodiversity. environmental concerns and energy security. providing a clear vision to developing nations in addressing current challenges and promoting newer horizons for science, engineering and technology for a sustainable future are important factors to help improve food security and livelihoods while protecting ecosystems and reduce dependence on conventional energy sources.,

Moreover, conference will provide a platform for the researchers working in the multi-disciplinary field of Engineering, Science and Technology to exchange new ideas and establish relationship to develop, acquire and adopt efficient and cost effective technologies for renewable power generation, as well.,

The International Conference on “Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development will surely provide a forum to the best talents in the academia & research institutions, industry experts, and executives to collaborate and address the current challenges, to seek new windows for discovery and exploration, and to promote the new horizon of science, engineering & technology for a sustainable future. The conference is aimed to promote synergetic partnership between academia and industry and also to showcase the growth of cutting-edge technology developed in recent past.

It is hoped that knowledge sharing and technology display on multiple tracks covering agriculture, biology, biodiversity conservation, Energy and Environment will be a rewarding learning experience for all and provide better opportunities for vibrant global cooperation,

I extend my warm greetings heartiest felicitations to the organizers and the participants and send my best wishes for a successful event.

Dr. V.K.Sharma

Amar P. Garg

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Sect. President-Env. Sci. (2020-23) Indian Science Congress
Former Vice-Chancellor, Shobhit Deemed University, Meerut
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Dated: 03-11-2025



MESSAGE

I am extremely pleased to know that 1000+ papers have been received from a galaxy of scientists across the world to present their research contributions/experiences in 3-day “9th International Conference on **Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development(ABCD-2025)**, being held at University of Mysore, Manasagangtri, Mysuru, 570006, Karnanatak, jointly organized by Agricultural Technology Development Society (ATDS) Ghaziabad, Swami Vivekanand Subharti University, Meerut, J. V. College, Baraut (Baghpat), Uttar Pradesh and several other national and international co-organizers from November 13-15, 2025. The highlights of the conference are keynote addresses by renowned academicians, scientists and industrialists that will provide an opportunity for networking with global professionals. Presentations on innovative research, panel discussions and practices in agriculture, biodiversity and sustainable development will provide an excellent platform for young and senior scientists to exchange their ideas for future endeavors.

Global climate changes and continued biodiversity and huge agricultural technological development for sustainable development are the central theme of the conference. Global warming and increasing population have compelled the scientists and farmers to design and develop various strategies to fill scientific gaps between high and low-income countries. To feed 10 billion population by 2050, we need to increase 56% more food production for which we need 593 million hectare more cultivable agricultural land area with mitigation of 11 Gigatons of greenhouse gases (GHG) and below 2°C of global warming including increased fertile soil, unpolluted clean water for irrigation and with reduced air pollutants to create sustainable life and environment with simultaneous industrial development to compete in the world. The new tariff threat by US and continued geopolitical crisis to become boss of the World has put a new challenge before the global agricultural scientists to improve nutritional quality and quantity of food crops. The topic of International Conference has very rightly been selected by the organizers and the enthusiastic participation of young researchers from all over India and abroad show that it will provide an excellent opportunity to the participants to learn different approaches and strategies to achieve the target of UN to eliminate poverty and hunger by 2030 with sustainable environment and high quality of education. The presence of galaxy of scientists working in various fields of agriculture, environment, biodiversity and sustainable development will facilitate the participants to interact with each other in a beautiful city of Mysore, known for its beautiful history, healthy climate and rich cultural heritage.

As chairman of the conference, I welcome all participants.

Amar P. Garg

Smt. M.K. Savitha K.A.S. (Senior Scale)

Registrar

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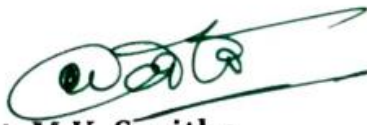
Registrar's Message

In today's rapidly changing world, the challenges of sustainable agriculture, biodiversity conservation, and environmental resilience are more pressing than ever. Jointly organized by the Department of Studies in Botany, University of Mysore, and ATDS, Ghaziabad, Uttar Pradesh, this conference offers a vital platform for experts from diverse fields to come together, share cutting-edge research, and explore innovative strategies to address these critical global issues.

The University of Mysore, with its rich legacy of academic excellence and commitment to scientific advancement, is proud to host this significant event. We are confident that the discussions and collaborations that emerge from this conference will contribute meaningfully to sustainable development goals and foster a stronger, more resilient future for our ecosystems and communities.

This conference promises to contribute meaningfully to addressing global challenges related to agriculture, biodiversity conservation, and environmental resilience. The insights gained and strategies formulated during this event have the potential to significantly influence policies and practices that promote sustainable agricultural productivity, protect vital ecosystems, and enhance the resilience of our natural environment in the face of climate change and other threats.

I extend my best wishes to the organizers and participants for a fruitful and impactful conference that will contribute meaningfully to global sustainability efforts.



Smt. M.K. Savitha

Prof. (Dr) H. Shivananda Murthy
Managing Chairman- ABCD-2025

Dean & Chair Professor
Division of Fisheries Science &
Former Registrar, Dean & Director
Karnataka Veterinary, Animal &
Fisheries Sciences University



Message

I am extremely happy to know that the 9th International Conference on “**Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development (ABCD-2025)**”, will be organized by the ATD Society, Gaziabad, UP at the University of Mysore from 13th to 15th November 2025, in collaboration with the Department of Studies in Botany, Mysore University. I am associated with the conference as Managing Chairman.

In this conference, in addition to covering Agricultural Sciences, Fisheries and Animal Science, Life Sciences, and other areas are covered. Apart from keynote addresses from eminent speakers, a large number of lead papers will be presented. Further, full papers of abstracts submitted by delegates will be presented. There will be best paper and poster presentation awards. Young scientists and other awards will be presented. Several edited books and other publications will also be brought out during the occasion. I know that the conference is organized in hybrid mode and there will be good number of online presentations as well. I believe more than 500 delegates and participants will attend the conference. I am sure the latest developments and recent advances in the identified areas will be discussed and deliberated in the three day conference

Mysore is a beautiful city with rich heritage, having lots of tourist attractions in and around Mysore. The royal Mysore palace built by Krishnaraja Wodeyar family is a place of prime attraction. Participants can utilise the opportunity to explore the important tourist places in and around Mysore. Organising committee will also arrange a free sight-seeing tour on third and last day for the registered participants.

I am happy that I am associated in the organization of this important international conference.

I am sure the participants will have good presentations, discussions and deliberations as well as a comfortable stay.

I wish all the best and success for the conference.

With regards



Prof (Dr) H Shivananda Murthy



Message

A-It gives me immense pleasure to know that the Department of Studies in Botany ,University of Mysore , Karnataka and the ATDS Society , Ghaziabad , Uttar Pradesh , and the Zoological Survey of India ,(KUFOS,UAS ,Mandya and Dharwad) and SWERI , among others ,are jointly organizing a Web International Conference on the topic “Advance in Agricultural ,Biological and Biodiversity Conservation for Sustainable Development (ABCD-2025) Scenario” during November 13-15, 2025. B-The central theme of the conference “Advance in Agricultural, Biological and Biodiversity Conservation for Sustainable Development (ABCD-2025) Scenario” is of global relevance today. The world is facing tremendous pressures on its limited agricultural resources due to the continuous population increase in developing countries, which ultimately led to an environmental imbalance. Therefore, there is a great need for institutional efforts and people's participation to address issues related to preserving natural resources for food security and life in general.

I am sure that this international web conference on “Advance in Agricultural ,Biological and Biodiversity Conservation for Sustainable Development (ABCD-2025)” will focus on the various scientific tracks covering the main areas of research in agriculture and biological and applied sciences and will become a platform for bringing together the global scientific community Including policy makers, administrators, industry representatives and other stakeholders to exchange and share experiences, new ideas, innovative approaches and solutions. During the three days of the conference, prominent speakers, researchers and scholars will cover the topic from different perspectives which will definitely provide appropriate solutions to global issues. I can confidently say that this conference will provide a discussion of practical problems and challenges and present solutions that workers and researchers adopt in their respective fields. The success of this conference will only be on the dedication and efforts of countless people who have worked tirelessly and in every way to make sure that this conference achieves its objectives in its entirety.

I offer my appreciation and best wishes to all the institutions involved in organizing this prestigious international online conference.

I wish this three-day International Conference grand success.

Prof. Attia El Gayar
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Agriculture Research Centre (ARC), Giza, Egypt
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Prof. Dr. Binay Kumar Chakraborty,
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Date: 10.09.2025

MESSAGE

It is my great pleasure to know that the Department of Studies in Botany, University of Mysore, KN, and ATDS, Ghaziabad, in collaboration with different organizations, jointly organized the 9th International Conference on "**Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development** (ABCD - 2025)," with 3 themes, which will be held from November 13 to 15, 2025, at the University of Mysore, Karnataka, India.

The goal of the 17 Sustainable Development Goals (SDGs) set forth by the UN is to guarantee that by 2047, everyone lives well on a healthy planet. Of the seventeen SDGs, nine to ten have benefited directly from aquatic resources. By 2050, the World Bank predicts that there will be nine billion people on the planet (FAO, 2010). Supplying fisheries, crops, fuel, fiber, food, and livestock should not be a simple task. Numerous challenges, such as starvation, malnutrition, ill health, and biodiversity loss, will need to be addressed in the near future. Additionally, these challenges act as barriers to human progress.

Environmental issues, including pollution and climate change, affect the agriculture and fisheries sector, which is vital to impoverished communities. The purpose of this conference is to give scholars a forum to talk about agriculture, fisheries, and livestock sectors. The topics of discussion will include crop improvement, biotechnology, genetic engineering, precision horticulture, agroforestry and the impact of climate change on biodiversity and food security, disease and pest management, crop productivity, animal health, dairy, poultry, and fisheries technology. To decrease the population's dietary requirements for minerals and protein, the conference themes are crucial.

I congratulate Professor Dr. Amar Garg, organizing chairman, and Dr. Joginder Singh, KDS and other members of the entire team for taking up this difficult and significant assignment. I am thus very hopeful that the three days of the conference will be full of thought-provoking debate and discussion that will result in the creation of first solutions to the problems that are currently being discussed.

Finally, it is my hope that the conference will be a great success in achieving its objectives.

(Prof. Dr. Binay Kumar Chakraborty)



NEPAL AGRICULTURAL RESEARCH COUNCIL



Dr. Shree Prasad Vista
Senior Scientist and Chief, National Soil Science Research Centre, NARC
General Secretary, Nepalese Society of Soil Science
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Message

I am very happy to know that ATDS and Department of Studies in Botany, University of Mysore is jointly organizing 9th International Conference on “**Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development (ABCD–2025)**” during November 13-15, 2025 at University of Mysore, Karnataka in association with several renowned academic institutions and research organizations, including the **Zoological Survey of India (Kolkata)**, **KUFOS (Kochi)**, **UAS Bangalore, Mandya & Dharwad)**, **KSOU (Mysuru)**, **HNB Garhwal University (Uttarakhand)**, and **SWERI (Giza, Egypt)**, among others. Agriculture, biology and biodiversity conservation are critical components of human development, providing the foundation for food security, health, and economic growth. However, they are facing a range of challenges, including climate change, land-use change, soil degradation, loss of habitat, etc. Sustainable Development Goals (SDG) set by the United Nations have covered wide range of such challenges but this is the time to critically think and analyse how much of the set goals have been achieved and what sort of contribution has been made by country, state, organization/institution and individual. Address these challenges and explore strategies for achieving sustainable food systems that promote human well-being and environmental health. I hope this conference will have the opportunity to examine challenges and explore strategies for achieving SDG through lively discussions, learnings from cutting-edge research, and sharing experiences and best practices from experts in a wide range of fields, including agriculture, biological science and biodiversity conservation that offer insights into the latest trends and innovations in these arenas.

I encourage all participants to take advantage of this unique opportunity to connect with peers, expand knowledge, and contribute for the sustainable development of the planet earth. Let us work together to create a brighter future for ourselves and for generations to come.

I wish grand success of the conference and wish for healthy society.

Prof. Dilfuza Jabborova
Institute of Genetics and Plant Experimental Biology
Academy Sciences of Uzbekistan



Message

The 9th International Conference on “Advances in Agricultural, Biological, and Biodiversity Conservation for Sustainable Development (ABCD–2025)” is a premier global platform that brings together scientists, researchers, academicians, industry experts, and policymakers to share knowledge, innovations, and practical solutions in the fields of sustainable agriculture, biological sciences, and biodiversity conservation. Scheduled to be held from November 13–15, 2025, at the University of Mysore, Karnataka, India, this conference is jointly organized by the Department of Studies in Botany, University of Mysore and the ATDS Society, Ghaziabad, with collaboration from leading national and international research institutions.

The conference addresses some of the most pressing global challenges of our time, including climate change, ecosystem degradation, soil infertility, water scarcity, and threats to biodiversity. By highlighting advances in agricultural productivity, ecosystem restoration, and biodiversity management, ABCD–2025 aims to provide sustainable solutions that support food security, environmental resilience, and the achievement of Sustainable Development Goals (SDGs). Researchers and scientists can engage in interdisciplinary discussions, present their findings, and learn from the experiences of experts working on similar challenges worldwide.

Participation in ABCD–2025 offers several benefits for researchers and scientists. It provides a platform to share innovative research, gain exposure to emerging technologies, exchange ideas, and establish professional networks. Attendees will have opportunities to present their work through plenary lectures, technical sessions, and poster presentations, allowing constructive feedback from leading experts. It equips scientists and researchers with the tools, insights, and partnerships needed to develop sustainable solutions for global challenges in agriculture, biology, and biodiversity conservation. This conference strengthens the scientific community’s ability to implement practical, impactful strategies for environmental sustainability, food security, and the long-term health of ecosystems.

I sincerely hope that the conference will be a great success and achieve its objectives of promoting knowledge exchange, collaboration, and innovative solutions in agriculture, biology, and biodiversity conservation.



Dr. Dilfuza Jabborova

President
ATDS, Ghaziabad, Uttar Pradesh



Message

It gives me immense pleasure and profound satisfaction to extend a warm welcome to all distinguished delegates, speakers, awardees, and participants attending the **9th International Conference on “Advances in Agriculture, Biological and Biodiversity Conservation for Sustainable Development (ABCD–2025)”**, being held from **November 13–15, 2025**, at the **University of Mysore, Manasagangotri, Mysuru, Karnataka, India**. This prestigious conference is **jointly organized by the Agricultural Technology Development Society (ATDS), Ghaziabad, Uttar Pradesh, and the Department of Studies in Botany, University of Mysore**, in association with several esteemed institutions, including the **Zoological Survey of India, Kolkata; KUFOS, Kochi, Kerala; Department of Environmental Science & SFS, UAS Karnataka; KVK, BF, Hiryur (KSNUAHS), Karnataka; KSOU, Mysuru; HNBGU, Garhwal, Uttarakhand; HSWERI, Giza, Egypt; UAS, Bangalore; UAS, Mandya; NSI, Mysore; G.S. (P.G.) College, Sultanpur, U.P.; and The Neotia University, West Bengal.**

The **ABCD–2025 Conference** serves as a vibrant platform that unites eminent scientists, academicians, policy makers, and research scholars from across the globe to deliberate on emerging trends, challenges, and innovations in the domains of agriculture, biological sciences, and biodiversity conservation. The deliberations and interactions during the conference aim to promote sustainable development by fostering knowledge sharing, academic collaboration, and interdisciplinary exchange of ideas.

I wholeheartedly encourage all participants to actively engage in the scientific sessions, keynote lectures, and discussions that have been meticulously curated to inspire innovation and advance our collective understanding of sustainable agriculture and biodiversity management. Your active involvement will undoubtedly enrich the proceedings and strengthen global scientific cooperation.

I extend my sincere appreciation and gratitude to all our collaborators, organizing committee members, invited speakers, and delegates for their tireless efforts and valuable contributions toward the success of this global event. My special congratulations go to all the **awardees** being recognized for their outstanding achievements and commitment to excellence in their respective fields. I wish everyone a fruitful, inspiring, and memorable conference experience on the serene and historic campus of the University of Mysore.

Dr. Anant Kumar
President
Agricultural Technology Development Society (ATDS)
Ghaziabad, Uttar Pradesh, India

Dr. G.R. Janardhana

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Senior Professor

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Dean's Message

In the current era, where environmental challenges and the need for sustainable development are paramount, this international conference serves as a critical platform for exchanging cutting-edge research, innovative ideas, and best practices in agriculture, biological sciences, and biodiversity conservation. Such interdisciplinary collaboration is vital to addressing the complex issues that threaten our ecosystems, food security, and overall planetary health.

The University of Mysore, with its rich heritage of academic excellence and research leadership, is honored to host this important event. The Faculty of Science and Technology takes great pride in supporting initiatives that advance sustainable development goals through rigorous scientific inquiry and cross-disciplinary engagement.

By fostering knowledge sharing and building partnerships, this conference not only enhances academic understanding but also drives the creation of practical strategies that can be applied at local, national, and global levels. The insights gained here will play a crucial role in shaping policies and practices that safeguard food security, conserve natural habitats, and strengthen ecological resilience for future generations.

I wish this conference proves to be both productive and inspiring, leaving a lasting impact on all those who take part.



-Dr. G.R. Janardhana

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Chairman's Message

Dear Professors, Scientists, ATDS Members, Research scholars and Students,

On behalf of organizing committee, it is my pleasure to extend a warm welcome to each one of you to the 9th International Conference on “Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development (ABCD-2025)” scheduled from November 13th–15th, 2025, at the University of Mysore, Karnataka, India. This esteemed event is being jointly organized by the Department of Studies in Botany, University of Mysore and the ATDS Society, Ghaziabad (U.P.), in association with several renowned institutions and organizations including the Zoological Survey of India (Kolkata), KUFOS (Kochi), UAS (Bangalore, Mandya & Dharwad), KSOU (Mysuru), HNB Garhwal University (Uttarakhand), and SWERI (Giza, Egypt), among others.

The Agricultural Technology Development Society (ATDS) has long been a key driver of scientific research, education, and innovation in agriculture, biological sciences, and biodiversity conservation. University of Mysore which was established in 1916, stands as a distinguished center of knowledge and innovation in India. Department of Studies in Botany boasts a rich legacy of pioneering research, extensive herbarium and museum collections, and a strong commitment to interdisciplinary collaboration and capacity building.

Jointly organized by ATDS and the University of Mysore, this conference reflects their shared commitment to sustainable development by addressing key challenges in agricultural productivity, biodiversity conservation, climate change mitigation, and ecological resilience. Focusing on recent advances in agriculture and biological sciences, the event aims to shape a more sustainable and resilient future, with its outcomes expected to enhance sustainable agricultural and biodiversity conservation strategies globally.

I extend my best wishes for a successful conference and look forward to the valuable outcomes it will generate. Let us join hands to make this conference a remarkable gathering where knowledge blossoms, collaborations thrive and friendship endure.

- Dr. Rajkumar H. Garampalli

Dr. K.N. Amruthesh

MSc, MPhil, PhD, PDF (USA), FNABS, FKSTA, FNASc

Professor and Director

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Organizing Secretary's Message

In the face of growing global challenges such as climate change, biodiversity loss, and the urgent need for sustainable agricultural practices, the three-day 9th International Conference on “Advances in Agriculture, Biological and Biodiversity Conservation for Sustainable Development” marks a significant milestone in the pursuit of ecological resilience and sustainable growth.

This conference is not merely an academic congregation, it represents a vital platform for scientists, researchers, educators, policymakers, and industry professionals to unite in addressing the most pressing issues facing global agriculture and biodiversity conservation. The collaboration between the Department of Studies in Botany, with its rich legacy of research and innovation, and ATDS, known for its commitment to advancing scientific knowledge, provides a unique opportunity to exchange ideas and forge actionable strategies for sustainable development.

By emphasizing cutting-edge research, technological innovation, and integrated approaches to sustainable agriculture and biodiversity management, this conference aims to foster collaboration and inspire transformative thinking among participants. It seeks to empower the next generation of researchers and practitioners to build resilient systems that ensure food security while preserving ecological integrity.

I extend my warmest wishes to all organizers and participants for a successful and thought-provoking conference that will inspire innovative approaches and strengthen our collective commitment to sustainable development and ecological well-being.



-Dr. K.N. Amruthesh

Dr. M. Murali

MSc, PhD, PDF (UOM)

Organizing Secretary - ABCD-2025

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Organising Secretary's Message

The Agricultural Technology Development Society (ATDS) has been at the forefront of advancing research in agricultural sciences and promoting innovations that strengthen global food security. Through its conferences and symposium, ATDS continues to foster scientific progress and provide valuable insights for sustainable and eco-friendly farming. The 9th International Conference on “Advances in Agricultural, Biological and Biodiversity Conservation for Sustainable Development” will undoubtedly play a key role in shaping the future of agricultural research and allied sciences, contributing to global efforts toward protecting crops, biodiversity, and ecosystems.

The University of Mysore, through its Department of Studies in Botany, has a rich legacy of excellence in plant sciences. Our researchers are actively engaged in innovative studies addressing current challenges in plant pathology, agricultural technology, and environmental sustainability. Hosting this prestigious event as Organizing Secretary is an honor, and it aligns perfectly with our vision to advance scientific research through collaboration and innovation.

I sincerely thank the Agricultural Technology Development Society (ATDS) for choosing the University of Mysore as the venue and extend my gratitude to all contributors and organizers for their dedicated efforts. I am confident that the deliberations at this conference will generate meaningful outcomes toward achieving sustainable agriculture and biodiversity conservation.

A handwritten signature in black ink, appearing to read 'M. Murali'.

- Dr. M. Murali

Dr. D. P. Singh
Convener, ATDS, Ghaziabad



Message

It is with great pleasure and enthusiasm that I extended a warm welcome to all participants of the 9th International Conference on “Advances in Agriculture, Biological and Biodiversity Conservation for Sustainable Development” (ABCD-2025), being held from November 13-15, 2025 at University of Mysore, Manasagangotri, Mysuru, Karnataka, India. This prestigious conference is jointly organized by the Agricultural Technology Development Society (ATDS), Ghaziabad, Uttar Pradesh, and the Department of Studies in Botany, University of Mysore In Association with Zoological Survey of India, Kolkata; KUFOS, Kochi, Kerala; Dept. Of ES. & SFS UAS, Karnataka; KVK, BF, Hiriyur (KSNUAHS) Karnataka; KSOU, Mysuru, Karnataka; HNBGU, Gharhwal, Uttarakhand; HSWERI Giza Egypt; UAS, Bangalore, Karnataka; UAS Mandia, Karnataka; NSI Mysore, Karnataka; G. S. (P.G.) College, Sultanpur, UP; and The Neotia University, WB.

The ABCD-2025 Conference brings together distinguished scientists, academicians, policy makers, and research scholars from across the globe to deliberate on recent advancements and innovative approaches in agriculture, biological sciences, and biodiversity conservation aimed at achieving sustainable development, this platform provides an opportunity to share knowledge, strengthen collaborations, and discuss practical strategies that integrate science, innovation, and sustainability. I encourage all participants to actively engage in the diverse session, keynote lectures, and discussions thoughtfully designed to inspire meaningful academic dialogue and exchange of ideas. Your active participation will enrich this event and contribute significantly to advancing scientific understanding and global cooperation in these vital areas.

I express my heartfelt gratitude to all our collaborators, speakers, participants, and organizing committee members for their invaluable efforts and contributions. I also take this opportunity to congratulate all the awardees for their achievements and commitment to excellence.

Wishing everyone a productive inspiring, and memorable conference experience at the beautiful campus of the University of Mysore, Manasagangotri, Mysuru, Karnataka

Warm regards,

(Dr. D. P. Singh)

Convener, ATDS, Ghaziabad

9th International Conference (ABCD-2025)

University of Mysore, Manasagangotri, Mysuru, Karnataka

**Message from the Secretary
ATDS, Ghaziabad, Uttar Pradesh**



It is with immense pleasure that I extend my heartfelt greetings and a warm welcome to all the eminent delegates, invited speakers, awardees, and participants joining the 9th International Conference on “Advances in Agriculture, Biological and Biodiversity Conservation for Sustainable Development (ABCD–2025)”, scheduled to be held from November 13–15, 2025, at the University of Mysore, Manasagangotri, Mysuru, Karnataka, India. This international gathering is a proud initiative of the Agricultural Technology Development Society (ATDS), Ghaziabad, Uttar Pradesh, and the Department of Studies in Botany, University of Mysore, organized in association with a distinguished group of national and international institutions. Their collective support and academic collaboration have been instrumental in shaping this multidisciplinary platform dedicated to innovation, research excellence, and sustainable development.

The ABCD–2025 Conference aims to bring together leading scientists, academicians, researchers, and policymakers from across the globe to share their insights and findings in the fields of Agriculture, Biological Sciences, and Biodiversity Conservation. By facilitating discussions on current challenges, research innovations, and practical solutions, this conference endeavors to inspire sustainable strategies that align science with societal and environmental needs. As Secretary of ATDS, I take immense pride in witnessing the dedicated efforts of our organizing team, collaborators, and contributors who have worked tirelessly to make this event a grand success. I also take this opportunity to express my sincere gratitude to all keynote speakers, session chairs, and participants for their valuable involvement, and to congratulate the awardees for their remarkable accomplishments and contributions to scientific advancement.

I am confident that the deliberations and exchanges during **ABCD–2025** will open new avenues for collaboration, strengthen research networks, and contribute meaningfully to global efforts toward sustainable agricultural and biological systems. Wishing you all an intellectually enriching, inspiring and memorable experience amidst the academic ambience of the University of Mysore.

Dr. Joginder Singh
Secretary
Agricultural Technology Development Society (ATDS)
Ghaziabad, Uttar Pradesh, India

Keynote / Lead Speakers

9th International Conference ABCD – 2025

University of Mysore, Karnataka (13-14 November, 2025)

We are honored to invite you to attend the **9th International Conference ABCD – 2025**, this prestigious event will bring together global experts and thought leaders to explore and discuss the conference's central themes. We are proud to present our lineup of **Keynote and Lead Speakers**, all of whom will be presenting In-person. Their sessions promise to deliver deep insights, innovative ideas, and engaging discussions that will enrich every participant's experience. **Please find the small attached list of confirmed Speakers:**

- 1- **Prof. M. Sanjappa** Former director of Botanical Survey of India Mahatma Gandhi Botanical Garden, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India
 - 2- **Dr. R. R. Rao** FNA, FASc, FNASc, FKSTA, Former Principal Scientist and Director-NBRI, NO. 5014, Prestige Silverdale Apartments, Halanayakana Halli, off Sarjapur Road, Bengaluru, Karnataka
 - 3- **Dr. V. K. Sharma** Senior Scientist, Division of Bioenergy, Biorefinery and Green Chemistry, ENEA Research Centre Trisaia, Rotondella (MT) Italy
 - 4- **Dr. Chakravartula Manoharachary** Department of Botany, Osmania University, Hyderabad
 - 5- **Prof. Binay Kumar Chakraborty** Department of Fisheries, Bangladesh Agricultural University, Bangladesh
 - 6- **Dr. Shree Prasad Vista** Chief, National Soil Science Research Centre, NARC, Kathmandu, Nepal
 - 7- **Dr. Dilfuza Jabborova**, Institute of Genetics and Plant Experimental Biology, Kibray,, Uzbekistan
 - 8- **Dr. Sitmuratova N. U.** National University of Uzbekistan Faculty of Biology and Ecology, Uzbekistan
 - 9- **K. R. Shivanna** INSA Honorary Scientist, Odekar Farms, Nandihalli, Tumakuru Taluk, Karnataka
 - 10- **Prof. Amar P Garg** Former Vice Chancellor & Director Research, Swami Vivekanand Subharti University, Subhartipuram, NH-58, Modipuram-Meerut
 - 11- **Prof. (Dr) H. Shivananda Murthy** Dean & Chair Professor Division of Fisheries Science & Former Registrar, Dean & Director Karnataka Veterinary, Animal & Fisheries Sciences University
 - 12- **A. Y. Hugar**, Professor, Department of Agronomy, College of Agriculture, KSNUAHS, Shivamogga, Karnataka, India
 - 13- **Dr. Devanshu Gupta**, Zoological Survey of India, New Alipore, Kolkata, West Bengal, India
 - 14- **Dr. H. P. Meena**, ICAR - Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad
 - 15- **Dr. Ashoka P**, Professor and Head, Department of Agronomy, College of Agriculture, Hanumanamatti (University of Agriculture Science, Dharwad), Karnataka, India
-

We warmly welcome your in-person participation and look forward to your valuable presence at this academic gathering

Organizing Team ABCD - 2025

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FLORISTIC DIVERSITY IN INDIA: AN OVERVIEW

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The vast geographical, and diverse climate and its location of topographical realms of India have resulted in enormous ecological diversity supporting about 10% of the world's biological diversity on 2.4% of earth's surface making it one of the 18 megadiversity countries in the world. India shares four of the hotspots of plant diversity viz., Himalayan, Indo-Burma, Indo-Sri Lankan and Sundaland with adjoining countries. Adding to this there is a very high diversity of human influenced ecosystems including agricultural and pasture lands and impressive range of domesticated plants and animals. The floral resources of India comprise about 56,177 species. The number of recorded species under major groups is about 22,368 in angiosperms, 83 in gymnosperms, 1325 in pteridophytes, 2850 in bryophytes, 9177 in algae, 3151 in lichens, 15,850 in fungi and 1297 microbes. About 21 % of these recorded species are endemic to India with main centers of endemism in Himalayas, NE India, Western Ghats and Andaman & Nicobar Islands. The NE region with about 130 species of primitive flowering plants is considered as cradle of Indian flowering plants. The natural forest covering about 21.34% of total geographical areas are known repositories of bioresources in the form of food, fodder, fuel, timber, medicines, fibres, resins, tannins, dyes, oils, fruits, vegetables, etc. About 10,000 species of flowering plants have recorded medicinal uses but only about 150 of them are extensively used in indigenous systems of medicine like Ayurveda, Siddha, Unani, Pso-rig-pa (The Tibetan system) and other local health traditions. About 320 species of wild relative of crop plants are known to have originated in India thus India is considered as one of the 8 Vavilovian centres of origin and diversification of cultivated plants called "Hindusthan Centre of Origin of Crop Plants". The rich diversity includes legumes, sugarcane, pepper, citrus, brinjal, banana, mango, jute, ginger, cinnaomum, cardamom, sesame, cucurbits, etc. Within each of them the genetic diversity is tremendous for example rice varieties grown in India are estimated to belong to about 60,000 land races.

PLANT NUTRITION BALANCE, SOIL FERTILITY AND ECONOMIC RETURNS OF INVESTMENTS

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Plant nutrition balance plays a major role in the universal need to increase food production to meet the demands of the growing world population. Fertilizer application resulted in marked crop yield increases, which for most crops were more than hundred. The extent to which fertilizers are used still differs considerably between various regions of the world. Soil nutrient status is widely constrained by the limited use of inorganic and organic fertilizers and by nutrient loss mainly due to erosion and leaching. Many small holder farmers do not have access to synthetic fertilizer because of high price of fertilizers, lack of credit facilities, poor distribution, and other socio-economic factors. Consequently, crop yields are low, in fact decreasing in many areas, and the sustainability of the current farming system is at risk. Therefore, the aim of this review was to review the role of integrated Plant nutrition balance management for improving crop yield and enhancing soil fertility under small holder farmers in dry areas, and recommend the appropriate approaches for enhancing soil fertility and increasing crop yield for small holder farmers in dry and semi-dry areas. These are the key challenges of adoption in the scaling up of such alternative soil fertility management practices to millions of small-scale farmers. There is a need, therefore, for research and extension to sort out issues of adoption and scaling up of the available options. In order to address soil fertility problems, potential synergies can be gained by combining technical options with farmers' knowledge as well as training of farmers and development agent on new soil fertility management approaches. So, the results of this review showed that, the integrated application of organic and inorganic fertilizers improve productivity of crops as well as the fertility status of the soil. The reasons for this are many, which include access or availability of inputs, use of organic resources for other purposes in place of soil fertility, nutrient balancing, collecting, transporting and management of organic inputs and economic returns of investments.

Keywords: Plant nutrition balance, soil fertility, integrated management, economic returns, investments.

BIOLOGICAL DIVERSITY & BIOPROSPECTION FOR ECONOMIC DEVELOPMENT AND HUMAN WELFARE: CONCERNS, STRATEGIES AND CHALLENGES FOR 21ST CENTURY

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Biological diversity refers to the variety and variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystem. This enormous richness of floristic diversity in India is due to the immense variety of the climatic and altitudinal variations coupled with varied ecological habitats. There are almost rainless areas to the highest rainfall area in the world. The altitude varies from the sea level to the highest mountain ranges of the world. The habitat types vary from the humid tropical Western Ghats to the hot desert of Rajasthan; from cold desert of Ladakh and icy mountains of the Himalayas to the long, warm coast line stretches of Peninsular India. Further, the strategic position of the Himalaya has not only drawn numerous elements from the adjacent countries and regions, but also through active speciation, has added many Neo-endemics. The extreme diversity of the habitats has resulted in almost all types of forests, ranging from scrub forest to the tropical evergreen rain forest, and coastal mangrove to the temperate and alpine floras. The rich biological diversity of the country is discussed with reference to various Bio-provinces such as Trans Himalaya, West Himalaya, East Himalaya, North-East India, Deccan region, Western Ghats, Arid and Semi arid zone, Indian desert, Indian coasts and Andaman and Nicobar Islands. The Himalayan bio geographic zone is the richest and unique botanical region in India and encompasses a broad range of ecological habitats varying from grassy meadows to dense humid evergreen forests; disturbed secondary formations to almost virgin and relict types as in 'Sacred Forests'. A mixture of tropical, temperate and alpine forests each type depicting its own characteristic biodiversity is represented in this region. About 50% of the total number of higher plant species of India occurs in this region which includes nearly 35% of endemic taxa. This region being the 'Sanctuary of Primitive Angiosperms' is considered as the *cradle of Flowering Plants* where some groups of angiosperms have originated and diversified (Takhtajan, 1969; Rao, 1994). Several families in the Himalaya show great floristic diversity both at species and infra specific level and are represented by more than 100 species. Some plants e.g. species of *Christolea*, *Arenaria*, *Thylacospermum*, *Acantholimon*, *Festuca* and *Juniperus* that occur especially in the high alpine meadows in cold desert regions of Trans-Himalaya survive the extreme adverse ecological conditions by special adaptations. Cushion forming plants include species of *Androsace* (Primulaceae), *Saxifraga* (Saxifragaceae), *Rhodiola* (Crassulaceae), *Thylacospermum* and *Arenaria* (Caryophyllaceae). Hundreds of plants aggregate together to form a dense, spherical or globose cushion-like habit. This is an adaptation against severe cold and heavy snowfall during winters. One cushion of *Arenaria* or *Thylacospermum* measuring ca 30cm diam takes as much as 100-150 years. Among the insectivorous plants *Nepenthes khasiana*, *Drosera burmannii*, *D. peltata*, *Utricularia* spp. are of significant interest. *Christolea himalayensis* is reported to be growing at 6300 m, which is the highest altitude known for a flowering plant in the world. On the other end of the spectrum there are some plants with unusual forms in the high alpine areas. These may be 'cushion forming' or 'snow ball' plants or the 'hot house' plants. The 'snow ball' plants, *Saussurea gossypiphora* and *S. graminifolia* (Asteraceae) look like a snow ball due to the dense, white woolly hairs which cover the entire plant and protect from cold wind and snow and keeps warm in day time even if outside temperature suddenly falls. Bees or flies take shelter in the warmth and at the same time pollinate the flowers. The dense woolly hairs that cover the apical meristem act as a sort of thermal insulation. There is yet, another interesting group of 'hot house' plants like the *Rheum nobile* and *Saussurea obvallata* which have their inflorescence sheltered by leafy bracts that can be compared to glasses of a 'hot house'. The flowers open inside the bracts, where the insects also take shelter for warmth and at the same time pollinate the flowers. Investigations on infraspecific diversity and genetic diversity of at least a few commercially important medicinal plants like *Berberis asiatica*, *Bergenia ciliata*, *Illicium griffithii*, *Myrica esculenta*, *Panax pseudo-ginseng*, *Plantago major*, *Saussurea lappa*, *Taxus wallichiana*, *Aconitum chasmanthum*, *Aconitum heterophyllum*, *Coptis teeta*, *Swertia chirayita*, *Swertia ciliata*, *Nardostachys grandiflora*, *Picrorhiza kurroa*, *Podophyllum hexandrum*, *Rheum australe*, *Rheum nobile*, *Valeriana jatamansi* are needed, so as to identify the 'elite' types for popularization and commercial cultivation. Converting the Biological wealth into economic wealth through bio-prospection is another major aspect stressed in the paper.

Bio-prospection and sustainable utilization of medicinal plants is much neglected in India. Biodiversity prospecting, particularly on medicinal plants, aromatic plants, wild food plants, cold tolerant high altitude species of Himalaya etc., can certainly result in some lead/novel molecules of great economic significance. Bio-prospection of some of the high valued medicinal plants like *pseudo-ginseng*, *Coptis teeta*, *Dactylorrhiza sp.*, *Swertia chirayita*, *Nepenthes khasiana*, *Aconitum spp.*, etc. is urgently called for. Bio-prospection for metal tolerant genes in families like Caryophyllaceae, Ceratophyllaceae, Portulacaceae, Tamaricaceae, Salvadoraceae, Thymeleaceae and Fabaceae could lead to discovery of genes/molecules tolerant to heavy metals and thus helpful in environmental bioremediation. Chemical prospecting of the wild aromatic flora belonging to Asteraceae, Lamiaceae, Apiaceae, Rosaceae, Lauraceae, Poaceae can provide some clues for newer potential aromatic crops for the future. Scanning of the entire biodiversity in some shortlisted species (through cross cultural ethnobotanical investigation) particularly at the population level making use of the modern biotechnological tools can be highly rewarding. Bioprospection of tree flora, particularly of Western Ghats, where important antitumor plants like *Aphanamixis polystachya*, *Nothopodytes nimmoniana*, *Mesua nagassarium*, *Semecarpus anacardium*, etc exist, would be rewarding. *Nothopodytes foetida* is shown to contain 0.1% camptothecine, an antitumor/anticancer drug. Camptothecine (0.005%) was earlier found only in *Camptotheca acuminata* (Nyssaceae) occurring in China, whereas our species contains 0.1%, highly promising for treatment of cancer. Another urgent task in this direction relates to the evaluation of intra specific diversity within a given species. Some of these habitat specific populations could be elite-types needing cultivation and commercialization. As the Tropical trees are well known for their variability, Bioprospection/chemoprospection of such medicinally important trees like *Nothopodytes foetida*, *Mesua nagassarium*, *Aphanamixis polystachya*, *Semecarpus anacardium*, *Butea monosperma*, *Hymenodictyon orixense* for commercial isolation of biochemicals and novel molecules could be rewarding. Finally, Prospects and problems of bio-prospection are discussed. 10.5 establishment of an Indian Institute of Intellectual property rights, public awareness in this direction, starting of a journal for Intellectual property are all much needed tasks for future. The role of TKDL (Traditional knowledge digital Library) by Government of India is praiseworthy in this direction.

STRATEGICALLY IMPORTANT ENVIRONMENTAL-FRIENDLY CLEAN ENERGY TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT

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With ever increasing growing environmental challenges, innovative solutions and advances in agriculture and biodiversity conservation are crucial for sustainable development because they support not only food security and economic growth but help protecting the environment, as well. Increased awareness about the contribution that agriculture makes to sustainable development measured in part by the impacts on conservation of biodiversity. Environmental concerns and energy security are of vital importance. Providing a clear vision to developing nations in addressing current challenges and promoting newer horizons for science, engineering and technology for a sustainable future, are important factors that not only help to improve food security and livelihoods while protecting ecosystems but to reduce dependence on conventional energy sources, as well. Advances in agriculture, like precision farming, innovative concept of agrivoltaics has been proved to be helping increase the yields while reducing chemical inputs and environmental damage. Biodiversity is essential for providing ecosystem services like pollination and pest control, which make agriculture more resilient, especially in the face of climate change. Also, important concept of solar farming has big perspectives to benefit society and business more than it has ever been before. The examination proved that farming and PV can be compatible. With partial light transmittance achieved by differentiating solar cell arrangement and placement, not only shading can be achieved but energy demand can be reduced drastically of such agrivoltaics greenhouses. It reduces competition for land and works efficiently too, while providing additional income for farmers. The last point is worth additional emphasis. One of the main reasons why farmers move to solar farming is a guaranteed financial gain and stress-free lifestyle. It has been discovered that PV installation can work along with traditional farming and bring income even if nature's conditions are incompatible grown culture's needs.

Keywords: Environmental-Friendly, Clean Energy, Sustainable Development, Agrivoltaics Greenhouses

CLIMATE RESILIENT CROPS AND AGRICULTURAL PRACTICES FOR SUSTAINABLE DEVELOPMENT

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The global agriculture is under huge crisis from climate change which has caused erratic rain pattern, loss of irrigable water, cyclones, floods and droughts, melting glaciers, rising sea level, global warming, reduced crop productivity, degraded soil fertility, poor quality of nutrients, increasing life threats to human, animals and biodiversity. The cumulative impact of changing climate is the shifting pattern of land use, cultivation of climate resilient crops and the use of sustainable agricultural practices to ensure global food security to feed 10 billion peoples on this earth by 2050. The climate change may reduce 15-25% agriculture income, affecting GDP. The use of climate resilient agricultural practices and crops are recommended globally by the scientists. Policy makers are making adequate changes to counter the challenges posed by climate change. Cultivation of drought tolerant breeds, water and nutrient management for efficient productivity, conservation of soil fertility, use of natural farming, encouragement of biofertilizer and biopesticides are in practice at local and global level to meet the climate challenges. Drought tolerant cultivars of green gram (*Vigna mungo*), chickpea (*Cicer arietinum*), pigeon pea (*Cajanus cajan*), pearl (*Pennisetum glaucum*), finger (*Eleusine coracana*) and jowar (*Sorghum bicolor*) millets have become popular in recent years at global level. Genetic engineering and plant breeding have facilitated the agricultural scientists to produce drought resistant new varieties of corn (*Zea mays*), wheat (*Triticum aestivum*) and rice (*Oryza sativa*). Diverse climate tolerant breeds of livestock and poultry, adapted to specific ecosystem across the world are now choice of farmers. Feeding system as a climate adaptation measure may indirectly improve the efficiency of livestock production. Water smart technologies like furrow-irrigated raised bed, micro-irrigation, rain water harvesting, cover crop method, green house, laser land levelling, alteration of fertilizer and irrigation schedule, adjustment of sowing dates, scientific water conservation, reuse of water, deficit irrigation and drainage management are the climate resilient agricultural practices followed by Indian farmers to produce satisfactory yields even in rainfall deficit warmer years. Reduced tillage, crop rotation, contour farming, and nutrient recharge strategies, application of organic and inorganic fertilizers, addition of farmyard manure, vermicompost, legume crop rotation, and natural degradation of crop residues in the field improve soil organic carbon providing soil functional stability. The Government of India has implemented National Mission of Sustainable Agriculture under National Action Plan on Climate Change, Per Drop More Crop, Pradhan Mantri Krishi Sinchayee Yojana, Paramparagat Krishi Vikas Yojana to meet the climate challenges. Sikkim has been declared as organic State in India. Indian models are taken forward by SAARC countries. Various western countries have already banned the use of several pesticides, particularly systemic ones, as they contaminate the food, water, soil and environment chains. It has seriously disturbed microbial populations leading to non-degradation of crop residues in the soil and the loss of soil fertility. The quality of foods produced under chemically monitored environment is nutritionally poor leading to several health issues due to malnutrition. Hence, organic farming, zero-budget natural farming, integrated pest management, intercropping, biological control, use of bio-fertilizers and bio-pesticides are the better sustainable environment friendly technologies that are safe for human and animal consumptions. The Universities, public and private organizations, farmers, business organizations, NGOs, policy makers need to focus on climate resilient agricultural crops to meet the requirements of 17 SDGs that are based on humanity, social, economic and environmental issues for the welfare of entire population and sustainable earth. The transition from Millenium Development Goals (MGDs) to Sustainable Development Goals (SDGs) has shifted world attention to a path of resilience focused on promoting social and economic welfare of human with sustainable environment and development. Exceptional efforts are required to address and overcome the effects of the pandemic, environmental degradation, political unrest between countries to achieve the sustainable development goals by 2030.

Keywords: Climate Resilient crops, Sustainable development, global warming, natural farming, Floods, Droughts, Biopesticides, Biofertilizers

OVERVIEW OF BIOCHAR RESEARCH IN NEPAL

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Biochar is a carbon-rich product derived from the pyrolysis of organic biomass. It is gaining popularity and attention in Nepal as a sustainable soil amendment and climate mitigation tool. Research conducted over the past decade by National Soil Science Research Centre of Nepal Agricultural Research Council (NARC) has demonstrated the potential of biochar to improve soil fertility, enhance crop productivity, and sequester carbon. Field trials across the Terai and hill regions have shown that biochar application especially when combined with compost, farmyard manure, or chemical fertilizers significantly improves soil physical and chemical properties such as pH, nutrient retention, and water-holding capacity. Commonly used feedstocks include rice husk, sawdust, crop residues, and twigs from fodder trees among many others. Optimal results were generally observed at application rates between 2–10 t/ha by charging with cattle urine. Despite these promising outcomes, Nepal's biochar research remains limited in scale, duration, and regional coverage. Challenges include the lack of standardized production methods, variable biochar quality, and insufficient long-term field data on soil carbon dynamics and economic feasibility. Future research should focus on multi-year, multi-site trials, quality assessment protocols, and cost-effective biochar production systems suitable for smallholder farmers. Integrating biochar into national soil health and climate-resilient agriculture policies could contribute significantly to Nepal's goals of improving soil organic matter (SOM) where Agriculture Development Strategy (2015-2035) envisage to reach national SOM to 4%.

Keywords: Biochar, soil fertility, soil health, soil organic matter, urine charged biochar, etc.

CHANGES IN CHLOROPHYLL AND CAROTENOID CONTENT IN SOYBEAN VARIETIES AND LINES DURING GROWTH

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Soybean (*Glycine max* L.) is a major legume crop cultivated worldwide for its high protein and oil content, making it an important source of food, feed, and industrial products. Its productivity is largely determined by photosynthetic efficiency, which is closely linked to the accumulation of chlorophyll and carotenoids. Photosynthetic pigments play a crucial role in determining the photosynthetic efficiency and overall productivity of crops. This study investigated changes in chlorophyll and carotenoid content in soybean varieties and lines during growth, focusing on chlorophyll a (Chl a), chlorophyll b (Chl b), total chlorophyll (TChl), and carotenoids (Car). At the flowering stage, Sochilmas, Xotira, and Nafis exhibited the highest Chl a contents (2.24 ± 0.17 , 2.14 ± 0.06 , and 2.13 ± 0.28 , respectively), whereas Genetik-1 (1.74 ± 0.19) and BK-84 (1.77 ± 0.12) showed the lowest values. A similar trend was observed for Chl b, with Sochilmas recording the maximum accumulation (0.95 ± 0.15). Total chlorophyll content was highest in Sochilmas (3.19 ± 0.32) and Nafis (2.99 ± 0.48), while Genetik-1 (2.34 ± 0.28) and BK-84 (2.37 ± 0.16) maintained lower levels. Carotenoid content was also superior in Sochilmas (2.60 ± 0.41) and Nafis (2.46 ± 0.57), indicating enhanced photosynthetic capacity. During the pod development stage, pigment concentrations exhibited noticeable changes across genotypes. Sochilmas, Xotira, Nafis, Gen-9, Gen-19, and Gen-26 maintained consistently higher pigment levels for Chl a, Chl b, TChl, and carotenoids. Notably, Sochilmas (Chl a: 2.14 ± 0.22 ; TChl: 3.01 ± 0.45 ; Car: 2.37 ± 0.53) and Gen-19 (Chl a: 2.17 ± 0.14 ; TChl: 3.05 ± 0.27 ; Car: 2.33 ± 0.29) outperformed other lines, demonstrating superior photosynthetic efficiency during reproductive growth. In contrast, Genetik-1 exhibited the lowest pigment concentrations (Chl a: 0.46 ± 0.06 ; Chl b: 0.16 ± 0.03 ; TChl: 0.62 ± 0.09 ; Car: 0.50 ± 0.07), reflecting reduced photosynthetic potential. Overall, the results indicate differences in photosynthetic pigment accumulation among soybean varieties and lines, which are closely linked to their photosynthetic performance and potential productivity. The superior pigment content observed in Sochilmas, Nafis, and Gen-19 suggests that these genotypes could serve as valuable parental lines in breeding programs aimed at improving soybean photosynthetic efficiency and yield. This study underscores the importance of pigment-based evaluation for genotype selection and provides a foundation for future research on optimizing photosynthetic traits in soybean.

Keywords: Soybean, Photosynthetic pigments, Chlorophyll a, Chlorophyll b, Total chlorophyll, Carotenoids

ECOLOGICAL ANALYSIS OF THE VEGETATION COVER OF THE EASTERN CHINK OF USTYURT (REPUBLIC OF KARAKALPAKSTAN)

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The Eastern Chink is located in the north-western part of the Republic of Karakalpakstan, along the eastern escarpment of the Ustyurt Plateau, between the Daūtata-Komsomolsk and Aktykendy zones, bordering the former shoreline of the Aral Sea to the east. The aim of the study was to conduct a comprehensive ecological and geobotanical assessment of the vegetation cover of the Eastern Chink, to determine the floristic diversity, and to identify dominant life forms that reflect plant adaptation to extreme arid and saline environments. As a result of field and analytical investigations carried out during 2020–2023, it was established that the flora of the Eastern Chink is characterised by high ecological heterogeneity and adaptation to salinity and moisture deficit. A total of 309 species of vascular plants were identified, belonging to 7 types, 18 formations, and 68 associations, among which 70 dominant species were recognised: 2 tree species (*Haloxylon aphyllum*, *Crataegus korolkovii*), 12 shrubs, 6 semi-shrubs, and 29 perennial grasses. The highest floristic richness was recorded in the Komsomolsk Kassarma sector, where *Atraphaxis spinosa*, *Lycium ruthenicum*, and *Artemisia terrae-albae* were prevalent. The distribution of plant communities is primarily determined by relief dissection, slope exposure, soil mechanical composition, and groundwater depth. A positive relationship was revealed between terrain dissection and the frequency of phytocenoses. Thus, the Eastern Chink of Ustyurt represents a key zone of floristic differentiation within arid ecosystems, and the obtained results provide a scientific basis for assessing vegetation stability under the ongoing process of regional aridisation.

Keywords: Ustyurt Plateau, Eastern Chink, floristic diversity, arid ecosystems, vegetation mapping, Karakalpakstan, ecological stability

COASTAL AQUACULTURE IN BANGLADESH: A CHALLENGE

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Bangladesh has an inland water area of about 4.72 million ha and almost 118,813 sq. km in the Bay of Bengal. In 2023-24, the fisheries sector contributes 2.53% to the national GDP, 22.26% to the agricultural GDP, and more than 0.91% to the total export earnings. A study was conducted to get an accurate picture of the catch and catch composition of the fish population, using a semi-structured questionnaire, and primary data was collected by focus group discussion (FGD), local ecological knowledge (LEK), and direct interviews with the individuals, publications of the Department of Fisheries, the internet, and related gray literature. The marine production contributed only about 12.53% of total production in 2023–24. A decreasing trend was found from 2021-22 to 2023-24. The increasing total production of prawns and shrimp in the coastal area was recorded from 0.0082 ± 0.03 to 0.3154 ± 0.04 million metric tons between 1983–84 and 2023–24. The regression trend was logarithmic, and the equation was $y = 0.1258 \ln(x) + 0.0005$, where R^2 is 0.9395. Between 2015–16 and 2023–24, the total production of mud crab in the coastal area was noted between 0.0132 ± 0.04 and 0.01078 ± 0.05 million metric tons, respectively. The crab production decreased between 2022-23 and 2023-24. The regression trend was polynomial, and the equation was $y = -0.0002x^2 + 0.0041x - 0.0069$, where R^2 is 0.7667. The potential traditional cultures of sea bass (*Lates calcarifer*) areas are Satkhira-Khulna-Bagerhat and Patuakhali-Barisal-Barguna. The fish farmer collected sea bass fry from the river and prawns and shrimp gher. No other aquaculture of fish species is not developed still now. Fishery resources are facing challenges due to natural and anthropogenic causes, including overexploitation of prawns, crabs, sea bass, and dolphins. An eco-friendly catch should be practiced until hatchery was not established. Developing biological management technology for coastal aquaculture reduces resource declination and enhances production.

Keywords: Marine Ecosystem, Aquatic resources, Aquatic resources management, Anthropogenic, Climate change, Livelihood.

EMERGING TRENDS IN FUNGI: DIVERSITY AND BIOTECHNOLOGY

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Fungal kingdom deals with several species characterized by various forms and applications. Fungi are ubiquitous and cosmopolitan in distribution colonizing diversified habitats including extreme habitats. They play an important role in the eco system functioning as decomposers of plant waste for nutrient cycling. They are also symbionts of plants which include mycorrhizae; their application enhances the plant growth and increases immunity among the plants. Fungi are also known to have utility for mankind since times immemorial in producing food, beverages and medicines. In recent times their role gained recognition in protecting the environment besides their application in industry, pharmaceuticals and agriculture. Fungi have wide range of applications such as the production of enzymes, organic acids, pigments, food and nutrition. In recent time's lot of literature has accumulated on the beneficial aspects of fungi such as their role in hydrocarbon degradation, bioremediation, biofuel production, mycofiltration, mycoproteins and others. However, there are also negative impacts such as the production of diseases on crop and forest plants. Mycotoxin production by fungi has become health hazardous impacting human health. Fungal biotechnology potential to sustainability resulted in the production of materials for textiles; constructing furniture has become important in transportation industry. All these have potential to significantly contribute to the United Nations sustainable development goals. Further fungi have become important in nano technology and biotechnology. In recent times increased use of ITS and multi gene phylogenies and also whole genome sequences lead to the discovery of many new fungi along with morphology and also to resolve taxonomic issues. Metagenomics and other techniques have added strength in enriching biodiversity studies. Increased attention has been paid on human pathogens, endophytic, bioactive molecules, study of biocontrol agents, biofertilizer technologies, myco-nanotechnology and related aspects. Further strengthening of diversified habitats for fungi, mangroves, marine habitats, ecosystem analysis and services culturing of fungi, preparation of monographs, checklist, provision of data bank, and other related aspects need emphasis.

Keywords: Biotechnology, culture collection, Diversity, Fungi, molecular techniques, ad mycotechnology

THERAPEUTIC POTENTIAL OF MEDICINAL PLANTS: TRADITIONAL USES, PHYTOCHEMICAL INSIGHTS, AND STRATEGIES FOR CONSERVATION

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Medicinal plants have been integral to traditional healthcare systems worldwide, serving as a foundation for modern drug discovery and primary healthcare in many developing regions. These plants possess diverse phytochemicals such as alkaloids, flavonoids, terpenoids, phenolics, and glycosides, which exhibit therapeutic potential against a wide range of diseases including diabetes, inflammation, cardiovascular disorders, and microbial infections. Ethnobotanical surveys and pharmacological studies have validated the efficacy of several species, such as *Withania somnifera*, *Curcuma longa*, *Azadirachta indica*, and *Ocimum sanctum*, in modern therapeutics. However, overexploitation, habitat destruction, and lack of sustainable harvesting practices have led to the depletion of many valuable medicinal plant species. Conservation strategies both **in situ** (protected areas, sacred groves, and natural reserves) and **ex situ** (botanical gardens, seed banks, and tissue culture techniques) are crucial for safeguarding this phytodiversity. Integrating traditional knowledge with modern biotechnological tools and sustainable utilization practices can ensure the long-term availability and pharmacological potential of these resources. This study emphasizes the therapeutic importance of medicinal plants, highlights key bioactive constituents, and proposes comprehensive approaches for their conservation and sustainable management to support global health and biodiversity goals.

Keywords: Medicinal plants, phytochemicals, ethnobotany, pharmacological activity, conservation strategies, sustainable utilization

ISOLATION AND IDENTIFICATION OF BACTERIAL STRAINS (PSEUDOMONAS SPP., BACILLUS SPP.) FROM LOCAL ENVIRONMENTS THAT ACCELERATE POLYETHYLENE DEGRADATION

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Plastic pollution, particularly from polyethylene (PE), has become one of the most persistent environmental problems worldwide due to its resistance to natural degradation. Biodegradation using microorganisms offers an eco-friendly and cost-effective alternative to conventional disposal and recycling methods. This study aims to isolate and identify local bacterial strains, specifically *Pseudomonas* spp. and *Bacillus* spp., capable of accelerating polyethylene degradation. Environmental samples such as soil, compost, and waste dumps were collected for bacterial isolation. The selected strains will be identified based on morphological, biochemical, and molecular characteristics. The most effective isolates will be evaluated for their polyethylene degradation potential under controlled laboratory conditions. The results of this study are expected to contribute to the development of sustainable biotechnological solutions for plastic waste management.

Introduction: Polyethylene (PE) is one of the most widely produced synthetic polymers globally, used in packaging, agriculture, and consumer goods. However, its high chemical stability and hydrophobic nature make it extremely resistant to natural degradation, leading to its accumulation in soil and aquatic environments. Traditional disposal methods such as landfilling and incineration contribute to soil contamination, air pollution, and greenhouse gas emissions. Recent advances in environmental biotechnology have revealed that certain microorganisms, including species of *Pseudomonas* and *Bacillus*, possess the enzymatic capability to degrade polyethylene through oxidation and depolymerization processes. These bacteria can colonize the polymer surface, secrete oxidative enzymes, and utilize low-molecular-weight degradation products as carbon sources. Identifying and characterizing efficient local strains adapted to native environmental conditions is crucial for optimizing biodegradation efficiency and developing practical applications for waste treatment. Thus, this study aims to isolate and identify indigenous bacterial strains with exceptional polyethylene-degrading capability. We assess the ecological and economic value of microbial degradation and argue that it can serve as a sustainable, cost-effective strategy to reduce plastic pollution. **Conclusion:** The isolation and identification of polyethylene-degrading bacterial strains from local environments represent a promising approach to addressing global plastic pollution. Utilizing microorganisms such as *Pseudomonas* spp. and *Bacillus* spp. offers an environmentally friendly alternative to conventional waste management practices. By understanding the metabolic and enzymatic mechanisms involved in polyethylene biodegradation, it will be possible to develop effective biotechnological applications for large-scale plastic waste treatment. This research underscores the growing importance of microbial biotechnology in achieving sustainable environmental conservation and waste reduction.

STUDY, SURVEY AND KNOWLEDGE OF TUBERCULOSIS IN DODA ALONG WITH CHALLENGES AND STATUS WITH SPECIAL REFERENCE TO JAMMU AND KASHMIR

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Tuberculosis (TB) is one of the most ancient diseases of mankind and is one the ten major cause of mortality worldwide particularly in developing countries .It is an infectious disease caused by bacteria *Mycobacterium tuberculosis*. It usually affect the lungs but can also affect other organs of body .Inspite of various measures taken to eliminate the TB by Govt .of India by 2025 .The trend of TB cases and drug resistant cases in India is very disturbing .The study presents survey, knowledge, challenges and status of tuberculosis in Jammu and Kashmir with special reference to District Doda where it was observed that still stigma regarding tuberculosis is prevalent in the society.

Keywords: Tuberculosis, India, Jammu and Kashmir, Doda, Drug resistant, Stigma

STUDY OF THE RELATIONSHIP BETWEEN PHYTOCHROME PHOTOACTIVITY AND THE DEGREE OF AUXIN BINDING TO THE RECEPTOR IN COTTON GENOTYPES WITH DIFFERENT WILT RESISTANCE

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One of the main diseases of cotton is verticillium wilt, which leads to significant losses in its yield. Despite numerous studies in the field of phytoimmunity, questions remain open regarding the influence of various endogenous (phytohormones) [Volynets, 1997; Slusarenko *et al.*, 2000; Fu, Wang, 2011] and exogenous (light, temperature, etc.) factors [Volynets, 2013, Akhmedzhanov *et al.*, 2017; Escobar-Bravo *et al.*, 2017] on the induction of various stages of the defense mechanism that determines cotton wilt resistance. There are practically no data on the mutual influence of these factors in the regulation of cotton resistance to wilt. The aim of the work was to study the relationship between the activity of phytochrome and the efficiency of binding of radioactively labeled auxin 3H-IAA to auxin-binding sites in membrane preparations and soluble proteins obtained from hypocotyls of cotton genotypes with different wilt resistance. Correlation dependence between resistance to the causative agent of verticillium wilt and photoactivity of the phytochrome system of cotton, as well as the relationship between the parameters of phytochrome photoactivity and hormone-receptor binding in plants of cotton genotypes with different wilt resistance were revealed. Photoactivity of the phytochrome system and the efficiency of auxin binding to the receptor increase in the series: susceptible-moderately resistant-resistant to verticillium wilt varieties and samples of the Genetic Collection of the Institute of Genetics and Experimental Plant Biology of the Academy of Sciences of the Republic of Uzbekistan. The establishment of a direct relationship between the photoactivity of phytochrome and the level of auxin affinity with its receptor creates the prospect for further advances in the study of phytochrome-phytohormonal interactions in the regulation of cotton plant resistance to the Verticillium wilt pathogen, the fungus *Verticillium dahlia* Kleb.

ISOLATION AND MORPHOLOGICAL CHARACTERIZATION OF ENDOPHYTIC MICROORGANISMS FROM LAVENDER (*LAVANDULA* SPP.)

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Endophytic microorganisms are symbiotic bacteria and fungi that inhabit plant tissues without causing harm and often provide beneficial effects to their host. This study aimed to isolate endophytic bacteria from different vegetative parts of the lavender plant (*Lavandula* spp.) and investigate their morphological characteristics. Plant samples were collected from lavender (*Lavandula* spp.), and to eliminate the epiphytic microflora, the roots, stems, and leaves were surface-sterilized stepwise using 70% ethanol and sodium hypochlorite solutions at different concentrations. The sterilized tissues were inoculated on Nutrient Agar (NA), Meat Peptone Agar (MPA), and Potato Dextrose Agar (PDA) media for endophyte isolation. A total of 39 endophytic bacterial strains were obtained from various plant organs of lavender. Gram staining revealed the presence of both Gram-positive and Gram-negative bacteria. The isolated strains showed morphological diversity in colony shape, color, and growth rate. These endophytic strains may play a significant role in enhancing the lavender plant's tolerance to stress factors, promoting its growth, and strengthening its defense mechanisms. Bioactive compounds, phytohormones, and antifungal substances synthesized by these microorganisms make them promising candidates for improving the agronomic traits of lavender.

Keywords: Endophytes, Lavender, Isolation, Morphological characterization, Bacteria

GLOBAL POLLINATOR CRISIS AND ITS IMPACT ON CROP PRODUCTIVITY AND BIODIVERSITY

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Pollination is the transfer of pollen grains from the anther to the stigma. It is a pre-requisite for fertilization and subsequent fruit and seed development. Fruits and seeds not only determine the yield in most of the crops but are also required for sustenance of biodiversity of wild species. Over 90% of the flowering plants use a range of animals especially insects to achieve pollination (biotic pollination) and the remaining plants use wind or water as pollinating agents (abiotic pollination). There have been overwhelming evidences around the world to indicate a marked decline in the density and diversity of pollinators in recent years leading to 'global pollinator crisis'. This decline is due to a number of interacting factors, largely habitat loss and degradation brought about by human activities and climate change. Pollination is not a major constraint in cereals, which provide largely the calorific value to our diet, as they are wind- and/or self-pollinated. However, productivity in most other crops such as pulses, oil-, fruit- and vegetable-crops, which provide nutritional value to our diet, depends partially or fully on biotic pollinators. Similarly, sustenance of biodiversity of wild species also depends on effective pollination. Western countries have been using managed pollinators such as honeybees, bumble bees and several solitary bees for sustaining pollination in a range of crop species. This eco-friendly technology has not percolated to our country except for apple to some extent. Now managed pollinators are also facing serious problems. The 'global pollinator crisis' has raised serious concern in sustaining crop productivity, nutritional quality and sustenance of biodiversity in the coming decades, particularly in developing countries. As human welfare depends on sustenance of pollinators and pollination services, Western countries are doing extensive research and extension programmes to conserve pollinators. Apart from a range of remedial measures, they are experimenting with vaccination of bees against some of the diseases and devising 'pollinator drones'. In spite of its importance, studies on pollinators and pollination in our country is ignored, particularly by agricultural scientists. We do not have relevant and dependable data as to what is happening to pollinators and pollination services of our crop and wild species. Although Indian Council of Agricultural Research (ICAR) has launched major initiatives to develop 'climate resilient agriculture' to sustain crop productivity, studies on pollinators are missing from these initiatives. One of the reasons for lack of interest in this important field seems to be that pollination is not a part of the curriculum of agricultural Universities of our country either in Undergraduate or Post-graduate courses. Unless serious efforts are made urgently to initiate research and extension programmes to sustain pollination services of our pollinator-dependent crops, it may be difficult even to sustain existing level of crop productivity in the coming decades. Also all our attempts to conserve biodiversity would fail.

INDUCED SPAWNING, FECUNDITY, FERTILIZATION RATE AND HATCHLING RATE OF INDIAN MAJOR CARP CATLA CATLA BY USING SYNTHETIC HORMONE AND CARP PITUITARY EXTRACT

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In the present study during the period June –August 2009 applying the appropriate doses of the hormones ovaprim and carp pituitary extract was studied on the number of eggs/Kg body weight, fertilization rate and hatchling rate at Fish breeding center at Jaikwadi, Paithan Dist. Aurangabad. Fishes were spawned successfully by using appropriate doses of synthetic Ovaprim and carp pituitary extract. The percentage of fertilization ranged (92.00% -95.00%) was found with ovaprim treatment and (69.58% - 85.29%) with pituitary extract treatment. The percentage of hatchling ranged (89.31 – 94.21%) with Ovaprim treatment and (58.82% - 78.82%) with pituitary extract treatment.

Keywords: Synthetic hormone ovaprim Carp pituitary extract Fish breeding center Catla catla

SUCCESS STORY OF INNOVATIVE FARMERS (SHRI DOMAN SHYAME): MUSHROOM PRODUCTION TECHNOLOGY: A REMUNERATIVE ENTERPRISE FOR MARGINAL AND TRIBAL FARMERS OF CHHATTISGARH

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Mushroom cultivation is promoted under the Farmer FIRST Programme by providing training, technical guidance, and critical inputs like spawn and polythene bags to farmers, often focusing on specialty mushrooms like oyster mushrooms. This initiative helps farmers create a profitable supplementary income source through modern, low-investment techniques, as seen in projects where farmers achieved high returns on their initial investment. The program includes support for establishing small-scale mushroom units, ensuring a sustainable enterprise that has especially benefited for rural youth. At present, the total mushroom production in India is approximately 0.13 million tons. More recent data from 2024 and 2026 indicates a significantly higher projected growth rate of around 12.50% CAGR for the Indian mushroom market in the future (2025-2033). Out of the total mushroom produced, white button mushroom share is 73% followed by oyster mushroom (16%), paddy straw mushroom (7%) and milky mushroom (3%). Compared to other vegetables; per capita consumption of mushrooms in India is meagre and data indicates it is less than 100 grams per year. The statement is a factual representation of a specific export data set for the Indian mushroom industry in 2024-2026, detailing revenue, volume, and product type. While a specific, verified report for this exact data is not publicly available, the provided figures of Rs. 7282.26 lacs in revenue from exporting 1054 quintals of white button mushroom in canned and frozen form appear to be an excerpt from a report or analysis, though a similar, slightly older statistic from a 2025 source mentioned lower revenue. Majority of this commercial spawn to the growers is being supplied by the private units and the contribution of public sector organizations in spawn supply was limited to 10% only. In this article we made based on success story of rural youth we are produce mushroom in tribal area under the Farmer FIRST Programme.

Name	: Shri Doman Shyame
Age	: 31 years
Phone	: 7724082959
Education	: 12th
Address	: Bharritola, distt. Mohala-Manpur-Ambagarh Chowki (CG)
Farming Experience	: 02 years
Module	: Enterprise based module
Intervention	: Spawn and mushroom production technology
Focus area	: Income, employment and nutritional security

Mushroom cultivation is a new phenomenon across the world. Commercial production of edible mushrooms represents unique exploitation of the microbial technology for the bioconversion of the agricultural, industrial, forestry and household wastes into nutritious food (mushrooms) and feed. These are important source of quality protein, minerals and various novel compounds of medicinal value, do not compete for land and have very high productivity per unit area and time. Chhattisgarh is also a major player in mushroom production in wake of availability of plenty of agricultural residues. Mushroom is very much liked by the tribal peoples of our state. There are 03 training programmes were organized in which 55 farmers were benefited on Mushroom Cultivation and Spawn Production Technology as results of training programme 05 farmers were started mushroom cultivation. Scientist given a training in different step for mushroom production under Farmer FIRST Project

Substrate Preparation: Mushroom was grown on various substrates viz., paddy straw, Wheat straw, vegetable plant residues etc. Since paddy straw is easily available and cheap, it is widely used. Paddy straw used was fresh and well dried.

Soaking: Wheat and paddy straw were chopped into 3-5 cm pieces and soaked in fresh water for 8-16 hours. Excess water from straw was drained off by spreading it on filter paper.

Heat Treatment: Heat treatment of substrate results in minimizing contamination problem and gives higher and almost constant yields. It can be done by pasteurization.

Pasteurization: Water was boiled in a wide mouth container such as tub or drum. The wet substrate was filled in gunny bags. The filled bag was dipped in hot water of 80-85°C for about 10-15 minutes. To avoid floating, it was pressed with some heavy material or with the help of a wooden piece. After pasteurization, excess hot water was drained off from container so that it can be reused for other sets & hot water temperature was maintained at 80-85°C for all sets to achieve pasteurization.

Spawning: When the pasteurized substrate had cooled down to room temperature, it was ready for filling and spawning. At this stage, substrate moisture content was about 70%. Polythene bags (35 x 50 cm, 150 gauges) or polypropylene bags (35 x 50 cm, 80 gauges) were used for its cultivation. One 500 ml bottle spawn (200-250 g) can be used for 10-12 kg wet straw (3 bags). Spawning can be done in layer spawning or through spawning. In case of layer spawning, substrate was filled in bag, pressed to a depth of 8-10 cm and broadcasted with a handful of spawn above it. Similarly, 2nd and 3rd layers of substrate were put and simultaneously after spawning, the bags were closed. After spawning, pasteurized straw was mixed with 2% spawn and filled in bags. After that it was gently pressed, and the bags were sealed for spawn running (development). Spawned bags were stacked on racks in neat and clean place, in closed position. Temperature at 25-35°C and humidity at 70-85% was maintained by spraying water twice a day on walls and floor. It took 15-20 days when bags were fully covered with white and pink mycelium respectively.

Cropping and Harvest: After 20-22 days, when bags were fully impregnated with white mycelium, they were transferred into cropping room and the polythene covers were removed. The open blocks were kept on racks about 20 cm apart with gap of 50-60 cm between two shelves. Mushrooms were grown in a temperature range of 20-33°C. Relative humidity was maintained by spraying water twice a day on the walls and floor of the room. A light spray of water was given on blocks as soon as the small pin heads appeared. Once pinheads were 2-3 cm big a little heavier watering was done on blocks and watering of blocks was stopped to allow them to grow. Mushrooms were plucked before they shed spores to maintain quality. After 1st flush of harvest, 0.5 to 1 cm outer layer of the block was scrapped. This helped to initiate 2nd flush which appeared after 10 days. After harvesting they were packed in perforated (5-6 small holes) polythene bags to keep them fresh. It loses freshness after about 6 hours, which can be enhanced by keeping them in refrigerator. Oyster mushroom can be shed dried for 2 days and dried product marketed in polythene bags. Dried mushrooms were soaked in water for 10 minutes before use.



Monitoring of scientist to cultivation of mushroom

Impact: Mushroom spawn production technology has doubled the input amount within a week of period. Cropping intensity increased by 600% (in oyster mushroom growing under natural conditions) to 1200% (in paddy straw mushroom under controlled). It has enhanced the shelf life and value added to address nutritional security of the tribal's which is heavily malnourished /undernourished. Farmers are earning additional income of Rs. 6,000-15,000 within two months.

Economics: Farmers are earning additional income of Rs. 10,000-18,000 within two- three months.

Table 1. Mushroom Production by rural youth in tribal area

	Technical Observation	Before	After
i	Mushroom	5.3 kg/day	9.5 kg/day
b.	Economic indicators		
i	Cost of cultivation	15 Rs./- kg mushroom production	25 Rs. /- kg mushroom production
ii	Net income	620 /- per day of mushroom	865 /- per day of mushroom
Iii	B:C ratio	1:3.9	1:4.5

Summary: Mushroom cultivation represents one of the economically viable processes for the bioconversion of agricultural and agro-industrial wastes into protein rich food making it a potent weapon against malnutrition in developing countries like India, which consume lowest per capita protein in the world. Edible mushroom production represented an attractive method of improving the nutritional quality of lingo cellulosic wastes. Under Farmer FIRST Programme, scientist were elected rural youth and in this period we are selected 2 group in adopted village namely Bharritola and Chikhali, a rural youth involve training for mushroom and spawn production under Farmer FIRST Programme In this programme create a enterprises for rural youth as well as increase social awareness, medicinal value of mushroom and generate job for tribal areas.

RESPONSE OF QUINOA (*CHENOPODIUM QUINOA* L.) TO DIFFERENT LEVELS OF SPACING AND FERTILIZER LEVELS UNDER UNDER NORTHERN TRANSITIONAL ZONE

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Quinoa (*Chenopodium quinoa* Willd.) is an herbaceous annual plant belongs to family Amaranthaceae. It was originated from the Andean region of South America. Quinoa cultivation is one of the main livelihoods of Andean farmers in South America but no longer restricted to them as it spread to different parts of the world. This is considered as pseudo-cereal crop, as it is a broad leaf plant with starchy dicotyledonous seed and therefore not a cereal. It is a hardy plant which can thrive well under moisture stress and can be grown in marginal soils as well. A field experiment was conducted during *rabi* season for the year 2024-25 under TSP grant at ICAR-Agriculture Research station. Hanumanamatti, Haveri, Karnataka. This zone falls under Northern Transitional Zone (Agro climatic Zone -VIII) of Karnataka. The soils are slightly acidic possessing red sandy loam texture. The experiment was laid out in Split Plot Design and replicated thrice for two consecutive years. The experiment was laid out in Split Plot Design with three different spacing (S₁-30x15 cm, S₂-45x15cm and S₃- 60x15cm) as main plots and three fertilizer levels (F₁- 20:10:10 NPK kg/ha, F₂- 40:20:20 NPK kg/ha and F₃-60:40:40 NPK kg/ha) in sub plots. In total there were nine treatment combinations, which were replicated thrice in split plot design. The results revealed that among different spacing, significantly higher grain yield was recorded with the spacing of 45 x 15cm (2012 kg/ha) which was on par with 30 x15 cm (1765 kg/ha) spacing as compared to wider spacing of 60 x 15cm (1565 kg/ha). Among sub plots, grain yield was significantly higher with the fertilizer level of 60:40:40 NPK kg/ha (1777 kg/ha) but which was on par with fertilizer level of 40:20:20 NPK kg/ha (1687 kg/ha) as compared to the fertilizer level of 20:10:10 NPK kg/ha (1332 kg/ha). Similarly, growth parameters viz., number of branches per plant and panicle length was significantly higher in wider spacing of 60 x15 cm as compared to other spacing. Whereas, plant height significantly higher in narrow spacing of 30 x 15 cm. However, number of branches per plant and panicle length was significantly higher with wider spacing of 60 x15 cm as compared to other spacing. Similarly, maximum net returns and B: C ratio were noticed in fertilizer level of 60:40:40 NPK kg/ha (Rs.145473/ha and 4.98, respectively) which was closely followed by 40:20:20 NPK kg/ha (Rs. 139580/ha and 4.47, respectively).

CLIMATE RESILIENT HIGH SEED AND OIL YIELDING SUNFLOWER HYBRID: TILHANTEC-SUNH-3 (IIOH-434)

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To develop highly heterotic hybrids for achene and oil yield coupled with resistant to major disease and tolerant to major insect pests for commercial cultivation in rainfed conditions is an important breeding goal for sunflower. Sunflower, being a highly cross-pollinated crop is ideally suited for exploitation of heterosis. In view of the growing demand for edible oils in the country, there is an urgent need to develop high yielding hybrids and enhance the productivity suited to rainfed areas of the country. Performance of TilhanTec-SUNH-3 was assessed at 31 locations in Zone-I, Zone-IV and Zone-V, respectively, during the *kharif* season over three years (2021 to 2023) through All India Coordinated Trials. A total of nine quantitative observations were recorded. Across three years and over locations, hybrid IIOH-434 recorded higher seed yield (1737 kg/ha) than national checks DRSH-1 (1445 kg/ha) and KBSH-44 (1563 kg/ha) and qualifying entries KBSH-91 (1654 kg/ha) and RSFH-124 (1655 kg/ha), which is 20.20%, 11.13%, 5.01% and 4.95% higher over DRSH-1, KBSH-44, KBSH-91 and RSFH-124, respectively. Oil yield superiority was 22.48% and 24.53% compared to national checks DRSH-1 and KBSH-44, respectively. Downy mildew disease reaction in sick plot (artificial epiphytotic condition), the hybrid IIOH-434 recorded highly resistance reaction (0%) showed against susceptible reaction recorded by check hybrids KBSH-44 (38.25%) and DRSH-1 (69.45%), respectively. It is also moderately resistant to leafhoppers with 2.4 MSI. A total of 60 SSR primers were used for DNA fingerprinting. Four SSR markers, viz., ORS-127, ORS-203 and ORS-499 can be confidently used for the identification of TilhanTec-SUNH-3 as well as for genetic purity tests. It is recommended by the Central Varietal Release Committee [S.O. 2128 (E); 13/5/2025] for commercial cultivation for both *kharif* and *rabi* seasons under rainfed and irrigated conditions of the sunflower growing states like Uttarakhand, Jammu and Kashmir, Gujarat, Maharashtra and Northern Karnataka, Andhra Pradesh, Southern Karnataka, Tamil Nadu and Telangana. This hybrid can replace the existing popular public and private sector hybrids and will be beneficial for farmers and growers.

Keywords: Achene yield, Downy mildew, Heterosis breeding, Molecular markers, Oil yield

ANTIFUNGAL ACTIVITY OF ENDOPHYTIC YEASTS AGAINST PHYTOPATHOGENS AFFECTING LOCAL GRAPE VARIETIES IN UZBEKISTAN

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Fungal phytopathogens causing grapevine diseases pose a significant threat to viticulture in Uzbekistan, leading to substantial yield losses and reduced fruit quality. Approximately 40% of major crop losses are attributed to plant diseases, resulting in an estimated annual economic loss of approximately 50 million USD. In Uzbekistan, grapevine diseases, particularly powdery mildew and gray mold (*Botrytis cinerea*), can reduce yields by 25–70%, with up to 70% of plants affected, causing damage to leaves, shoots, fruits, and roots. Climate change, notably increased drought and precipitation, exacerbates the spread of these pathogens. This study evaluates the antifungal potential of endophytic yeast strains isolated from local grape varieties, against major phytopathogenic fungi, including *Fusarium oxysporum*, *Aspergillus niger*, *Aspergillus flavus*, and *Penicillium spp.* Seventeen yeast strains were tested in vitro using the disc diffusion method at 28°C for 48 hours. *Meyerozyma sp. 01* exhibited strong inhibitory effects against *Penicillium spp.*, forming inhibition zones of 32–40 mm, while *Metschnikowia sp. 03* produced inhibition zones of 25–30 mm. These strains demonstrated broad-spectrum antifungal activity, indicating their potential as biocontrol agents for sustainable grapevine protection. The findings provide a scientific foundation for developing environmentally friendly biopreparations to extend the post-harvest storage period of grapes and manage fungal diseases in Uzbek viticulture. These yeast strains may also be tested for controlling fungal diseases in other agricultural crops, such as apples and tomatoes. This research contributes to global efforts to reduce reliance on chemical pesticides by advancing sustainable biocontrol strategies.

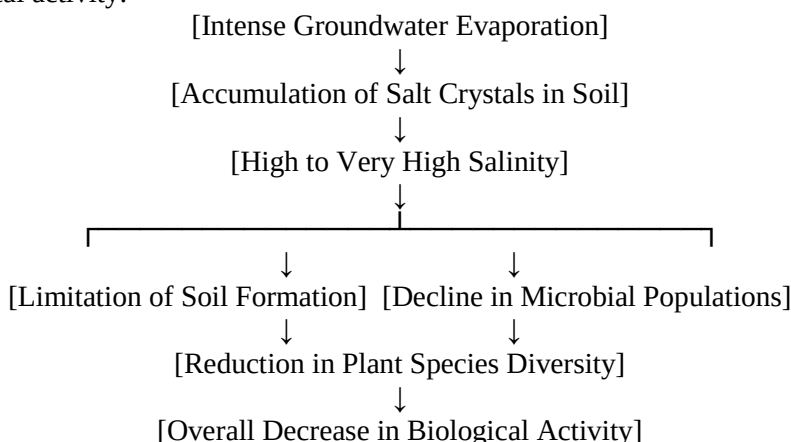
Keywords: endophytic yeasts, antifungal activity, phytopathogenic fungi, biocontrol agents, grapevine diseases

DEVELOPMENT AND FORMATION OF SOILS AND GROUND LAYERS IN THE DESICCATED Aral Sea BASIN

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As a result of the drying of the Aral Sea, vast areas have turned into arid desert landscapes where the gradual formation of soil–ground complexes is still ongoing. The exposed seabed is covered with sand and salt residues, and due to strong winds and sparse vegetation cover, frequent dust storms occur. Consequently, salt and dust particles are lifted into the atmosphere, adversely affecting the health of the local population and agricultural productivity. Secondary salinization of irrigated lands has intensified. According to scientific studies, dust and salt particles lifted from the dried bottom of the Aral Sea can be transported up to 300–400 km away by wind. Therefore, the establishment of protective shelterbelts and the restoration of vegetation cover in the Aral region are scientifically justified measures to reduce wind erosion and atmospheric dust transport. Soil ground formation is a slow and complex process that occurs through the long-term interaction of pedogenic factors. On average, the formation of a 1 cm soil layer may take 100–200 years. Considering that the desiccation of the Aral Sea began in the 1960s, the soils currently developing on the exposed seabed represent newly forming soil–ground systems. Vegetation cover plays a crucial role in this process: plant roots, stems, and leaves decompose to provide organic matter, retain soil moisture, serve as a habitat for microorganisms, and protect the surface from erosion and extreme temperatures. Studies conducted on the dried seabed of the Aral Sea have demonstrated that intense evaporation of groundwater results in the accumulation of salt crystals within sandy desert soils, leading to elevated salinity levels ranging from high to very high. This pronounced salinization acts as a significant limiting factor in soil formation processes, contributing to a decline in microbial populations, a reduction in plant species diversity, and an overall decrease in biological activity.



In conclusion, the study of the limiting factors influencing soil–ground formation in the dried bottom of the Aral Sea requires an integrated scientific approach. Investigating the effects of climatic and soil physicochemical factors, selecting suitable plant species for afforestation, and promoting natural vegetation growth are essential for restoring biological diversity. Implementing ecological measures to prevent the loss of vegetation will accelerate soil formation processes and contribute to the stabilization of the Aral Sea region’s ecosystems. This thesis was carried out as part of the project financed by the Innovation Development Agency of the Republic of Uzbekistan under the project number IL-942411503 titled “Selecting promising plant species suitable for the dried bottom of the Aral Sea and cultivating them using innovative methods, as well as implementing them in practice”.

DOCUMENTATION OF SCARABAEIDAE, LUCANIDAE AND SILPHIDAE (COLEOPTERA) IN THE NYSHI TRIBAL REGIONS OF ARUNACHAL PRADESH, INDIA

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The present study provides a baseline documentation and diversity assessment of selected beetle families (Coleoptera) from the Nyshi-inhabited regions of Arunachal Pradesh, a biogeographically significant part of the Eastern Himalaya. Surveys were conducted between April 2025 and September 2026 across forested areas and village surroundings in five districts (*Papum Pare, Lower Subansiri, East Kameng, Kurung Kumey, and Kra Daadi*). Beetles were systematically collected using light traps, pitfall traps, and manual hand-picking during both day and night sessions. A total of 113 specimens were collected and identified through taxonomic literature and comparison with reference collections at the Zoological Survey of India, Kolkata. The specimens represented 17 species under three families: Lucanidae (Stag Beetles), Scarabaeidae (Scarab Beetles), and Silphidae (Carrion Beetles). The family Lucanidae was represented by *Dorcus reichei reichei* (Hope, 1842), *Kirchnerius spencei spencei* (Hope, 1840), and *Odontolabis cuvera cuvera* Hope, 1842. The Scarabaeidae showed the highest diversity, comprising 12 species, including *Popillia cyanea*, *P. cupricollis*, *Anomala dimidiata*, *Cheironotus macleayi*, *Torynorrhina apicalis*, *T. hyacinthina*, *T. opalina*, *Trigonophorus nepalensis*, *Catharsius molossus*, *Copris magicus*, *C. corpulentus*, *Liatongus gagatinus*, and *Eupatorus hardwickii*. The Silphidae was represented by *Diamesus osculans* and *Nicrophorus antennatus*. This research represents the first systematic documentation of these beetle groups from the specific Nyshi tribal landscapes. The findings highlight the importance of community-linked biodiversity exploration in enhancing the taxonomic knowledge of the entomofauna of Arunachal Pradesh and contributing critical data to the Eastern Himalayan biodiversity hotspot.

Keywords: Coleoptera, Nyshi tribe; Arunachal Pradesh; Eastern Himalaya; Biodiversity assessment.

STUDY OF THE ANTIBACTERIAL ACTIVITY OF PROPOLIS OBTAINED FROM LOCAL HONEY BEES (*APIS MELLIFERA* L.) AGAINST STAPHYLOCOCCUS AUREUS AND ESCHERICHIA COLI STRAINS

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Propolis is a natural resinous substance collected by honey bees from plant sources and enriched with biologically active compounds. The aim of this study was to determine the antibacterial activity of propolis samples produced by local honey bees (*Apis mellifera* L.) against *Staphylococcus aureus* and *Escherichia coli* strains. Ethanol extracts of local propolis were prepared, and their antibacterial effects were evaluated using the disk diffusion method. The results showed that propolis extracts inhibited the growth of both bacterial strains to varying degrees, with *Staphylococcus aureus* showing higher sensitivity. This effect is attributed to the rich content of phenolic and flavonoid compounds in the propolis extract.

Introduction: Propolis contains more than 300 biologically active compounds, including flavonoids, aromatic acids, essential oils, and waxes. These components exhibit antimicrobial properties by disrupting bacterial cell walls, inhibiting protein synthesis, and inducing oxidative stress. *Staphylococcus aureus* is a Gram-positive bacterium, while *Escherichia coli* is Gram-negative, and their structural differences influence their sensitivity to propolis. The chemical composition of propolis produced by local honey bees varies depending on the regional flora and environmental conditions. Therefore, studying its antibacterial activity is important for evaluating its potential use in food safety and as a pharmaceutical raw material. **Conclusion:** The results of the study indicate that propolis produced by local honey bees possesses significant antibacterial properties against bacterial pathogens. In particular, higher inhibition zones were observed against *S. aureus*, demonstrating that propolis is more effective against Gram-positive microorganisms. These findings suggest the potential of local propolis as a natural and eco-friendly antibacterial agent for future biotechnological and pharmaceutical applications.

ANTIBACTERIAL PROPERTIES OF ISOLATED ENDOPHYTIC YEASTS AGAINST OPPORTUNISTIC TEST CULTURES

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Endophytes are microorganisms that live within plant tissues without harming them. Their relationship based on symbiosis: Endophytic microorganisms obtain nutrients, a stable and protected living environment and protection from competition from their host plant while endophytes synthesize phytohormones that support plant growth and development. Moreover, their secondary metabolites possess antibacterial, antifungal, anti-inflammatory, and antioxidant properties. The most common endophytes have been identified as fungi and bacteria. However, recent studies have demonstrated that endophytic yeasts also play an important role. They are emerging as promising sources of bioactive compounds with potential applications in biotechnology, agriculture, and medicine. The advantage of endophytic yeasts is that their cultures are easier to grow and can be preserved for a longer period compared to endophytic bacteria and filamentous fungi. This study aimed to isolate endophytic yeasts from the fruits, flowers and leaves of local plants of Uzbekistan and evaluate the antibacterial activity of several strains. Samples were surface sterilized and cultured on wort agar to isolate endophytic yeast strains. The purified isolates were identified based on morphological and further confirmed through molecular methods. Antibacterial activity of the yeast isolates was assessed against opportunistic bacterial test cultures, including *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, using the agar well diffusion method. Several yeast isolates exhibited significant inhibitory effects against both Gram-positive and Gram-negative bacteria. The results indicate that endophytic yeasts associated with local flora of Uzbekistan possess notable antibacterial potential, likely due to the production of secondary metabolites. These findings suggest that endophytic yeasts can serve as alternative natural sources of antimicrobial agents.

Keywords: endophytic yeasts, secondary metabolites, antibacterial activity, opportunistic bacteria, agar well diffusion

MANAGEMENT STRATEGIES OF INSECT PESTS OF CAULIFLOWER (*BRASSICA OLERACEA* VAR. *BOTRYTIS*)

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Studies on management strategies of insect pests of Cauliflower in district Gurugram (Haryana) was carried out during two Rabi crop seasons. Hence, survey was carried out in the infested area covering four different blocks i.e., Pataudi, Farukhnagar, Sohna and Gurugram. It was found that Cauliflower crop was damaged by many insects such as Tobacco caterpillar, Diamondback moth, Stem borer, Cauliflower aphid, Mustard aphid, Leaf webber and Painted bug. The study revealed that Diamondback moth (*Plutella xylostella*) population appeared in second week of October and gradually reached up to maximum level of 8.33-8.67 diamondback moth larvae/05 plants during second- third week of December in both years. However, Tobacco caterpillar (*Spodoptera litura*) population appeared in fourth week of October and gradually reached to maximum level of 2.90 - 3.42 tobacco caterpillar larvae / 05 plants during third week of December in both years. 6 integrated pest management (IPM) modules against Diamondback moth and Tobacco caterpillar involving the ecofriendly components i.e. bio-pesticides and /or botanical pesticides was taken in field experiments besides control (Module-7). Pooled data of Diamondback moth and Tobacco caterpillar larvae revealed that on 3rd, 5th and 7th days after second application in all the IPM modules were found significantly superior over control. There was substantial increase in Cauliflower yield from 1.45 to 4.70 t/ha in different IPM modules (1- 6) and highest yield obtained in IPM Module-4, 4.70 t/ha. with the cost benefit ratio 1:4.42, comprising spray of Spinosad 45% SC @ 500ml/ha followed by second spray of NSKE 5% @5 ml/l 10 days after first spray and again repeated after 5 days could be applied for getting highest pooled gross income Rs. 202500.00 over control ie. Rs. 155500.00.

NATIONAL UNIVERSITY OF UZBEKISTAN NAMED AFTER MIRZO ULUGBEK

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Biological Characteristics of Endophytic Fungi

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Endophytic fungi represent a diverse group of microorganisms that colonize internal plant tissues without causing apparent disease symptoms. These fungi establish mutualistic relationships with their host plants, residing asymptotically in various organs including leaves, stems, roots, and seeds. The biological characteristics of endophytic fungi encompass their unique colonization strategies, metabolic capabilities, and ecological significance. **Introduction:** Endophytic fungi are ubiquitous organisms found in virtually all plant species examined to date. Unlike pathogenic fungi, endophytes maintain a balanced relationship with their hosts, often providing beneficial services such as enhanced stress tolerance, growth promotion, and protection against herbivores and pathogens. Understanding their biological properties is crucial for agricultural and pharmaceutical applications. **Colonization and Host Interaction:** Endophytic fungi enter plant tissues through natural openings (stomata, lenticels) or wounds, subsequently spreading intercellularly or intracellularly. They possess specialized mechanisms to evade or suppress plant defense responses, allowing asymptomatic colonization. This delicate balance between fungal invasion and plant immunity represents a sophisticated co-evolutionary adaptation. **Metabolic Diversity:** These fungi exhibit remarkable metabolic versatility, producing diverse secondary metabolites including alkaloids, terpenoids, phenolic compounds, and peptides. Many of these bioactive compounds possess antimicrobial, antifungal, anticancer, and antioxidant properties, making endophytes valuable sources for drug discovery and biotechnological applications. **Ecological Functions:** Endophytic fungi enhance host fitness through multiple mechanisms: they improve nutrient acquisition, particularly nitrogen and phosphorus; confer drought and salinity tolerance; produce phytohormones that promote plant growth; and synthesize defensive compounds that deter herbivores and inhibit pathogenic microorganisms. These mutualistic benefits make endophytes potential candidates for sustainable agriculture. **Diversity and Distribution:** Endophytic fungal communities display high taxonomic diversity, with Ascomycota being the dominant phylum. Species composition varies depending on host plant species, tissue type, geographical location, and environmental conditions. This diversity reflects complex ecological interactions and niche specialization. **Conclusion:** Endophytic fungi represent a fascinating example of symbiotic relationships in nature, characterized by sophisticated colonization strategies, diverse metabolic capabilities, and significant ecological roles. Their biological characteristics position them as promising agents for enhancing crop productivity, discovering novel bioactive compounds, and developing sustainable agricultural practices. Further research into endophyte biology will undoubtedly reveal additional applications in medicine, agriculture, and environmental management.

INFLUENCE OF ENDOPHYTES OF HORSERADISH (ARMORACIA RUSTICANA) ON DENTAL PATHOGENS

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Dental caries is an infectious process characterized by the destruction of tooth tissues resulting from the activity of microorganisms inhabiting the oral cavity. These microorganisms decompose carbohydrates, producing acids that cause demineralization of tooth enamel. They often exhibit high resistance to environmental factors and antibiotics. Therefore, there is growing interest in natural antibacterial sources, particularly endophytic microorganisms, for combating dental pathogens. Endophytes are beneficial microorganisms that live inside healthy plant tissues in a symbiotic association with the host plant. They possess several mechanisms of protection against pathogens, including the production of antibacterial compounds, competition for nutrients, and activation of host defense responses. The aim of this study was to isolate pathogenic microorganisms from dental caries-affected tooth samples and to evaluate their interaction with endophytes. The bacteria isolated from the tooth samples were identified based on morphological and biochemical characteristics using MALDI-TOF analysis and were confirmed as *Rothia dentocariosa* and *Staphylococcus aureus*. Endophytes were isolated under sterile conditions from the root, leaf, and stem tissues of healthy horseradish (*Armoracia rusticana*) plants. The interaction between pathogens and endophytes was assessed using the co-cultivation method on Petri dishes. The results showed that certain endophytic strains slowed the growth of pathogens, while others exhibited strong antagonistic effects. This indicates that endophytes possess defense mechanisms against external microbial influences. The obtained findings are of significant scientific value for understanding the interaction mechanisms between microorganisms and for identifying new natural antibacterial sources.

Keywords: dental caries, pathogenic microorganisms, endophytes, microbiology, antibacterial activity.

COMPARISON OF DISEASE SEVERITY BASED ON IMMUNOLOGICAL MARKERS USED FOR THE DETECTION OF COVID-19

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This study investigates the relationship between immunological markers and the clinical severity of COVID-19. The aim is to perform a comparative analysis of immune parameters among patients with mild, moderate, and severe disease manifestations. Immunological profiles, including lymphocyte subsets (CD4+, CD8+, NK cells, B cells), activation markers (HLA-DR, CD95), and cytokine levels, were analyzed to determine their correlation with disease outcomes. The findings demonstrate a significant association between decreased T-cell counts, elevated inflammatory markers, and increased disease severity. This research highlights the potential of immunological markers as prognostic tools for early risk assessment and targeted patient management in clinical practice. **Introduction:** Coronavirus disease 2019 (COVID-19), caused by the SARS-CoV-2 virus, remains a major global health challenge. The clinical course of COVID-19 varies widely, ranging from asymptomatic infection to severe respiratory failure. Understanding the immunological mechanisms underlying disease severity is essential for effective patient management and prognosis. Previous studies have reported immune dysregulation, including lymphopenia and cytokine storm, as key contributors to severe outcomes. This study focuses on the comparative evaluation of immunological markers to identify patterns associated with disease progression and severity. **Research Methods:** A cross-sectional study was conducted on patients with laboratory-confirmed COVID-19. Participants were divided into three groups based on clinical severity: mild, moderate, and severe. Blood samples were collected to assess immunological parameters using flow cytometry and ELISA. Lymphocyte subsets (CD3+, CD4+, CD8+, CD19+, NK cells), activation markers (HLA-DR, CD95), and serum cytokine levels (IL-6, TNF- α , IFN- γ) were measured. Statistical analysis was performed using ANOVA and Pearson correlation to evaluate associations between immunological markers and disease severity. **Research Results:** The analysis revealed a significant decrease in CD4+ and CD8+ T-cell counts in patients with severe disease compared to mild and moderate groups ($p < 0.01$). Elevated IL-6 and TNF- α level were strongly correlated with increased severity ($r > 0.7$). HLA-DR expression showed a marked decline in severe cases, indicating immune suppression. These findings suggest that a combination of reduced T-cell counts and elevated pro-inflammatory cytokines may serve as reliable predictors of poor prognosis in COVID-19 patients.

Keywords: COVID-19, immunological markers, lymphocyte subsets, cytokines, disease severity, immune response, prognostic indicators

CHANGES IN MICROAGGREGATES IN OIL-CONTAMINATED SOILS

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Nowadays, the contamination of soils with various substances leads to changes in their chemical, physical, and biological properties. As a result, soil fertility deteriorates, negatively affecting plant growth and development. In particular, contamination with oil and oil products significantly alters the microaggregate composition of soils. These changes depend on the soil type and the concentration of oil. Experimental studies have shown that when irrigated typical gray soils are artificially contaminated with 10% oil, the quantity of aggregates sized 0.05; 0.25; 1; 2; 3; 5; 7; and 10 mm undergoes significant changes (figure 1). As the table indicates, significant changes occurred in the microaggregate composition after contamination with 10% oil. Notably, the proportion of fine aggregates smaller than 0.25 mm drastically decreased from 20.495% to 0.24%, indicating a disruption in soil structure. Oil particles envelop soil colloids, enhancing their adhesion and leading to the formation of larger aggregates. The share of 1 mm aggregates also decreased from 13.206% to 6.9%, which reflects a reduction in structural stability. On the other hand, the proportion of 2–3 mm aggregates increased from 14% to 24.58% and from 12.506% to 15.024%, respectively. This suggests that due to the oil's effect, certain particles adhered together to form larger aggregates. Additionally, the slight increase in the number of aggregates 5 mm and larger (e.g., 10 mm aggregates increased from 15.021% to 15.175%) demonstrates the cohesive effect of oil particles in the soil. However, such enlargement of aggregates reduces the soil's air and water permeability, worsening the conditions for plant root development. In general, oil contamination alters the microaggregate composition of soil, disrupts its structural stability, reduces fine fractions, and increases the presence of large aggregates. Consequently, the physical properties of soil deteriorate, including its aeration, water absorption capacity, and biological activity.

ADVANCES IN IMPROVING PLANT SALT TOLERANCE

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Soil salinity is one of the major abiotic stresses limiting crop productivity worldwide. In recent years, significant progress has been made in understanding and enhancing plant salt tolerance through physiological, molecular, and biotechnological approaches. Advances in genomics and transcriptomics have identified key genes and regulatory networks responsible for ion homeostasis, osmotic adjustment, and antioxidant defense in plants exposed to salinity stress. Genetic engineering and CRISPR/Cas-based genome editing technologies have enabled the precise modification of salt-responsive genes such as HKT, NHX, and SOS family transporters. These breakthroughs have improved the ability of crops to exclude sodium ions, maintain potassium levels, and reduce oxidative damage under saline conditions. Moreover, the application of beneficial soil microorganisms, including plant growth-promoting rhizobacteria (PGPR) and mycorrhizal fungi, has shown promise in boosting plant resilience by enhancing nutrient uptake and stress signaling. Breeding programs integrating molecular markers and genomic selection are accelerating the development of salt-tolerant crop varieties, and notable progress has been observed in staple crops like rice, wheat, maize, and soybean. Additionally, the use of transcriptome-guided selection and high-throughput phenotyping platforms is helping researchers identify salt-tolerant genotypes more efficiently. Overall, the combination of advanced molecular biology, genome editing, and sustainable agricultural practices is paving the way for developing resilient crops capable of withstanding saline environments. These achievements are crucial for ensuring global food security, particularly in regions where soil salinity is an increasing challenge due to climate change and irrigation practices. **Introduction:** Soil salinity poses a significant constraint to agricultural productivity. Understanding molecular and biotechnological mechanisms for salt tolerance is essential to develop resilient crops. **Methods/Approaches:** Recent advances relied on genomics and transcriptomics to identify salt-responsive genes and regulatory networks. Genetic engineering and CRISPR/Cas-based genome editing targeted transporters (HKT, NHX, SOS) for improved ion homeostasis. Application of beneficial soil microorganisms (PGPR and mycorrhizal fungi) and breeding programs integrating molecular markers and genomic selection were combined with transcriptome-guided selection and high-throughput phenotyping. **Results/Outcomes:** These approaches have enhanced the capacity of plants to exclude sodium, preserve potassium balance, and reduce oxidative damage under saline conditions. Progress has been reported in staple crops including rice, wheat, maize, and soybean, where integrated molecular and breeding strategies have accelerated the development of tolerant varieties. **Conclusion:** Integrating advanced molecular biology, precise genome editing, and sustainable agronomic practices offers a viable pathway to mitigate the adverse effects of soil salinity. Such interdisciplinary strategies are essential to secure crop productivity in saline-prone regions and contribute to global food security.

Keywords: soil salinity; salt tolerance; genomics; CRISPR/Cas; HKT; PGPR

GENOME-WIDE EVOLUTION AND POLYPLOIDY IN BRASSICACEAE

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Polyploidy or whole-genome duplication plays an important role in innovation, and it is broadly distributed across the plant's life, although its long-term evolutionary importance is still arguable. While polyploidy expanded much slower than diploidy, polyploidy has very fast extinction and biological evolution rate. It is also demonstrated, that polyploidy has played a crucial part in the shaping of the current-day differences among species' richness within the *Brassicaceae* family, along with the forthcoming intimations in explaining the pattern of genetic diversity beyond the plant's life. Although the potential role of whole genome duplication in plant evolution remains debatable, there are some evidences that the long-term establishment of polyploidy might be associated with environmental changes, stress conditions, or periods of extinction. The two diploid sub-genomes, i.e., *B. oleracea* and *B. rapa*, known for historical polyploids, still have ancestry of triplicated genome structure, connected from *B. napus* (oilseed rape). However, no evidence of wild canola varieties has been found; its genome evolution has only been artificially manipulated by human needs and agricultural systems. *Arabidopsis* as a model plant, the genomic evolution of the genus *Brassica* (particularly *B. napus*) has been genome-wide explored via polyploidy. A comparative study of *Arabidopsis* and *Brassicaceae* was highly appreciable for some significant traits, i.e., flowering stage and susceptibility against stress to detect candidate genes by sequencing data considering *Arabidopsis* as a reference genome. The positive and close genomic relationships between *Brassica* and *Arabidopsis* anticipate comparing similarities or differences by their sequences and genetic explanation.

Keywords: Evolution, Polyploidy, Gene expression

ROOT SYSTEM ARCHITECTURE OF ZYGOPHYLLUM FABAGO L.

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Zygophyllum fabago L. is an important medicinal plant widely distributed in arid and semi-arid regions, including the southern part of the Kattaqum area, Surxondaryo State Forestry. Traditionally, it has been used for its anti-inflammatory, antimicrobial, antioxidant, and diuretic properties. The plant contains bioactive compounds such as flavonoids, alkaloids, and phenolics, contributing to its pharmacological activity and therapeutic potential. Understanding the morphological and physiological traits of *Z. fabago*, particularly its root system, is essential for its conservation, sustainable use, and cultivation in dryland ecosystems. This study investigated the root system architecture of *Z. fabago* under natural conditions to assess its adaptation strategies and ecological significance. Among the species studied, *Z. fabago* exhibited the shortest root system, reflecting a unique adaptation to semi-arid soils. Detailed measurements revealed a total root length of 45.37 cm, root surface area of 12.16 cm², root projection area of 5.04 cm², root volume of 0.45 cm³, and mean root diameter of 0.38 mm. Such a compact and fine root system likely supports efficient absorption of surface water and nutrients, enabling survival and growth under harsh environmental conditions. These root traits provide insights into the plant's resource-use strategies and drought adaptation. Furthermore, the medicinal value and pharmacological potential of *Z. fabago* were emphasized in this study. The presence of bioactive compounds enhances its anti-inflammatory, antimicrobial, and antioxidant activities, highlighting its importance in traditional medicine. By integrating root morphological data with pharmacological relevance, this study provides a foundation for conservation, sustainable utilization, and cultivation strategies of *Z. fabago* in dryland ecosystems. In conclusion, *Z. fabago* demonstrates ecological resilience and medicinal significance through its root morphology and bioactive composition. The observed root traits enhance water and nutrient uptake, supporting growth under natural conditions. These findings serve as a scientific basis for future studies on sustainable management, pharmacological exploration, and cultivation of *Z. fabago*, emphasizing the integration of ecological and medicinal knowledge for optimal utilization and conservation of valuable plant in arid environments.

Keywords: *Zygophyllum fabago*, Medicinal plant, Root morphology, Total root length, Root surface area.

ENHANCING TOMATO (*SOLANUM LYCOPERSICUM*) YIELD THROUGH TARGETED GENE SILENCING VIA RNA INTERFERENCE

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This thesis explores the potential of RNA interference (RNAi) as a novel molecular approach to improve tomato (*Solanum lycopersicum*) yield by targeted gene silencing. Tomatoes represent one of the most valuable horticultural crops globally, yet their productivity is limited by both genetic and environmental factors. By silencing specific negative regulatory genes through RNAi constructs, the study aims to enhance fruit set, improve stress tolerance, and optimize biomass allocation to reproductive organs. Preliminary findings indicate that RNAi-mediated regulation can result in a 20–25% increase in fruit yield under controlled greenhouse conditions, accompanied by enhanced resistance to biotic stress. These results suggest that RNAi technology holds significant promise for sustainable tomato yield improvement and can reduce the reliance on chemical fertilizers and pesticides. **Introduction:** Tomato (*Solanum lycopersicum*) is one of the most important vegetable crops, widely consumed for its nutritional and economic value. However, tomato production is often constrained by factors such as pathogen infections, abiotic stresses, and suboptimal genetic regulation. Conventional breeding has improved tomato varieties, but molecular tools like RNAi now offer precise control over gene expression. RNAi enables the selective suppression of genes that negatively affect yield and stress response, providing opportunities for targeted crop improvement. **Research Methods:** The study involved literature review, gene selection based on transcriptomic analysis, and development of RNAi constructs for targeted gene silencing. Tomato plants were transformed with RNAi vectors under greenhouse conditions, and parameters such as fruit set, yield per plant, biomass distribution, and stress tolerance were measured. **Research Results:** Experimental results demonstrated that RNAi-mediated silencing of specific regulatory genes enhanced reproductive growth, improved tolerance to fungal pathogens, and increased overall fruit yield by up to 25% compared to control plants. These outcomes confirm the potential of RNAi as an efficient tool in molecular breeding for tomato productivity enhancement. Future directions include optimizing RNAi constructs for field trials and assessing ecological safety for large-scale applications.

Keywords: Tomato, RNA interference, gene silencing, crop yield, biotechnology

SOIL POLLUTION AROUND HOUSEHOLD WASTE LANDFILLS

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This study investigated the accumulation levels, spatial distribution patterns, and ecological risk indicators of heavy metals in soils surrounding a household waste landfill. The results showed that the concentrations of metals in soils near the landfill were several times higher than background values. In recent years, the growth of the population and the increase in consumption has led to a rise in the amount of household waste. The accumulation of pollutants especially heavy metals in soils around landfills has become a serious environmental problem. This process reduces soil fertility and, through plants, allows contaminants to enter the food chain, posing potential risks to human health. The research was conducted in four directions north, south, east, and west around the landfill. Soil samples were collected from the 0–30 cm layer in each direction. The concentration of elements was determined using atomic absorption spectrophotometry. The obtained results were compared with hygienic standards and regional background values. The study revealed that the Clarke concentrations of side reptile elements such as Fe, Co, V, Ga, Mo, and Cr in landfill soils did not exceed the background levels. However, the Clarke concentration of Co was found to be higher in soils located on the western side of the landfill. The data indicate that the Clarke concentration of Co in the western soils is higher than in the northern and southern ones. This can be explained by the prevailing wind direction shifting toward the west, which causes dust and metallic particles from within the landfill to settle more heavily in the western soils. Additionally, the flow direction of groundwater contributes to the higher accumulation of Co in this area. The contents of Ni, Mo, Pt, and Re were unevenly distributed in the soils surrounding the landfill, with their concentrations increasing farther from the landfill. This phenomenon may be attributed to the transport of smoke and fine particles produced by waste combustion, which are carried long distances by wind and deposited in more distant soils. The increased concentrations of Ni and Mo represent the most significant ecological risks for these soils. High concentrations of heavy metals in soils around the landfill indicate clear anthropogenic pollution. The most contaminated areas were identified in the western and northern directions, where the migration of metal ions is more active. To improve the ecological condition of these soils, reclamation and remediation measures should be implemented. Acknowledgments: The authors express their gratitude to the Agency for Innovative Development of the Republic of Uzbekistan and the leadership of the Faculty of Biology, who funded this research under the project AL-8624042553.

STUDY OF THE MORPHOLOGICAL CLASSIFICATION OF SALINE SOILS AROUND THE CEMENT PLANT IN QORAO'ZAK DISTRICT

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The cement plant located in Qorao'zak district has been operating for many years. It is primarily designed for cement production, which results in the emission of various gases that settle on the soil surface and negatively impact the surrounding soils. Observations reveal that the soils in the area exhibit reduced fertility, varying degrees of salt accumulation, and the presence of heavy metals introduced through toxic chemical compounds, all of which have adverse effects on plant life. The area is characterized by non-irrigated sandy takyr soils, typical of arid desert zones, with sparse vegetation adapted to desert conditions. The main pollutant cement dust emitted from the plant settles on the soil surface, altering its color to a bluish-gray hue. The parent materials of the soils are composed primarily of proluvial deposits such as gravel, sand, and other coarse mechanical elements accumulated in foothills and uplands. Additionally, aeolian sediments formed under the influence of varying wind speeds in dry desert climates are also present. **Profile 1:** A soil pit was excavated 200 meters from the cement plant, in the northeastern direction aligned with the prevailing wind direction. The 0–30 cm layer had a light gray color, sandy texture, and was dry. Plant roots and animal traces were observed in the layer. The environmental impact of the pollution source could be visually identified in the field, as dust emissions from the plant formed a thin layer of ash-like dust on the topsoil. The transition to the lower layer was marked by changes in color and moisture content. **Profile 2:** Another soil pit was excavated 1 km away from the cement plant. The 0–30 cm layer was light gray, with slightly increased moisture content compared to the topsoil in Profile 1. It lacked a defined structure and contained few aggregates. The texture was sandy loam, with increased density compared to the upper layers. Numerous plant roots, decayed organic residues, and animal traces were present. Additionally, medium to large white salt crystals were observed. In total, six soil profiles were excavated and analyzed in the laboratory. Based on the findings, it can be concluded that the cement plant has a negative impact on the surrounding soils. The bluish coloration of the soil, disturbed structure, and high carbonate content have all contributed to a decline in soil fertility in the region.

VARIATION OF Na AND Al ELEMENT CONTENT IN SOILS AROUND A HOUSEHOLD WASTE LANDFILL
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This study examines the variations in sodium (Na) and aluminum (Al) concentrations, their spatial distribution characteristics, and ecological significance in soils surrounding a household waste landfill. The primary objective was to assess the extent to which anthropogenic impacts from landfill activities influence the content of these elements in nearby soils. In recent years, urbanization and the increased volume of domestic waste have altered the chemical composition of environmental components, particularly the soil layer, around landfill sites. Lithophile elements, which predominantly occur in silicate minerals, can significantly affect the physical and chemical properties of soils when their concentrations fluctuate. Field research was conducted in four directions north, south, east, and west around the landfill. Soil samples were collected from the 0–30 cm depth at each site. Laboratory analyses were performed using atomic absorption spectrophotometry, and the obtained results were compared with regional background values and hygienic standards. The analysis revealed that Na and Al concentrations deviated significantly from Clarke values, indicating a higher accumulation of these elements compared to other lithophile elements. In contrast, Be and B exhibited relatively low concentrations. Comparative assessment across sampling directions (south, east, north, and west) showed that Na levels were particularly elevated in the western and northern sectors of the landfill, while Al concentrations remained relatively uniform across all sites. These findings suggest that the accumulation of Na and Al is influenced by prevailing wind directions and subsurface water flow, which facilitate the transport and deposition of fine dust and metal particles in adjacent soils. Furthermore, excessive accumulation of Na may enhance soil salinization, adversely affecting its physicochemical structure. Elevated Al concentrations can increase soil acidity, potentially creating toxic conditions for plants. Overall, the results indicate that the concentration of lithophile elements tends to be higher near the landfill and decreases with distance, highlighting the disruption of geochemical balance due to anthropogenic influence. **Conclusion:** The study confirms that sodium (Na) and aluminum (Al) concentrations in soils around the landfill vary significantly by location. Higher levels observed in the northern and western zones reflect the combined effects of wind transport and groundwater migration. Lower concentrations in the eastern and southern areas are likely due to limited waste dispersion and local topographic conditions. These findings demonstrate that landfill activities contribute to soil contamination and geochemical imbalance. Continuous environmental monitoring and soil remediation measures are therefore essential to mitigate the negative ecological impacts. **Acknowledgments:** The authors express their gratitude to the Agency for Innovative Development of the Republic of Uzbekistan and the leadership of the Faculty of Biology, who funded this research under project AL-8624042553.

YOUTH ENGAGEMENT IN AGRICULTURE

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Agriculture remains the backbone of India's economy, contributing around 17% to the national GDP and supporting nearly two-thirds of the population. However, the sector faces a critical challenge declining youth participation. Despite 65% of India's population being under 35, only a small fraction of rural youth view agriculture as a viable livelihood. This study examines the factors behind youth disengagement from farming and explores opportunities and policy interventions to attract and retain them in agriculture. A comprehensive review of secondary data, national programs and case studies was conducted to assess both challenges and success stories across India. Findings reveal that limited access to land, credit, and technology, coupled with low profitability and social stigma, discourage youth involvement. Yet, initiatives like **ICAR's Attracting and Retaining Youth in Agriculture (ARYA)** and **Skill India** demonstrate that targeted training, financial support, and entrepreneurship promotion can significantly improve employment, income, and migration trends. For instance, under ARYA, youth-led enterprises in goat farming, beekeeping and poultry reported an average income increase of 120-160% and higher livelihood security. The study concludes that empowering youth through skill development, agripreneurship and technology-driven approaches is essential for revitalizing Indian agriculture. Sustainable engagement of youth not only curbs rural-urban migration but also ensures food security, innovation, and inclusive rural growth.

Keywords: Youth in agriculture, ARYA project, agripreneurship, skill development, rural livelihood, India

RANGELANDS OF THE NORTHWESTERN KYZYLKUM: STRUCTURE, PRODUCTIVITY, AND ECOLOGICAL RESILIENCE

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This study presents the ecological and structural characteristics of the *Haloxylon ammodendron*–*Halocnemum strobilaceum*–*Halostachys belangeriana* rangeland located in the northwestern Kyzylkum Desert. These rangelands represent a typical arid ecosystem complex formed under conditions of pronounced soil salinity and geomorphological heterogeneity. The vegetation community is dominated by *Haloxylon ammodendron*, *Halocnemum strobilaceum*, and *Halostachys belangeriana*, which act as key edificators stabilizing the saline soils and maintaining the ecological equilibrium of desert landscapes. The study revealed that the average vegetation cover is about 25%, with *Haloxylon ammodendron* contributing approximately 15% and halophytic shrubs (*Halocnemum strobilaceum*, *Halostachys belangeriana*) about 10%. The total area of the studied rangeland is 11,673.1 ha, located across Takhtakupyr, Karaozak, and Muynak districts of the Republic of Karakalpakstan. According to the regional bonitation scale, the rangeland is classified as moderately productive, with a bonitet value of 778 feed units per hectare (77.8 points). Seasonal forage yield varies from 7.5 to 14.0 c/ha, with maximum productivity observed in autumn (14.0 c/ha) and minimum in spring (7.5 c/ha). The average annual yield is 10.4 c/ha. The total forage reserve reaches up to 39.1 c/ha in summer and averages 24.5 c/ha annually. Forage nutritive value fluctuates between 51 and 146 feed units, with the highest nutritional content in spring due to elevated levels of digestible protein. Degradation assessment indicates a moderate disturbance level (31 points), mainly driven by overgrazing, shrub cutting for fuel, and localized salinization. However, the community demonstrates strong regeneration potential and ecological resilience supported by deep-rooted xerophytic species capable of withstanding salinity and aridity stress. The optimal grazing load is estimated at 0.6 sheep units or 0.09 camel units per hectare, ensuring sustainable pasture utilization under arid conditions. The *Haloxylon ammodendron*–*Halocnemum strobilaceum*–*Halostachys belangeriana* Rangeland can be effectively used year-round, particularly during autumn and winter when forage biomass and palatability reach their peak. Overall, this study highlights the structural integrity, moderate productivity, and ecological stability of the *Haloxylon ammodendron*–*Halocnemum strobilaceum*–*Halostachys belangeriana* Rangeland, emphasizing its significance as a valuable component of the natural forage resources in the northwestern Kyzylkum Desert and its potential for inclusion in the national rangeland cadastre and sustainable land management programs.

Keywords: Northwestern Kyzylkum, rangeland, structure, productivity, ecological resilience, degradation.

EVALUATION OF ANTIOXIDANT PROPERTIES IN FRUIT BODIES AND MYCELIAL EXTRACTS OF *COPRINOPSIS CINEREA*, AN EDIBLE COPROPHILOUS MUSHROOM

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Preventive healthcare and the food industry are increasingly focused on developing natural antioxidants, as commonly used synthetic antioxidants face restricted application in foods due to their adverse effects. Mushrooms are well-documented for their antioxidant potential, largely attributed to their ability to neutralize free radicals. In the present study, the antioxidant properties of methanolic extracts derived from fruit bodies and mycelia of the coprophilous mushroom *Coprinopsis cinerea* were evaluated in vitro through assays of total equivalent antioxidant capacity (TEAC), free radical scavenging, reducing power, total phenolics, and total flavonoid content. The results revealed that fruit body extracts exhibited stronger DPPH, ABTS, and H₂O₂ radical scavenging activities (EC₅₀ values: 5.39, 5.72, and 2.82 mg/ml, respectively) compared to mycelial extracts (EC₅₀ values: 7.89, 7.93, and 4.64 mg/ml, respectively). Similarly, fruit body extracts contained higher TEAC (2.04 mg AAE/g DW), phenolic content (2.08 mg GAE/g DW), and flavonoid content (0.71 mg QE/g DW) than mycelial extracts (1.70 mg AAE/g DW, 1.37 mg GAE/g DW, and 0.52 mg QE/g DW, respectively). Pearson's correlation analysis demonstrated a positive relationship between phenolic and flavonoid content with antioxidant activities (DPPH, ABTS, H₂O₂, and TEAC). HPLC profiling identified ascorbic acid, vanillin, gallic acid, butylated hydroxyanisole (BHA), and butylated hydroxytoluene (BHT), while GC–MS analysis revealed 16 volatile compounds, with stearolic acid and succinic acid dimethyl ester as major constituents. Further in vivo studies are warranted to validate the antioxidant potential of *C. cinerea* and to isolate the principal bioactive components responsible for these activities.

Keywords: *Coprinopsis cinerea*, Coprophilous, Mushroom, Antioxidant, HPLC, GC-MS,

MEDICINAL PLANTS AFFECTING LIVER FUNCTION

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Liver diseases are diverse, and among them, inflammatory conditions of the liver and bile ducts such as hepatitis, cholecystitis, and cholangitis are more common. It is known that the liver performs very important functions in the animal body. Firstly, it participates in almost all types of metabolism; secondly, it neutralizes and metabolizes many toxic chemical substances absorbed from the intestine, including drugs; and thirdly, liver cells (hepatocytes) produce bile acids and other components of bile. Bile, in addition to bile acids, contains cholesterol and the pigment bilirubin, with a daily production of 0.5–1 liter. It accumulates in the gallbladder through the bile ducts and is periodically released into the duodenum as needed. This physiological process is related to the passage of acidic food mass from the stomach into the duodenum. In medical practice, most drugs used for liver diseases are either synthesized chemically or prepared from animal bile. These agents generally improve liver function (hepatoprotectors), increase bile secretion, act against the causes of inflammation (microbes, viruses), and have choleric effects. Among them, there are drugs widely used for inflammation that are prepared from local medicinal plants. These agents do not severely affect hepatocytes and do not lead to adverse complications. Most herbal medicines are harmless to the body, which allows their long-term use in chronic liver diseases. Medicinal plants contain various chemical compounds, so their effects may be multifaceted. Choleric agents used for liver and biliary tract diseases are divided into two groups according to their mechanism of action: those that increase bile acid production and those that promote bile flow into the intestine. The use of these drugs in certain doses contributes to hepatocyte regeneration and improvement of liver function. The properties of medicinal plants differ in their effects on liver function. Parsley, celery, dill, and lettuce leaves have tonic and antimicrobial effects. In problems of the gastrointestinal tract, liver, and gallbladder, simple plants such as rosehip, hawthorn, and mulberry fruits are beneficial, being rich in vitamins. Ginseng, plantain, yarrow, horsetail, motherwort, chamomile, quince leaves, thyme, dill, flax seeds, and tansy, among others, exhibit immunostimulatory effects. It is also recommended to eat one tablespoon of honey before bedtime, followed by a glass of warm boiled water. Alternatively, black cumin seeds (*Nigella sativa*) may be crushed, mixed with honey, and consumed daily on an empty stomach in chickpea-sized amounts. The immune system is a unique and complex system that ensures precise processes of identifying microbes, viruses, and protozoa that enter the body through various routes and eliminating them. Medicinal plants play an important role in this function. Their effects on hepatocytes promote the complete regeneration of nucleated cells, leading to full purification of the blood and normalization of liver cell activity. Thus, the role of medicinal plants in detoxifying the body is considered highly significant.

SAFFRON (*CROCUS SATIVUS* L.) BIOTECHNOLOGY: TISSUE CULTURE, BIOACTIVE COMPOUND PRODUCTION, AND MEDICINAL APPLICATIONS

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Saffron (*Crocus sativus* L.) is a highly valued spice, known for its unique aroma, color, and medicinal properties. Cultivated primarily in Iran, India, and Spain, saffron is derived from the dried stigmas of the flower and is considered the most expensive spice by weight. The plant requires specific agro-climatic conditions, including well-drained soil and temperate climates, for optimal growth and high-quality stigma production. Recent studies have focused on improving cultivation techniques, yield enhancement, and the standardization of saffron quality. Analytical methods such as high-performance liquid chromatography (HPLC) and spectrophotometry are widely used to quantify its bioactive compounds, including crocin, picrocrocin, and safranal, which are responsible for its characteristic color, bitter taste, and aroma, respectively. These compounds also exhibit strong antioxidant, anti-inflammatory, and neuroprotective activities, making saffron a valuable nutraceutical and therapeutic agent. Experimental studies have demonstrated its potential in managing depression, cardiovascular disorders, and certain cancers, highlighting its significance beyond culinary applications. Additionally, the development of sustainable cultivation practices and biotechnology approaches, such as tissue culture propagation, is essential to meet increasing global demand while preserving genetic diversity. In conclusion, saffron represents a multifunctional crop with substantial economic, medicinal, and scientific importance. Continued research on cultivation optimization, bioactive compound standardization, and pharmacological applications will contribute to its broader utilization in food, medicine, and industry.

Keywords: Saffron (*Crocus sativus* L.), bioactive compounds, crocin, picrocrocin, safranal, tissue culture, medicinal properties

ECOLOGICAL INDICATOR ANALYSIS OF *FERULA FOETIDA* (BUNGE) REGEL IN UZBEKISTAN

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Investigating the edaphic determinants influencing the distribution of *Ferula foetida* (Bunge) Regel provides a sound scientific basis for understanding species–environment relationships across its habitats. This study aims to identify the key edaphic determinants influencing the distribution and ecological preferences of *F. foetida* (Bunge) Regel across Uzbekistan. Edaphic variables, species cover, and analytical models were applied to characterize the ecological niche of the species. The research encompassed sandy, clayey, and stony habitats distributed across foothill and plain regions. A dataset of 418 observations with 18 edaphic variables, including soil texture, salinity, organic matter, pH, and elevation, was analyzed. Spearman correlation, Redundancy Analysis (RDA), XGBoost SHAP, and Weighted Average (WA) combined with Weighted Percentile Zone (WPZ) were applied to identify ecological gradients and indicator ranges. Spearman correlation assessed the strength of monotonic relationships between *F. foetida* abundance and environmental variables, whereas RDA explored multivariate species–environment associations. XGBoost SHAP revealed the relative importance of predictors, highlighting elevation, soil salinity, clay content, and organic carbon as the most influential edaphic factors. WA and WPZ approaches were used to estimate optimum, minimum, maximum, and amplitude values defining the tolerance limits of the species. Results showed that *F. foetida* prefers moderately elevated terrains (86–343 m; optimum 216 m) with loamy-clayey soils containing 18–28% clay and 36–49% sand. The species grows best in slightly alkaline conditions (pH 7.8–8.1; optimum 7.9) and moderate nitrogen levels (0.95–1.79 cg kg⁻¹; optimum 1.26 cg kg⁻¹). Its abundance increases at low R-horizon probability (9–28%; optimum 18.5%). The ecological amplitude indicated broad tolerance to elevation and soil texture but decline under high salinity or low organic carbon. These results underscore the adaptive capacity of the species to semi-arid soils and delineate the main edaphic thresholds determining its ecological niche across Central Asia.

Keywords: *Ferula foetida* (Bunge) Regel, ecological indicators, ecological niche, environmental factors, Uzbekistan

EVALUATION OF NANO PHOSPHORUS THROUGH SOIL DRENCHING ON GROWTH, YIELD AND PHYTOTOXIC RESPONSE OF MAIZE (*ZEA MAYS* L.)

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A field experiment entitled “Evaluation of Nano Phosphorus through Soil Drenching on Growth, Yield and Phytotoxic Response of Maize (*Zea mays* L.)” was conducted during the summer season of 2023 at the Agricultural and Horticultural Research Station, Kathalagere, Davanagere District, Karnataka. The study aimed to evaluate the effect of Nano Phosphorus on growth and yield of maize and to assess any potential phytotoxic effects. The experiment was laid out in a Randomized Block Design with seven treatments and three replications. Treatments included Nano Phosphorus applied as soil drenching at 5, 7.5 and 10 ml/L, along with reference products of Nano NPK, granular DAP, RDF + Nano NPK and an untreated control. Results revealed that application of Nano Phosphorus significantly enhanced the growth and yield parameters of maize. The treatment T₃ (Nano Phosphorus @ 10 ml/L) recorded the tallest plant (184.6 cm), total dry matter (293.3 g plant⁻¹), cob length (16.3 cm), cob girth (13.7 cm), cob weight (208.7 g) and grain yield (6644 kg ha⁻¹), showing a 123.7% increase over control. Treatments T₂ and T₁ also performed notably well, being statistically comparable to T₃. The lowest performance was recorded in the untreated control (2969 kg ha⁻¹). Phytotoxicity observations recorded at multiple intervals after application indicated no visible symptoms such as chlorosis, necrosis, epinasty or stunting across all tested concentrations. Overall, the study confirmed that Nano Phosphorus applied through soil drenching at 5–10 ml/L is safe and effective in improving the growth, yield and productivity of maize under field conditions, suggesting its potential as a sustainable nano-fertilizer for maize cultivation.

Keywords: Maize, Nano fertilizer, Nano Phosphorus, Growth, Yield, Phytotoxicity

THE MOST WIDELY CULTIVATED VINE CROPS IN THE SOUTH-EASTERN REGIONS OF THE REPUBLIC OF KARAKALPAKSTAN

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The south-eastern regions of the Republic of Karakalpakstan are mainly situated within the lowlands along the Amudarya River, representing one of the zones where irrigated agriculture and melon-growing are highly developed. This geographical region includes the districts of Amudarya, Beruniy, To'rtko'l, Xo'jayli, and Ellikqal'a. These areas constitute the irrigated, fertile, and agriculturally intensive part of Karakalpakstan, where large areas are traditionally allocated for the cultivation of cotton, wheat, vegetables, and vine crops. Analysis of the land resources in the Republic of Karakalpakstan indicates that approximately 45% of the total territory consists of natural pastures used for livestock grazing, while 5–7% represents irrigated arable lands. The remaining portion is occupied by settlements, industrial zones, and natural desert ecosystems. According to the last decade's statistical data and field observations, although the total area of irrigated lands in To'rtko'l, Amudarya, Ellikqal'a, Beruniy, and Xo'jayli districts has remained relatively stable, their meliorative conditions have significantly deteriorated. This degradation is mainly associated with water scarcity, increased soil salinization, reduced drainage efficiency, and intensified evaporation processes due to climate change. Traditionally, vine crops (melon, watermelon, pumpkin, etc.) have played a significant role in the agricultural system of Karakalpakstan, maintaining their importance up to the present time. In To'rtko'l district, large areas are occupied by watermelon, melon, and pumpkin, while in certain years, cucumber and carrot cultivation also covers a considerable area. The Amudarya district has long been recognized as one of the main centers of melon cultivation, particularly famous for its diverse watermelon varieties, with a total cultivated area reaching 8–10 thousand hectares in recent years. In Ellikqal'a district, the combination of a warm climate and sandy soils provides favorable agroecological conditions for vine crops such as melon, watermelon, and pumpkin, with approximately 5–7 thousand hectares sown annually. In Beruniy district, the total area of vegetable and vine crops reaches 6–8 thousand hectares, mainly consisting of cucumber, tomato, melon, and watermelon. Meanwhile, in Xo'jayli district, besides vine crops, leafy vegetables such as spinach, lettuce, and various greens are widely cultivated, and the total area allocated for vine crops averages 4–6 thousand hectares.

ENHANCED ANTIFUNGAL ACTIVITY AND PROMOTION OF GROWTH IN WHEAT THROUGH ZNO NANOCONJUGATES AGAINST SEED-BORNE DISEASES

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Seed-borne fungal pathogens such as *Aspergillus niger* and *A. fumigatus* significantly reduce wheat germination, seedling vigour and yield potential. To address this challenge, a ZnO nanoconjugate was developed through green synthesis approach to enhance antifungal efficacy while minimizing the drawbacks of chemical fungicides. The synthesized nanoconjugate was characterized using TEM, SEM, zeta sizer, and zeta potential analysis, confirming its nanoscale uniformity and stability. *In vitro* assays, including poisoned food and spore germination inhibition tests, demonstrated superior antifungal activity of the nanoconjugate compared to commercial Mancozeb and individual ZnO nanoparticles. *In vivo* seed priming and foliar application trials revealed that the nanoconjugate not only suppressed fungal infections but also improved germination percentage, root and shoot length and overall seedling vigour index. Enhanced biochemical responses such as increased catalase, peroxidase, and SOD activities, along with higher relative water content and soluble protein levels, indicated improved stress tolerance and physiological performance. These results suggest that ZnO nanoconjugates effectively control seed-borne mycotic infections while simultaneously promoting wheat growth, offering a sustainable and efficient alternative to conventional fungicides in crop protection.

Keywords: Wheat, ZnO nanoconjugate, *Aspergillus niger*, *A. fumigatus*, Seed-borne fungi, Growth promotion.

PHYTOPATHOGENIC NEMATODE INFESTATION OF VINE CROPS IN THE SOUTH-EASTERN REGIONS OF THE REPUBLIC OF KARAKALPAKSTAN

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In the south-eastern part of the Republic of Karakalpakstan particularly within the Amudarya, To'rtko'l, Beruniy, Ellikqal'a, and Xo'jayli districts vine crops such as watermelon, melon, pumpkin, cucumber, and other creeping species are widely cultivated. Recent agronomic surveys and laboratory analyses indicate a notable increase in phytopathogenic nematode infestations, primarily belonging to the genera *Meloidogyne*, *Heterodera*, *Pratylenchus*, and *Ditylenchus*. In To'rtko'l and Amudarya districts, the infection rate of vine crop root systems by *Meloidogyne incognita* reaches 30–60%, significantly reducing nutrient uptake and photosynthetic efficiency, which in turn leads to 20–40% yield losses. In Ellikqal'a district, under conditions of water scarcity, soil salinity, and high temperature, nematode populations actively proliferate, affecting 30–35% of cultivated vine crop areas. In the Beruniy district, the presence of *Pratylenchus penetrans* has been confirmed. This species causes necrosis of root tissues, thereby disturbing the plant's water and nutrient absorption processes. In Xo'jayli district, *Meloidogyne javanica* and *Ditylenchus dipsaci* were detected, primarily infesting cucumbers and leafy vegetables, resulting in root deformities, chlorosis, and stunted growth. The findings show that nematode population growth is most active when soil temperature ranges between +25°C and +35°C, which correspond to the prevailing arid and semi-arid climatic conditions of the south-eastern Karakalpakstan region. Moreover, light-textured soils (sandy and sandy-loam types) and continuous monoculture cultivation of cotton, melon, or watermelon create favorable conditions for nematode survival and reproduction, diminishing the natural biological control mechanisms within the soil ecosystem. Overall, the high infestation rates of phytopathogenic nematodes in these regions negatively influence soil fertility, ecological stability, and crop productivity. Therefore, the adoption of integrated pest management strategies combining agronomic, biological, and chemical control methods as well as the introduction of resistant cultivars, is considered an essential measure for sustainable agricultural development in the region.

Keywords: Karakalpakstan, vine crops, phytopathogenic nematodes, *Meloidogyne incognita*, *Pratylenchus penetrans*, *Heterodera schachtii*, *Ditylenchus dipsaci*.

PLANT-BASED DIETARY MILK PRODUCTION TECHNOLOGY

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The consumption of beverages produced from plant raw materials has expanded rapidly, offering a valuable alternative for people with lactose malabsorption or milk-protein allergies. This paper explores methods for manufacturing dietary milk using oats, rye, and maize, with attention to its nutritional characteristics. **Introduction:** Worldwide interest in plant-derived drinks continues to rise. Among them, oat milk is appreciated for its β -glucan content, which contributes to cardiovascular well-being (Gunilla Öst, 1998). Developing techniques that suit local resources is important for strengthening the functional-food market. **Aim:** To establish and assess, under laboratory conditions, a process for producing lactose-free, nutrient-rich milk from cereals. **Materials and Methods:** Oats (*Avena sativa*), rye, and maize grains were used. The procedure included: sorting and washing; soaking; milling; aqueous extraction; filtration; enzymatic hydrolysis with α -amylase; homogenization (15–20 MPa); and pasteurization (72 °C, 15 s). Protein, fat, and β -glucan levels were measured (Lowry, Gerber, and enzymatic colorimetry). Sensory attributes were scored on a 5-point scale. **Results and Discussion:** Oat formulations provided 1.25–1.5 % protein, 1.1–1.3 % fat, and 0.42–0.5 % β -glucan. Thermal treatment improved texture stability. Rye- and maize-based milks had lower β -glucan (0.18–0.22 %) but contained more carbohydrates. The oat version achieved the highest ratings for flavour, aroma, and appearance, retaining acceptable quality for approximately a week.

Conclusion: Producing dietary beverages from plants is a promising approach to diversify healthy diets. Oat milk, in particular, combines mild flavour, limited fat, and valuable β -glucan. Using domestic cereals makes small-scale production technically and economically feasible.

Keywords: oat beverage, cereal-based milk, β -glucan, lactose-free, functional drink.

SUSTAINABLE NUTRITION AND ECONOMIC EMPOWERMENT: CASE OF NOVEL SORGHUM-PIGEON PEA PRODUCT IN KENYA

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Background and Objective: Sustainable Nutrition and Economic benefit, is critical to all humanity. It involves utilization of current resources without compromising its availability for future use economically, socially and environmentally. The aim of the study was to determine Sustainable Nutrition and Economic Empowerment of Sorghum-Pigeon Pea Flakes (SPPF). **Methodology:** Survey was conducted on consumers from Makueni and Busia counties. The study interviewed 223 consumers obtained using Glenn (2011) formula, selected by Simple Random Sampling where data on income and consumption was obtained. Demand model through consumer surplus was used to deduce Economic benefit for Sorghum-Pigeon Pea Flakes (RTEC). **Results:** The results showed SPPF Economic Benefit of Kshs.840.00 and Kshs. 502.00 over Assorted Breakfast and Existing Flakes respectively in a given week. Protein level obtained by consuming SPPF in 100gms is 9gms with Existing Breakfast cereals giving 7gms at a cost of Ksh. 50.00 and Ksh. 114.00 respectively while a consumer will spend Ksh.176.00 to obtain 2.57grams protein in every 100grams on any choice picked among the Assorted Breakfast types. Among the communities, the respondents who said they receives an income were only 34.5% , where 89% in Busia said No while in Makueni 56.5% said Yes, with the mean expenditure per month being Ksh. 16,383.29. Regression analysis on factors affecting acceptance of SPPF revealed gender in decision making, marital status, awareness of SPPF and location (Busia) had significant effect at P-value 0.042. **Conclusion:** The study concludes that SPPF stands as an economic empowerment to consumers as well as farmers which is seen in the consumer surplus and the enhance protein nutrition, thereby advocating for nutritional campaigns to raise awareness of the benefits of consuming SPPF among families, especially children between 1-5 years, the aged over-60 years and school-going children in order to enhance protein levels for a healthy future generation. **Recommendation:** The study recommends government to consider SPPF as part of school feeding programs for breakfast as well as snacks to enhance the level of protein intake among the school going children. Additionally, the study recommends government to create policies towards Minimum Support Price (MSP) for sorghum and pigeon pea crops to enhance farmers' capacity to grow these climate resilient crops towards sustainable nutrition.

Keywords: Economic benefit, Ready-to-eat Cereals, Sorghum-pigeon pea flakes, Sustainability

EXPLORING THE ANTIBACTERIAL POTENTIAL OF ENDOPHYTIC BACTERIA FROM *CHELIDONIUM MAJUS*

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In recent years, endophytic microorganisms of plants have become widely accepted as the primary sources of drugs, and many compounds with new structures and various bioactivities are constantly being isolated from them. Endophytes are responsible for producing numerous metabolites that possess biologically active functions and their involvement in synthesizing or modifying the plant's secondary metabolites. This research work examined the activity of bacteria isolated from various parts of the plant against pathogenic microorganisms, including *Staphylococcus aureus* and *Bacillus subtilis* from gram-positive bacteria, *Pseudomonas aeruginosa* and *Escherichia coli* from gram-negative bacteria, and *Candida albicans* from yeast. The results of studies showed that four isolates - BK14, BC8, BL2, BK 17-from 19 bacterial isolates isolated from the roots, stems, and leaves of the *Chelidonium majus* plant showed antibacterial activity. The MALDI-TOF mass spectrophotometer was employed to identify endophytic bacteria with high activity in *Chelidonium majus* L. According to him, our isolates BK14 and BK17, separated from the root part of the plant, were found to belong to the *Lysinibacillus fusiformis* and *Bacillus pumilis* species, and our isolates BC8 and BL2, separated from the steam and leaf part, were found to belong to the *Bacillus cereus* species. So, literary sources and our experiments *Chelidonium majus* L. the strains *Lysinibacillus fusiformis* BK14, *Bacillus cereus* BC8, *Bacillus cereus* BL2 and *Bacillus pumilus* BK17, which the isolated from this plant, confirm that it has potential as a natural antibacterial agent for the treatment of bacterial infections and resistance to antibiotics, as well as for use as preservatives in the food industry.

Keywords: *Chelidonium majus* L, endophytic bacteria, antibacterial activity, MALDI-TOF

VIABILITY AND MORPHOLOGICAL-CULTURAL PROPERTIES OF THE PIGMENT-FORMING STRAIN *STREPTOMYCES IAKYRUS ACT-P-20* DURING STORAGE FOR A YEAR

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Microbial pigments can be produced by a wide range of microorganisms of the genera *Pseudomonas*, *Azotobacter*, *Bacillus*, *Mycobacterium*, *Streptomyces*, and various other genera of actinomycetes and micromycetes. In the collection of industrially important cultures of microorganisms of the Institute of Microbiology of the Academy of Sciences of the Republic of Uzbekistan, there are about 200 strains of actinomycetes and micromycetes capable of producing pigments of various chemical natures and colors. Especially valuable among them are actinomycetes unique microorganisms functioning in various conditions of Uzbekistan. In order to study the preservation of viability and variability of cultures during storage by the method of periodic subculturing after 1 year, the pigment-producing actinomycete strain from the collection fund *Streptomyces iakyrus ACT-P-20* was studied. To study the morphological and cultural properties of the actinomycete, starvation agar, Gauze medium, Chapek medium, organic and glycerol-nitrate agar were used. The pigment color was determined on the 7th, 14th, and 21st days of growth. First of all, the viability of *Streptomyces iakyrus ACT-P-20* cells was studied after storage using the method of periodic subcultures. It was found that survival reached up to 90%. In our subsequent studies, the morphological and cultural properties of the actinomycete *S. iakyrus ACT-P-20* were examined. It was shown that the strain retained viability and did not change its morphological properties after a year of storage. When grown on various nutrient media, the strain formed different pigments: from red to dark burgundy color. The color intensity was more pronounced on organic and glycerol-nitrate media and on velvet-like colonies. It was noted that after a year of storage, the strain *S. iakyrus ACT-P-20* did not lose its ability to form pigments and retained its cultural characteristics (R-type), while on mineral medium Gauze No. 1, it formed a grayish aerial mycelium and pigment color. Thus, the revealed high viability of microorganism's producers of biologically active compounds is a practically important indicator for recommending their theoretical and practical applications, use in scientific research, in the fields of agriculture, industry, medicine, and in the development of new bioadditives and biopreparations, which serves as a guarantee.

Keywords: *Streptomyces iakyrus*, pigment-producing actinomycete, microbial pigments, morphological properties, cultural characteristics, viability, storage stability.

USEFUL PROPERTIES OF JAPANESE SOFORA

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The wood of the Japanese maple is dense and hard. A yellow dye is obtained from its fruit. This tree grows naturally in Japan and China. It was brought to the CIS about 150 years ago. It is frost-resistant, so it is planted in the southern regions of Ukraine, in the Crimea and the Caucasus. It is a light-loving plant, not picky about soil, grows even on acidic soils, and is drought-resistant. The main product is the Japanese Sophora cyrutin (produced at the Tashkent Chemical Pharmaceutical Plant). A tincture made from its fruit is used to treat purulent and trophic ulcers and burns. The tincture has a bactericidal and wound-healing effect. Rutin (and supplemental quercetin) diseases caused by lack of vitamin R (hypo- and avitaminosis), diseases caused by vascular devor permeability disorders, hemorrhagic diathesis, conjunctiva hemorrhage, capillary toxicosis, light sickness, hypertension, rheumatism, measles, gout, typhus and used to treat and prevent other diseases. Rutin (available in powder and tablet form), quercetin (available in tablet form), and a tincture made from the fruit. Japanese sophora has beautiful flowers. It is important to plant it in the mountains to protect the soil from being washed away by rain. It is recommended to use widely in landscaping work. The plant contains rutin (17% in leaves, 30% in buds), flavonoids, sophorins. It has been found to be a natural medicine that helps prevent irritability, anger, anxiety, severe depression, insomnia, and people who forget easily, have poor memory, and are forgetful. It serves as a medical aid for shortness of breath, allergies, excessive cholesterol levels in the blood, and (cardiotonic) cardiovascular diseases. It helps in external diseases, for example, eczema, donkey's disease. In such cases, the flowers are ground into powder and sprinkled on the body (prisypka).

PROTECTION OF RAINFED LANDS AND WAYS OF RATIONAL USE OF ERODED SEROZEMS

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The article presents the results of the authors' long-term research into the properties of rainfed soils of the Gissar Range and their changes under the influence of erosion processes. Erosion processes have significantly changed the morphogenetic structure, chemical, agrochemical and agrophysical properties of soils. Crop rotations play a significant role in the complex of agricultural measures to improve the fertility of rainfed soils, which are part of scientifically based farming systems. Currently, for the rainfed farming zone of Uzbekistan, accumulation and conservation of soil moisture, reduction of surface runoff and increasing the fertility of eroded soils are the main problems, since predominantly cereal crops are cultivated here. Rainfed dark serozem soils are widespread on the foothill wide-rolling plains of the Gissar range. Serozem soils are divided into light, typical, and dark, which alternate with the approach to the mountains and increasing altitude. The main differences between these subtypes are due to varying humus content, the degree of soil eluviation from carbonates, and the thickness of the genetic horizons. Morphological methods of study were used in field studies. Rainfed dark serozem soils are much less common than rainfed typical serozem soils. They are located in the rolling, undulating, and folded foothills and lowlands that frame the eastern part of the region. These soils form on loess-like and rocky proluvium, and in places on eluvial and deluvial deposits. Their texture is predominantly medium loamy. The clay formation process in the profile is more pronounced than in typical serozem soils. Rainfed dark serozem soils are deeply leached of water-soluble salts and gypsum. Within a two-meter depth, salts are 0.30-0.58%, and gypsum 0.17-0.38%. Carbonates in dark serozem soils are only 5-8%. The smallest amount of carbonates is found in the arable horizon. Depending on the formation conditions, the degree of erosion, and the agricultural practices used, the humus content in the arable horizon of rainfed dark serozem soils ranges from 0.94 to 2.61%. Soils at the foot of slopes and along the bottoms of flattened depressions are the most humus-rich. Soils on slopes contain minimal humus due to erosion. Dark serozem soils are also richer in nitrogen, especially unwashed varieties (up to 0.19%). The carbon-to-nitrogen ratio ranges from 5 to 7. Available forms of phosphorus range from 3 to 36 mg/kg of soil, and potassium from 32 to 412 mg/kg. The richest soils are unwashed soils, the humus reserves in the meter-thick layer are 164.98 t/ha; mobile forms of phosphorus 0.333 t/ha; mobile potassium 3.992 t/ha. Slightly eroded soils contain humus 118.46 t/ha; mobile forms of phosphorus 0.307 t/ha; mobile potassium 3.226 t/ha and occupy an intermediate position. Moderately eroded soils contain 73.98 t/ha of humus; mobile forms of phosphorus - 0.175 t/ha; mobile potassium 1.468 t/ha, which is significantly less than slightly eroded and non-eroded soils. Rainfed dark serozem soils of the mid-altitude zone are characterized by varying degrees of erosion. The soil texture of the study area was found to be medium loamy, dominated by silt fractions, indicating low weathering of the parent material. Erosion processes have significantly altered the morphogenetic structure, chemical, agrochemical, and agrophysical properties of soils. As erosion increased, the humus content and reserves, nutrient reserves, and physical clay content decreased, soil structure deteriorated, and soil moisture content decreased. The deterioration of water-physical properties, nutrient and water regimes in eroded rainfed serozems led to a decrease in the overall productivity of agricultural lands, and a decrease in the yield on slightly and moderately eroded soils in relation to non-eroded ones. Perennial grass crops dramatically improve the chemical and physical properties of eroded, rainfed dark serozem soils, thereby preventing erosion, restoring fertility, and ensuring high yields of grain and forage crops.

Keywords: Rainfed lands, dark serozem soil, mechanical composition, erosion, vertical zoning, slope exposure, humus, nitrogen, phosphorus, potassium, fertility.

ECONOMIC IMPORTANCE AND EFFECT OF ACORN CULTIVATION

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Cotton (cotton) cultivation occupies a leading place in agriculture. It plays an important role not only as a raw material, but also in increasing the country's export potential, ensuring employment, and forming production chains. Economic essence of cotton cultivation. Cotton cultivation is not only agriculture, but also a set of value chain elements: sowing, plant density, cultivation, harvesting, cotton re-biting, cleaning, transport and logistics, domestic and foreign trade and marketing. At each stage, added value is created and costs are formed. For example, processing allows the product to be stored for a long time, fully customized, emblematic, and compliant with standards, which allows the manufacturer to achieve high margins. In economic terms, the introduction of such methods as automation, "smart" greenhouses, water-saving technologies, and hydroponics will increase the efficient use of resources (water, energy, labor). The analysis of expenses and revenues is characterized as follows: 1. **Fixed costs:** greenhouse construction, heating (gas, electricity), depreciation, infrastructure (water losses, pumps, sewerage). 2. **Variable costs:** seeds, fertilizers, pesticides, working molds, water (irrigation), transport, energy (ventilation, heating, surface modification), etc. 3. **Income:** harvest (ton, kilogram), unit price (nominal and real), quarter trade comparison with international prices. 4. **Profitability:** Net profit=Total income–Total costs Commercial and market factors. Profitability (%) = Total costs Net profit ×100%. It is also important to calculate income and expenses per hectare or per kilogram. Return on capital investments (payback period), internal income ratio (IRR), net daily profitability, etc. can be calculated. Provision of seeds: Provision of certified seeds of foreign and domestic varieties; Service with machinery and agricultural machinery: service with cultivators, sowing and harvesting equipment; Introduction of agronomic advice and innovations: Variety selection, fertilization, insect control measures; Assistance in processing and sales: Processing of raw cotton and its release to the market as a finished product. These economic relations are carried out on a contractual basis, through fixed quantities and prices, and in most cases are managed through the cluster system. There are specific aspects of cooperation with agro-services in the cultivation of foreign and domestic cotton varieties: Foreign varieties usually have high yields and early maturity, but they require special agricultural techniques, a moderate climate, and high-quality agricultural services; Local varieties are adapted to local conditions, require less resources, and are stable in terms of safety. Therefore, it is necessary to establish effective and strong economic relations between farms and agro-service enterprises in the implementation of agrotechnical measures, water supply, fertilization, and protection measures corresponding to each variety. **Social significance:** Cotton cultivation plays an important role in ensuring employment of the population in rural areas. Employment opportunities will be created, especially for women and youth. In addition, rural infrastructure (roads, water supply, electricity networks) will also be developed. **Its role in industrial development:** Cotton is the main sector that supplies the industry with raw materials. The majority of industries in the country, such as light industry, textiles, and yarn production, depend on cotton. **Impact on scientific and technological progress:** In recent years, as a result of the transition to a cluster system based on a scientific approach, the introduction of intensive technologies and modern agricultural techniques, productivity has increased. This increases the competitiveness of national agriculture. **Conclusion:** Cotton cultivation is one of the sectors of strategic importance for the economy of Uzbekistan. It is not only the main source of national income, but also the main foundation of social stability and industrial development. Therefore, the further development of this sphere, making it competitive and highly effective, will remain one of the important directions of economic policy. Cotton cultivation is becoming not only a traditional agricultural activity, but also an innovative, industrialized, and export-oriented complex system. In the new era, the following proposals are important for the development of this industry: Increasing the number of agro-innovation clusters and their integration with science; Popularization of digital agricultural platforms for dekhkans and farmers; Wide introduction of resource-saving and environmental technologies in cotton growing; Strengthening the mechanisms linking production with research institutes; Implementation of the "organic cotton" and "eco-label" systems to ensure competitiveness in the international market. **Keywords:** Cotton, economic importance, export, agriculture, fibrous raw materials, cluster system, industrial development, employment, agrarian policy, oil and fat industry.

COMPOSITION AND CHANGES OF THE ARAL SEA MICROFLORA

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Objective: To study the changes in the Aral Sea microflora and determine the role of halophilic microorganisms formed under increased salinity. **Hypothesis:** The ecological crisis of the Aral Sea is recognized not only as a regional but also as a global problem. The drying of the sea, increased salinity, and loss of biological resources has disrupted the ecosystem's balance. Studying the changes in microflora is therefore crucial, as microorganisms are key stabilizing components of ecosystems. Moreover, halophilic microorganisms represent valuable resources for biotechnology and hold practical importance in developing new bio-based products. **Materials and Methods:** Several basic methods were used in this study. Water and sediment samples were collected from different parts of the Aral Sea under sterile conditions and transported to the laboratory in special containers. Sediment layers were separated for microbiological analysis. To identify microorganisms, microscopy, cultivation on nutrient media, and observation of colony morphology were performed. Colonies were described based on their color, shape, and growth rate. Chemical analyses included measuring water salinity, pH, and total mineralization using standard laboratory equipment. The content and composition of organic matter in sediments were also determined and evaluated for their influence on microflora development. **Results:** Preliminary microbiological analyses revealed that the composition of microorganisms varied across different regions of the Aral Sea. Microscopy of water samples showed the presence of several unicellular algae and bacteria, but overall diversity was found to be very limited. Many phytoplankton species have disappeared due to increased salinity. Cultivation of water and sediment samples on nutrient media resulted mainly in the growth of salt-tolerant bacteria. Colonies typically displayed reddish-brown pigmentation, indicating the presence of halophilic microorganisms. Some samples exhibited slow growth, suggesting a general decline in the total number of microorganisms. Chemical measurements confirmed that the sea's salinity level is significantly elevated. The pH remained close to neutral, but total mineralization exceeded the normal range several times over. The content of organic matter in sediments was relatively low, indicating limited nutrient availability for microorganisms. Overall, the findings show that the microflora of the Aral Sea has drastically diminished under normal conditions, with halophilic microorganisms now dominating the ecosystem.

Conclusion: As a result of the ecological crisis, the microflora of the Aral Sea has fundamentally transformed, with diverse plankton species replaced by halophilic microorganisms. Although this process disrupted the biological balance, it also opened new prospects for biotechnological applications. Therefore, an in-depth study of the Aral Sea microflora is essential for understanding ecological problems and developing practical biotechnological solutions.

Keywords: Aral Sea, microflora, halophiles, ecological crisis, biotechnology

PHARMACEUTICAL SIGNIFICANCE OF CHLORELLA

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Introduction: In recent years, there has been growing interest in natural resources within biotechnology and pharmaceutical fields. Chlorella has gained attention as a rich source of pharmacologically active compounds that can be applied in preventive and therapeutic medicine. **Research Methods:** A review of scientific literature and pharmaceutical applications was conducted to evaluate the significance of Chlorella in drug development. **Research Results:** Chlorella-derived chlorophyll exhibits anti-inflammatory and detoxifying properties. Its polysaccharide and peptide complexes act as immunomodulators and possess antiviral activity. Furthermore, antioxidant components contribute to slowing aging processes and reducing the risk of cardiovascular diseases and cancer. Extracts of Chlorella are already used in the pharmaceutical industry for the production of dietary supplements, capsules, and therapeutic agents. **Conclusion:** Chlorella represents a promising bioresource in pharmaceutical science, offering natural and effective compounds for the creation of novel therapeutic preparations.

Keywords: Chlorella, pharmaceuticals, chlorophyll, immunomodulator, antioxidant

THE IMPORTANCE OF SUPPORT FOR BIOCONTROL IN AGRICULTURE BY STUDYING THE GENE OF *TRICHODERMA* FUNGI *EPL-1* UNDER CERATO PLATANIN

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Fungicides and fumigants are frequently applied at higher rates than herbicides or insecticides in agricultural systems, yet they impose substantial risks to environmental and human health. Therefore, the reduction or replacement of synthetic pesticides with environmentally safe alternatives is highly desirable. Biological control agents have emerged as a sustainable solution, capable of suppressing phytopathogenic fungi and simultaneously inducing natural plant resistance. In addition, these agents can be integrated with reduced doses of chemicals, thereby minimizing ecological impact. Among them, *Trichoderma* species are the most extensively studied and applied biocontrol fungi in both agriculture and forestry. Their effectiveness is attributed to multiple synergistic mechanisms, including antibiosis through the production of antifungal secondary metabolites; mycoparasitism involving the secretion of cell wall-degrading enzymes; competition for nutrients and ecological niches; and the induction of systemic resistance via elicitor molecules. In this study, the functional role of the *T. harzianum* Epl-1 protein during interactions with both host plants and phytopathogens was analyzed, with particular emphasis on its role in mycoparasitism. The absence of this elicitor was evaluated with respect to pathogen resistance induction in bean plants, as well as its involvement in self- and host-recognition processes and in structural defense mechanisms. Both wild-type and deletion mutant strains were effective against a wide range of pathogens, exhibiting hyperparasitism. Antibiosis was primarily manifested by the capacity of *Trichoderma* species to inhibit pathogenic fungal growth through the secretion of antagonistic metabolites. *Trichoderma* spp. is capable of producing more than one hundred antimicrobial secondary metabolites, including trichomycin, gliotoxin, chlorotrichomycin, as well as antibacterial peptides. These compounds not only function as potent antimicrobial agents, but also promote plant development and constitute a valuable reservoir of bioactive molecules for the development of next-generation agricultural antibiotics.

FOENICULUM VULGARE MILL. MEDICINAL AND MEDICAL USE

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Foeniculum vulgare Mill. is a spice plant that has been loved by the peoples of Central Asia and the East since ancient times. *Foeniculum vulgare* Mill. grows naturally in the steppes of Crimea, the Caucasus and southern Central Asia. It is cultivated in Ukraine, the North Caucasus, the Krasnodar Territory and Belarus. Medicinal fennel - *Foeniculum vulgare* Mill. is grown in the southwestern regions of Ukraine, the Krasnodar Territory, and the North Caucasus. Medicinal fennel - *Foeniculum vulgare* Mill. A perennial plant of the caraway family, reaching a height of 90-200 cm. The root system is a taproot, yellowish-green, located mainly in the arable layer of the soil (3-20 cm). The main root is tuberous, fleshy, up to 55 cm long, the lateral root is up to 2.5 cm long. The stem is straight, round, slightly twisted, with a bluish-green pubescence, branched. The leaves are alternate, ovate-triangular in shape, divided into three or four pinnately lobed parts. The flowers are small, yellow, and collected in a complex umbel. The umbel does not have a whorl or whorl, the sepals are very small, the corolla is single, the male has 5, the female node is two-celled, located at the bottom. Fruit - double pistachio. The fruit is gray or bluish-brown, oblong, up to 10 mm long, up to 3 mm wide, with prominent five-sided edges. The weight of 1000 seeds is 3-6 grams. It blooms in July-June, the fruits ripen in August. The seeds consist of double pistachios of light green-brown color. Both ends of the seed are slightly narrowed, 8-10 mm long, 4 mm wide, and easily split into two pieces lengthwise. The outer side of each seed is convex, the inner side is flat. The smell and taste of the seed are reminiscent of the taste and smell of fennel fruit. In folk medicine, medicinal fennel - *Foeniculum vulgare* - is used as an expectorant in inflammatory diseases of the respiratory organs (acute respiratory diseases, bronchitis, laryngitis, pulmonary tuberculosis), as a medicine to relieve asthma attacks. In addition, it is recommended to increase milk in nursing women, to quench thirst, as a carminative, choleric, diuretic, and is also prescribed for diarrhea, intestinal bleeding, and painful menstruation. Medicinal fennel is mixed with egg white and used to treat burns. In modern medicine, tinctures made from the fruits of dill and dill oil is prescribed as expectorants for laryngitis, tracheitis, bronchiectasis, lung gangrene, and whooping cough. Dill preparations are used as laxatives for hypoacid gastritis and flatulence, and also as diuretics. Medicinal dill oil is added to expectorant mixtures (novshadil - medicinal dill drops, chest ointment). Medicinal dill fruits are part of combined medicines used to soften the stomach and treat respiratory diseases. In addition, they are widely used in the perfumery, liquor and vodka industries, and in everyday life as a spice. It has been established in animal experiments that medicinal dill fruits have a beneficial effect on the digestive tract, have expectorant, antipyretic, and disinfectant properties.

MAIN DIRECTIONS AND SIGNIFICANCE OF GREEN ECONOMY IN UZBEKISTAN

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The green economy in Uzbekistan refers to economic activities aimed at environmental protection and ensuring the efficient and sustainable use of resources. Over the past eight years, this sector has been gradually developing. The main directions of the green economy in Uzbekistan include: *Renewable energy sources*: solar energy, wind energy, geothermal energy, and biomass energy. These energy sources are economically very cost-effective, especially solar energy, which is considered particularly efficient for Uzbekistan. The application of this type of energy is supported by the government, with preferential loans provided by banks. Primarily, state organizations are transitioning to solar energy systems, contributing to energy savings obtained from thermal energy. Notably, private individuals are installing solar panels on their homes, fulfilling daily energy needs and economically benefiting by selling surplus electricity back to the state. In addition, electricity is generated through solar photovoltaic (PV) power plants and supplied to the national electrical grid. This provides additional capacity and stable energy supply to the country's energy system. For example, the 100 MW solar photovoltaic power plant in Sirdaryo serves as a key illustration. The economic significance of this green energy system lies firstly in job creation; local personnel are employed in construction, operation, and maintenance activities within the solar energy sector, which increases employment rates. Furthermore, the development of local enterprises specializing in the production and installation of solar panels positively impacts the economy. Secondly, solar energy enhances economic independence and energy security by reducing reliance on imported fuel and energy sources, thereby strengthening energy security. This ensures economic stability during price increases or supply disruptions in external markets. Moreover, solar energy presents opportunities for entrepreneurship and investment. Small and medium-sized enterprises can expand economic activities in the solar energy sector by engaging in the sale, installation, and maintenance of solar panels. In agriculture, the use of solar-powered heating systems and pumps contributes to water resource conservation and reduces energy expenses. Additionally, solar energy is widely used in more than 223 domestic waste processing plants in Uzbekistan for obtaining biochar organic fertilizers from household waste.

ISOLATION OF OIL-DEGRADING BACTERIAL STRAINS FROM OIL-CONTAMINATED SOILS IN THE BUKHARA REGION OF THE REPUBLIC OF UZBEKISTAN AND STUDY OF THEIR BIOREMEDIATION EFFICIENCY

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The presence of oil-degrading bacteria in oil-contaminated soils in the Bukhara region of the Republic of Uzbekistan is a serious problem for oil products. Because bacteria contribute to soil fertility by breaking down oil. Biotechnological solutions based on obtaining oil-degrading bacteria strains are studying their bioremediation efficiency. These approaches include characterizing the biodegradation of bacterial strains and developing formulations with high stability and efficiency. **Introduction:** In Uzbekistan, oil and gas deposits are found in desert regions, on irrigated lands or in adjacent areas. Currently, more than 270 oil and gas deposits have been discovered. Oil pollution causes a shift in the soil solution environment to alkaline and salinization by the chloride type. The use of microorganisms in the reclamation of oil-contaminated soils is highly effective only in one season, that is, the used oil-degrading microorganisms act in the upper aerated layer of the soil. In the lower layer, the bioremediation process does not occur. This is a disadvantage or limitation of biological reclamation. The most economical and environmentally beneficial method for eliminating hydrocarbons from contaminated environments is microbial bioremediation. Through enzymatic pathways, hydrocarbon-degrading microorganisms, also known as hydrocarbonoclastic bacteria, use petroleum hydrocarbons as sources of carbon and energy. Anaerobic processes depend on enzymes like alkyl succinate synthase, which facilitate the addition of fumarate to hydrocarbons and integrate intermediates into bacterial core pathways. Conversely, aerobic processes are started by oxygen-dependent enzymes like monooxygenase and dioxygenase which cleave hydrocarbons by integrating oxygen into otherwise stable structures. Both degradation procedures depend on the fragmentation of hydrocarbons into smaller, usable components. Biosurfactants (BS), which emulsify hydrocarbons and reduce surface tension, are frequently used to improve these microbial processes and increase the bioavailability of hydrophobic compounds. **Conclusion:** This study demonstrates that it is possible to successfully isolate Crude oil-(CO) CO-degrading bacteria from soils that have been artificially contaminated. Strong BE and CO degradation activity was shown by bacterial strains S4 and S5 (*Pseudomonas indica*), however, S1 (*Brevibacillus formosus*) showed a moderate rate of CO degradation. The findings show that native soil bacteria possess a range of metabolic abilities suitable for hydrocarbon breakdown and BS synthesis. In order to reduce CO pollution in

SOIL-VEGETATION INTERACTIONS AND ECOSYSTEM SUCCESSION ON THE DESICCATED ARAL SEA BED

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The Aral Sea, once the world's fourth-largest inland water body, has almost vanished due to decades of unsustainable water diversion. Its desiccation created the Aralkum Desert an emerging ecosystem and one of the most striking examples of human-induced environmental transformation. This study investigates vegetation colonization and biodiversity dynamics across the desiccated Aral Sea bed, emphasizing the interactions between soil properties, plant composition, and ecosystem development. Over a 35-year investigation period, five distinct ecosystem types were identified: ephemeral, wasteland, post-, remnant, and neo-ecosystems. Thirty dominant species were recorded across these types, showing generally low floristic similarity, with notable overlap only between ephemeral and neo-ecosystems (41.4 %) and between neo- and post-ecosystems (54.1 %). An ecological framework encompassing 65 ecotypes was established based on soil mechanical composition, salinity, and groundwater depth. Vegetation cover and activity were highest in sandy and moderately textured soils with low salinity ($< 4 \text{ g L}^{-1}$) and intermediate groundwater depth (1.0–1.5 m). Regression models and Canonical Correspondence Analysis (CCA) demonstrated that soil mechanical composition exerts a stronger influence on vegetation dynamics than either salinity or groundwater variation. Gradient Boosting and SHAP (SHapley Additive exPlanations) analyses confirmed the pivotal role of soil texture in shaping ecosystem differentiation. Successional processes were non-linear and mosaic-like, with regressive and cyclical trajectories. Projections for 1980–2030 indicate expanding neo- and post-ecosystems and declining ephemeral types, partly due to the formation of artificial water bodies supporting tugai vegetation. These findings highlight the complex interplay between soil factors and plant succession, offering a scientific basis for restoration and sustainable land management in the Aralkum Desert and similar arid landscapes.

Keywords: Aral Sea desiccation; soil gradients; vegetation succession; ecosystem heterogeneity; saline land restoration

PROMOTING CROP CULTIVATION ON THE DRIED BED OF THE ARAL SEA USING RHIZOBACTERIA

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One of the solutions to the global environmental problem associated with the drying of the Aral Sea and the spread of toxic salts in its surrounding areas is the organization of afforestation and greening works on the dried seabed. The aim of this research is to obtain a high biomass yield from three associations of rhizobacteria using a salt-tolerant reagent, Hypan, as a flocculant that simulates salinity stress conditions. Experimental results demonstrated successful immobilization of rhizobacterial strains that form the composition of the biofertilizer “Zamin-M”, registered in Uzbekistan *Pseudomonas stutzeri* SKB 308, *Bacillus megaterium* SKB 310, and *Bacillus subtilis* SKB 309 on the Hypan reagent. The study presents the development of a method for concentrating microbial biomass from the cultural liquid; determining the antagonistic activity of the concentrated microbial biomass; assessing its stimulatory properties; immobilizing viable and active rhizobacteria on the Hypan carrier under laboratory conditions; developing a technology for producing dry bioformulations based on the immobilized form of the “Zamin-M” biofertilizer; and evaluating the economic efficiency of using the dry, Hypan-immobilized “Zamin-M” biofertilizer for plant cultivation in the saline soils of the dried Aral Sea bed. The stimulatory and antagonistic properties of the immobilized cells were comprehensively studied, showing that their interaction with plants under local soil and climatic conditions improves cell viability and functional characteristics. This enhances their efficiency and allows their application in long-term experiments. The study concludes that the use of immobilized microbial bioformulations in cultivating halophytic plants (such as saxaul, tamarisk, and *Peganum harmala*) on saline soils of the dried Aral Sea bed yields effective and promising results.

STUDY OF THE CHARACTERISTICS OF TEXTILE MATERIALS USED IN THE SHELLS OF THERMAL PROTECTIVE PRODUCTS

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Modern materials science places increased demands on textiles used in multilayer thermal insulation systems. Before designing multilayer structures, it's essential to carefully analyze the properties of the fabrics, as their performance, durability, and comfort of the finished product depend on their characteristics. Selecting the components of the system requires theoretical justification, knowledge of the interaction patterns between the layers, and rational distribution of the functional load between them. The methodology for selecting optimal materials for thermal insulation products is discussed in. This methodology provides for a specific sequence of work, consisting of four stages: developing a general description of a garment, taking into account its intended use, operating conditions, design features, and manufacturing technology; developing material requirements for the product, compiling a list of quality indicators, and establishing performance standards; selection of specific materials, conducting the necessary tests based on the adopted nomenclature of quality indicators, determining the values of these indicators, and assessing the materials' compliance with established requirements; development of recommendations and proposals aimed at the rational and economical use of materials, and clarification of the parameters and modes of technological processing of materials. The implementation of this methodology has allowed us to optimize the selection of materials for products and ensure an improvement in the quality of manufactured products. The formation of a thermal protective product with an insulating package for both household and special purposes is carried out by assembling a multilayer package from the following components: materials from the outer fabric, an insulating layer (filler or insulating lining) and the lining of the product. Each layer of the bag must fulfill a specific functional purpose. The outer material is designed to protect the entire bag from environmental influences. The combination of materials in the chosen bag significantly affects the durability and longevity of the garment. An analysis of literary sources revealed that, when developing thermal protection products, the rational use of individual material layers is of great importance in terms of their performance of specific functions during the operation of the product package. To create a rational structure for the thermal protection product package, it is advisable that the functions of its individual layers be strictly specialized. The upper fabric must meet the basic requirements of wear resistance, strength, wrinkle resistance, resistance to climatic influences, dirt, and ease of cleaning and fashion requirements. The thermal insulation properties of a product package are determined by its thickness, which is a structure consisting of several layers of materials: a base (outer), insulating filler, and a lining (inner). The base and lining materials are called shell materials. The insulating (filler) layer performs the primary function of providing the necessary thermal insulation. Its mechanical and thermal properties depend on the layer's thickness and the nature of the insulation's fibrous composition. The insulating layer (filler) prevents the movement of the air within it, preventing the formation of convective air currents between the shell materials. The insulating interlayer is the layer of the product package designed to provide thermal insulation. The key requirements for insulating interlayers are: layer thickness and stability during operation; low bulk density; air permeability, vapor permeability, and resistance to mechanical stress during operation. It's well known that still air is the best thermal insulator. The more fibers contained in a unit volume of insulation material, the greater their total surface area, enabling the insulation to retain a large volume of air. However, with a significant increase in air volume, convection currents occur in the insulation, which reduce the insulating properties of the material. If the density of the insulation increases, then the decrease in the heat capacity of the raw material is due to the fact that the effective total thermal conductivity of the material also begins to increase, and the thermal conductivity component of the fibers themselves, which is tens of times greater than that of air, begins to increase. The authors, while studying the physical and hygienic properties of material packages, determined that the fibrous composition of the materials composing the packages does not play a determining role in air flow velocity, as air permeability indicators depend primarily on the structure of the materials. The degree of influence of the air permeability of each layer on the air permeability of the package depends on the level and integrals of variation of the air permeability of each layer. The materials used for the outer layer of products have a high surface density and thickness, which is driven by the desire to improve the product's thermal insulation properties, wear resistance, and mechanical strength. However, such fabrics make the product heavy and negatively impact worker productivity. Research shows that the thermal insulation properties are imparted by insulating materials, while the outer materials serve to protect the wearer from external mechanical and physical impacts.

The optimal packages of materials can be considered those that, on the one hand, have the lowest thermal conductivity coefficient and the highest thermal resistance, and on the other hand, higher vapor permeability values. It should be noted that applying force to a material degrades its thermal insulation properties. The degree of reduction in thermal resistance depends on both the applied pressure and the material's initial density. Underestimating the impact of force pressure on changes in the structural, geometric, and thermal properties of a product's material package can lead to a distortion of the actual thermal resistance values of these materials during operation. For example, if the thermal resistance values of insulating nonwoven materials in their original (uncompressed) form are used when designing thermal protection products, the actual thermal resistance of the material package during operation may be several times lower than required. Such a reduction in the thermal insulation properties of the package materials, resulting from the forceful pressure during operation, can lead to hypothermia. Therefore, during the design stage of a product that includes an insulating lining; thermal calculations for the material packages must be performed taking into account comfortable operating conditions. It has been established [6] that changes in environmental parameters and the impact of mechanical pressure on materials can significantly affect the thermal insulation properties of a package of materials. The combined effect of moisture and pressure reduces the porosity of the textile material, increases the contact area between its structural elements, and promotes the filling of the pores with moisture, which ultimately leads to a significant increase in the thermal conductivity of the material and, consequently, to a decrease in its thermal resistance. Adding a highly sorption-absorbing outer fabric (like wool drape) to various insulating materials leads to a more dramatic reduction in the thermal resistance of the entire package. When using a low-sorption outer fabric, the thermal resistance of the package is reduced less significantly. According to the authors, heat transfer in porous materials (textiles and fillers) is an extremely complex process, dependent on many factors. In a solid material, heat transfer is facilitated by conduction, while through pores, it is facilitated by radiant heat exchange and convection. Furthermore, the thermal conductivity of the medium (air) contained within the pores must be taken into account. When analyzing the process of heat transfer in porous bodies, it is necessary to take into account not only the number, size of pores and their orientation in space, but also the chemical structure of the constituent fibers, their interweaving, density, packing and other physical, chemical, mechanical and geometric properties. Structurally, composite insulation materials are soft frame elements made of sheet material with air-filled cells. The cells themselves are created by cutting the sheets across the entire surface in a specific sequence and then stretching them transversely. For such cellular cores, which are under tension, it is necessary to secure them across the entire surface of the component. Otherwise, the cells are in a state of readjustment, subject to change in size when the tension or compression force is removed. The insulating gasket must have the lowest density, high porosity, and elasticity. Effective development of insulating gaskets for various climatic conditions requires the selection of a rational gasket design, both in terms of composition and thickness, which is possible through appropriate testing of the thermal insulation properties of the gaskets and their components.

Keywords: thermal insulation materials, textile fabrics, multilayer package, thermal insulation, air permeability, insulating layer, thermal resistance.

IN VITRO MICROCLONAL PROPAGATION OF MEGACARPAEA GIGANTEA REGEL

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Megacarpaea gigantea Regel is a plant with medicinal properties. This plant is used to treat various diseases. To study the medicinal properties of this plant by microclonal propagation in vitro. *Megacarpaea gigantea* is a rare and endangered plant. *Megacarpaea gigantea* Regel is a rare and endemic plant species belonging to the Brassicaceae family, protected and native to Uzbekistan. Propagation and conservation of this species hold significant ecological and scientific importance. In vitro microclonal propagation is an advanced biotechnological method widely used for multiplying rare and endangered plants, preserving genetic resources, and supporting breeding programs. This species grows in alpine areas, often at altitudes between 3,000 and 5,000 meters. Its habitat includes moist, grassy slopes and rocky areas. Widely distributed in the Alpine regions of Ecuador, *Megacarpaea gigantea* is known for its unique properties and potential medicinal uses. Anti-inflammatory properties: Traditionally, indigenous communities have used various parts of the plant to relieve inflammation-related ailments. Digestive health: It can be used to treat digestive problems such as bloating and indigestion due to its calming effects. Wound healing: The leaves have antiseptic properties, helping to treat minor wounds and promote faster healing. *Megacarpaea gigantea* Regel can be successfully propagated using in vitro microclonal propagation techniques. The developed protocol provides valuable data for conserving rare species and restoring biodiversity.

THE INFLUENCE OF THE ARRANGEMENT OF THREADS IN THE FABRIC STRUCTURE ON THE STRENGTH PROPERTIES OF TEXTILE MATERIALS

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In world practice, there is a wide range of activities aimed at applying the latest achievements of science and technology for the modernization and implementation of progressive equipment in textile and sewing enterprises. In this area, among other things, the tasks are set to develop effective technologies and create textile materials with high physical, mechanical and hygienic properties. For this purpose, it is necessary to study the properties and structure of the fabric. The article presents the essence of the developed fabric of reinforced structure for the manufacture of shells of heat-protective packages of products. The use of this textile material of reinforced structure of the heat-protective package allows increasing the reliability, hygroscopicity of the product and the shape stability of the package. The proposed fabric with a reinforced structure has two zones: a typical zone with a plain weave, in the reinforcement zone - 4-shaft satin. At the same time, air permeability decreases in the reinforcement zone. The structure of a fabric is understood as the nature of the arrangement of its constituent elements – threads and fibers. For a more justified choice of control parameters of the structure, we will consider three main models of the structure: the formation model, the state model, the model of the dependence of the properties of the fabric on the state of its structural elements. Структура ткани является функцией нескольких переменных: $C_m = \varphi(T_z, T_k, P_m, O, E)$, where, T_z - the filling characteristics of the fabric (the nature of the original threads, the number of threads per unit length, the type of weave); T_k - the features of the filling parameters of the weaving loom during the production of the fabric (warp and weft tension, the position of the scallop, etc.); P_t - the features of the relaxation of the fabric after removal from the weaving loom, including the friction force between the threads; O – the nature of the change in the structure of the fabric during finishing; E – the nature of the change in the structure of the fabric during use. Of those considered above, the main factors controlling the structure of the fabric are the composition and structure of the threads, the number of threads per unit length, the type of weave and the conditions of formation on the loom (tension of the warp and weft threads, the linear value of the overhang, etc.). These factors are the ones that govern the structure of the fabric and determine the essence of the structure and all its parameters, characteristics, indicators. These same factors are the objects of design or the given parameters of the structure.

BIOTECHNOLOGICAL POTENTIAL OF BIOACTIVE COMPOUNDS FROM ENDOPHYTIC BACTERIAL OF THE MEDICINAL PLANT *PHYSALIS ALKEKENGII*

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Medicinal plants are widely recognized as reservoirs of biologically active compounds, many of which have been successfully utilized in pharmacology, biotechnology, and agriculture. Recent studies highlight that, in addition to the plants themselves, their endophytic microorganisms represent an untapped source of novel metabolites with unique bioactivities. *Physalis alkekengi* L. (family Solanaceae), traditionally used in folk medicine for its anti-inflammatory, antioxidant, hepatoprotective, and anticancer properties, offers a promising model for investigating the biotechnological potential of its endophytic bacteria. In this study, endophytic bacterial strains were isolated from different tissues of *P. alkekengi* and characterized using morphological, biochemical, and molecular approaches. The isolates were screened for the ability to produce secondary metabolites with antimicrobial, antioxidant, and cytotoxic activities. Preliminary results indicate that several strains demonstrate strong antagonistic effects against pathogenic microorganisms, as well as significant free radical scavenging capacity. Additionally, some isolates exhibited plant growth-promoting traits, including phytohormone production and phosphate solubilization, suggesting potential applications in sustainable agriculture. The diversity of metabolites detected supports the hypothesis that endophytes contribute to the pharmacological properties attributed to *P. alkekengi* and may serve as alternative sources of valuable bioactive compounds. The exploration of such microbial resources not only expands our understanding of plant-microbe interactions but also provides new opportunities for the development of natural products in medicine, biotechnology, and environmental applications. Overall, the findings emphasize the biotechnological significance of endophytic bacteria associated with *Physalis alkekengi* as a promising reservoir of novel bioactive substances with wide-ranging applications.

ECOLOGICAL STATE OF AGRICULTURAL LANDSCAPES OF TASHKENT REGION

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An environmental assessment of the current state of soil fertility in the Tashkent region has established that it meets the nutritional requirements of vegetable, melon, and grain crops. These soils do not exhibit dehumification problems, and their mineral nutrient content is stable. We have found virtually no noticeable imbalances in the nutrient regime that would lead to deterioration in the quality of plant products. At the same time, the toxicological state of soils, irrigation and groundwater, and plant products is a cause for well-founded concern and requires significant improvement. No toxic amounts of heavy metals were detected in the soils of the dark serozem soil belt of the Tashkent region. In fact, they exhibit a deficiency of trace elements such as copper and zinc, apparently caused by a deficiency of these components in the parent material. The organochlorine pesticides DDT and HCH were detected only in the arable soil horizon; they occur in trace amounts in the lower layers of the soil profile. The presence of residual quantities of pesticides in these soils is most likely of an eolian nature, since DDE is present in the uppermost, 0- 2 cm layer of soil in quantities exceeding the maximum permissible levels, and in the underlying layers it is found in trace quantities. Drinking water is free of heavy metals but contains trace amounts of α and γ isomers of HCH; small amounts of lead and nickel, and trace amounts of metabolites and isomers of DDT and HCH were found in the waters of the Charvak Reservoir; elevated amounts of α - HCH were found in irrigation water, and waste water is contaminated with lead (3.5 MPC), copper (9.0 MPC), and nickel (1.6 MPC). The significant concentration of organochlorine pesticides (1-2.5 MPC) were detected in irrigated soils in the city of Chirchik, with the highest levels found in the subsurface soil layer. These soils are also contaminated with chromium (3-4 MPC). The residual levels of organochlorine pesticides in the soils of the Kibray district significantly exceed permissible levels for both the content of HCH isomers and the amount of DDT metabolites. The presence of the latter in the soil suggests recent use of the pesticide. The presence of elevated levels of chromium in the soil, particularly in the subsurface horizon, indicates the influence of industrial enterprises in Chirchik. The pressure of organochlorine pesticides and chromium increases soil toxicity, particularly sharply in the subsurface horizon, where organochlorine pesticide levels exceed permissible limits by 16 times, chromium levels by 1.7 times, and soil toxicity by 2.1 times. A study of the agrochemical and ecological status of irrigated typical serozem soils in the Tashkent district revealed that these soils are not depleted of humus, nitrogen, or phosphorus. However, all the soils studied contained high levels of organochlorine pesticide residues (up to 3.4 MPCs, or 0.1 mg/kg of soil) and increased toxicity (up to 1.8 MPCs). Naturally, such high phytotoxicity hinders crop yields and impairs their hygienic properties. Irrigation and drainage water also contained elevated levels of organochlorine pesticides, as well as elevated nickel and chromium levels. Soils in the Zangiata district have slightly elevated chromium levels (chromium toxicity threshold up to 25 mg/kg). Topsoil toxicity is twice as high as permissible levels. Pesticide and heavy metal levels in irrigation and drainage water are many times higher than sanitary standards and can be a source of soil and crop contamination, directly impacting human health. The ecological condition of the soils in the Urta chirkhik district is characterized by the absence of heavy metal contamination, but residual amounts of organochlorine pesticides significantly exceed maximum permissible and threshold values in two out of three cases (4.6-10.6 MPC). High soil contamination with organochlorine pesticides contributes to the development of negative processes in the soil, increasing soil toxicity by 2.5 times. Irrigation and drainage water contain toxic levels of organochlorine pesticides. Thus, it can be concluded that the vast majority of vegetable farms have created favorable soil conditions for plant nutrition. Humus levels are relatively high, and, with rare exceptions, nitrogen and phosphorus levels are also sufficient. However, the toxicological status of soils and waters is a legitimate concern.

Keywords: irrigated soils, irrigation and groundwater, organochlorine pesticides, heavy metals.

TYPES OF ORGANIC FERTILIZERS AS A FACTOR IN REDUCING SALINITY STRESS AND INCREASING SOIL FERTILITY

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The Uzbekistan part of the Aral Sea's dried-up bottom (about 3 million km) has various soil types, which are being damaged by soil erosion. However, in these areas, high salinity levels and unfavorable salt content limit plant growth, so restoring soil fertility and mitigating salinity stress are an urgent task. In a certain part of the dry bottom of the Aral Sea, saplings of saxaul and other plants have been planted, creating a green area, but in some areas, including the southwestern, that is, point "0", plants do not grow at all or their growth is only 1-3%. This is due to the formation of semi-automorphic, shelly, soft-shelled sandy loams with signs of gleying in the lower layer of the soil. The purpose of the study is to determine the effect of various organic and organomineral fertilizers on salinity stress relief, soil absorption capacity and fertility indicators in the saline soils of the dry bottom of the Aral Sea. **Research Objectives:** Systematization of organic and non-traditional types of local fertilizers; identifying the main nutritional elements in their composition; evaluation of which types of organic fertilizers are effective in saline soil conditions. Nutrient elements in organic fertilizers have a positive effect on the physical and chemical properties of the soil. For example, from every 1 ton of dry cattle manure, an average of 20 kg of nitrogen (N), 10 kg of phosphorus (P_2O_5), 24 kg of potassium (K_2O), 28 kg of calcium (CaO), 6 kg of magnesium (MgO), 4 kg of sulfur (SO_3) and a number of trace elements (boron, copper, manganese, zinc, cobalt, molybdenum) fall into the soil (Sattarov J. and others). Therefore, cattle manure is considered a complete source of nutrients. Taking this into account, organic, organomineral, residues and waste can be divided into the following types: Some of these substances (phosphogypsum, defecate, dolomite and gypsum-containing substances) serve as ameliorants that reduce salinity. At the same time, fertilizers and green manures increase the amount of organic matter, improve soil structure and enhance biological activity. According to the experimental results, the application of semi-rotted and fully rotted forms of cattle manure in semi-automorphic saline soils reduces the physical density of the soil, reduces the concentration of saline salts and increases the water permeability of the soil. This, in turn, creates a favorable environment for plant growth. The conducted analyses show that the introduction of organic and organomineral fertilizers into saline soils alleviates salinity stress, improves the agrophysical condition of the soil, and increases productivity. For saline soils on the dried-out bottom of the Aral Sea, the most effective method is the use of semi- and fully decomposed forms of cattle manure in combination with phosphogypsum or defecate. These results have important scientific and practical significance for expanding bioremediation work in the region. **Acknowledgments:** The authors express their gratitude to the Agency for Innovative Development of the Republic of Uzbekistan and the leadership of the Faculty of Biology and ecology, who funded this research under the AL-9424104858: "Creating optimal conditions for plant growth by improving the properties and characteristics of residual-marsh saline soils on the dried bottom of the Aral Sea"

STUDY ON THE DYNAMICS OF VINCA ALKALOID PRODUCTION BY ENDOPHYTIC FUNGI ISOLATED FROM VINCA SPECIES

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This study explores the dynamics of Vinca alkaloid production by endophytic fungi isolated from three *Vinca* species *V. minor*, *V. erecta*, and *V. rosea*. The investigated fungal strains included *Alternaria* sp. (VM85L), *Penicillium* sp. (VM86S), *Acremonium* sp. (VM96L, VR179L), *Aspergillus terreus* (VE90R, VR176L), and *Aspergillus amstelodami* (VR177L). Cultures were grown in a corn-based liquid medium, and samples were collected after 7, 10, and 13 days to evaluate both biomass accumulation and alkaloid production profiles. The major alkaloids vincristine, vinblastine, and vincamine were identified and quantified using high-performance liquid chromatography (HPLC). The results revealed that biomass accumulation peaked on the 7th day of incubation for most strains, while alkaloid biosynthesis exhibited no direct correlation with growth. Alkaloid production varied significantly among strains and incubation periods, indicating a strain-dependent biosynthetic capability. Some isolates showed early synthesis of alkaloids, whereas others demonstrated higher yields after prolonged incubation (10–13 days). These findings suggest that alkaloid production is more closely related to the metabolic and genetic characteristics of each strain rather than to biomass increase alone. Overall, this study highlights the biotechnological potential of endophytic fungi associated with *Vinca* species as alternative producers of pharmacologically important alkaloids. The strain-specific and time-dependent biosynthetic patterns emphasize the importance of selecting high-yield strains and optimizing cultivation parameters to enhance Vinca alkaloid production.

Keywords: *Vinca* species, endophytic fungi, vincristine, vinblastine, vincamine, HPLC, secondary metabolites, fermentation dynamics

CLIMATE RISK ASSESSMENT IN ARID CENTRAL ASIA: THE KARAKALPAK USTYURT CASE STUDY

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Rangeland resilience under climate change constrains livestock production in arid Central Asia, and the Karakalpak Ustyurt functions as a key ecotone. We evaluated climate risk across 43 pasture varieties representing five haloxerophytic pasture types dominated by *Anabasis salsa*, *Halocnemum strobilaceum*, *Haloxylon ammodendron*, *Kalidium caspicum*, and *Tamarix ramosissima*. We implemented a species–climate prediction module that links species-level physiology to climate forcing and converts these constraints into biomass projections. For each taxon, derived parameters for transpiration, water-use efficiency, and thermal optima and limits were coupled with climate projections under four Shared Socioeconomic Pathways. Prognostic outputs were synthesized with a qualitative Climate Risk Index reading strongly negative for pronounced biomass deficits relative to historical values, near zero for equivalence, and positive for substantial gains. Across the dataset, site-specific contrasts exceeded scenario-specific contrasts, indicating a key role of microhabitat conditions. *A. salsa* pasture types were broadly stable to mildly contracting, with index values slightly below zero, commonly from -0.01 to -0.10. In *H. ammodendron* pasture, the foundation tree showed small to moderate declines and type-level risk was mildly negative, often around -0.02 to -0.13; vulnerability increased where *Kalidium* variety weakened markedly. *H. strobilaceum* pastures were more heterogeneous: many sites remained close to baseline, yet hypersaline and solonchic flats produced distinctly negative indices near -0.30 to -0.34. In contrast, the *K. caspicum* pasture type was tolerant, with projected biomass close to historical levels and index values clustering near zero. *T. ramosissima* pastures were the most vulnerable, with type-level indices around -0.12 to -0.14 and concurrent sensitivity in forbs and semishrubs. In conclusion, most Karakalpak Ustyurt pastures range from tolerant to mildly vulnerable, with highest risk concentrated in saline microsites and among sensitive associates. These findings support targeted monitoring of ecological communities, conservation of facilitative shrubs, and adaptive grazing to sustain forage under a warming climate. **Keywords:** Karakalpak Ustyurt, pasture type, pasture varieties, prediction module, Climate risk index

SCREENING OF ENDOPHYTIC BACTERIAL ISOLATES FOR PLANT GROWTH PROMOTION AND ANTAGONISTIC ACTIVITY

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There are various antimicrobial drugs that activate plant growth and increase productivity by inhibiting the spread and development of phytopathogenic fungi, but ongoing research is being conducted to search for new strains of dominant bacterial isolates, study their morpho-cultural characteristics, identify them, and enrich the collection of microorganisms. Also, the development of more effective biofertilizers, the creation of new directions for improving plant growth, the study of the properties of endophytic bacteria isolated from various plant tissues, the study of the positive effect of their ontogonistic activity against phytopathogenic fusariums on increasing vegetable yields, the study of the properties of endophytic bacteria in increasing plant and soil fertility, the creation of new environmentally friendly microbiological drugs based on them, and their application in practice today are of significant scientific and practical importance. Experiments were conducted to observe the ability of the selected endophytic bacteria to inhibit the growth of *Fusarium oxysporum* and *Fusarium solani* fungi and stimulate the growth of cucumber plants. In the experiment, which lasted 10 days (the experiment was performed 3 times for each suspension), 10 ml of the suspension was placed in sterile Petri dishes (with filter paper at the bottom) and 5 cucumber seeds (each seed gives 20%) were placed. The development of the root system and stem of the seeds was measured in days. The strains that recorded the best results were marked with a special symbol. In sage plants, AST-2, AST-3 showed similar results. ART-8, ART-9 and ART-11 strengthened the root system and improved branching. In strain ART-13, it was observed that the stem and root system continued to grow at the same length. The results of screening endophytic bacteria from sage are shown. Of the 15 isolates studied, AST-8 was the most active in accelerating cucumber growth, increasing root length from 5.2 cm to 15.3 cm compared to the control. After inoculation of seeds with the AST-3 isolate, the stem length increased from 3.1 cm to 9.4 cm compared to the control. In addition, this isolate inhibited the growth of the fungus *F. oxysporum* to a greater extent than others, and in the Petri dish experiment its growth inhibition zone was 8 mm. Therefore, the AST-3 isolate was selected for further studies. Isolates with improved root system in seeds and high activity in terms of antagonism against fusarium were selected for experiments in pots. This, in turn, creates conditions close to natural in laboratory conditions, allowing the development of the root system in the soil and the manifestation of antagonism against infected fusariums.

CHARACTERISTICS OF THE NEW "SHIJOAT" COTTON VARIETY OF AVERAGE AND HIGH PRODUCTIVITY, INDICATING PRODUCTIVITY POTENTIAL IN SEVERELY SALINE AND DIFFICULT-IRRIGATED AREAS

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Today, in scientific research aimed at improving the economic-price and quality indicators of medium-staple cotton, special attention is paid to the widespread use of wild species. In particular, using hybridization and experimental polyploidy methods, it is important to obtain unique genetically enriched introgressive hybrid forms with different types of resistance to pests and diseases, as well as to create new varieties with high economic and price indicators. In this regard, one of the urgent tasks is to determine the genetic potential of medium-staple cotton in terms of yield, early maturity, fiber quality, and yield, to improve the indicators of polygenic control of quantitative traits, and to create varieties by widely using wild species with different genomes. It is important to note the importance of studying the biological and economically valuable traits of polyploid species of the *Gossypium* L. genus preserved in the cotton gene pool collection and creating new medium-fiber varieties by involving their intergenomic introgressive lines in breeding practice. Therefore, in our long-term experiments, we studied the comparison of the medium-fiber C-654 variety with the T-24/1 model cotton variety based on the use of *Gossypium* L. *hirsutum* x (*G. thurberi* x *G. raimondii*) hybridization, experimental polyploidy, and a comprehensive assessment of the economic traits of complex three-genome hybrids, as a result of applying methods of long-term selection from a mixture of biotypes. Currently, under market economy conditions, one of the urgent tasks of our breeders is the creation of early-ripening, high-yielding, fiber-rich varieties that meet world standards and are resistant to diseases. It is known that large-fruited varieties are often late-ripening, but due to complex hybridization, their growing season may be shortened. For the practical solution of these pressing problems, we have been conducting individual breeding research for many years - from morphobiological traits of biotypes in the cotton population to technological fiber quality indicators, taking as a priority the state of results obtained in previous years, that is, the stability of traits. Our experiments were conducted in the "Zangi Ota" experimental field of the Institute of Genetics and Experimental Plant Biology of the Academy of Sciences of the Republic of Uzbekistan from 2010 to 2023. In fertile gray soils with deep groundwater, the planting rate is 75-80 thousand/ha. When the row spacing is 60 cm, it is necessary to provide for the placement of 6-7 single plants per 1 m, and when the row spacing is 90 cm - 8-9 single plants per hectare. On lands with low fertility, the number of plants per hectare can be increased to 5-7 thousand. In gray soils with deep groundwater, irrigation should be carried out according to the 1-3-1 scheme, and in meadow-bog soils with close groundwater, the number of irrigations should be reduced to a minimum. Timely cultivation of row spacing after irrigation will ensure moisture retention. This ensures good plant development and prevents wilting. In conclusion, it should be noted that, according to the above data, the agrotechnology of the "Shijoat" variety, when carried out correctly and timely, ensures an increase in yield. This variety is recommended for cultivation in large areas in regions with high soil salinity and abundant irrigation, with a plant density of 170-200 thousand plants per hectare, i.e., according to 76 schemes. Created as a result of a comprehensive study of biotypes identified based on population analysis and long-term selection, the Shijoat variety is recommended for cultivation in the regions of the republic with high soil salinity and abundant irrigation: Syrdarya, Jizzakh, Khorezm, Bukhara, Navoi, Kashkadarya regions and the Republic of Karakalpakstan.

PRODUCTION OF BLUE PIGMENT BY THE ACTINOMYCETE *AMYCOLATOPSIS LURIDA* 51, ISOLATED FROM ANTHROPOGENIC ZONES OF UZBEKISTAN

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During research aimed at identifying the microbial diversity of soils in contaminated areas located at varying distances from the Bozsu Aeration Station in Tashkent in 2021, a strain was isolated that produced a blue soluble pigment, coloring both solid and liquid Czapek media. Based on morphological, cultural, physiological, and biochemical characteristics, as well as Maldi-TOF mass spectrometry analysis, this strain was identified as belonging to the species *Amycolatopsis lurida*, family *Actinomycetales* (*Nocardia*). The strain *Amycolatopsis lurida* 51 has been preserved for 4 years by periodic transfers on solid slanted Czapek medium at +4 °C. Over time, however, the strain lost its ability to form blue pigment under this preservation method. We conducted studies to select conditions for restoring pigment production by *Amycolatopsis lurida* 51. For this purpose, Czapek, Gauze, starch-ammonia, and glycerol-nitrate agar media were used. The strain was cultivated on solid media in Petri dishes at 30 °C, pH 7.2. The results were recorded on the 7th, 14th, and 21st day of growth to observe clear pigment formation. It was shown that the optimal conditions for pigment production of strain *Amycolatopsis lurida* 51 are cultivation on glycerol-nitrate agar and Gauze media at 32 °C, pH 7.2, for 21 days. The strain retained the ability to synthesize the blue soluble pigment on these media, while no pigmentation was observed on Czapek and starch-ammonia media. Thus, it was demonstrated that the optimal conditions for pigment formation by *Amycolatopsis lurida* 51 are cultivation on glycerol-nitrate agar and Gauze media at 32 °C, pH 7.2, for 21 days.

Keywords: actinomycetes, pigments, preservation, *Amycolatopsis*

THE DYNAMICS OF MICROELEMENTS IN IRRIGATED TYPICAL GRAY SOILS OF THE REPUBLIC OF UZBEKISTAN

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The experience of studying the efficiency of microfertilizers in the Republic of Uzbekistan has a history spanning half a century. However, the practical application of these microfertilizers cannot be considered fully resolved due to the lack of sufficient information regarding the composition of trace elements in the soils of the Republic's cotton-growing zones, as well as the absence of inter-district distribution data on the physiological availability levels of essential micronutrients in these soils. Moreover, further increasing the already high rates of macronutrient application leads to an imbalance in the ratio of macro- to micronutrients in the soil because the progressive annual loss of these microelements is not compensated. Studies on irrigation and groundwater microelement composition have shown that groundwater is clear, with a pH ranging from 7 to 8. It contains only boron (B) and molybdenum (Mo) in ionic form, while other microelements precipitate out at lower pH values and typically become absent. Irrigation waters (rivers, canals, and ditches) often carry loamy sediments known as "suspended solids," the quantity of which varies seasonally. Filtered waters (pH 7.8–7.9) contain boron and are characterized by the presence of molybdenum ions. Iron group microelements (Cu, Zn, Mn, Co) are bound within the "sediment" fraction and are transported together with it. The total amount of these microelements is approximately equal to their content in soils along the irrigation channels, but they are regenerated as Mn^{2+} ions, which are readily available to plants. In recent years, information on the study of microelements in the soils of Uzbekistan has increased significantly, with the development of small-scale cartographic schemes. Research has been conducted on improving the efficiency of microfertilizers for certain crops, yielding specific results. However, scientific studies on the application of microfertilizers, effectively utilizing modern computer technologies depending on plant species and soil conditions, remain insufficient. Particularly in irrigated soils, especially in typical gray soils, it is urgent to determine the status of micronutrient availability in order to develop recommendations for the optimal norms and ratios of microfertilizer application for specific crop types in the region. Research is planned to be carried out on irrigated typical gray soils in the Piskent district of the Tashkent region regarding this issue. Preliminary data have already been collected in this regard. Comprehensive scientific research is being conducted to improve the agrochemical properties of irrigated soils widespread across the Republic, enhance agricultural crop yields through the timely application of new types of mineral fertilizers containing macro- and microelements, and implement agronomic technologies aimed at improving fiber quality. These efforts contribute to the development of scientifically based intensive farming, yielding specific outcomes. Among the findings are the persistent deficiencies of molybdenum (Mo) and boron (B) in most regions. Copper (Cu), zinc (Zn), and nitrogen ($N-NO_3$, $N-NH_4$) exhibit variable levels, with some areas having sufficient amounts and others experiencing deficiencies. Manganese (Mn) and iron (Fe) are generally present in moderate to high concentrations.

FROM MICROBIAL INTELLIGENCE TO FIELD INNOVATION: INTEGRATED BIOLOGICAL PLATFORMS DRIVING SUSTAINABLE AGRICULTURAL TRANSFORMATION

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The rising need for sustainable crop production demands innovations that bridge biological discovery and field performance. With over 15 agro-climatic zones and more than two dozen soil groups in India and even greater diversity globally, no single biological can perform uniformly everywhere. Capsber Agriscience addresses this through science-driven innovation, translating microbial intelligence into field-ready solutions. Our proprietary platforms viz., BioIntelX™, CapsElicit™ and CapSulX™, form an integrated pipeline driving sustainable and resilient agriculture. BioIntelX™ serves as a dynamic microbial intelligence repository and discovery platform, housing over 24,000 microbial isolates, of which more than 3,000 are extensively characterized for their biochemical, genomic, and functional traits. This platform integrates multi-omics insights with advanced data-driven analytics to identify microorganisms and metabolites possessing key agronomic functionalities such as nutrient mobilization, stress tolerance and pest suppression, directly contributing to soil health restoration and resource efficiency. CapsElicit™ functions as an environmental simulation technology that recreates dynamic stress and nutrient conditions to induce overproduction of targeted bioactive compounds in selected strains. By mimicking soil–plant–microbe interactions *in-vitro*, this system enhances metabolite yield and consistency, thereby bridging laboratory optimization and real-world application. CapSulX™ complements these platforms through advanced encapsulation and stabilization technologies that employ biodegradable polymers for controlled release and improved field stability of microbial and metabolite-based products. Various products are currently in the development pipeline leveraging these integrated technologies, targeting improved nutrient efficiency, pest management and abiotic stress mitigation across major crops. Together, these proprietary systems represent Capsber Agriscience's integrated biological innovation pipeline, reaffirming the mission to make biologicals not just good-to-use, but must-to-use for sustainable, resilient agriculture. By uniting discovery, simulation and delivery under one framework, Capsber has built a scalable model for biological product development. This approach improves reproducibility, shortens development time and ensures performance consistency, addressing key bottlenecks in commercializing agricultural biologicals.

FIELD PERFORMANCE OF MAIZE (ZEA MAYS L.) UNDER SOIL DRENCHING WITH NANO POTASSIUM: EFFECTS ON GROWTH, YIELD AND PHYTOTOXICITY

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A field study was carried out during the summer season of 2023 at the Agricultural and Horticultural Research Station, Kathalagere, Davanagere District, to evaluate the efficacy of Nano Potassium on growth, yield and phytotoxicity of maize (*Zea mays* L.) under field conditions. The experiment was laid out in a Randomized Block Design with seven treatments replicated three times. Treatments comprised soil drenching of Nano Potassium at 5, 7.5 and 10 ml/L, Nano NPK at 15 ml/L, MOP (as per RDF), RDF + Nano NPK and an untreated control. Application of Nano Potassium significantly enhanced growth and yield parameters compared to the control. The treatment receiving Nano Potassium @ 10 ml/L recorded the tallest plant (202.2 cm), total dry matter (273.3 g plant⁻¹), cob length (16.3 cm), cob girth (13.7 cm), cob weight (208.7 g) and grain yield (6335 kg ha⁻¹), reflecting a 91.8% increase over the control (3303 kg ha⁻¹). Treatments T₂ and T₁ also performed comparably well. The lowest yield and growth were observed in the untreated control. No visible phytotoxic symptoms such as chlorosis, necrosis, epinasty, hyponasty or stunting were observed at any concentration. The results indicate that Nano Potassium applied through soil drenching at 5–10 ml/L is safe and effective for improving maize growth, yield and productivity, highlighting its potential as a sustainable nano-fertilizer for field use.

Keywords: Maize, Nano fertilizer, Nano Potassium, Growth, Yield, Phytotoxicity, Soil drenching

DISTRIBUTION AND ANTAGONISTS OF PHYTOPARASITIC NEMATODES IN VEGETABLE CROPS OF THE FERGANA VALLEY, UZBEKISTAN

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Introduction: This study (Fergana Valley, 2024–2025) aimed to identify nematode taxa associated with root systems of carrot, tomato and onion and to isolate soil and water derived antagonistic microorganisms. Root and rhizosphere samples (>50) and 20 water samples (500 mL) were collected and processed using Baermann extraction and sucrose-gradient centrifugation; Key findings show predominance of *Meloidogyne* spp. in carrot roots (65%), *Pratylenchus* spp. in tomato, and *Heterodera* spp. cysts in onion (38%); *Bacillus* spp. (72%) and *Pseudomonas fluorescens* (54%) were common soil inhabitants with antagonistic potential. The results underline the wide distribution of plant- parasitic nematodes in valley vegetable production and the presence of native biocontrol agents. **Materials and Methods:** Sampling was performed across vegetable fields in the Fergana Valley during 2024–2025. For each field at least ten plants were sampled; >50 root/rhizosphere samples (carrot, tomato, onion, cabbage, cucumber) and 20 water samples (500 mL) were collected. Nematode extraction employed the Baermann funnel technique (48 h) and sucrose- gradient centrifugation (1,500 rpm, 5 min). Extracted nematodes were fixed in 60% glycerol and identified under light microscopy (40×, 100×) by stylet length, tail morphology and presence of cysts or galls. Microorganisms were isolated using standard microbiological media (NA, PDA, starch- casein agar); 0.1 mL aliquots from 10^{-1} – 10^{-6} dilutions were plated and incubated at 28 ± 2 °C for 48–72 h. Experiments were performed in triplicate (n=3); results were processed in Microsoft Excel and R and associations were evaluated with χ^2 tests. **Results and Discussion:** Carrot root samples were dominated by root- knot nematodes (*Meloidogyne* spp.: *M. incognita*, *M. hapla*). Quantitative analysis indicated nematode occurrence in roots at 65% for carrot, 52% for tomato and 38% for onion. Tomato roots frequently hosted *Pratylenchus* spp. (root- lesion nematodes), while cysts of *Heterodera* spp. were notable in onion. Soil microbial analysis revealed high relative abundance of *Bacillus* spp. (~72%) and *Pseudomonas fluorescens* (~54%); actinomycetes were also detected. Water samples contained predominantly bacteria (~80%), with minor representation of fungi (~5%) and cyanobacteria. The presence of native *Bacillus* and *Pseudomonas* strains and actinomycetes indicates available biocontrol resources that may suppress nematode activity and associated soilborne pathogen complexes. **Conclusion:** Phyto- parasitic nematodes are widespread in valley vegetable crops and pose significant yield risk (reported reductions 20–80%). This study confirmed *Meloidogyne*, *Pratylenchus* and *Heterodera* as principal taxa in the sampled crops and documented a diverse soil microbiota with antagonistic taxa (*Bacillus* spp., *Pseudomonas* spp., actinomycetes). Isolation of these native antagonists supports development of integrated, biologically based nematode management strategies in the region. Further work should characterise local antagonists at strain level and evaluate their efficacy in controlled trials.

Keywords: phytoparasitic nematodes; *Meloidogyne*; *Pratylenchus*; *Heterodera*; *Bacillus* spp.; *Pseudomonas fluorescens*; vegetable crops; biological control

BIODEGRADABLE POLYMERS FOR A SUSTAINABLE FUTURE: THE ROLE OF PHAS IN COMBATING PLASTIC POLLUTION

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Objective: This study evaluates polyhydroxyalkanoates (PHAs) as sustainable alternatives to conventional plastics, aiming to reduce environmental pollution and health risks associated with microplastics. **Hypothesis:** PHAs, as biodegradable polymers structurally similar to synthetic plastics like polypropylene, can replace conventional plastics while addressing ecological and health concerns. **Methodology:** Different PHA molecules were analyzed based on monomer composition, production parameters, and thermal stability. Industrial biopolymer alternatives, including biomass-derived polyethylene and extrudable cellulose, were reviewed. Strategies to enhance PHAs' processability and heat resistance were also explored. **Key Findings:** PHAs exhibit diverse properties influenced by their molecular composition and production methods. Current biopolymers partially meet industrial requirements, but tailored modifications can significantly improve thermostability and extrusion performance. Utilizing crop residue streams for PHA production enhances resource efficiency, reduces plastic waste, and offers a cost-effective, sustainable production pathway. **Conclusion:** PHAs hold strong potential as biodegradable substitutes for synthetic plastics. Optimized production and functional improvements can overcome industrial limitations, aligning with global sustainability goals, including good health (SDG 3), sustainable cities (SDG 11), responsible consumption (SDG 12), climate action (SDG 13), and marine protection (SDG 14).

Keywords: Biopolymer, Polyhydroxyalkanoates, Synthetic Polymers, Crop Residues, PHA producing bacteria.

THE PLANT GROWTH-PROMOTING POTENTIAL OF ENDOPHYTIC BACTERIA ISOLATED FROM *ROSA CANINA*

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In recent years, the use of beneficial microorganisms to accelerate plant growth and development has attracted considerable attention. The intricate mechanisms of interaction between plants and microorganisms are regulated through the production of phytohormones, siderophores, gene expression, osmolytes, and volatile organic compounds. These processes enrich the nutritional status of plants and enhance their metabolic activity. Endophytes microorganisms that inhabit plant cells, interact with exudates, and possess biofilm-forming ability are distinguished by their capacity to produce a wide range of metabolites that promote plant growth and development. Since most endophytes reside within plant tissues and are not directly accessible from outside, they function in stable symbiotic associations. A key feature of endophytes is their ability to serve as sources of unique biochemical compounds that are otherwise difficult to synthesize under natural conditions. For this reason, endophytes hold particular importance as biostimulators for plant growth promotion. Contemporary research extensively highlights the occurrence of endophytes, their mechanisms of action, and their potential applications in agrobiotechnology. Scientific evidence reported in the literature confirms the invaluable role of endophytes in plant growth and development. Based on these scientific premises, we aimed to isolate endophytic bacteria from *Rosa canina* and experimentally evaluate their plant growth-promoting properties. In this study, the plant growth-promoting traits of the isolated endophytic bacteria were assessed through several key tests: nitrogen fixation in a malate-based medium; indole-3-acetic acid (IAA) production using the Sarwar and Kramer method with Salkowski's reagent; phosphate solubilization in NBRIP medium; ACC deaminase activity in ACC-based basal medium; and siderophore production on chrome azurol S agar. The results revealed that isolates RCB1, RCB4, RCB10, RCB16, RCB19, RCB22, RCB31, and RCB35 exhibited the highest plant growth-promoting activity. Additionally, RCB2 demonstrated phosphate-solubilizing ability, RCB9 showed ACC deaminase activity, while RCB15 and RCB18 were capable of synthesizing IAA. These findings indicate the potential applicability of these isolates as bioinoculants in practical agriculture.

Keywords: *Rosa canina*; endophytic bacteria; plant growth-promoting; nitrogen fixation; indole-3-acetic acid; phosphate solubilization; ACC deaminase; siderophore

CHARACTERIZATION OF ENDOPHYTIC BACTERIA FROM *CALENDULA OFFICINALIS* L. WITH EMPHASIS ON THEIR ANTIFUNGAL POTENTIAL AND ROLE IN PLANT GROWTH PROMOTION

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Among medicinal plants, *Calendula officinalis* L. holds particular importance due to its rich chemical composition. According to researchers, this species exhibits anti-inflammatory, regenerative, antimicrobial, and antioxidant properties, in addition to exerting anticancer effects and providing protective pharmacological activity on various organs. Other studies have also revealed the presence of bacterial strains associated with *C. officinalis* that enhance seed germination, stimulate plant growth, increase lateral root density and length, and promote the formation of root hairs. The objective of the present study was to isolate endophytic bacteria from different organs of *C. officinalis*, to evaluate their plant growth-promoting traits, and to identify the most active isolates using molecular genetic approaches. Healthy plant samples were collected from the Surkhandarya State Forestry Region of Uzbekistan. The samples were surface-sterilized with ethanol and sodium hypochlorite, cut into 1.5–2 cm segments, and incubated on nutrient media for 36–48 hours. Resulting colonies were subcultured to obtain pure bacterial isolates, which were then morphologically characterized through microscopic examination. The biological activities of the isolates were assessed, including nitrogen fixation, phosphate solubilization, hydrogen cyanide (HCN) production, and antagonistic activity against pathogenic fungi. Experimental results demonstrated that isolates COSB2, COSB5, CORB1, CORB4, CORB8, CORL3, and CORL5 exhibited the highest levels of activity. These isolates showed superior plant growth-promoting properties and antifungal activity against phytopathogenic fungi compared to the other isolates. The selected active strains hold considerable promise for application as biofertilizers or biocontrol agents in agricultural practice, highlighting their potential scientific and practical significance for sustainable crop production.

Keywords: *Calendula officinalis* L.; endophytic bacteria; phosphate solubilization; antifungal activity; biofertilizers; nitrogen fixation

ISOLATION AND BIOCONTROL POTENTIAL OF ENDOPHYTIC BACTERIA ASSOCIATED WITH *GLYCYRRHIZA GLABRA* L.

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Glycyrrhiza (licorice) belongs to the *Fabaceae* family, characterized by a deep root system and notable tolerance to adverse conditions such as salinity and drought. Numerous clinical and experimental studies have demonstrated that licorice root possesses diverse pharmacological properties, including anti-inflammatory, antiviral, anticancer, immunomodulatory, and hepatoprotective activities, which are attributed to its wide range of bioactive compounds. Among triterpenoid saponins, glycyrrhizic acid is the most abundant and represents a key pharmacologically active constituent with anti-inflammatory, antiviral, immunoregulatory, and other biological activities. Recent investigations have further revealed that licorice flavonoids exhibit multiple pharmacological functions and are gradually becoming a focal point in pharmacological research. Various beneficial microorganisms associated with *Glycyrrhiza glabra* play a crucial role in promoting plant growth, improving nutrient uptake, and enhancing natural defense mechanisms against pathogens. However, licorice remains vulnerable to several phytopathogens. For instance, *Phytophthora* species are responsible for root rot, while *Fusarium* species damage the vascular system, leading to wilt disease and severely inhibiting plant growth and development. As an eco-friendly approach to combat these pathogens, endophytic bacteria isolated from licorice represent a promising alternative to chemical control. In this study, the antagonistic potential of endophytic bacteria against phytopathogenic fungi was evaluated, highlighting their possible application as natural biocontrol agents to replace chemical treatments. As a result of the conducted research, a total of 18 endophytic bacterial isolates were obtained from the leaves, stems, and roots of *Glycyrrhiza glabra* L. In vitro assays revealed that several of these isolates exhibited significant antifungal activity against *Fusarium solani*. In particular, isolates ShI-2, ShI-3, ShP-4, ShB-1, ShB-6, and especially ShB-8 demonstrated strong antagonistic activity. Among them, ShB-8, which showed the highest antifungal effect, was selected as a promising candidate for further investigation. The biological activity of these isolates confirms their potential role in maintaining plant health and contributing to the development of sustainable biological protection strategies against plant diseases.

Keywords: *Glycyrrhiza glabra* L.; endophytic bacteria; phytopathogenic fungi; *Fusarium solani*; *Phytophthora*; antifungal effect; biocontrol

MECHANISMS OF INSECTICIDAL ACTION OF BACILLUS THURINGIENSIS CRY-TOXIN AGAINST WAX MOTH (*GALLERIA MELLONELLA*)

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Introduction: *B. thuringiensis* is a Gram-positive bacterium with catalase activity, lacking oxidase activity, strictly aerobic, and equipped with peritrichous flagella that enable motility. Its life cycle includes two main stages: vegetative growth and sporulation. Cry protein crystals are formed during sporulation, which consists of seven successive phases: (1) formation of axial filaments; (2) development of a prespore septum; (3) formation of parasporal crystals and prespores; (4–6) development of exospores, primary cell wall, and transformation of spore nucleoids; (7) maturation of spores and lysis of mother cells. Crystal synthesis begins after the second stage of sporulation and occurs within the cell, where crystals may account for up to 30% of the dry mass of sporulating cells. Parasporal crystals can exhibit various morphologies bipyramidal, pyramidal, cubic, flat-rhombic, spherical, or rectangular and may contain one or several endotoxins with molecular weights ranging from 60 kDa to 140 kDa. Different classes of Cry toxins of *B. thuringiensis* interact with specific receptors (cadherins, aminopeptidases, alkaline phosphatases, ATP-binding transport proteins), which determines the specific toxicity of Bt-based bioinsecticides against particular pest species. Toxic *B. thuringiensis* strains harbor genes encoding δ -endotoxins, commonly referred to as Cry proteins or crystal proteins, due to their ability to undergo self-crystallization inside the bacterial cell. After ingestion by an insect or larva, these crystalline protoxins are activated by proteolytic enzymes in the midgut. The activated toxins bind to specific receptors on the midgut epithelial cells, leading to disruption of membrane transport processes and ultimately to insect or larval death within 2–48 hours. **Conclusion:** At present, two main molecular concepts explain the insecticidal mechanism of Cry toxins: the sequential binding model, which suggests pore formation in the cell membrane, and the signaling pathway model, which describes a cascade of events leading to programmed cell death (apoptosis).

ISOLATION OF ANTIBACTERIAL COMPOUNDS FROM ENDOPHYTIC FUNGI OF ALOE VERA

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The global spread of bacterial infections and the emergence of antibiotic-resistant strains have created an urgent need for new sources of natural antibacterial agents. Endophytic fungi, living within plant tissues without causing harm, are known to synthesize biologically active secondary metabolites. Aloe vera, a medicinal plant widely used in traditional and modern medicine, represents a promising host for endophytes with potential antibacterial properties. **Objective:** To isolate and evaluate antibacterial secondary metabolites produced by endophytic fungi associated with Aloe vera. **Tasks:** 1. Isolate endophytic fungi from the root, stem, and leaf tissues of Aloe vera, 2. Identify the isolated fungi using morphological and molecular methods, 3. Extract secondary metabolites from fungal cultures, 4. Test the antibacterial activity of extracts against Gram-positive and Gram-negative bacteria, 5. Determine the most active fungal strain with the highest antibacterial potential. **Methods:** Isolation and identification: Plant tissues will be sterilized and cultured on selective media; fungi will be identified microscopically and by ITS-based molecular analysis. Metabolite extraction: Fungal cultures will be fermented and extracted using organic solvents (ethyl acetate, methanol). Antibacterial assays: Extracts will be tested using disk-diffusion and minimum inhibitory concentration (MIC) methods against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, and *Pseudomonas aeruginosa*. **Expected Results:** Diversity of *Aloe vera* endophytic fungi will be determined, Extracted metabolites will show antibacterial activity against selected pathogens. The most promising strains could serve as sources for the development of novel natural antibiotics. **Conclusion:** Endophytic fungi of Aloe vera represent a valuable and underexplored source of antibacterial compounds. Their study may contribute to the development of alternative therapies against antibiotic-resistant bacterial infections.

IMPROVING THE HUMUS STATE, AGROCHEMICAL AND BIOLOGICAL PROPERTIES OF TYPICAL IRRIGATED GRAY SOILS USING INNOVATIVE TECHNOLOGIES

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Soil is the main tool for the modernization and rapid development of agriculture, further strengthening food security, and expanding the production of environmentally friendly products. Improving soil properties, especially increasing soil fertility, and enriching it with organic matter is a guarantee of high and quality yields. World experience in enriching soil with organic matter shows that attention is being paid to non-traditional organo-mineral composts obtained from various residues and waste. Various composts and plant residues are used to increase soil fertility and improve the humus state. The goal of the research is to scientifically substantiate the possibility of increasing the fertility of typical irrigated gray soils by improving some physical, chemical, and biological properties using innovative technologies, and to develop scientifically based measures to improve the humus state of soils, maintain, and increase their fertility. The research work was carried out at the stationary field experimental site of the Department of Soil Science at the Botanical Educational and Scientific Center of the M. Ulugbek National University of Uzbekistan. Based on the results obtained, the humification process of cultivated and ephemeral plant biomass in the conditions of typical gray soils of the gray soil zone, which have been irrigated for a long time, was studied, the humification coefficient of plant residues was determined, and scientific foundations were developed for increasing soil fertility, improving the state of humus, some physical, chemical properties and biological activity of the soil by agrobiological methods, composting the soil with plant residues. In the field experimental area, the humus content in the topsoil increased from 1.110% to 1.130%, the total nitrogen content from 0.081% to 0.095%, phosphorus from 0.196% to 0.230%, and potassium from 1.51% to 1.81%. Soils with very low levels of mobile nitrogen, phosphorus, and potassium moved to low and moderate levels. Agrotechnology applied on the background of N250P180K150 fertilizer increased the amount of ammonifiers from microorganisms in 1 g of soil by 2.7×10^7 CFU (colony forming units) in the 0-15 cm layer, 2.3×10^7 CFU in the 15-30 cm layer, the amount of oligonitrophilic microorganisms by 1.7×10^6 CFU in the 0-15 cm layer, 1.4×10^6 CFU in the 15-30 cm layer, the amount of actinomycetes by 4.6×10^4 CFU in the 0-15 cm layer, and the amount of micromycetes by 1.5×10^4 CFU in the 0-15 cm layer, and 1.3×10^3 CFU in the 15-30 cm layer, improving microbiological activity in the soil and ensuring stability in the agroecosystem.

ANALYSIS OF THE GRANULOMETRIC COMPOSITION OF SOILS OF KOGON DISTRICT, BUKHARA REGION USING ARTIFICIAL INTELLIGENCE TECHNOLOGIES

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Population growth, along with socio-economic factors, has historically been associated with food shortages. Over the past 50 years, the world's population has increased from three billion to seven billion, creating a high demand for food. Land degradation and water pollution, climate change, government policies and market changes are adding to the threats to food security. These threats require improving agricultural productivity while reducing its environmental impact. In this context, the use of new innovative technologies in agriculture, including information technologies, is urgent. The Kagan district of the Bukhara region was chosen as the object of research. Several sources were used to analyze the state of soils using artificial intelligence technologies. For the analysis based on remote sensing data of soil conditions, it is planned to use Landsat 8 space images. The values of 11 direct bands (Bands) of Landsat 8 images were selected as indicators. For the analysis based on spectral indices, 20 spectral indices (NDVI, DVI, RVI, EVI, Cigreen, NNIR, GNDVI, GOSAVI, SAVI, MSAVI, NDWI, OSAVI, ARVI, SCI, GVMI, NDSI, NDNI, SBL, RDI, SI, SCI) were selected as indicators. The results of soil laboratory analyzes were taken as the main source for analyzes based on artificial intelligence technologies. Medium, light, heavy loamy, partially sandy and clay soils are distributed in the district. According to the mechanical composition of the recorded soils in the district, it was noted that 2962.5 ha of heavy loamy soil, 9215.1 ha of medium loamy soil, 3897.8 ha of light loamy soil, 1217.0 ha of sandy loam and 42.6 ha of sandy soil. At the next stage, the data obtained from these sources were analyzed on the basis of artificial intelligence and appropriate models were developed. Soil granulometric composition was analyzed by the amount of physical clay. Then, algorithms based on artificial intelligence were used. We used 20 AI-based models in our research. Studies on determining the amount of dry residue in soils based on 20 algorithms are given below. When analyzing the results using the algorithms described above, it can be seen that the highest result was obtained using the Logistic Regression model (0.74). The next best results were obtained using the Ada Boost Classifier (0.66), ExtraTreesClassifier (0.64) algorithms. In conclusion, it can be said that analyzing soil conditions using artificial intelligence technologies is promising, and based on the developed intelligent models, it is possible to predict soil fertility indicators with varying degrees of accuracy. This, in turn, creates opportunities for rapid determination of soil fertility conditions and, on this basis, effective determination of appropriate agrotechnical measures.

Keywords: soil analysis, artificial intelligence, remote sensing, vegetation indices, algorithm, model.

NEXT-GENERATION SEQUENCING UNVEILS HIDDEN VIROMES: REVOLUTIONIZING PLANT VIRUS DETECTION

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Next-generation sequencing (NGS) has revolutionized plant virology by unveiling hidden viromes, significantly advancing plant virus detection, discovery, and characterization beyond traditional methods. The technology's high-throughput, unbiased approach enables comprehensive metagenomic analysis of plant-associated viral communities, revealing a vast diversity of known and novel viruses and viroids in both cultivated and wild plants. Recent discoveries have expanded the catalog of plant viruses by more than 100 novel DNA and RNA viruses, many of which were undetectable by conventional diagnostics. NGS not only aids in detecting low-titer and mixed infections but also supports real-time surveillance and epidemiological tracking of viral outbreaks, critical for disease management and quarantine. Advances in bioinformatics, including machine learning and deep learning, have enhanced the identification and classification of viral sequences from complex datasets, improving diagnostic accuracy while addressing challenges such as contamination and sequence interpretation. Coupled with emerging genome editing technologies like CRISPR-Cas, NGS is paving the way for precision breeding of virus-resistant plants and advanced epidemiological research. However, the high sensitivity that enables detection of diverse viruses also demands careful validation to distinguish biologically relevant infections from contaminants. Overall, NGS has transformed plant virology by uncovering hidden viromes and providing robust tools for comprehensive virus detection, epidemiological surveillance, and innovative disease control strategies essential for sustainable agriculture.

Keywords: virome, diseases, NGS, detection, metagenomics

SEASONAL DYNAMICS OF FILTRATION AT THE KATTAKURGAN RESERVOIR

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Reservoir filtration exhibits periods of both increase and decrease, depending on various environmental and operational factors. **Periods of Increased Filtration: Spring (March–May):** During this season, the melting of snow, increased rainfall, and rising groundwater levels lead to a significant increase in the water level of the reservoir. This results in elevated hydraulic pressure on the dam body and foundation, intensifying filtration. **Summer (June–August):** In this period, especially during peak irrigation demands, the reservoir maintains a high water level. Elevated temperatures slightly alter water's physical properties, such as viscosity, further enhancing filtration activity. **Periods of Decreased Filtration: Autumn (September–November):** Although rainfall may still occur, water withdrawal increases, causing a decline in reservoir levels. Groundwater levels also stabilize, resulting in reduced filtration. **Winter (December–February):** The water level is typically lower due to the end of the irrigation season and increased water release. Lower temperatures raise water viscosity, which slows down the filtration process. In addition, snowfall reduces inflow into the reservoir. Over a four-year study period, filtration data were analyzed, revealing the following: **Daily Time Variations: Morning (7:00):** Filtration rates were generally higher in almost all months (ranging from 0.085 to 0.116 m³/s). **Evening (19:00):** Lower filtration rates were recorded (ranging from 0.043 to 0.101 m³/s). **Monthly Averages: Highest filtration rates** were observed in: June (7:00 → 0.116 m³/s) May (7:00 → 0.115 m³/s) March (7:00 → 0.114 m³/s) **Lowest filtration rates** were recorded in: January (19:00 → 0.043 m³/s) February and November (19:00 → 0.051 m³/s) **Seasonal Trends: Winter:** Morning: 0.083–0.102 m³/s, Evening: 0.043–0.101 m³/s, significant variation between morning and evening, but the average filtration rate remained low. **Spring:** Morning filtration ranged from 0.103 to 0.115 m³/s — the highest seasonal values were observed during this period. **Summer:** Morning: 0.109–0.116 m³/s, Evening: 0.055–0.058 m³/s. **Autumn:** Morning: 0.101–0.108 m³/s, Evening: 0.051–0.054 m³/s. It has been observed that higher water levels in the reservoir lead to greater saturation of the surrounding soil, enhancing soil moisture conditions. The fact that filtration rates are higher in the early morning hours indicates increased capillary movement and a more active soil moisture balance at that time. Over the years, an increase in water volume has contributed to intensified reduction processes within the soil. This is primarily due to limited air exchange, which results in slower decomposition of organic matter and an increased risk of waterlogging. Seasonal hydrological cycles play a crucial role in maintaining dynamic stability in the processes of soil hydromorphism, helping to regulate the balance between saturation, aeration, and biochemical activity in the soil profile. These analyses suggest that **the highest filtration rates were observed during the spring and summer months**, particularly in the **early morning (7:00)**. The **lowest filtration** occurred in the **winter months**, especially in **January during the evening (19:00)**. The **monthly dynamics of filtration at the Kattakurgan Reservoir** are illustrated in table 1. The filtration rate varies by **month, season, and time of day**. According to the analysis, filtration is highest during the **summer season** and lowest in **winter**, with **higher rates in the morning** compared to the evening.

SYNTHETIC DYE REMOVAL BY AGRI-WASTE DERIVED BIOCHAR AND FUNGAL BIOMASS

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Synthetic dyes are released in the environment as toxic pollutants via industrial effluents, posing threat to animals and humans. These dyes are extensively used in textile, paper and leather industries primarily for colouring during the manufacturing process and also for tinting, sourcing, and mercerization. Many of these dyes are potential carcinogens and exert serious effects on human health such as acute toxicity, renal dysfunction, hormonal imbalance and metabolic disorders. Therefore, there is an urgent need to find sustainable, eco-friendly and effective dye removal methods. In this study, agri-waste and fungal biomass were used to rapidly remove anionic dye Congo Red from its aqueous solutions. The agri-waste biomass was used for dye adsorption in three forms- as dried biomass, as biochar and as chemically modified biochar. The fungal mycelia of previously characterized fungus were used as fresh biomass for biosorption and biodegradation of dye. The functional groups of all the samples were analysed through FTIR and crystallinity of biochar was evaluated through XRD. The dye removal was monitored and quantified on the basis of absorbance measured at 497 nm for Congo Red. The chemically modified biochar and fungal biomass demonstrated high adsorption rate against Congo red dye, and removed 95.46% and 97.75% of Congo Red dye respectively.

Keywords: Agri-waste bioadsorbent, biochar, fungal biomass, Congo red, dye removal

FORMATION, DEVELOPMENT DYNAMICS, AND PHENOLOGICAL CHANGES OF VEGETATION COVER ON THE DRIED BOTTOM OF THE ARAL SEA

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The desiccation of the Aral Sea is regarded as one of the most severe ecological and climatic disasters that has significantly altered the environmental stability of Central Asia. Since the second half of the twentieth century, the rapid shrinkage of the sea has exposed vast areas of the former seabed, which have transformed into saline and dusty desert landscapes known as Aralkum. Dust, salt, and chemically enriched aerosols emitted from this area have had a complex and far-reaching influence on the regional ecosystem and, in particular, on climatic processes. Research findings indicate that one of the principal factors driving microclimatic transformations in the Aral Sea basin is the high intensity and spatial spread of aerosol dispersion and dust transport. The airborne particles consist primarily of sodium chloride, magnesium sulfate, carbonates, and pesticide residues. These particles ascend to the upper layers of the atmosphere, increasing the reflection of solar radiation and disturbing the surface energy balance. Consequently, radiative energy exchange is disrupted, leading to prolonged cold periods in winter and intensified hot and arid conditions in summer. Due to changes in the optical properties of the atmosphere, the albedo coefficient increases, reducing photosynthetic activity and altering the dynamics of vegetation cover. This has led to a decline in soil temperature, accelerated evaporation, and a gradual decrease in soil fertility across irrigated and semi-desert zones. Most of the airborne dust is not confined to local regions but is capable of long-range transport. Aerosols originating from the Aral Sea basin have been detected over southern Kazakhstan, Tajikistan, and even as far as Russia and western China. Meteorological modeling suggests that dust plumes can travel between 500 and 1000 km, thus contributing to the continentalization of the regional climate. The accumulation of salt and dust particles in the lower atmosphere has also reduced cloud formation and precipitation levels. Observational data over the past three decades reveal that annual rainfall in the Aral region has decreased by approximately 15–25%, while average wind speed has increased by 1.5 times, amplifying the frequency of dust storms. In conclusion, the large-scale dust–aerosol emissions resulting from the desiccation of the Aral Sea have become one of the major anthropogenic drivers of climatic change in the region. These processes directly affect air temperature, precipitation regimes, wind dynamics, and soil moisture balance. Furthermore, enhancing climate monitoring systems and developing regional aerosol-transport models are essential for mitigating the environmental and climatic consequences of the Aral Sea disaster

Keywords: soil-grunt, Aral Sea desiccation; dust storms; aerosols; climatic change; desertification; atmospheric circulation; soil degradation.

METALLIC NANOPARTICLES IN ENHANCING PLANT GROWTH, STRESS TOLERANCE AND HEALTH

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Metallic nanoparticles (NPs) have emerged as promising tools in modern agriculture for enhancing plant growth, productivity and disease resistance. Due to their unique physicochemical properties, such as high surface area and reactivity, metallic NPs like zinc oxide (ZnO), silver (Ag), copper (Cu), and iron oxide (Fe₃ O₄) can interact efficiently with plant tissues and soil microbiota. When applied at optimal concentrations, these nanoparticles improve seed germination, root and shoot elongation, nutrient uptake and photosynthetic efficiency. Moreover, metallic NPs induce antioxidant enzyme activities including catalase, peroxidase and superoxide dismutase etc., thereby strengthening the plant's defence system against oxidative stress and pathogen attack. Studies have shown that nano-based delivery of essential micronutrients enhances bioavailability and reduces environmental losses compared to bulk fertilizers. Additionally, their antimicrobial properties help suppress a wide range of phytopathogens, that contribute to better plant health. However, excessive concentrations may cause phytotoxicity, emphasizing the need for precise dose optimization. Overall, the use of metallic nanoparticles represents a sustainable and innovative approach to improving plant growth, stress tolerance, and crop yield while reducing dependence on conventional agrochemicals.

Keywords: Metallic nanoparticles, Plant growth, Antioxidant activity, Stress tolerance, Sustainable agriculture.

INFLUENCE OF SOIL-APPLIED NANO NITROGEN ON GROWTH, YIELD AND PHYTOTOXICITY OF MAIZE (ZEA MAYS L.) UNDER FIELD CONDITIONS

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The present investigation entitled “Influence of Nano Nitrogen on Growth, Yield and Phytotoxicity of Maize (*Zea mays* L.) under Field Conditions” was carried out at the Agricultural and Horticultural Research Station (AHRs), Kathalagere (Karnataka), during the *summer* season of 2023 under sandy clay loam soil conditions. The primary objectives were to assess the efficacy of Nano Nitrogen on growth and yield performance of maize and to examine any potential phytotoxic effects at different application doses. The field experiment was laid out in a Randomized Block Design comprising seven treatments replicated thrice. Treatments included Nano Nitrogen at 5, 7.5 and 10 ml/L (soil drenching), IFFCO Nano Urea (2 ml/L, foliar spray), granular urea as per RDF, RDF + Nano Urea and an untreated control. Results revealed that application of Nano Nitrogen significantly influenced the vegetative growth and yield attributes of maize. Among the treatments, Nano Nitrogen @ 10 ml/L recorded the highest plant height (187.5 cm), total dry matter (297.6 g/plant), cob length (16.6 cm), cob weight (212.3 g) and grain yield (6736 kg/ha), showing a 122.1% increase over control. All tested doses of Nano Nitrogen outperformed the control and were comparable or superior to conventional nutrient sources. Phytotoxicity assessments indicated no visual symptoms such as chlorosis, necrosis or stunting across all application stages, confirming the product's safety at tested concentrations. Overall, the study demonstrated that soil drenching with Nano Nitrogen at 5–10 ml/L effectively enhanced maize growth and yield without any adverse effects, indicating its potential as a safe and efficient nano-fertilizer for sustainable maize production under field conditions.

Keywords: Maize, Nano fertilizer, Nano Nitrogen, Growth, Yield, Phytotoxicity

CHANGES IN THE COMPOSITION OF PLANT COVER UNDER THE INFLUENCE OF HOUSEHOLD WASTE

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This study, the environmental impact on the composition of vegetation growing around household waste dumps was studied. The research results showed that there are significant changes in the biological diversity, biomass, and morphophysiological indicators of plants in the areas surrounding the landfill. In recent years, as a result of urbanization and an increase in the volume of household waste, the negative impact on the natural ecosystems around landfills is increasing. Changes in vegetation cover in such areas are an important bioindicator of the level of anthropogenic pressure. Research work was carried out in areas located in 4 directions (north, south, east, and west) around the landfill. Changes in the amount of elements in the plant composition were analyzed in each region. The content of heavy metals (Pb, Cd, Zn, Cu, Ni) in soil samples was determined, and their absorption coefficient (ABC) in plants was calculated. According to the studied results, Fe, Co, Ni in the composition of plants is in the range of byk-0.1-0.6, which indicates that they are moderately absorbable elements. The highest value is observed in the MCH-3 zone (0.60 for Fe), which indicates the active assimilation of Fe by plants in this zone. Mo MCHSHI-3, MCHSHI-9, MCHG-1 accumulated in large quantities in the vegetation of the region. In plants growing in the eastern (EPC) and northern (EPC) parts of the landfill, the LPC is highest, which indicates the high metal bioactivity in the soil-plant system around the landfill. Fe, Co, Ni is relatively stable in the western region, but the activity of Mo and Pt is high. Mo and Re are the most biologically active elements (BPC > 1-10) therefore; plants accumulate these elements as active accumulators. As, Zn, Cu elements are biologically active elements and play an important role in the plant nutrition system, however, high values of Byk increase the risk of toxic effects. The highest amount of arsenic was found in the plants of the western region (Byk-181.96-211.92) and the northern region (Byk-75-213). This situation indicates that the processes of waste combustion, the accumulation and corrosion of metal residues, which are a potential source of pollution, can be located in the western direction. In conclusion, it can be concluded that the degree of biological absorption of heavy metals in the soil-vegetation system around the landfill varies significantly by region. In the composition of plants, the values of the BWC of Fe, Co, Ni elements are in the range of 0.1-0.6, which belong to the category of moderately absorbable elements. The MCHG-3 region has the highest BPC value (0.60) for the Fe element, which indicates that plants in this region are actively absorbing iron. Around the landfill, the metal-absorbing activity of the vegetation cover is high, which can be assessed as an ecological hazard zone.

THE IMPACT OF DUST AND AEROSOLS EMITTED AS A RESULT OF THE ARAL SEA DESICCATION ON CLIMATE

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The rapid desiccation of the Aral Sea over the past few decades has led to the emergence of vast new land areas, collectively known as the Aralkum Desert. This region represents one of the world's largest models of anthropogenic desertification, characterized by complex geochemical, hydrological, and biogeocenotic processes. The formation of vegetation cover on the dried seabed plays a crucial role in the restoration of natural landscapes and the establishment of new ecological systems. Therefore, studying the phenological development, adaptation mechanisms, and ecological interactions of plant species in this area is of significant scientific importance for ensuring long-term environmental stability. Research results indicate that the plant composition of the dried Aral seabed is dominated by halophyte and xerophyte species. The main pioneer species, such as *Halostachys belangeriana*, *Salsola orientalis*, *Atriplex* spp., *Calligonum*, *Tamarix*, and *Halocnemum*, occupy new desert surfaces, contributing to the accumulation of organic matter and the formation of biogenic nutrient cycles in the early stages of ecosystem development. Phenological observations reveal that these species exhibit high adaptability to varying environmental conditions, with the timing of vegetation onset, flowering, and fruiting being strongly influenced by soil moisture, temperature, wind regime, and salinity levels. Analysis of vegetation development dynamics shows that in the initial stages, ephemeral and semi-shrub species dominate, while over time, deep-rooted shrub communities replace them, leading to enhanced biogeochemical cycling, increased microbial activity, and improved soil structure. However, factors such as climate change, wind erosion, soil salinization, and low moisture availability impose significant stress, altering the phenological cycles of many plant species. The findings demonstrate that vegetation in the Aralkum region is forming adaptive ecological strategies that play an important role in mitigating desertification processes through natural succession. The formation of stable vegetation cover on the dried seabed contributes not only to the restoration of biological diversity but also enhances the region's landscape resilience, regulates carbon cycling, and reduces atmospheric dust emissions. These results provide a scientific foundation for developing revegetation, phytomelioration, and ecological rehabilitation strategies aimed at restoring the environmental balance of the Aralkum Desert and the broader Aral Sea Basin.

Keywords: Aral Sea desiccation; Aralkum Desert; vegetation cover formation; phenological development; halophyte and xerophyte species; ecological adaptation; biogeochemical cycles; soil salinization; climate impact.

DE NOVO DOMESTICATION: A GENOMIC REVOLUTION IN CROP IMPROVEMENT

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De novo domestication using modern genetic tools to transform wild or semi-wild plants into new, agriculturally useful crops represents a promising route to expand crop diversity and enhance resilience in the face of climate change, pests and limited agricultural land. Recent scientific studies have provided concrete evidence of its feasibility. *Oryza alta*, a wild allotetraploid rice species, was *de novo* domesticated by first establishing an efficient transformation and genome editing system and assembling its genome into two subgenomes. Six genes homologous to known domestication loci in cultivated rice. Wild tomato (*Solanum pimpinellifolium*), where multiplex CRISPR/Cas9 editing of multiple domestication trait genes resulted in lines with up to tenfold increase in fruit number, multiple fold increases in fruit size, and substantially elevated levels of lycopene relative to the wild type. These successes show that *de novo* domestication can combine beneficial traits inherent in wild species such as stress tolerance, high biomass, and wide environmental adaptability with domestication traits desired for agriculture in a relatively short number of generations. Nevertheless, several challenges remain, including linkage drag, issues of fertility and stable inheritance and regulatory or acceptance hurdles in deploying genome-edited crops. Overall, scientific evidence supports *de novo* domestication as a viable strategy to develop new crops or broaden the genetic base of existing ones, contributing to sustainable, climate-resilient agriculture.

Keywords: *De Novo*; Domestication, Crop Improvement; Climate Resilient

DEVELOPMENT OF AN ANTIMICROBIAL BIOPREPARATION DERIVED FROM FLAVONOIDS OF *AMMOTHAMNUS LEHMANNII*

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This research focuses on the extraction, characterization, and assessment of the antimicrobial potential of flavonoids derived from *Ammothamnus lehmannii*, with the aim of developing a plant-based biopreparation effective against pathogenic microorganisms. *Ammothamnus lehmannii*, belonging to the Fabaceae family, represents a valuable source of bioactive flavonoids with promising applications in biotechnology. These flavonoid compounds, endowed with notable antimicrobial properties, can compromise the structural integrity of bacterial and fungal cell membranes, ultimately leading to microbial inhibition. **Introduction:** The excessive and uncontrolled use of synthetic antibiotics has triggered the rapid emergence of drug-resistant pathogens, posing a critical threat to both medicine and agriculture. In response, scientific attention is increasingly directed toward natural biologically active compounds exhibiting antimicrobial potential. *Ammothamnus lehmannii*, a species native to Central Asia and long utilized in traditional medicine, is particularly rich in flavonoids, making it an attractive and valuable subject for biotechnological exploration and innovation. **Research Methods:** The study was carried out in several stages: Collection and extraction of plant material: Samples of *Ammothamnus lehmannii* were collected in natural habitats, dried, and subjected to solvent extraction to isolate flavonoid fractions. Identification and quantitative analysis of flavonoids: HPLC (high-performance liquid chromatography) and spectrophotometry were used to determine the composition and concentration of flavonoids. Testing antimicrobial activity: The inhibitory effect of flavonoid extracts was assessed using the agar diffusion method against bacterial and fungal strains including *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Candida albicans*, and *Aspergillus niger*. **Research Results:** Flavonoids from *Ammothamnus lehmannii* showed strong antimicrobial activity by suppressing pathogenic bacteria and fungi, likely through disruption of microbial cell membranes. These results emphasize their potential as eco-friendly alternatives to conventional antibiotics.

DESIGNING AN ALKALINE-TOLERANT LACCASE BIOCATALYST: ISOLATION AND SEQUENTIAL OPTIMIZATION FROM RHIZOSPHERIC BACTERIA

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Laccases are multicopper oxidases with wide substrate specificity and are useful enzymes for various industrial applications but in present scenario there is a great need for halotolerant and alkaline bacterial laccases, as world is moving toward low-impact sustainable bioprocessing. The present study offers a two-pronged investigation on halotolerant and alkaline laccase-producing bacterial strains isolated from two dissimilar ecological niches: saline soil and the rhizosphere of a banana plant. These environments were chosen for their capacity to host extremophilic microbes that are capable of vigorous enzymatic activity under extreme conditions. Among 70 bacterial isolates screened from saline soil samples by using selective M9 medium, five showed laccase activity. Based on the best performance, one strong strain was chosen. Solid-state fermentation (SSF) by employing chickpea peel as a low-cost agro-waste material gave an initial activity of 11 U/mL of enzyme. Optimization by One Variable at a Time (OVAT) raised the activity to 30 U/mL, and additional improvement by Response Surface Methodology (RSM) made it 46 U/mL. Concurrently, a new isolate from banana rhizosphere soil showed high laccase activity under saline and alkaline conditions. A stepwise optimization strategy was adopted, starting with OVAT to determine key physicochemical factors, followed by RSM to optimize interactive effects. The resultant biocatalyst showed high activity across the saline alkaline range, reflecting high potential in textile effluent degradation and industrial biobleaching. These combined findings highlight the synergy in microbial sourcing, agro-waste valorization, and statistical modeling for building robust laccase systems for sustainable and green chemistry purposes.

Keywords: Enzyme, Laccases, rhizosphere, RSM, OVAT

EVALUATION OF HIGH-YIELDING GROUNDNUT GENOTYPES IN STATION TRIAL AT RRS, BAWAL

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Rapeseed–mustard group of crops are grown in diverse agro-climatic conditions ranging from north-eastern/north- western hills to down south under irrigated/rainfed, timely/ late-sown, saline soils and mixed cropping. Indian mustard is predominantly grown species in this group and accounts for 80% of the cultivated area in India. Rapeseed–mustard group of crops are grown in diverse agro-climatic conditions ranging from north-eastern/north- western hills to down south under irrigated/rainfed, timely/ late-sown, saline soils and mixed cropping. Indian mustard is predominantly grown species in this group and accounts for 80% of the cultivated area in India. Rapeseed–mustard group of crops are grown in diverse agro-climatic conditions ranging from north-eastern/north- western hills to down south under irrigated/ rainfed, timely/ late-sown, saline soils and mixed cropping. Indian mustard is predominantly grown species in this group and accounts for 80% of the cultivated area in India. Rapeseed mustard group of crops are grown in diverse agro-climatic conditions ranging from north-eastern/north- western hills to down south under irrigated/ rainfed, timely/ late-sown, saline soils and mixed cropping. Indian mustard is predominantly grown species in this group and accounts for 80% of the cultivated area in India. Groundnut (*Arachis hypogaea*) is a monoecious annual legume crop mainly grown for food, oilseed and animal feed. It is an allo-tetraploid crop having chromosome number $x = 10$ with self-pollination mode. It belongs to family Leguminose and sub-family paillionoidae. Its seed contains about 48 % oil content, 25 % proteins and about 18 % carbohydrates. Considerable variation has been recorded for morphological, physiological and agronomic traits. Assessment of genetic diversity in a crop species is prerequisite to its improvement. Genetic variability is essential in plant breeding for crop adaptation in a specific environment, enhancing yield potential, creating resistance to biotic and abiotic stresses, improving quality attributes, and most importantly, selecting desirable and better parents for hybridization programs. In this research experiment, seven genotypes of groundnut were evaluated for yield and its component characters against check varieties MH - 4, HNG-10 and HNG-69 at CCS HAU, Regional Research Station Bawal. Three genotypes viz., GC-55 (37.5 q/ha), GC-24 (34.5 q/ha) and GNH-804 (33.3q/ha) were recorded higher pod yield as compared to the best check variety HNG-69 (25.9 q/ha). The check variety MH-4 was observed as the most dwarfs (44.4 cm) and earliest in maturity (113 days) whereas ICGV-07270 and ICGV-07286 were the tallest (59.6 cm). The genotype TG-81 possessed maximum 100-kernel wt. (41.5 g) followed by HNG-69 (41.4 g) and GC-24 (40.0 g) whereas maximum shelling percentage was found in HNG-69 (67.8 %) followed by GNH-804 (65.5), GC-24 (64.3 %), ICGV-07270 (63.2 %) and TG-81 (63.2 %). Two genotypes namely ICGV-07270 (52.1) and TG-81 (51.2) showed higher oil content as compared to check HNG-69 having oil content 50.4%.

Keywords: Variability, diversity, Pod yield and oil content

UTILIZING WILD RELATIVES FOR OKRA (*ABELMOSCHUS ESCULENTUS*) FOR YVMV DISEASE IMPROVEMENT

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Wild relatives of okra (genus *Abelmoschus*) are increasingly being utilized to enrich the genetic base of cultivated okra (*A. esculentus*) by introducing resistance to viral diseases, abiotic stresses, and improving yield- related traits. Recent studies have identified wild species such as *A. moschatus*, *A. tetraphyllus*, *A. caillei*, *A. manihot*, and *A. angulosus* as promising sources of resistance to Yellow Vein Mosaic Virus (YVMV) and Enation Leaf Curl diseases (OELCuD). *A. moschatus*, *A. tetraphyllus* and *A. caillei* (Sikkim) exhibited very low incidence of YVMD and no incidence of ELCuD, making them highly resistant. *A. moschatus* ssp. *moschatus* were YVMD. Wide hybridization and embryo rescue techniques have been used to transfer such disease resistance from wild species into the cultivated gene pool. For instance, an interspecific hybrid between *A. esculentus* (cv. Pusa Sawani) and *A. moschatus* subsp. *tuberosus* was developed via embryo rescue, overcoming normal embryo abortion in distant crosses. Also, more comprehensive pre- breeding work (wide hybridization, backcrossing, amphidiploidy) has produced okra hybrids combining wild traits with cultivated appearance, though some linkage drag remains. Morphological and fertility barriers have been partially mitigated using colchicine to restore fertility in hybrids showing sterility. These recent advances suggest that wild species can contribute significantly toward developing okra cultivars resilient to viral diseases, heat/drought stress, and with improved agronomic traits. Continued efforts are needed to refine hybrid fertility, remove deleterious wild traits, and combine multiple stress tolerances for stable, high- performing okra in varied agro- ecologies.

Keywords: Okra; YVMV; Resistance; Wild species; Hybridization

NUTRIENTS RECYCLING EFFICIENCY OF HYDROPONIC GROW-OUTS IN AN INDIGENOUSLY DESIGNED LOW-TECH AQUAPONIC SYSTEM

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A low-cost, do-it-yourself (DIY) aquaponics system was developed to assess the performance of three hydroponic grow-out configurations i.e. river stone (T1), crushed stone (T2), and raft or deep-water culture (T3). This indigenous low-tech system was operated without a dedicated external biofilter. The system was evaluated using a co-culture of rainbow trout (*Oncorhynchus mykiss*) and lettuce (*Lactuca sativa*) over a 45-day period, with a fish-only unit maintained as control. Results indicated that, crushed stone (149.11 ± 0.532 g) and river stone (148.34 ± 0.467 g) treatments produced significantly higher final weights of rainbow trout compared to other experimental groups. Similarly, the final weight of lettuce was significantly greater across all treatments relative to the control (89.15 ± 4.37 g). System performance was evaluated based on water quality regulation and nutrient recycling efficiency. Both gravel-based and raft systems demonstrated effective stabilization of water quality parameters compared to the control. Among treatments, nitrite (78.874 ± 2.331 %) and total dissolved solids (0.794 ± 0.018 %) removal were highest in the river stone and raft systems respectively. Conversely, the crushed stone unit exhibited superior removal of total ammonia nitrogen (86.166 ± 0.221 %), nitrate (71.677 ± 0.203 %) and phosphate (61.869 ± 0.943 %). These findings highlight that, substrate composition substantially influences microbial colonization, nutrient dynamics and overall system efficiency in aquaponics. Considering the observed growth performance, water quality stability and nutrient removal efficiency, the stone substrate-based aquaponic systems, particularly those using crushed or river stone, can be recommended for small-scale, sustainable farming applications in low-thermal agro-climatic regions.

Keywords: Nutrients recycling, Crushed stone, River stone, Raft system, aquaponics

HARNESSING BIOTECHNOLOGICAL INNOVATIONS FOR SUSTAINABLE IMPROVEMENT OF LITCHI (*LITCHI CHINENSIS*)

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Litchi (*Litchi chinensis* Sonn.) is an economically significant subtropical fruit known for its distinctive flavour, nutritional richness, and export potential. Despite its commercial value, litchi production faces major constraints such as irregular flowering, short fruiting duration, susceptibility to pericarp browning, and sensitivity to environmental stresses. Biotechnology provides transformative tools to address these challenges and accelerate genetic improvement. Future perspectives in litchi biotechnology centres around whole-genome sequencing, transcriptomic profiling, and marker-assisted selection to identify genes regulating flowering behavior, fruit quality, and stress resilience. Emerging genome editing techniques such as CRISPR/Cas systems offer precise and rapid avenues for introducing desirable traits while preserving varietal integrity. Integrative omics approaches combining genomics, proteomics, and metabolomics—will further elucidate the molecular mechanisms underlying litchi's aroma development, pigment biosynthesis, and postharvest physiology. Development of efficient *in vitro* regeneration and transformation systems remains crucial to enable gene transfer and micropropagation of elite cultivars. Moreover, biotechnological interventions targeting postharvest metabolism and enzymatic browning can enhance shelf-life and fruit appearance. The integration of molecular tools with conventional breeding, supported by digital phenotyping and data-driven analytics, is poised to redefine litchi improvement programs. Strengthened collaborative research, germplasm characterization, and translational genomics will collectively shape the future of sustainable litchi cultivation.

Keywords: *Litchi chinensis*, genomics, CRISPR/Cas, omics, genetic improvement, stress tolerance, postharvest biology.

STUDIES ON SURFACE COATING MATERIALS ON QUALITY ATTRIBUTES OF CUSTARD APPLE FRUITS UNDER AMBIENT CONDITION

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Custard apple being highly perishable fruit, is highly susceptible to spoilage, softens very rapidly during ripening, and becomes squashy and not easy to consume fresh. The fruit has a short shelf-life due to high respiration and ethylene production. Hence there is greater need to preserve the custard apple fruits and to process into suitable products viz., juice, jam, ice cream, milkshake etc. to minimize the post-harvest losses which further helps in value addition and in generation of a good income for a needy farmer. Post-harvest losses are defined as any measurable qualitative and quantitative loss of food along the supply chain, starting from the time of harvest until its consumption or other end uses (Hodges et al., 2011). The post-harvest losses of fruits and vegetables are about 35-40%. This is due to infrastructure and management limitations of a given food value chain. The management of higher crop production and its conservation in quality and quantity is necessary to reduce post-harvest losses. Postharvest losses result not only in the loss of the actual crop, but also have an adverse impact on the environment, resources, labour needed to produce the crop and livelihood of individuals involved in the production process. The reduction in post-harvest losses will contribute significantly to increasing the availability of nutritionally very important fruits. The present experiment entitled effect of surface coating materials on quality attributes of custard apple fruits under ambient condition was conducted at Laboratory of Pt. KLS college of horticulture and research station Rajnandgaon during the year 2023-2024 laid out in CRD with 15 treatment replication three times. The present investigation was on coated custard apple fruit cv. Balanagar comparison on various aspects with untreated fruit of Control, thus the experiment consist total 15 treatments control along with 14 different concentration of organic lipid (oil, wax) and secondary metabolite(gum) based coating materials which is viz. 10 and 20% of Paraffin, Beewax and Gumm Arabic each respectively, Karanjool, Coconut oil, Neem oil and Linseed oil each at 50 and 100% of two different concentration which were dissolved with the help little amount of polar solution (Twin twenty). Fresh apple fruits were procured from fruit orchard and subjected to different physio- chemical parameters assessment in laboratory after coating with above mentioned concentration of organic materials. The fruits were stored on plates at room temperature at lab for 9 days for monitoring to make observations of different chemical and physiological analysis at every 3 days interval till 9 days of storage period. The finding after analysis for quality parameter viz. total soluble solid, pH, acidity, ascorbic acid, and sugars of custard apple fruits were significantly differed under the various treatments. Observation makes on coated fruit analysis was registered superiority as maximum TSS, pH, ascorbic acid and minimum acidity with 38.55°Brix, 5.3 pH, 30.07mg/100g pulp and 0.21% followed by Bee wax 20% (37.09°Brix, 5.2 pH, 28.93mg/100g pulp and 0.22%) respectively for each the mentioned chemical analysis. The increasing trend in TSS upto 6 day later decreasing pattern upto 9day was registered whereas the pH, ascorbic acid and acidity were following a decreasing trend and form linear pattern of reduction on further increasing storage days observation till 9 day or examine. While the minimum (27.29°Brix, 4.5 pH, 21.29mg/100g pulp and 0.42%) was analyses for same aspects in untreated fruits of T1 (control) at 9 day of storage period. Also, the significant influence on sugars was registered. The sugar content was found in increasing amount at 6 day then gradually reduction was registered on 9 day of analysis. The superiority of wax coatings are as on; the maximum in Paraffin 20% (27.39, 15.19 and 12.20%) followed by Bee wax 20% (27.34, 15.16 and 12.18%) registered respectively for total sugar, reducing sugar and non- reducing. However, minimum values on the same 9 day (21.00, 11.64 and 9.36%) for similar aspects were reported to analysis of uncoated fruits.

A STUDY FINDING THE ROLE OF ANTHOCEPHALUS CADAMBA (INDIAN KADAM) IN CURBING THE FUNGI AND BACTERIA

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Introduction: Indian kadam was tested for its antimicrobial activity. The leaf extracts of the plants were tested against bacteria and Fungi. **Methods:** The antimicrobial effect was seen by using the Kirby Bauer disc diffusion method using MHA. The ethanol and methanol extracts of leaves of the plant were prepared by using soxhlet apparatus. A concentration of 2 mg/ml of extract was used to evaluate the curbing activity. Zones of inhibition were measured using positive and negative control. **Results and Conclusions:** Ethanol extract was found to have maximum antagonistic activity against *Candida* followed by *Staphylococcus*, *Enterococcus* and *klebsiella* and the methanol extract has shown almost equal activity for all the above mentioned fungal and bacterial isolates. Further studies against other strains are recommended. **Keyword:** Antimicrobial effect, *Anthocephalus cadamba*, *Enterococcus*, *Candida*, *klebsiella*

RUTIN MITIGATES HIGH-SUCROSE DIET-MEDIATED ADVERSE IMPACTS ON REDOX HOMEOSTASIS, LIPID CONTENT AND LONGEVITY IN DROSOPHILA MELANOGASTER

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Sucrose is a widely used ingredient in various food preparations across the globe. It is abundant in cookies, fruit juices, soft drinks, candies, and in many other food items. However, recent findings have suggested that consumption of excessive sucrose can be detrimental to the health. Rutin is a bioflavonoid that has multiple health promoting efficacies. Nonetheless their beneficial impacts against High-Sucrose Diet (HSD) have not been assessed. Hence, the present study aims to explore the health promoting impacts of rutin against HSD induced changes in endogenous antioxidant enzymes, lipid droplets accumulation in alimentary tract, body morphology and longevity in a model organism, *Drosophila melanogaster*. Results of the study indicated that chronic exposure to HSD (30%) induced redox imbalance through elevated endogenous antioxidant formation. Furthermore, HSD was found to inflict excess lipid droplets accumulation in the gut, reduction in body size, and longevity. Interestingly, treatment with rutin (200µM) was found to minimize HSD induced redox imbalance, and enhance body size and Longevity in *D. melanogaster*.

Keywords: High Sucrose Diet, Rutin, Antioxidant, *Drosophila melanogaster*

EFFECT OF DIFFERENT SEED TREATMENTS ON SEED GERMINATION OF MELIA DUBIA CAV.

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The present study was undertaken to evaluate the effect of various seed pre-treatments on the germination behaviour of *Melia dubia* Cav., an economically important multipurpose tree species with inherently poor germination. The experiment was conducted under controlled laboratory conditions using a completely randomized design with multiple pre-treatments, including concentrated sulfuric acid (H_2SO_4), gibberellic acid (GA_3), cow dung slurry, and water soaking, along with an untreated control. Observations were recorded for germination percentage, germination speed, germination capacity, and days to initial germination. The results revealed significant differences among treatments, indicating that seed treatment substantially influences the germination potential of *Melia dubia*. Among the treatments, H_2SO_4 scarification for 30 minutes recorded the highest germination percentage (63.88%), germination speed (0.97), and germination capacity (75.50%), with the shortest duration to initial germination (26 days). Other treatments showed comparatively lower performance. The findings emphasize the importance of acid scarification as a cost-effective and efficient pre-treatment method for improving germination in *Melia dubia*, thereby facilitating large-scale seedling production for agroforestry and industrial applications.

Keywords: *Melia dubia*, seed germination, pre-treatments, acid scarification, germination percentage, nursery management

INFLUENCE OF DIFFERENT POTTING MEDIA ON SEED GERMINATION AND SEEDLING GROWTH OF *MELIA DUBIA* CAV.

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The study was carried out to evaluate the influence of various potting media combinations on the germination and seedling growth of *Melia dubia* Cav., a fast-growing multipurpose tree species widely used in agroforestry and wood-based industries. The experiment was conducted under nursery conditions using a completely randomized design (CRD) comprising different combinations of soil, sand, farmyard manure (FYM), and vermicompost. Growth parameters such as germination percentage, seedling height, number of leaves, leaf area, collar diameter, sturdiness quotient, biomass, and relative growth rate were recorded at 30, 60, and 90 days after emergence. Significant variations were observed among treatments, indicating that the potting media composition greatly influenced the physiological performance of seedlings. The potting mixture containing **soil + vermicompost + FYM (1:1:1)** recorded the highest seedling height (30.82 cm), maximum leaf area (151.14 cm²), and highest biomass (33.91 g/plant) at 90 days after emergence. The control (soil alone) recorded the lowest growth in all parameters. The results highlight the synergistic effect of organic amendments such as vermicompost and FYM in improving aeration, nutrient availability, and moisture retention, ultimately enhancing seedling vigour and quality. The findings suggest that the use of soil + vermicompost + FYM as a potting medium can significantly improve nursery management and sustainable propagation practices for *Melia dubia*.

Keywords: *Melia dubia*, potting media, vermicompost, FYM, nursery growth, seedling vigour

PRELIMINARY ASSESSMENT OF HEAVY METALS IN INSHORE WATERS AND SEDIMENT OF BELEKERI, ANKOLA, UTTARA KANNADA DISTRICT

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Coastal and marine ecosystems play a vital role in maintaining global ecological balance and supporting diverse biological communities. However, these ecosystems are increasingly threatened by industrialization, urbanization, and other anthropogenic pressures. Ports and harbors serve as major centers of maritime and economic activity but are also potential sources of pollution, particularly from heavy metals released during cargo handling and shipping operations. This study investigates the concentration and distribution of selected heavy metals iron (Fe), manganese (Mn), zinc (Zn), lead (Pb), copper (Cu), cadmium (Cd), and nickel (Ni) in the water and sediment of the inshore waters at Belekeri (Port), Ankola, located in Uttara Kannada District, Karnataka. The analysis was conducted to evaluate the pollution status, sediment characteristics, and potential ecological risks associated with heavy metal accumulation. The concentration of heavy metals in water samples followed the order Fe > Mn > Zn > Pb > Cu > Cd > Ni, with values ranging from 0.0874–7.3077 mg/L, 0.0324–0.3547 mg/L, 0.1884–0.3490 mg/L, 0.0004–0.0940 mg/L, 0.0060–0.0710 mg/L, BDL–0.0602 mg/L, and 0.00044–0.0475 mg/L, respectively. Similarly, in sediments, the concentration order was Fe > Mn > Pb > Ni > Zn > Cu > Cd, ranging from 0.1463–15.6756 µg/g, 1.1767–8.7059 µg/g, 0.0002–0.5446 µg/g, BDL–0.2653 µg/g, 0.0079–0.0924 µg/g, 0.0019–0.0543 µg/g, and BDL–0.0194 µg/g, respectively. Sediment parameters including temperature (26–37 °C), pH (6.76–8.25), organic carbon (0.15–1.83%), and texture [(sand) 63.45–99.09%, (silt) 0.71–36.30%, (clay) 0.04–1.31%] indicated slightly alkaline conditions and sandy sediment composition. The observed metal concentrations suggest localized enrichment likely influenced by port-related activities such as ore handling and shipping operations. Overall, the study highlights the need for continuous monitoring and implementation of pollution control measures to maintain the ecological integrity of the Belekeri coastal environment.

Keywords: Heavy metals, sediment, inshore waters, Belekeri (Port), Ankola, Uttara Kannada District

INTRODUCTION OF NEW AJWAIN VARIETY AA-1 AS RABI CROP BOOSTED THE ECONOMICS OF FARMERS OF NORTH KARNATAKA

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Ajwain is well known as carom seed and is a popular seed spice crop of India having good medicinal value. The front-line demonstration (FLD) on Ajwain (Ajmer Ajwain-1) variety was conducted by ICAR-Krishi Vigan Kendra of Bagalkot, Karnataka. Ajwain variety AA-1 is grown as rabi season crop suitable for cultivation both under irrigated and rainfed conditions and is rich in essential oil content in seed, AA-1 variety is developed by National Research Centre on Seed Spices, Ajmer, Rajasthan. This AA-1 variety was introduced and was demonstrated in farmer's field for two consecutive years from 2021-22 and 2022-23 to check the performance of AA-1 variety over local variety. As a result of FLD, it was observed that the demo field Ajwain variety (AA-1) recorded high yield of 9.2 q/ha with net return of Rs. 1,57,720 as compared to local variety (Kadapa), which produced average yield of 7.28 q /ha with net return of Rs. 92,320. Ajwain AA-1 variety (demo) was early to mature (64.2 days), B: C ratio was higher (4.43) compared to Kadapa (check) which showed less B: C ratio of 3.10. The seeds had good aroma and oil content in AA-1 variety hence fetched higher market. There was very less pest and disease incidence in ajwain crop unlike chickpea as a rabi crop and also ajwain (AA-1) could withstand biotic and abiotic stresses. The other parameters like extension gap, Technology gap and Technology index were derived for the assessment of technology adoption rate. The average extension gap, Technology gap and Technology index were 6.78, 8.87 and 13.50 per cent respectively. The farmers could get additional income of Rs. On an average 26.37 % yield increase was observed in ajwain demo plots (AA-1) over check plots (Kadapa). The demonstrated technology proved more remunerative and economically feasible to the Ajwain farmers. The results clearly showed the positive impact of front-line demonstrations over farmer practice towards increasing the productivity of ajwain in Bagalkot district of Karnataka.

Keywords: Ajwain, AA-1, Biotic stress, Crop yield, Extension gap, Technology index

EFFECT OF BIOSTIMULANTS ON GROWTH AND YIELD OF GREEN CHILLI

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A field experiment was conducted to study the "Effect of biostimulants on growth and yield of chilli (*Capsicum annum* L.)" during Kharif season 2023-2024 at ICAR- Krishi Vigyan Kendra, Dharwad, Karnataka, India with a view to identify the effects of different doses of bio stimulant and its role in growth, yield and quality of Chilli. The experiment was laid out in Randomised Block Design (RBD) with 7 treatments and 3 replications Among the seven treatments, the foliar application of T3 (Shado Gold @ 750 ml/ha) with three applications at 30, 60 and 90 days after transplanting showed significantly increased the growth and yield attributes when compare to all other treatments. Significantly maximum values for plant height (85.17 cm), plant spread (64.42 cm), number flowers per plant, (38.17), number of fruits per plant (35.17), fruit length (14.07 cm), fruit diameter (13.03 mm), individual fruit weight (19.00 g), fruit yield per plant (668.08 g), fruit yield per hectare (31.90 tons) with B: C ratio of 3.15 recorded in T₃ (Shado Gold @ 750 ml/ha). Whereas, T₄ (Shado Gold @ 1250 ml/ha) recorded on par growth, yield and yield attributes for plant spread (59.95 cm), number flowers per plant (35.67), number of fruits per plant (32.22), fruit length (13.47 cm), individual fruit weight (18.40 g), which is superior over control T₇- no application (water spray). It is evident from the study that there is an increase in yield (31.90 t/ha) of chilli in treatment with Shado Gold @ 750 ml/ha (T₃) as foliar spray which was on par with T₄ (29.67 t/ha) and superior over the control T₇ (26.60 t/ha).

Keywords: Biostimulants, Chilli, Growth and Yield, Foliar application, Shado gold

CHECKLIST OF AVIAN DIVERSITY AT ALANIA DAM

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The Alania wetland, located near Kota in Rajasthan, represents a seasonally dynamic and ecologically significant habitat for a wide array of avian species. This study presents a comprehensive assessment of bird diversity based on fortnightly field surveys conducted using both line and point transect methods. A total of 89 species were recorded, spanning multiple feeding guilds and including resident, summer, and winter migratory birds. Noteworthy sightings included Greater Flamingos (*Phoenicopterus roseus*) and Sarus Cranes (*Antigone antigone*), underscoring the wetland's role as a refuge for globally significant taxa. Species-level population trends were analyzed using data from the IUCN Red List, enabling insights into conservation status and regional abundance patterns. The surrounding landscape comprises a mosaic of forest patches, open grasslands, crop fields, riverine streams, shrubs, and scattered trees, contributing to habitat heterogeneity and supporting diverse avifaunal assemblages. However, parts of the floodplain are annually impacted by agricultural cultivation, posing potential threats to habitat integrity and bird nesting grounds. The integration of field-based observations with global conservation metrics highlights the wetland's potential designation as an Important Bird Area (IBA), offering a valuable baseline for long-term ecological monitoring. This dataset contributes to understanding migratory connectivity, habitat use, and the influence of seasonal dynamics on avian community structure in semi-arid wetland ecosystems. The findings advocate for continued monitoring and habitat protection to ensure the persistence of both migratory and resident bird populations in the region.

NUTRITIONAL AND PHYTOCHEMICAL EVALUATION OF A SEAWEED-BASED ENERGY BAR

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Nutrition bars are often considered supplements or meal replacements due to their high nutrient density, convenience, and portability. As macroalgae are a sustainable and nutrient-rich ingredient suitable for diverse food applications, there is a growing interest in incorporating them into food formulations. A seaweed enhanced nutrition bar holds potential as a functional snack, as seaweed is abundant in bioactive compounds with health-promoting properties. To encourage broader consumption of edible seaweeds, this study aimed to develop and characterize a nutrition bar using different types of edible seaweed. In this study, a nutrition bar was developed and characterized using five distinct marine macroalgae. Edible seaweeds belonging to red, brown, and green algae were collected from the R.K. Algal Project Center, Tamil Nadu. The collected seaweed was thoroughly washed to remove impurities, then shade-dried and ground into powder. The dried seaweed was coarsely powdered and used for further analysis. *The proximate composition of the seaweed based nutritional bar showed highest protein content, crude fiber, carbohydrate and low fat content. The developed bar exhibited higher antioxidant activity than the control. Phytochemical analysis of the developed bar showed highest phenolic, tannin content, and flavonoid content. Further studies are needed to assess long-term safety, improve sensory quality, and validate health effects. The findings are expected to benefit the food industry and help meet the rising consumer demand for functional foods.*

Keywords: Seaweed, Nutritional bar, Nutritional profile, phytochemical analysis

EVALUATION OF EFFECTIVE PRE-SOWING SEED TREATMENTS FOR ENHANCED GERMINATION OF *DALBERGIA LATIFOLIA* AND *PTEROCARPUS MARSUPIUM*

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The present investigation was carried out to evaluate the effectiveness of different pre-sowing seed treatments on germination and early seedling growth of *Dalbergia latifolia* and *Pterocarpus marsupium*, two important tropical timber species of high economic and ecological value. The study was conducted in the mist chamber at the Forest Nursery, Department of Silviculture and Agroforestry, College of Forestry, Sirsi, Uttara Kannada District, Karnataka. The experiment was laid out in a Completely Randomized Design (CRD) with eight treatments and three replications using 100 seeds per replication. The treatments included control, soaking in water for 24 h and 48 h, soaking in hot water for 24 h, soaking in 1% and 2% H₂ SO₄, cow dung slurry treatment for 12 h, and nicking treatment. Seeds were sown using the dibbling method in nursery beds and later transplanted into polybags containing soil, sand, and FYM in a 2:1:1 ratio. Observations on germination period, germination energy, germination percentage, and survival percentage were recorded at monthly intervals for three months. Results revealed that soaking in cold water for 48 hours significantly enhanced germination and survival in *Dalbergia latifolia*, whereas acid scarification with 2% H₂ SO₄ gave the best results in *Pterocarpus marsupium*. Both treatments effectively broke seed dormancy and promoted uniform germination and seedling vigor. The study concluded that species-specific pre-sowing treatments are essential for improving seedling establishment and large-scale propagation of these valuable forest trees.

Keywords: *Dalbergia latifolia*, *Pterocarpus marsupium*, Pre-sowing treatments, Germination percentage.

EFFECT OF VARIOUS POTTING MIXTURES ON THE GROWTH ATTRIBUTES OF *PTEROCARPUS MARSUPIUM* UNDER MIST CHAMBER CONDITIONS

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The present investigation entitled “Effect of Various Potting Mixtures on the Growth Attributes of *Pterocarpus marsupium* under Mist Chamber Conditions” was carried out in the Mist Chamber at the Forest Nursery, Department of Silviculture and Agroforestry, College of Forestry, Sirsi, Uttara Kannada District, Karnataka. The study site was located in the hilly zone (Zone 9) of Karnataka at an elevation of 619 m above mean sea level, positioned at 14°36' N latitude and 75°53' E longitude. The experiment was laid out in a Completely Randomized Design (CRD) with six treatments and four replications, consisting of a total of 480 cuttings. The treatments included different potting mixtures: T₁ –Sand (Control), T₂ –Vermiculite, T₃ –Cocopeat, T₄ –Sand + Vermiculite, T₅ –Sand + Cocopeat, and T₆ –Sand + Cocopeat + Vermiculite. Root trainers were used to hold the rooting media, and after root initiation, the cuttings were transplanted into polybags containing Soil: Sand: FYM (2:1:1). Observations were recorded at monthly intervals for three months on parameters such as shoot length, root length, collar diameter, number of leaves per seedling, and shoot-to-root ratio. The study aimed to determine the most effective potting mixture for promoting superior growth performance of *Pterocarpus marsupium* under nursery conditions. The results may reveal that one or more potting mixtures provided favorable conditions for root and shoot development, thereby improving seedling vigor and offering useful recommendations for large-scale propagation and plantation of this valuable timber and medicinal species.

Keywords: *Pterocarpus marsupium*, Potting mixtures, Growth performance, Nursery propagation

CARBON SEQUESTRATION POTENTIAL AND GREENHOUSE GAS REDUCTION ANALYSIS OF PLATS FROM ABJARANYA OF UDUPI DISTRICT, KARNATAKA

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Carbon sequestration is a process of capturing and storing atmospheric carbon dioxide thereby reducing its concentration in the atmosphere and combat climate change. The study was conducted in Abjaranya, a sacred grove within Poornaprajna (Autonomous) college campus known for its cultural and spiritual significance. Such ecosystems play an important role in maintaining ecological balance and reducing the effects of global warming. Tree parameters such as the girth and height were measured to estimate above-ground biomass. The carbon content was derived from biomass values, and the corresponding CO₂ sequestration potential was calculated. Total of 25 trees were recorded showing high carbon storage capacity. The result highlights that Abjaranya acts as a natural carbon sinks that continuously absorb atmospheric carbon dioxide, contributing to climate change mitigation. The importance of conserving sacred grove, not only enhances cultural and spiritual value but also their ecological significance in reducing greenhouse gas concentration and promoting sustainable environmental practices. The study also aims to spread awareness among people by providing baseline data on the carbon storage capacity of individual tree species, emphasizing how natural ecosystem directly supports a healthier atmosphere and a sustainable future.

Keywords: Abjaranya, Carbon Sequestration, Green House gasses, Global Warming.

A NEW REPORT OF RUST FUNGUS PUCCINIA BHAGYANARAYANII SPECIES FROM UDUPI DISTRICT, KARNATAKA

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A new report of rust fungus, *Puccinia bhagyanarayanii* was identified on the living leaves of *Justicia betonica* (family: Acanthaceae) in Udupi, coastal Karnataka. The present study aims to investigate the occurrence, morphology, and host range of *P.bhagnarayanii*, with a particular focus on identifying its secondary host. Field observation revealed characteristic telial pustules on the lower surface of *J. betonica* leaves, confirming its role as the primary host. The teliospore was observed to be brownish orange, two celled and oblong, typical of genus *Puccinia*. Surveys conducted in the surrounding vegetation aimed to locate potential alternate hosts. Distinctive microscopic characteristics were observed, including longer pedicels and smooth-walled teliospores, which distinguish it from related rust species known to infect *Justicia*. During microscopic examination, a spore morphologically distinct from the typical teliospore was also discovered, raising questions about its true origin and role in the fungal cycle. Interestingly, mites were observed on the outer surface of the telial sori, suggesting a potential association between rust fungus and micro arthropods. The study provides a preliminary account of this rust fungus from coastal region of Karnataka and contributes to understanding its life cycle, host association, and ecological relationships of *P.bhagyanarayanii*.

Keywords: Rust Fungus, Coastal Karnataka

EXPLORING ACTIVATED CARBON NANOPARTICLES FOR DROUGHT STRESS ALLEVIATION IN MUNG BEAN (*VIGNA RADIATA* L.)

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Drought stress or water scarcity largely affects growth, development, and yield of crop plants. Nanoparticles application is emerging as a promising approach for alleviating drought stress impacts. The current study aims to evaluate the impacts of activated carbon nanoparticles (ACNPs) on Mung bean (*Vigna radiata* L.) plants under drought stress (PEG 6000) in a Hoagland's medium. Five different concentrations of ACNPs (10, 20, 30, 40, and 50 mg/L) were used to treat mungbean plants grown in conditions without stress (Hoagland's medium) and with drought stress (Hoagland's medium with 5% PEG 6000). The physiological parameters and activity of antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), and peroxidase (POX) were studied after 7 days of NP treatment. The induced drought stress caused a prominent reduction in morphological parameters of plants and upregulated antioxidant enzymatic machinery. The ACNPs treatment improved stress tolerance in a concentration-dependent manner, and 40 mg/L ACNPs was found to be the most effective among all. The ACNPs treatment at 40 mg/l concentration, increased shoot length (26%), roots length (50%), leaf area (9%), and plant fresh biomass (45%) in stressed plants. The antioxidant enzyme activities were also significantly induced at 40 mg/L compared to other concentrations. The current findings suggested that ACNPs at 40 mg/l concentration can mitigate the adverse impacts of drought stress on Mung bean plants.

Keywords: Mung bean; Drought; Nanoparticles; Growth and Development; Stress; Antioxidants; Stress alleviation.

INFLUENCE OF SEED INOCULATION WITH SOME PLANT GROWTH PROMOTING MICROORGANISMS ON PAPAYA

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Papaya faces problem with seed germination. Hence the research work was carried out with the aim to study the influence of seed inoculation with some plant growth promoting microorganisms on germination and early papaya development. The experiment was carried out during the academic year of 2024-2025 at the Department of Horticulture, Institute of Agricultural Science, University of Calcutta. The experiment comprised ten treatments, including a control and inoculations with Azospirillum, Azotobacter, and Vesicular Arbuscular Mycorrhiza (VAM) for varying durations (1, 3, and 5 hours). The study assessed parameters such as germination percentage, shoot and root length, number of leaves, root number and chlorophyll content, at 35, 45 and 55 days of sowing. Results revealed that treatments T₈ (VAM for 3 hours) and T₉ (VAM for 5 hours) exhibited superior performance in terms of shoot and root development, leaf number, and chlorophyll content. T₆ (Azotobacter for 3 hours) showed the highest germination rate, while T₇ (VAM for 1 hour) had the longest root system. Overall T₉ (Vesicular Arbuscular mycorrhiza inoculation for 5 hours) was the best treatment among all the treatments. Thus, the findings highlighted that inoculation, especially with VAM for extended durations, significantly improves early seedling vigor and overall growth

Keywords: microorganisms, papaya, seed, growth, study.

EDIBLE INNOVATIONS: REDEFINING CUISINE THROUGH 3D FOOD PRINTING

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3D food printing represents a groundbreaking technology that is transforming traditional perceptions of food production and consumption. By employing digital design and constructing food layer by layer, it enables the creation of edible products customized to individual preferences for taste, appearance, and nutritional value. Recent advancements demonstrate significant potential in producing personalized meals, reducing food waste, and promoting sustainable alternatives such as plant-based or lab-cultivated foods. Techniques including extrusion, inkjet printing, and laser sintering allow for the fabrication of foods that not only exhibit visual appeal but also meet specific dietary requirements benefiting consumers, hospital patients, and even astronauts in space. However, several challenges hinder widespread adoption: high equipment costs, technical complexity, limited consumer acceptance, and concerns over product quality, safety, and standardization. Ongoing research aims to address these barriers by developing intelligent systems for real-time monitoring, improving texture and shelf stability, and integrating microwave-assisted processes or bioactive compounds to enhance functionality and nutritional performance.

Keywords: 3D food printing, digital design; sustainable food technology; extrusion, smart food systems

ASSESSMENT OF MICROPLASTIC CONTAMINATION IN SELECTED FISH SPECIES OF SASTHAMKOTTA LAKE, SOUTHERN KERALA

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Microplastic is an emerging pollutant, which has a size of <5mm diameter originated from the degradation of larger plastic particles. The present study analyses microplastic contamination in selected fish species of Sasthamkotta Lake, a Ramsar site in Kerala. Sasthamkotta Lake is the largest freshwater Lake in Kerala, and it is the major drinking water resource of half million people of Kollam district. Fishes from the Lake used as a major food by local peoples and it has commercial and economic importance. *Channa striata*, *Etroplus suratensis*, *Horabagrus branchysoma*, and *Mystus occulatus* were the fish species selected for the study. Fishes were collected with the help of local fishermen from the site using Dip net, Gill net and Cast net. KOH digestion method was used for microplastic analysis from fish samples. Preliminary examination of microplastic was done by using stereomicroscope. Polymer identification was done by using Raman spectroscopy. A total of 4635 microplastic identified from fishes. Fiber, fragment, film and pellet were the type of microplastic particle identified. Fibers were the prominent category followed by fragments, pellet and film. Blue, black, brown, green, pink and red coloured microplastic particles were obtained. Polyethylene and polypropylene were the prominent category of microplastic polymer type identified.

Keywords: Microplastic, Sasthamkotta Lake, Fish, Raman spectroscopy, Polymer type.

IMPACT OF CHANGE PRONENESS, SCIENTISM AND RISK ORIENTATION

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This paper aims to measure the impact of change proneness, scientism level and orientation effect on farmers by estimating the impact of Rural Agriculture Work Experience Programme on farmers'. The study was conducted in Yamunagar district of Haryana. As many as 120 farmers were selected as respondents. To identify the causes of change proneness among farmers was on the statement "If something bad is going to happen to me, it will happen no matter what I do" with highest mean value (2.62) followed by "there is no sense in planning a lot; if something" with mean value (2.35), while "there is no sense in planning a lot; if something" with mean value (2.25). However, prediction of change proneness was in effect to that "I have learned that what is going to happen will happen" with mean value (2.21). In case of scientism which refers the idealization and scientific method of human activities the ways they work or think. It was found in the study way of thinking of farmers on the statement "I have learned that what is going to happen will happen" with highest mean value (2.76) followed by "If something bad is going to happen to me, it will happen no matter what I do" with mean value (2.17) while "If bad things happen, it is because they were meant" with mean value (2.46). Study also investigates that effect of risk orientation on farmers in case of "Cautious towards making plans for the assigned task" with mean value (2.29) followed by "I follow the motto, nothing ventured, nothing gained" with mean value (2.78) while "When task seems interesting I, choose to do it with my competence" (2.55).

Keywords: Change Proneness, Impact, Scientism, Risk Orientation, Farmers and RAWEP

MULTIVARIATE STATISTICAL APPROACH TO WATER QUALITY ASSESSMENT OF SPRINGS IN SIRMAUR DISTRICT, NORTH-WESTERN HIMALAYAS, INDIA

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Springs in the Sirmaur district of the North-Western Himalayas, serve as vital freshwater sources for local communities. However, comprehensive information on their water quality and influencing factors remains limited. This study assessed 30 springs over a two-year period (2021–2023), analyzing physicochemical and heavy metal parameters, seasonal variations, and land use impacts through multivariate statistical methods. The spring water was neutral to mildly alkaline (pH 6.97–8.06) and exhibited moderate mineralization. Calcium and magnesium levels occasionally exceeded BIS standards, indicating geogenic inputs from carbonate and dolomite rich formations. Among heavy metals, lead concentrations exceeded permissible limits in both pre- and post-monsoon seasons (up to 0.0163 mg L^{-1}), while iron exceeded limits during the pre-monsoon season (up to 0.3004 mg L^{-1}), reflecting localized anthropogenic and lithological influences. Water Quality Index (WQI) assessments classified the overall water quality as 'Good' (pre-monsoon: 36.26; post-monsoon: 37.63), with forested catchments consistently showing superior quality. A statistically significant difference ($p < 0.05$) in water quality between springs in agricultural and settlement areas during the pre-monsoon season indicates enhanced contaminant transport under low-flow conditions. Spearman correlation analysis identified positive associations between pH and key elements like Ca, Zn & Mn, suggesting the influence of mineral weathering. Principal Component Analysis (PCA) distinguished regional geogenic controls from site-specific anomalies shaped by land use and lithology. The study provided a comprehensive, data-driven understanding of spring water quality dynamics in the North-Western Himalayas, offering valuable insights for spring shed management, pollution mitigation and sustainable water resource planning in Himalayan headwater regions.

Keywords: Spring shed management, BIS standards, Spearman correlation, WQI, Lithology, Land use impact

DESIGNING A SOIL-FREE GROWTH MEDIUM FOR INDOOR PLANTS USING HYDROGEL DERIVED FROM THE MARINE RED ALGA *KAPPAPHYCUS ALVAREZII*

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The rapid expansion of urban populations has created an urgent demand for sustainable, space-efficient agricultural practices. Soil-less cultivation systems have emerged as a promising solution, yet current growth media often rely on synthetic, non-biodegradable substrates. This project explores the potential of *Kappaphycus alvarezii*, a marine red alga rich in κ -carrageenan, to develop a biodegradable hydrogel-based growth medium tailored for indoor plant systems. κ -carrageenan will be extracted through eco-friendly alkaline methods and formulated into hydrogels optimized for water-holding capacity, porosity, and biodegradability. These hydrogels will be physicochemical characterized (FTIR, SEM, rheometry) and tested for stability and compatibility with indoor crops such as leafy vegetables and ornamentals. Plant growth performance including germination rate, biomass accumulation, root-shoot development, and chlorophyll content will be evaluated against soil and conventional substrates. By bridging marine biotechnology and sustainable agriculture, this study pioneers the application of seaweed-derived hydrogels in soil-less indoor farming within the Indian context. Expected outcomes include a functional prototype of a hydrogel-based cultivation system, a patentable formulation, and training modules for wider adoption. Beyond enhancing indoor agriculture, this innovation vaporizes marine biomass, supports coastal farming communities, and contributes to circular bioeconomy and urban food security.

Keywords: *Kappaphycus alvarezii*, hydrogel, indoor farming, carrageenan, soil-less cultivation, sustainable agriculture

AIR POLLUTION IN INDIA: CHALLENGES, IMPACTS, AND MODERN MITIGATION STRATEGIES A COMPREHENSIVE REVIEW

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Air pollution remains a major environmental and public health concern in India, caused by rapid urbanization, industrial growth, and increasing energy demand. This paper presents a comprehensive review of the key sources, effects, and control measures related to air pollution across the country. Major contributors include vehicle emissions, coal-based power generation, industrial activities, construction dust, and agricultural residue burning. The Indo-Gangetic Plain experiences the highest pollution levels due to dense population and unfavorable meteorological conditions. Prolonged exposure to pollutants such as $PM_{2.5}$, PM_{10} , and nitrogen oxides has led to serious health issues, crop damage, and economic losses. The Government of India has initiated several programs, including the National Clean Air Programme (NCAP), Bharat Stage-VI vehicle norms, and renewable energy expansion, to curb emissions. Technological innovations like electric mobility, flue-gas desulfurization, and advanced air quality monitoring are improving control efficiency. Despite these measures, challenges remain in enforcement, coordination, and public participation. The study emphasizes the need for integrated airshed management, stronger institutions, and community involvement to achieve sustainable air quality improvement and safeguard public health in India.

Keywords: $PM_{2.5}$, National Clean Air Programme (NCAP), air quality management, mitigation technologies, environmental policy, airshed management.

ONE FARM, ONE SOLUTION: INTEGRATED APPROACH TO NUTRIENT, WEED, AND PLANT PROTECTION MANAGEMENT

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Sustainable crop production requires a comprehensive strategy that integrates nutrient management, weed control, and plant protection practices. The “One Farm, One Solution” concept emphasizes an integrated and balanced approach that combines scientific knowledge with agronomic techniques to ensure soil health, crop vigor, and environmental safety. Integrated Nutrient Management (INM) optimizes the use of organic and inorganic sources to maintain soil fertility, while Integrated Weed Management (IWM) focuses on mechanical, biological, and chemical measures to control weed competition. Similarly, Integrated Pest and Disease Management (IPDM) aims to reduce crop losses by promoting environmentally friendly pest control methods. When implemented together, these systems reduce input costs, increase crop productivity, and promote long-term agricultural sustainability. This holistic model not only improves agricultural efficiency but also reduces dependence on synthetic chemicals, preserving ecological balance for future generations.

Keywords: Integrated nutrient, weed & pest management, sustainable, agricultural productivity, soil fertility - plant health

RESEARCH FRONTIERS IN LAND USE CHANGE: A BIBLIOMETRIC STUDY OF TRENDS AND COLLABORATIVE NETWORKS (2000–2023)

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Land use and land cover (LULC) change has become a central theme in global environmental research due to its close association with urbanization, climate variability, agricultural transitions, and sustainability challenges. This study presents a bibliometric analysis of research trends, collaboration networks, and emerging hotspots in land use change literature from 2000 to 2023. Data were extracted from Web of Science, Scopus, and Dimensions databases and analyzed using VOSviewer to visualize keyword co-occurrence and international collaborations. The analysis reveals a steady increase in LULC research, with exponential growth in publications since 2017. Research has evolved from basic land cover classification to integrative studies involving climate models, socio-economic impacts, and predictive simulations. Emerging research themes include climate change mitigation, sustainable land management, scenario-based predictions, and policy-driven land system science. Keywords such as “urban expansion,” “remote sensing,” and “climate resilience” frequently co-occur, reflecting the interdisciplinary nature of the field. This study provides a systematic overview of the evolution and direction of land use research, emphasizing the growing need for integrated frameworks to address environmental and policy challenges in a rapidly transforming global landscape.

Keywords: Land use evolution, Bibliometric analysis, VOSviewer, Collaboration networks, Sustainable development

AGRITOURISM: A SUSTAINABLE PATHWAY TO BIODIVERSITY CONSERVATION

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Agritourism, an emerging facet of sustainable rural development, plays a crucial role in promoting biodiversity conservation by integrating agricultural practices with ecological awareness. It encourages farmers to adopt environment-friendly methods such as organic farming, mixed cropping, agroforestry, and traditional seed conservation, thereby maintaining ecological balance. Through agritourism, visitors gain firsthand experience of farm life and learn the importance of preserving natural resources, native flora, and fauna. This exchange of knowledge not only generates additional income for farmers but also strengthens community participation in conserving biodiversity. Moreover, agritourism fosters the protection of traditional landscapes, indigenous breeds, and local agricultural heritage, which are vital for ecological resilience. By linking conservation with economic incentives, agritourism emerges as a powerful tool for sustainable livelihood and environmental stewardship. Thus, it serves as a bridge between nature and society, ensuring that agricultural prosperity goes hand in hand with biodiversity preservation.

ISOLATION AND SCREENING OF CHITINOLYTIC BACTERIA FOR ITS ANTIFUNGAL POTENTIAL AND SUSTAINABLE BIOCONTROL

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Soil-borne fungal pathogens like *Fusarium* sp., *Rhizoctonia* sp., *Pythium* sp., *Phytophthora* sp., cause severe plant diseases, hampers crop yields, damage produce quality resulting into loss of economically agricultural crops. Also, excessive fungicide usage results in ecosystem pollution, creates pathogen resistance towards fungicides, effects on non-target organisms and increasing health risks in humans. An alternative approach to avoid the undesirable effects of chemicals is by biological control using antifungal bacteria that displays a direct action against fungal pathogens. Since chitin in fungal cell walls is a target for biocontrol agents, chitinases are considered as one of the important antifungal molecules. As part of an integrated pest management strategy, chitinases can replace or minimize hazardous pesticide use. Chitinase-producing bacteria can be developed as bio-fungicides since they inhibit phytopathogen growth. The aim of this study deals with isolation and screening of chitinase-producing bacteria from the organic wastes and rhizospheric soils from Punjab region. The isolate was screened based on the size of the zone formed. The best chitinase producer was subjected to 16s ribosomal RNA sequencing. The bacterial strain will further be subjected to purification of the enzyme produced and will be evaluated as an effective antifungal agent against fungal phytopathogens.

Keywords: Biocontrol, Chitinase, Phyto-Pathogens, Antifungal

INVESTIGATION OF FREE RADICAL-MEDIATED STRESS AND CHROMOSOMAL DAMAGE CAUSED BY POLYVINYL CHLORIDE MICROPLASTICS (PVC-MPS) IN *OREOCHROMIS MOSSAMBICUS*

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Microplastic pollution has raised significant environmental concerns. The common source of Polyvinyl Chloride Microplastics (PVC-MPs) in freshwater aquatic ecosystems is via leaching and degradation of PVC pipes used for the water supply infrastructure. The present study analyzed the accumulation of PVC-MPs in tissues of Tilapia (*O. mossambicus*) and investigated the effects of PVC-MPs on antioxidant enzymes, biomolecules and genotoxicity after 14 days exposure to PVC-MPs at three different doses. Antioxidant enzymes such as TBARS, Catalase and SOD showed a significant increase while medium to lower alterations in enzymes ALP and ALT were observed. Biomolecules like Proteins and Carbohydrates in all the tissues, decreased significantly when compared to the control. The micronucleus test showed a significant increase in the frequency of micronuclei formed, pointing to the potential chromosomal damage. These findings highlight that exposure to PVC-MPS can induce physiological stress in Tilapia. These findings underscore the biochemical and genotoxic risks posed by polyvinyl chloride microplastic pollution in freshwater fish and highlight the urgent need for further research and mitigation strategies to address microplastic contamination in aquatic environments.

Keywords: Polyvinyl chloride microplastics, *Oreochromis mossambicus*, oxidative stress, genotoxicity, freshwater fish, environmental contamination

BIOCHEMICAL CHARACTERIZATION AND METABOLIC PROFILING OF MAHUA (*MADHUCA LONGIFOLIA*) ACCESSIONS WITH EMPHASIS ON BIOACTIVE AND MEDICINAL COMPOUNDS

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Mahua (*Madhuca longifolia*) is an important Indian tree valued for its cultural, nutritional, and medicinal significance. A study at BUAT, Banda, analyzed 13 Mahua accessions for morphology, texture, sensory attributes, biochemical composition, and metabolic pathways. Based on texture, Group 1 (BM-6, BM-10) showed high toughness; Group 2 included BM-4 (springiness) and BM-5 (sweetness, aroma, texture); and Group 3 (BM-1) balanced toughness with hardness. Biochemical analysis revealed BM-1 and BM-5 had the highest sugar, protein, and antioxidant contents. GC profiling identified 440 compounds—fatty acids and terpenes in leaves, carbohydrates and furfurals in flowers, and fatty acids in seeds. KEGG pathway analysis uncovered 290 metabolic pathways, including those related to terpene, phenol, and fatty acid metabolism. Key identified compounds such as 5-Hydroxymethylfurfural, 3(2H)-Furanone, 4-hydroxy-5-methyl, Furaneol, Hexadecanoic acid ethyl ester, Phytol, 1H-Imidazole, 2-methyl-4-(2-methylpropyl)-, 3-Furanmethanol, 12-Oleanen-3-yl acetate (3 α), Epilupeol; 20(29), Lupen-3 α -ol acetate (isomer 1), and Lup-20(29)-en-3-ol acetate (3 β) contribute to Mahua's wide-ranging bioactive profile. These compounds are known for their antioxidant, anti-inflammatory, antimicrobial, hepatoprotective, and antidiabetic properties, while also enhancing aroma, flavor, and therapeutic value. The presence of triterpenoids and phenolic derivatives supports its potential use in managing diabetes, oxidative stress, and liver disorders. Medicinally, Mahua demonstrates strong nutraceutical potential and may serve as a functional ingredient for food, pharmaceutical, and agricultural innovations, emphasizing its role as a medicinally and industrially valuable plant.

Keywords: *Madhuca longifolia* (Mahua), KEGG, Bioactive compounds, Antioxidant activity, Antidiabetic potential.

A PRELIMINARY REPORT ON DIVERSITY OF EMIGRANT BUTTERFLY SPECIES (LEPIDOPTERA: PIERIDAE) FROM MOHALI, PUNJAB

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Butterflies belonging to the order Lepidoptera and suborder Rhopalocera are one of the most diverse and widely distributed groups of insects. Butterflies are like tiny detective of environment, any changes in their surroundings are easily picked up on by these sensitive creatures. Butterflies serve as an excellent bioindicators for the health of natural ecosystems due to their sensitivity to microclimates and light levels. Butterflies are amongst the most the studied insect groups in terms of classification. Globally approximately 20,000 butterfly species have been documented with 1800 species recorded in India alone (Robins *et al.*, 1997; Kunte, 2000) and 1200 species are recently reported in Punjab. *Catopsilia* Hübner (1819), a Pierid Genus, includes six species of butterflies distributed widely across the globe. They are commonly known as migrants or emigrants, are renowned for their distinctive migratory behavior, often seen in large numbers across various landscapes. In India, *Catopsilia* is represented by four species, three of which are known from Punjab, viz., *Catopsilia pyranthe* (Linnaeus, 1758), *Catopsilia pomona* (Fabricius, 1775), and *Catopsilia florella* (Fabricius, 1775). The present studies focus on the diversity of migrant butterflies from the Chandigarh University Campus, and adjoining areas and thus proposing the conservation strategies for declining populations of butterfly fauna due to extensive urbanization projects and extensions.

PHYTOCHEMICAL FINGERPRINTING AND BIOLOGICAL EVALUATION OF *TAXIPHYLLUM TAXIRAMEUM* (MIT.T) M. FLEISCH: A PROMISING MEDICINAL MOSS

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Bryophytes are cosmopolitan plants known for their rich with secondary metabolites with diverse bioactivities. *Taxiphyllum taxirameum* (Mit.t) M. Fleisch is a moss under the family Hypnaceae, commonly grows in shaded habitats on rocks or soil banks, particularly near riparian areas. Traditionally, *T. taxirameum* has been used by tribals communities to cure various ailments including skin burns and rashes. In both Indian and Chinese folk medicines, this moss is reported for its anti-inflammatory, hemostatic and wound healing properties. However, the phytochemical profile of this plant remains largely unexplored. The present study is aimed to evaluate the phytochemical composition and assess the antioxidant and cytotoxic activities of *T. taxirameum*. Phytochemical screening revealed the presence of a pool of secondary metabolites like phenols, flavonoids, saponin, terpenoids, alkaloids, glycosides, steroids and quinones with the total flavonoid content ($45.67 \pm 1.2 \mu\text{g/ml}$) being notably high, indicating the moss as a rich source of flavonoid compounds. FTIR fingerprinting revealed the presence of diverse functional groups such as hydroxyl, aromatic, aliphatic, nitrile, ketone, metal carbonyl, and aryl disulfide groups. LC-MS profiling further validated the occurrence of key polyphenolic derivatives, including quercetin, kaempferol, coumarins, caffeic acid, and other flavonoids. Antioxidant assays of flavonoid demonstrated 28.19% inhibition in the DPPH assay (IC_{50}) and 28.37% activity in the FRAP assay at 100 ng/ml. The cytotoxic activity, evaluated by the MTT assay, revealed a dose-dependent reduction in cell viability, with 90.62% viability in MCF-7 and 83.63% in Caco-3 cell lines after 24 h of treatment, indicating moderate cytotoxic potential. Overall, the findings highlight *T. taxirameum* as a promising source of bioactive phenolic and flavonoid compounds with moderate antioxidant and cytotoxic properties, warranting further bioassay-guided isolation and characterization of its active constituents.

Keywords: *T. taxirameum*, flavonoid, antioxidant DPPH, FRAP, MTT assay

CLIMATE SMART PRODUCTION OF VEGETABLES UNDER PROTECTED CULTIVATION SYSTEMS

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Climate-smart agriculture (CSA) has emerged as a strategic approach to sustainably increase crop productivity, enhance resilience to climatic stresses, and reduce greenhouse gas emissions. Among various CSA interventions, protected cultivation systems offer a viable solution for year-round vegetable production under changing climatic scenarios. Under protected conditions, yields have been observed to increase by 40-150 % compared to open field cultivation. The integration of protected structures such as polyhouses, shade nets, and low tunnels with precision farming technologies enables efficient management of temperature, humidity, light, and soil moisture. These systems significantly improve resource-use efficiency: water use efficiency increases by 30-50 % through the use of drip irrigation and fertigation in protected environments, while fertilizer-use efficiency can reach up to 95 % under optimized fertigation systems. In one study of capsicum under polyhouse in Himachal Pradesh, optimized drip-fertigation treatments saved 40-60 % water compared to less efficient regimes, and achieved water use efficiency of about $13.94 \text{ g m}^{-2} \text{ mm}^{-1}$ yield per mm of water applied. Another study with tomato under poly-mulched, drip-irrigated ridges showed that applying 3 mm/day irrigation with mulching yielded water productivity of 9.73 kg/m^3 , compared to 4.68 kg/m^3 under bare ridges at lower irrigation. Similarly, zucchini grown under protected cultivation required only about 68 % of the water compared to open-field production, reflecting water savings of ~30-40 %. Protected cultivation also improves quality, crop scheduling and reduces losses: for example, tomato under a naturally ventilated polyhouse showed water use efficiency in the range 49.23 to $71.27 \text{ kg/m}^2\text{-m}^{-1}$ under polyhouse vs 13.55 to $31.15 \text{ kg/m}^2\text{-m}^{-1}$ in open field.

Keywords: Climate-Smart Agriculture, Protected Cultivation, Vegetable Production, Resource-Use Efficiency, Sustainability

NUTRITIONAL AND LIFESTYLE INTERVENTIONS IN AUTOIMMUNE DISEASES: AN INDIAN WOMEN'S HEALTH PERSPECTIVE

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One of the most important features of our immune system is the ability to differentiate self from foreign entity. Autoimmune diseases are chronic disorders in which the body's immune system mistakenly attacks its own tissues. Globally, these conditions are more prevalent among women, and in India, this gender gap is increasingly evident. Indian women face unique biological and socio-cultural factors hormonal changes, nutritional deficiencies, genetics, environment, stress, and limited access to healthcare that influence the onset and progression of autoimmune disorders such as thyroiditis, lupus, rheumatoid arthritis, Sjogren's syndrome which can affect joints, skin, blood vessels and even vital organs. Many women dismiss early symptoms – fatigue, joint stiffness or swelling – as routine tiredness or age related changes. This paper explores the importance of nutritional and lifestyle interventions as supportive measures for managing autoimmune diseases in Indian women. Balanced diets rich in anti-inflammatory foods, probiotics, and micronutrients like vitamin D, selenium, and iron play a critical role in modulating immune function. Traditional Indian foods and spices such as turmeric, ginger, and fermented preparations provide natural anti-oxidative and immunoregulatory effects. In addition, lifestyle habits including yoga, meditation, adequate sleep, and physical activity help reduce stress-induced immune imbalance. Urbanization, processed diets, and sedentary behaviour have, however, increased disease risk. Integrating evidence-based nutrition with culturally relevant lifestyle practices can complement medical therapy, improve treatment outcomes, and enhance overall well-being. This study highlights the urgent need for awareness programs so it can move from margins to the mainstream, gender-specific research, and preventive health strategies tailored to Indian women to mitigate the growing burden of autoimmune diseases.

Keywords: Immune System, Autoimmune diseases, rheumatoid arthritis, anti-inflammatory foods

A SUSTAINABLE AGRICULTURE GREEN APPROACH: INTEGRATING NANOSTRUCTURED SiO_2 FROM SUGARCANE TRASH WITH MICROBIAL DECOMPOSERS - A REVIEW ON NON-THERMAL VALORIZATION FOR SOIL AND CROP PRODUCTIVITY

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After sugarcane is grown, a lot of waste is left behind, which is typically burned, causing pollution and harm to the land. The concept reduces sugarcane waste more efficiently and in a more ecological way by using natural microbe's microscopic living organisms. This process could be improved, and sugarcane waste turned into a valuable resource by adding silica (SiO_2) nanoparticles that were recovered from the sugarcane trash. Without the use of toxic chemicals, the microorganisms and nanoparticles will work together to enhance soil fertility, release nutrients, and encourage crop development. This strategy not only promotes more eco-friendly farming methods but also stops dangerous residues from being burned. The project aims to provide farmers with a workable, affordable, and sustainable way to manage agricultural waste while boosting harvests. While SiO_2 nanoparticles increase microbial efficiency, soil aeration, and nutrient uptake, microbial consortia break down lignocellulosic biomass and enrich the soil with organic matter and nutrients. This well-rounded strategy reduces groundwater and environmental contamination. It aids in the battle against climate change by reducing greenhouse gas emissions and air pollution. It provides lower input costs, better soil fertility, and increased agricultural output. Healthier air, safer food, and reduced exposure to hazardous agrochemicals lead to a comprehensive approach to sustainable agriculture and regional well-being. The concept provides policymakers and agricultural communities with a cost-effective and ecologically responsible method of turning sugarcane trash into a natural soil enhancer that reduces pollution and increases crop yields without the use of pesticides.

Keywords: Sugarcane waste; biogenic silica; nanostructured SiO_2 ; microbial decomposers; green extraction; circular bioeconomy; sustainable agriculture; non-thermal valorization

PHYTOCHEMICAL SCREENING AND EVALUATION OF ANTIBACTERIAL, ANTI-DIABETIC AND ANTIOXIDANT ACTIVITIES OF LEAF AND FLOWER EXTRACTS OF *CLERODENDRUM INFORTUNATUM* L.

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Introduction and Aim: Medicinal plants have long been used to prevent and treat diseases, containing complex bioactive compounds with diverse pharmacological potentials. They form the basis of many traditional medicine systems and continue to inspire modern pharmaceuticals. *Clerodendrum infortunatum* L., commonly found in tropical South and Southeast Asia, particularly India, has a rich history in traditional medicine, though detailed scientific studies on its bioactive compounds and therapeutic effects remain limited. This study aimed to investigate the phytochemical constituents and assess the in vitro antimicrobial, antioxidant, and anti-diabetic activities of distilled water, isopropyl alcohol, and chloroform extracts from the leaves and flowers of *Clerodendrum infortunatum* L. **Materials and Methods:** Fresh leaves and flowers of *Clerodendron infortunatum* L. were collected from natural habitat, Alappuzha district, Kerala. Cold extraction method was used for the preparation of. Qualitative phytochemical screening was carried out by using standard procedures. The antimicrobial, antioxidant, and anti-diabetic activities were evaluated using the agar well diffusion method, DPPH free radical scavenging assay, and alpha-amylase inhibitory assay, respectively. **Results:** Phytochemical screening of *Clerodendrum infortunatum* revealed alkaloids, flavonoids, phenols, tannins, saponins, terpenoids, and glycosides, in various flower extracts showing a broader and more intense profile, especially in chloroform and isopropyl alcohol. Flower extracts exhibited stronger antibacterial activity, while leaf extracts, particularly chloroform extracts, showed higher antioxidant and anti-diabetic potential. These findings highlight the plant's medicinal value as a source of natural antibacterial, antidiabetic, and antioxidant agents.

Keywords: Antibacterial activity, Anti-diabetic activity and Antioxidant activity

ISOLATION AND CHARACTERIZATION OF RHIZOSPHERIC BACILLUS SPP. AS ECO-FRIENDLY BIOCONTROL AGENTS AGAINST SEED-BORNE RICE BROWN SPOT PATHOGEN *BIPOLARIS ORYZAE*

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Brown spot disease of rice, attributed to *Bipolaris oryzae* (syn. *Cochliobolus miyabeanus*), remains a significant challenge to global rice yields. Reported yield losses due to brown spot range widely, from minor reductions to severe crop damage, from 1% to 75% depending on region and conditions. The high cost of chemical fungicides and environmental concerns such as non target effects has intensified the search for sustainable, microbe-based disease management alternatives. The present study evaluated the biocontrol potential of thirty-three *Bacillus* spp. isolates obtained from the rhizospheres of rice, lucerne, soybean, medicinal plants, and sunhemp against *B. oryzae*. Molecular identification involved PCR-based amplification of 16S rDNA (approx. 1.46 kb), with subsequent sequence comparison via NCBI BLAST. Phylogenetic trees were constructed with the neighbor-joining method implemented in MEGA v7 software. Among the isolates, 19 were identified as *Priestia megaterium*, six as *Bacillus pseudomycoides*, three each as *Bacillus thuringiensis* and *Bacillus velezensis*, and one each as *Enterobacter roggenkampii* and *Ectobacillus funiculus*. Dual culture assays revealed antifungal inhibition of *B. oryzae* ranging from 0% to 78.8%. Three isolates—Ba23, Ba27, and Ba31—exhibited strong antagonistic activity (>75% inhibition), while six isolates (Ba5, Ba7, Ba14, Ba22, Ba32, and Ba33) showed moderate inhibition (50–75%). These results indicate that selected *Bacillus* isolates, particularly Ba23, Ba27, and Ba31, possess strong antifungal potential and may serve as effective biocontrol agents for managing brown spot in rice through eco-friendly approaches.

Keywords: *Bipolaris oryzae*, *Bacillus* spp., brown spot, biocontrol, seed-borne pathogen,

NANOELICITATION POTENTIAL OF PHYTOSYNTHESIZED COPPER OXIDE NANOPARTICLES IN *ANNONA MURICATA* CELL CULTURES

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Nanobiotechnology is an interdisciplinary field that merges two major fields' nanotechnology and biotechnology and is a proven promising tool in plant biotechnology for enhancing the production of valuable secondary metabolite in an eco-friendly approach. In this study, we investigate the bioactivities of the green synthesized CuO nanoparticles and their ability to elicit secondary metabolite production in *A. muricata* cell suspension cultures. CuO nanoparticles were synthesized using *Bryophyllum pinnatum* leaf extracts and the effect of concentration of the leaf extract and precursor solution, pH, temperature and reaction time on nanoparticle synthesis were also studied. Characterization of the synthesized nanoparticles was done using UV-Vis spectrophotometry, FTIR, EDX, DLS and SEM analysis techniques. The synthesized nanoparticles were tested for their anti-inflammatory, anti-diabetic and anti-lithogenic properties. For studying the nanoelicitation potential of the synthesized CuO nanoparticles, 100 ppm CuO nanoparticles was added to the *A. muricata* cell suspension culture and harvested at 24, 48, 72 and 96 hours post-treatment and stored the pellets and supernatant separately. Quantitative estimations of phenol and flavonoids as well as the antioxidant activities of both were analyzed. A strong peak found at 273nm for CuO nanoparticles confirmed the successful synthesis of CuO nanoparticles. SEM images showed a range of 87.89nm to 118.1nm size for the particles. Although the treatment exhibited lower bioactivities compared to the standard, it still confirmed the bioactive potential of nanoparticle-elicited extracts and provides a foundation for optimization in future studies. Phenolic and flavonoid accumulation were found to be enhanced by the CuO nanoparticle in cells but it was very low in the supernatant indicating very minimal release to extracellular media. Highest TPC (0.114 mg GAE/g) and TFC (0.0431 mg QE/g) was shown at 96 hrs. Results of DPPH and ABTS assays showed highest response at 48 hrs post-treatment with 48.61% and 30.98% inhibition respectively in treated cells whereas 25.31% at 24 hrs and 72.4% at 48 hrs post-treatment respectively in the supernatant. These results strongly supports that abiotic elicitors can mimic stress signals and stimulate the plant's internal defence mechanisms, thereby upregulating the metabolite biosynthesis. This study successfully demonstrates the ability of green synthesized CuO nanoparticles to act as effective elicitor in promoting the biosynthesis of secondary metabolites in *A. muricata* cell suspension culture. It aids as an evidence for supporting eco-friendly nanobiotechnology solutions in plant science and highlights a sustainable path forward for the large-scale production of plant-based therapeutic compounds.

Keywords: Nanoelicitation, Secondary metabolites, *Annona muricata*, *Bryophyllum pinnatum*, Cell suspension culture, Copper oxide nanoparticles, Phytosynthesis, Antioxidant activity, Anti-inflammatory, Anti-diabetic, Anti-lithogenic

NOURISHING YOUR BODY: POST-PREGNANCY CARE FOODS USED IN BANTWAL TALUK

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Residents of Bantwal Taluk, Karnataka rely on various local foods to treat different ailments related to maternal and child health. This study carried out an ethnobotanical survey to record and document the foods used in traditional maternal healthcare practices in Bantwal Taluk. The objectives of the survey were to document the foods consumed during the postpartum recovery period, identify ingredients that promote lactation and aid in faster healing, and record foods rich in iron content. Traditional foods include- Ragi laddoo, Fenugreek rice porridge, onion curry, Turmeric milk, Ajwain curry, *Elwendia persica* (kala jeera) decoction, Manar madhu (prepared by using different spices and jaggery). It contains iron, calcium, magnesium, phosphorus, omega-3 fatty acids, vitamin c, etc. These foods are essential for a mother's recovery and well-being after childbirth, as they help to heal tissues, restore energy, and support milk production. They help strengthen the immune system also maintains joint health weakened by pregnancy. Reduce inflammation. Moreover, balanced postnatal nutrition helps regulate hormones, stabilizes mood, improves sleep quality, and enhances overall vitality, enabling new mothers to regain physical strength and emotional resilience.

Keywords: Ethnobotanical survey, Bantwal Taluk, Maternal healthcare, Traditional foods, Medicinal property.

ADSORPTION OF CIPROFLOXACIN ON SUSTAINABLE NANOBIOCHAR

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Nanobiochar plays a crucial role as sustainable and eco-friendly nanomaterial due to its high surface area, tunable surface functionality and excellent adsorption properties, making it highly effective for removing emerging contaminants like pharmaceuticals from water. In this study, sustainable nanobiochar was synthesized from teak wood biomass using a laboratory muffle furnace for 2 hours at three different pyrolysis temperatures (300°C, 500°C and 900°C). The obtained biochar was further processed by sonication and centrifugation to produce nanoscale biochar with improved dispersion and surface activity. The nanobiochar was characterized using EDS, DLS, FTIR, Zeta potential analysis, XRD, SEM, TEM and BET surface analysis to assess its morphological, structural and surface properties. Functionalization of nanobiochar was performed to improve its adsorption efficiency. The synthesized nanobiochar was evaluated for ciprofloxacin removal (CIP) through batch experiments by studying effects of initial adsorbate and adsorbent concentration, temperature, pH and contact time. Comparative FTIR analysis of control ciprofloxacin, nanobiochar before and after adsorption and degraded samples were carried out to understand surface interactions. Quantitative analysis of residual ciprofloxacin was performed using HPLC. Adsorption kinetic and isotherm models were applied to elucidate the equilibrium behaviour and adsorption rate. Statistical analysis using ANOVA was employed to determine the significance of different parameters influencing ciprofloxacin adsorption. The results revealed that nanobiochar produced at moderate temperatures with alkali modification exhibited enhanced adsorption capacity due to its large surface area, developed porosity and abundant oxygen-containing functional groups. Overall, teak wood derived nanobiochar synthesized via muffle furnace demonstrated high potential as a sustainable, efficient and eco-friendly adsorbent for the removal of pharmaceutical contaminants from aqueous environments.

Keywords: Nanobiochar, Ciprofloxacin degradation, Adsorption, FTIR, HPLC.

GENETIC PURITY IDENTIFICATION OF RICE VARIETIES THROUGH PHENOL TEST

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Genetic purity identification of rice varieties through Phenol test was studied during *Kharif* 2022-23, 2023-24 in the Department of Seed Science and Technology at the Seed Research and Technology Centre, College of Agriculture, PJTAU, Rajendranagar, Hyderabad, Telangana. The experiment was conducted with 21 rice varieties in two consecutive years using completely randomized design (CRD) with 2 replications as per the rice DUS guidelines. All the 21 rice varieties under study were tested with 1.5% aqueous phenol solution and evaluation of the colour reaction of the lemma on the rice seed were observed. The individual varieties have resulted as positive and negative to phenol colouration. The validation of this test was assessed by adding 5 number of off-type seeds to the individual original seed sample. By adopting this method some of the seeds with similar physical appearance could be differentiated by colour variation. Based on phenol test among the 21 rice varieties 16 showed a positive phenol reaction with a score of 9, indicating the presence of phenolic compounds, which is genetically controlled and 5 varieties showed no phenol reaction with a score 1, confirming their distinctiveness.

Keywords: Genetic purity, DUS, rice, varieties, phenol

IN-SILICO STUDIES ON EFFECTIVE PHYTOCHEMICALS OF CROCUS SATIVUS, OCIMUM TENUIFLORUM AND ITS MODIFICATION TARGETING NIPAH VIRUS

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Nipah virus is a zoonotic pathogen with high fatality rate and pandemic potential with no effective medicines or vaccines. It is essential to develop potential medicinal substance for treating Nipah virus. This study investigates the antiviral potential of forty-nine novel phytochemicals from two common herbs, *Crocus sativus* and *Ocimum tenuiflorum*, against Nipah virus glycoproteins (2VWD, 2VSM and 3D11). Molecular docking analysis of these phytochemicals identified colchicine and cadinane as lead compounds with superior binding affinities compared to the reference drug ribavirin. These phytochemicals were then modified and then optimized using Density Functional Theory (DFT), which produced improved docking performance, particularly derivatives C4 of colchicine, C6 and C8 of cadinane. The phytochemicals and derivatives that scored highest binding energies were then subjected to molecular dynamics (MD) analysis. The top eight protein-ligand complexes underwent a thorough examination for structural stability (RMSD), intermolecular hydrogen bond interactions, the impact of solvent accessibility (SASA), and compactness (Rg) factors. The results showed that these complexes are highly stable and display folding behavior. In addition to the docking and MD testing, drug-likeness and toxicity tests have identified compounds like cadinane, colchicine, and derivatives C4, C6 and C8 have potential in treating the Nipah virus.

Keywords: Nipah virus, Molecular dynamics, Molecular docking, Density functional theory, drug

IN-SITU PRODUCED VITAMIN B₁₂ RICH READY TO RECONSTITUTE NUTRI MIX

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Vitamin B₁₂ plays a vital role in the body, supporting DNA synthesis, red blood cell formation, and a healthy nervous system. Vitamin B₁₂ is naturally found only in animal-based foods such as meat, fish, and eggs. Due to the absence of B₁₂ in plant-based diets, vegetarians, pregnant women, and individuals with impaired absorption in India are at a higher risk of deficiency (47%), often leading to pernicious anaemia, neurological and haematological disorders. Though synthetic cyanocobalamin is commonly used in food fortification and supplementation, it presents limitations such as low bioavailability and the release of trace cyanide during metabolism, raising safety concerns upon prolonged intake. To address this challenge, the present study explored a sustainable approach to developing a B₁₂-rich milk millet matrix through microbial fermentation. Among the capable microorganisms of synthesizing B₁₂, *Propionibacterium freudenreichii* subsp. *Shermanii* is widely recognized. In this study, the *Propionibacterium Shermanii* (PS-4) strain was used to produce vitamin B₁₂ using a milk-millet matrix. The formulation incorporated millet malt, legume powder, and milk solids, which naturally provide precursors such as cobalt, niacin, and riboflavin essential for vitamin B₁₂ biosynthesis. Fermentation parameters, including inoculation level, lactate concentration, and incubation period, were optimized using Taguchi design. The fermented base was dried with spray drying and recorded a vitamin B₁₂ concentration of 25 µg/100 g dried fermented base. To develop a vitamin B₁₂ rich nutriment powder, ingredient proportions were further refined through i-optimal mixture design. The optimized nutriment contained 50% fermented base, 12% cereal malt, 30% sugar, and 8% cocoa powder. The final nutriment showed high sensory acceptability (8.10), good wettability (1.42 min), and satisfactory dispersibility (77.55 %). Nutritionally, it provided 72.96% carbohydrates, 18.3% protein, and 12.5 µg/100 g of B₁₂. A 20 g of nutriment serving delivers 2.5 µg of B₁₂, meeting nearly 100% of the recommended daily requirement.

Keywords: vitamin B₁₂, nutriment, natural, fermentation and milk

LINKING ECOLOGICAL RESEARCH, POLICY FRAMEWORKS, AND LOCAL STEWARDSHIP FOR THE CONSERVATION OF SMOOTH-COATED OTTERS (*LUTROGALE PERSPICILLATA*)

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The smooth-coated otter (*Lutrogale perspicillata*), a key apex predator and bioindicator of freshwater ecosystem health, is undergoing significant population declines across its South and Southeast Asian range. In India, the species is primarily threatened by anthropogenic pressures, including habitat fragmentation, sand mining, overfishing, pollution, and hydrological alterations due to dam and canal construction. Additional challenges, such as retaliatory killing, incidental entanglement in fishing gear, and illegal trade for pelts and pet purposes, further exacerbate its vulnerability. The Wildlife Protection (Amendment) Act, 2022, has strengthened the legal status of the species by placing it under Schedule I, affording it the highest degree of protection against hunting and trade, and by incorporating CITES Appendices directly into national law to ensure compliance with international obligations. Effective conservation of *L. perspicillata* now requires an integrated strategy linking **science-based monitoring, habitat restoration, and community-driven management** within this enhanced legal framework. Recent initiatives highlight the efficacy of camera-trap monitoring, riparian vegetation restoration, regulation of destructive fishing practices, and local capacity-building to mitigate conflict and restore ecological balance. Strengthened coordination among Forest Departments, conservation organizations, and local stakeholders supported by the updated legal provisions—can reinforce enforcement, promote awareness, and ensure sustainable coexistence. Aligning empirical research with statutory protection under the Wildlife Protection (Amendment) Act, 2022, provides a timely opportunity to safeguard smooth-coated otter populations and the freshwater landscapes upon which they depend.

Keywords: Smooth-coated otter (*Lutrogale perspicillata*), otter conservation, freshwater ecosystems, Wildlife Protection (Amendment) Act 2022, habitat restoration, human–wildlife conflict, community participation

MICROMORPHOLOGICAL ASSESSMENT OF POLLEN DIVERSITY IN *CROTON HIRTUS* L'HÉR. AND *CROTON BONPLANDIANUS* BAILL. USING SEM

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Pollen morphology is a vital tool in plant taxonomy and evolutionary studies. This study aimed to comparatively examine the micromorphological characteristics of pollen in *Croton hirtus* and *Croton bonplandianus* using scanning electron microscopy (SEM). It was hypothesized that the two species exhibit distinct pollen surface patterns and structural features reflecting their taxonomic differentiation. Key morphological parameters, including pollen size, shape, exine ornamentation, aperture type, and surface sculpturing, were systematically assessed. SEM observations showed that both species have spheroidal to sub-spheroidal pollen grains with tricolpate apertures, but differ in exine ornamentation and surface patterns. *Croton hirtus* displayed a finely reticulate exine with smaller lumina, while *C. bonplandianus* exhibited a coarser, verrucate-reticulate exine with prominent muri. Quantitative measurements revealed differences in pollen diameter and colpus length, supporting morphological distinctions. These results demonstrate that micromorphological traits can reliably differentiate closely related *Croton* species and provide insights into their evolutionary relationships. SEM-based pollen analysis effectively highlights subtle structural differences, underscoring its value in taxonomic verification, species delimitation, and phylogenetic studies. This study contributes to a broader understanding of pollen diversity and emphasizes the importance of micromorphological characterization as a complementary approach in plant systematics.

Keywords: *C. hirtus*, SEM, Phylogenetic analysis, Taxonomy

FLORISTIC SURVEY OF PTERIDOPHYTES IN PONMUDI HILLS AND THE SURROUNDING AREAS OF SOUTHERN WESTERN GHATS

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Ponmudi Peak is situated within the Western Ghats Mountain range, a recognized biodiversity hotspot that supports a rich pteridophytic flora. This study documents the diversity and distribution of ferns and lycophytes in the Ponmudi hills, data essential for assessing the area's ecological balance and conservation status. Intensive field surveys were carried out at multiple sites, with emphasis on species identification, abundance, and habitat characteristics, allowing for detailed documentation. A total of 92 pteridophyte species were recorded, representing 22 families; Pteridaceae was the most dominant family, followed by Polypodiaceae. Members of the major families (Pteridaceae, Dryopteridaceae, and Polypodiaceae) occur from the lowest to the highest elevations. Pteridophytes representing diverse habitats were observed in the study area, which includes 16 epiphytes, 18 lithophytes, and 58 terrestrial species. Among the 92 species, 49 have recognized medicinal value, and several possess notable economic importance. The study identified 12 rare, 18 endemic, and 3 threatened pteridophyte species, highlighting the region's significance for pteridophyte conservation. Conservation efforts should prioritize habitat preservation and microhabitat protection to maintain pteridophyte diversity and their ecological functions.

Keywords: Epiphytes, Lithophytes, Ponmudi hills, Pteridophytes, Terrestrial

PATHOGENICITY OF *FUSARIUM UDUM* AND *IN VITRO* EFFICACY OF BIOCONTROL AGENTS AGAINST *FUSARIUM* WILT IN PIGEON PEA

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Fusarium wilt, caused by *Fusarium udum*, poses a major threat to pigeon pea (*Cajanus cajan*) cultivation, leading to substantial yield losses. The present study aimed to assess the pathogenicity of *F. udum* and evaluate the *in vitro* efficacy of two promising biocontrol agents, *Trichoderma harzianum* and *Bacillus subtilis*, for sustainable disease management. Pathogenicity testing was conducted using the root-dip inoculation method on susceptible pigeon pea cultivars, confirming *F. udum* as the causal organism based on characteristic vascular browning and wilt symptoms. Among the isolates tested, FU-17, FU-18, and FU-20 exhibited the highest virulence, causing up to 92% wilt incidence. The antagonistic potential of *T. harzianum* and *B. subtilis* was evaluated through dual culture assays. Results revealed significant inhibition of mycelial growth by both antagonists, with *T. harzianum* showing maximum suppression (76.59%), followed by *B. subtilis* (68.95%). The bacterial antagonist also produced distinct inhibition zones, demonstrating its potential in biological control. Overall, the study highlights the strong biocontrol potential of *T. harzianum* and *B. subtilis* against *F. udum*, suggesting their combined or sequential use as eco-friendly alternatives to chemical fungicides. These findings contribute to the development of integrated disease management strategies for pigeon pea wilt and underscore the role of microbial antagonists in sustainable pulse production systems.

Keywords: *Fusarium* wilt, pigeon pea, *Fusarium udum*, *in vitro* evaluation, biocontrol agents, *Trichoderma harzianum*, *Bacillus subtilis*

LETHAL TOXICITY OF PHENOL TO FRESHWATER FISH

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Phenolic wastes containing phenol have adversely affected freshwater fisheries by direct toxicity to fishes and phenolic compounds are frequently found as contaminants in aquatic habitats and has several sources including industrial wastes, coal, wood distillation, road tars, petroleum refining, chemical and plastics manufacturing and they enter natural water causing contamination and affecting fishes and other aquatic organisms, phenol act as nerve poison paralyse fish and suffocate them by causing congestion of blood in gills, coagulation of blood in the heart cavity inflammation and necrosis of the gills. The toxicity of phenol to fish were studied. So the static renewal bioassays were done for 96 hours to study the lethal toxicity of phenol the freshwater fish *Gambusia affinis* and *Lepidocephalichthys guntea* for 96 hours were studied at laboratory conditions and oxygen consumption of the fish was observed and calculated. The 24, 48, 72 and 96 hours LC₅₀ values were calculated respectively for the both fish exposed to phenol.

Keywords: Toxicity, freshwater fish *Gambusia affinis*, *Lepidocephalichthys guntea*, Oxygen Consumption, Phenol

MULTIVARIATE ANALYSIS USING MORPHO-PHYSIOLOGICAL AND EARLY-STAGE SEEDLING PARAMETERS IN CHICKPEA GENOTYPES FOR IMPLICATION IN BREEDING PROGRAMMES

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Chickpea (*Cicer arietinum* L.) is a vital legume crop valued for its nutritional richness and adaptability to diverse agro-climatic conditions. In the present study, analysis of variance revealed highly significant differences among genotypes, indicating substantial inherent variation across all measured traits. The genotypes exhibited a wide range of variability for agronomic traits. The range for number of days to 50 % flowering varied between 82 to 96 days, days to physiological maturity (136-147days), plant height (31.9 to 62.6 cm), primary branch per plant (4 to 8), number of pods per plant was (35 to 121) and seed yield per plant (15.6 g to 30.1 g). The biochemical trait, crude protein content varied from 17.7 to 24.7 percent and physiological parameters also varied considerably. The physiological parameters viz., SPAD chlorophyll content (41.2 to 60), relative water content (65.4 to 81.0 %), canopy temperature (24.7-29.9°C) and NDVI (0.69-0.78) also showed great variation. Only few genotypes such as PG 317, NBeG 1469, H 1926, GJG 1907 and NBeG 1420 exhibited lower wilt incidence combined with higher seed yield and moderate crude protein content. The findings suggest that lower wilt incidence is generally associated with higher biological and seed yields, while crude protein content alone is not a reliable indicator of disease resistance. The D² statistics grouped the genotypes into five clusters, revealing considerable variability. The highest intra-cluster distance was observed in Cluster I (D² = 74.51), indicating substantial diversity among its members, while the greatest inter-cluster distance occurred between Clusters II and IV (D² = 88.40), suggesting these combinations as ideal for hybridization to exploit heterosis. Cluster IV exhibited superior performance for traits such as number of pods per plant, seeds per pod, harvest index, and NDVI. Principal Component Analysis (PCA) showed that five principal components with eigenvalues >1 explained 72.60% of the total variance, with canopy temperature, seed yield, and biological yield emerging as major contributors.

Keywords: Chickpea, physiological traits, crude protein, wilt disease, genetic diversity, PCA

STANDARDIZATION OF GRAFTING TECHNIQUES IN AVOCADO (*PERSEA AMERICANA* MILL.) FOR IMPROVED PROPAGATION EFFICIENCY AND GROWTH PERFORMANCE

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Avocado propagation is crucial to ensure uniform, true-to-type plants with desirable fruit quality and yield. Since seed propagation results in high variability and delayed bearing, standardization of vegetative propagation techniques such as grafting is essential for establishing high-yielding and commercially viable orchards. The present study was undertaken to evaluate different grafting techniques cleft, veneer and epicotyl grafting using uniform seedling rootstocks and scions of a high-yielding cultivar Hass. Grafts were maintained under a mist chamber to provide optimal humidity and temperature for callus formation and graft union, and each graft was covered with poly caps to minimize desiccation and enhance scion survival. Observations on graft success percentage, days to bud sprouting, graft height, number of leaves, and survival rate were recorded 90 days after grafting. Among the techniques tested, **cleft grafting** exhibited the highest success rate (88 %), followed by **veneer grafting** (74 %), while **epicotyl grafting** showed moderate results. Grafts prepared during **February–March** performed better compared to those done during monsoon months. The study concludes that **cleft grafting**, when maintained under a **mist chamber with poly caps**, ensures superior graft union, early sprouting, and vigorous growth. This method is recommended for the **large-scale multiplication of avocado** under Indian subtropical conditions.

Keywords: Avocado, grafting, Hass, propagation, graft union, cleft grafting, veneer grafting

AUTOMATION SMART SYSTEMS: REVOLUTIONIZING LIVESTOCK PRODUCTION

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In the modern era of Agricultural, automation and intelligent systems are redefining livestock management by integrating cutting-edge technologies such as sensors, robotics, Artificial Intelligence (AI), and the Internet of Things (IoT). These innovations have revolutionized conventional farming practices, enabling data-driven decision-making and promoting sustainable production. Smart systems support veterinary planning based on individual animal parameters such as weight, age, and health status ensuring precise feeding, balanced nutrition, and improved animal welfare. Through continuous monitoring of feed intake, rutting behaviour, and health indicators, farmers can detect diseases early, optimize feeding patterns, and enhance overall productivity. By reducing manual labor, automation empowers farmers to focus on preventive healthcare, breeding efficiency, and resource optimization. Additionally, intelligent livestock systems contribute to sustainability by minimizing carbon footprints, improving feed conversion efficiency, and reducing land use pressures. This emerging ecosystem represents a transformative step toward ethical and sustainable livestock production, where science, technology, and responsible management converge to ensure food security, animal health, and economic resilience for the future.

Keywords: IoT, smart feeding systems, robotics, sustainable agriculture, animal health.

IN VITRO ORGANOGENESIS RESPONSE OF APPLE (*MALUS DOMESTICA* BORKH.): HARNESSING AUXIN–CYTOKININ SYNERGY FOR CALLUS INDUCTION AND SHOOT REGENERATION

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Apple (*Malus domestica* Borkh.) is an economically important temperate fruit crop widely cultivated for its high nutritional and commercial value. Conventional propagation through grafting and budding is limited by seasonal dependence, low multiplication rates, and risk of pathogen transmission. In vitro culture offers a rapid, disease-free, and reliable alternative for mass propagation and genetic improvement. The present study aimed to standardize an efficient protocol for callus induction and indirect shoot regeneration from leaf explants of apple by optimizing auxin–cytokinin combinations. Leaf segments were cultured on Murashige and Skoog (MS) basal medium supplemented with varying concentrations of 2,4-dichlorophenoxyacetic acid (2,4-D), α -naphthalene acetic acid (NAA), and 6-benzylaminopurine (BAP). Among the treatments, MS medium containing 2,4-D (1.0 mg L^{-1}) + BAP (0.5 mg L^{-1}) produced the highest callus induction rate (95%), with friable, light-green callus formed within three weeks of culture. For organogenesis, transferring callus to MS medium fortified with BAP (1.5 mg L^{-1}) + NAA (0.1 mg L^{-1}) resulted in the highest regeneration frequency, producing an average of 3.1 shoots per callus with a maximum shoot length of 3.2 cm. The regenerated shoots were further elongated and rooted successfully on half-strength MS medium supplemented with indole-3-butyric acid (IBA) 0.5 mg L^{-1} . This study establishes an efficient and reproducible in vitro protocol for callus-mediated shoot regeneration in apple, demonstrating the synergistic role of auxins and cytokinins in promoting organogenesis. The optimized protocol provides a foundation for large-scale micropropagation, genetic transformation, and conservation of elite apple germplasm.

Keywords: Apple, *in vitro*, callus induction, regeneration, auxin, cytokinin

RNA-SEQ-BASED IDENTIFICATION OF GENES INVOLVED IN IRON AND ZINC ACCUMULATION IN RICE GRAINS

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Micronutrient deficiencies, particularly of iron (Fe) and zinc (Zn), remain a major global health concern, especially in populations dependent on rice as a staple food. Enhancing the micronutrient content of rice grains through biofortification is an effective and sustainable strategy to combat “hidden hunger.” In this study, RNA sequencing (RNA-seq) was employed to investigate the transcriptomic differences between high and low Fe/Zn accumulating rice genotypes during grain development. High-quality reads were aligned to the *Oryza sativa* reference genome, and differential gene expression analysis was performed using the DESeq2 package in R. A set of significantly up- and down-regulated genes associated with metal transport, chelation, and storage were identified, including members of the ZIP, YSL, NRAMP, and VIT families, as well as genes involved in nicotianamine and phyto siderophore biosynthesis. Gene Ontology (GO) and KEGG pathway enrichment analyses revealed the activation of pathways related to metal ion homeostasis, oxidative stress response, and secondary metabolite biosynthesis. Co-expression network analysis further highlighted potential regulatory transcription factors that may coordinate Fe and Zn translocation to developing grains. The results provide valuable insights into the molecular mechanisms underlying micronutrient accumulation and identify promising candidate genes for marker-assisted selection or genetic engineering of nutrient-enriched rice varieties.

BIOREMEDIATION OF DYES BY USING FUNGI

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Synthetic dyes are widely used in textile, leather, paper and food industries. These dyes are released into water bodies which have significant harmful effects on aquatic environments and overall water quality. These dyes reduce sunlight penetration in water, which impairs photosynthesis in aquatic plants and algae, disrupting the base of the food chain. Their presence also lowers dissolved oxygen levels, which can suffocate fish and other aquatic life. There is a need to treat this contamination condition of the dyes in the water bodies. A chemical treatment method is often inefficient, costly and produces secondary pollutants. One of the most promising and eco-friendly ways to deal with this problem is Bioremediation. Bioremediation is a natural, eco-friendly, cost effective and sustainable method for dye decolourisation and detoxification. This method uses living organisms such as bacteria and fungi to cleanup pollutants. Certain types of fungi, especially white rot fungi, produce powerful enzymes that can break down the complex dye molecules into simpler, less harmful forms. Some common examples include *Trametes*, *Phanerochaete*, *Pleurotus*, *Aspergillus*, and *Penicillium*, which are known for their ability to remove color and toxicity from wastewater. Fungi can absorb and breakdown Dye molecules using special enzymes like laccase and peroxidase. These enzymes help convert harmful dye chemicals into simpler non toxic substances. When conditions such as temperature, oxygen and pH are optimized, fungi can remove more than 80 to 90% of some dyes within a few days. This process also improves water quality and helps seeds to germinate and microorganisms to grow again in treated water. Using fungi for dye removal is an eco-friendly approach that can reduce water pollution and protect ecosystem. Future approaches aim to combine fungal consortia and hybrid bio-physicochemical systems to achieve complete mineralization and real-time pollutant monitoring. Thus, fungal bioremediation represents a promising frontier in achieving efficient, green, and sustainable management of dye-contaminated effluents, contributing significantly to environmental protection and industrial wastewater management. Continued research on fungal species and their enzymes activities will help us develop even more effective and sustainable methods for cleaning industrial wastewater in the future.

Keywords- Bioremediation, Laccase, Peroxidase, Enzymes, Optimized, Detoxification

EVALUATION OF VALUE ADDED PIPER BETEL LEAVES ENRICHED HERBAL WINE PREPARATION FORMULATED WITH ANTIOXIDANT INDUCED BEET VINEGAR.

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This research study is focused on the preparation and evaluation of a value-added herbal wine formulated from Piper betel leaves and antioxidant-enriched beet vinegar. Beetroot (*Beta vulgaris* L.) was selected for its high concentration of betalains, phenolic compounds, and natural antioxidants that enhance the functional properties of the prepared wine. Piper betel leaf wine was incorporated with natural vegetable vinegar to improve therapeutic efficacy, aroma, and sensory appeal. The fermentation was carried out under controlled conditions using selected yeast strains to obtain yield with TSS value of 4.1, optimal alcohol content and product stability. The final prepared piper betel herbal wine was evaluated for physicochemical parameters, total phenolic content, antioxidant activity (DPPH and FRAP assays), and sensory characteristics. The results has revealed with better preparation of herbal wine with enhanced beet vinegar of TSS value 3.9 .The prepared formulation has shown significant enhancement in the antioxidant potential and overall acceptability rate of the wine with longer storage durability. This study demonstrates that antioxidant-induced beet vinegar can be effectively utilized to produce a novel, health-promoting, value-added herbal wine with promising nutraceutical and commercial potential.

Keywords: Piper Betel, Beet Vinegar, Antioxidant, Value –Added Herbal Wine

NUTRITION IN NON-INVASIVE VENTILATION

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Malnutrition is a frequent yet under-recognized problem among critically ill patients requiring non-invasive ventilation (NIV), where nutritional inadequacy can worsen morbidity, length of stay, and mortality. This study aimed to assess the nutritional risk, dietary intake, and outcomes of patients on NIV within 48 hours of admission, hypothesizing that higher NUTRIC scores are associated with prolonged ICU stay and increased mortality. A retrospective cross-sectional study was conducted over three months at Apollo Hospital, Bangalore, involving 31 adult patients (>18 years) on NIV either continuously or intermittently within 48 hours of admission. Data on demographics, anthropometry, comorbidities, caloric and protein intake, feeding route, and clinical outcomes were collected. Nutritional risk was assessed using the NUTRIC score, and severity of illness by APACHE II and SOFA scores. The study included 18 males and 13 females aged 18–85 years, with most patients above 60 years. Mean NUTRIC, APACHE II, and SOFA scores were 3.32 ± 1.19 , 16.41 ± 3.68 , and 4.51 ± 2.68 , respectively. High nutritional risk ($\text{NUTRIC} \geq 5$) was observed in 16.12% of patients, who also had longer ICU stays (12.0 ± 6.04 vs. 9.73 ± 5.47 days) and higher mortality (41.26% vs. 23.28%) compared to those at low risk. Caloric and protein intake were suboptimal in both genders, primarily due to anorexia and discomfort during NIV use. Oral feeding was predominant (77.4%), while all patients on enteral feeds required intubation, likely due to nasogastric air leakage compromising NIV effectiveness. In conclusion, nutritional risk is prevalent among NIV patients, and higher NUTRIC scores correlate with poorer outcomes. Early nutritional screening, individualized feeding strategies to ensure adequate calorie and protein intake are crucial to improving clinical prognosis and reducing mortality.

Keywords: Non-invasive ventilation (NIV), Nutritional risk, NUTRIC score, critically ill patients, Caloric intake, Protein intake, APACHE II, SOFA score, ICU outcomes, Mortality, Nutritional assessment.

THE ART OF CULTIVATING BONSAI A TOOL FOR BIODIVERSITY CONSERVATION

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Bonsai, the art of cultivating miniature trees, extends beyond aesthetics to serve as a tool for biodiversity conservation and environmental education. By propagating and maintaining rare and endemic species, bonsai collections act as living gene banks, fostering plant diversity and providing an ex situ safeguard against species loss in natural habitats. Ethical sourcing and the promotion of native species further strengthen bonsai's positive environmental impact. Originating in China and Japan, bonsai involves training young trees, shrubs and vines to mimic the form of mature plants. Trees can live for more than a century, and techniques such as *Jin* are used to create an aged appearance. Successful cultivation relies on consistent pruning of shoots and roots, appropriate fertilization and suitable environmental conditions, especially when bonsai are grown indoors. This study aimed to promote bonsai-making activities and raise awareness among students and the general public. A total of 169 plants representing 62 genera were collected as healthy saplings or pre-bonsai nursery stock with woody stems. These were cultivated in shallow pots with drainage holes using well-draining soil mixes designed for each bonsai species. Beyond conservation, bonsai serves as an educational tool that deepens understanding of plant biology, ecology and biodiversity. The long-term care required cultivates patience, responsibility and long-term thinking, fostering a stronger connection with nature. Through these combined roles, bonsai promotes sustainable practices, supports conservation initiatives, and encourages broader public engagement with environmental stewardship.

Keywords: Bonsai, Biodiversity Conservation, Endemic species.

FOOD HABITS OF SLOTH BEARS AND THEIR FOOD DEPENDENCY ON WILD AND AGRICULTURAL CROPS IN AND AROUND FRINGE VILLAGES OF GUDEKOTE SLOTH BEAR SANCTUARY, VIJAYANAGARA DISTRICT, KARNATAKA

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The present study was conducted on the food habits of sloth bears and their dependency was studied in the fringe villages around the Gudekote Sloth Bear Sanctuary (Hereafter Gudekote SBS) distributed in the three taluks of Vijayanagara, Chitradurga and Ballari districts of Karnataka. The study approached the methods for collection of data through questionnaire survey and field visits during the year 2025. The study revealed that sloth bears are depended on wild plants for food during summer include *Ixora pavetta*, *Diospyros montana*, *Grewia orbiculate*, *Lanatana camera*, *Zanthoxylum rhetsa*, *Gardenia latifolia* and *Cassia fistula*. Sloth bears are intervening the agriculture fields for searching for the food during summer and they depend on the agricultural crops in the fringe areas of the sanctuary like *Elaeisqueensis* and *Musa sapientum* crops and honey is one of the favourite foods in this season. During rainy season, sloth bears are depending on the wild plants like *Zanthoxylum rhetsa*, *Gardenia latifolia*, *Cassia fistula*, *Syzygium cumini*, *Prosopis juliflora*, *Grewia hirsute*, *Grewia domine*, *Pterocarpus marsupium* etc. Meanwhile sloth bears visit agricultural fields for searching food and feeds on *Manilkara zapota*, *Mangifera indica* etc. Alongside, the food habits of sloth bear include termites, ants, and other insects, dung worms are the favourite foods at their locality during rainy season. During winter season, sloth bears feed on wild plants like *Ficus racemose*, *Ziziphus oenoplia*, *Phoenix sylvestris*, *Ziziphus maurifiana*, *Annona squamosa*, *Madhu calotifolia*, *Tephrosia purpurea* etc. These changes of food habits of sloth bears change with availability of fruit bearings plants in the particular seasons in the wild and the changes of crop pattern with the season are the major findings. These food adaptation strategies causing the human-sloth bear conflicts in the fringe villages of Gudekote Sloth Bear Sanctuary. The food adaptation was confirmed with the scat analysis of sloth bears showed the dependency of wild plants and agricultural crops ratio changes with the seasons in the study area. The study recommends the growing of more wild plants in the eco sensitive zones of protected areas like *Annona squamosa* *Cassia fistula* *Diospyros montana*, *Ficus racemose*, *Gardenia latifolia*, *Grewia orbiculate*, *Ixora pavetta*, *Madhu calotifolia*, *Pterocarpus marsupium*, *Syzygium cumini*, *Grewia hirsute*, *Ximenia americana*, *Calpophyllum antillanum* etc.

Keywords: Sloth bears; protected area; Wild plants; Food habits; Crop pattern.

STRATEGIES FOR DISSECTING NON-ADDITIVE GENE ACTION TO IDENTIFY SUPERIOR HYBRID COMBINATIONS IN UPLAND COTTON (*GOSSYPIMUM HIRSUTUM* L.)

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The present study evaluated 45 F₁ hybrids of upland cotton (*Gossypium hirsutum* L.) developed through a line × tester mating design to assess the relationship between specific combining ability (SCA), hybrid *per se* performance, and heterosis for yield and fiber quality traits. The parental lines included fifteen high yielder and low fiber strength genotypes and three testers, evaluated under field conditions during *kharif* 2023. Hybrids were compared against five commercial checks to determine standard heterosis. Significant variation was observed for all traits, with maximum heterosis recorded for the number of monopodial branches per plant (−33.33% to 200%) and seed cotton yield per plant (−40.24% to 58.43%). Several hybrids, including P1-190 × Suraksha, P2-103 × Suraksha, and P2-103 × Subhiksha, exhibited superior *per se* performance, significant positive *sca* effects and high standard heterosis for key yield and fiber quality traits. Correlation and regression analyses revealed strong positive associations of *sca* effects with *per se* performance, mid-parent heterosis (MPH), and better-parent heterosis (BPH) for traits such as sympodial branches, number of bolls, seed cotton yield, fiber length and fiber strength, while traits like monopodial branches showed weaker associations. These results underscore the predominance of non-additive gene action in governing heterotic expression of yield and fiber traits, highlighted the utility of *sca* as a predictive tool in cotton hybrid breeding. The study identifies promising hybrids with concurrent superiority in yield and fiber quality traits for potential commercial exploitation and provides trait-specific insights to guide efficient heterosis breeding strategies.

Keywords: Cotton, *per se*, *sca*, hybrids

THE ROLE OF COLD CHAIN INFRASTRUCTURE IN REDUCING FOOD WASTE AND IMPROVING FARMER RETURNS

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The part of Cold Chain structure in Reducing Food Waste and perfecting Farmer Returns Abstract The aspiration of the form is to pick up on perception into the conventional ordinances of agronomist's advertence and trials toward keeping up the postharvest cold chain. India, the world successive – largest stage manager and one of the capitals of origin of fruits and vegetables is a like one of the biggest food fritterers in the world. The challenge of feeding India's billion plus people isn't really about husbandry and about husbandry food product but learning the quality food to the concerned people in an accurate time. The biggest contributors to this extravagance are absence of temperature controlled transport and insufficient quality of cold storehouse establishments for both agriculturists and food merchandisers i.e. retailers. What India lacks, and needs, is a well- developed world- class cold chain architecture. Cold chain structure plays a pivotal role in reducing food waste and perfecting farmer's returns by preserving the quality and self life of perishable agricultural products. Improve cold chain management can minimize post-harvest losses, increase market access for farmers, and enhance their income. This, in turn, can contribute to food security and support the livelihoods of farmers.

INNOVATIONS IN CLIMATE SMART AGRICULTURE: TOOLS, TECHNOLOGIES, AND TRANSFORMATION PATHWAYS

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The agrifood sector possesses major challenges due to a growing world population and the depletion of natural resources caused by climate change, which impacts food security and producer income. In order to feed around 9 billion people by 2050, nations worldwide will need to produce almost 70% more food, thereby rendering the problem of food security even more challenging. Agriculture must, therefore, adapt to the current environment in order to meet the demand for food security and to withstand the effects of a changing climate. A key strategy for climate change adaptation is sustainable intensification, which additionally reduces emissions per unit of output. AI-based climate-smart agriculture technologies enable to maximize the utilization of resources, minimize environmental impact, and enhance crop resilience. This analysis examines current climate-smart innovations in the agrifood sector that support sustainable solutions and increase profitability for farmers. Smallholder farmer communities in India can benefit from increased agricultural output, food security, and the sustainability of their livelihoods through the use of digital technologies for scaling Climate-Smart Agriculture practices. As climate smart agriculture is based on three components boosting productivity, reducing greenhouse gas emissions, and building resilience and adapting key concepts like carbon sequestration, resilience, vulnerability, and productivity serve as indicators for future empirical measurements of the concept. By using adaptation and mitigation approaches, it supports the agricultural system in resisting from losses and fast recoveries.

Keywords: Climate Smart Agriculture; food security; Sustainable; climate change; artificial intelligence; sustainability

TOWARDS 2050: TECHNOLOGY-DRIVEN STRATEGIES FOR FOOD SECURITY IN INDIAN AGRICULTURE
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Agriculture remains the cornerstone of India's economy, providing livelihoods to nearly half of the country's population and playing a vital role in its GDP. As the population is expected to surpass 1.5 billion by 2050, ensuring food security for every citizen has become a major challenge. To meet these growing demands, India's time-tested farming systems must adapt to the realities of climate change, limited natural resources, and evolving consumer preferences. The advent of modern technologies such as precision agriculture, biotechnology, digital tools, and artificial intelligence is transforming the agricultural sector. The integration of these modern innovations offers significant potential to enhance productivity, resilience, and sustainability, thereby ensuring long-term food and nutritional security for the nation.

Keywords: AI, Drones, Genome editing, Precision farming, Robots, Sustainable Agriculture

STUDY OF YPTHIMA SPECIES (NYMPHALIDAE: SATYRINAE): SEASONALITY, WING VARIATION AND EYESPOTS
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Butterflies (Lepidoptera), due to their remarkable beauty, which is characterized by the diverse patterns, colors, and sizes of their wings, grab the attention of all humankind. The butterfly wings show both pigmentary and structural coloration, which often varies due to seasonal variation. These dynamic wing variations make butterflies an excellent model organism for research in evolutionary biology, ecology, and developmental genetics. The main aim of this study is to highlight the wing coloration, eyespot patterns, and seasonal variations in two selected species of the genus *Ypthima*, i.e., the Common Three-ring (*Ypthima asterope* Klug, 1832) and the Lesser Three-ring (*Ypthima inica* Hewitson, 1865). The hierarchical classification of both species is related to the tribe Satyrini, falls under the subfamily Satyrinae, and belongs to the family Nymphalidae. This analysis of observations indicated that both species underwent significant changes with the seasons, exhibiting different morphs during the wet and dry seasons. The number of ocelli (eyespot arrangements) presents on both the forewings and hindwings of the butterflies shows how the species varied from each other. The results indicate that the distinctive wing markings and color of the genus *Ypthima* and other species of butterflies are crucial for studying ecological and evolutionary processes.

Keywords: eyespot (ocelli), Satyrinae, *Ypthima asterope*, *Ypthima inica*, seasonal variation, morphs.

DIETARY SUPPLEMENTATION OF LANTANA CAMARA PLANT EXTRACT ON LARVAL GROWTH WEIGHT AND COCOON CHARACTERISTIC SILKWORM, BOMBYX MORI L.
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The phytoecdysteroid isolated from the plant, *Lantana Camara* and were tested against 3rd 4th and 5th instar larvae of silkworm for improving the performance of growth and cocoon characteristics of silkworm, *Bombyx mori* L. The various concentrations of *Lantana Camara* plant extract (0.5, 1.0, 1.5, 2.0 and 2.5 %) were administered to 3rd, 4th and 5th instar silkworm with mulberry. The larval weight, cocoon characteristics were influenced by various concentration of plant extract. The intensity of influence was depending on the time and dose exposure. The plant extract at 2.0 %. Concentration resulted higher larval growth and increased cocoon weight. The mean larval weights, relative growth rate of silkworm, *Bombyx mori* were increased. The average pupa weight, shell weight, shell ratio and silk filament length were also increased with this supplementation of plant extract over the control. In the present study the plant extract of *Lantana Camara* have growth promoting effect in silkworm which helps to improve the performance of silk in *Bombyx mori*.

Keywords: Plant Extract, *Bombyx Mori*, Economic Parameters.

ADVANCES IN AGRICULTURAL, BIOLOGICAL, AND BIODIVERSITY CONSERVATION FOR SUSTAINABLE DEVELOPMENT

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Agriculture and biodiversity are the twin pillars of global sustainability, providing food security, ecosystem stability, and livelihood opportunities. In recent decades, rapid population growth, industrialization, and climate change have exerted immense pressure on natural resources, demanding innovative and sustainable approaches to agricultural and biological systems. Advances in agricultural sciences such as precision farming, biotechnology, genetic modification, and integrated pest management have revolutionized crop productivity and resource efficiency. Similarly, developments in biological sciences, including molecular genetics, bioinformatics, and microbial biotechnology, have opened new frontiers in enhancing soil fertility, developing stress-tolerant crop varieties, and restoring degraded ecosystems. Biodiversity conservation remains central to sustainable development, as it ensures ecological resilience and adaptability in changing environmental conditions. Modern conservation strategies emphasize in situ and ex situ preservation, sustainable land-use planning, and the integration of traditional knowledge with scientific innovations. Furthermore, the use of advanced remote sensing, GIS technologies, and environmental DNA (eDNA) tools has improved biodiversity monitoring and management at local and global scales. The synergy between agricultural advancement and biodiversity protection is essential for achieving the United Nations Sustainable Development Goals (SDGs), particularly those related to zero hunger, climate action, and life on land. This paper highlights the intersection of agriculture, biological research, and biodiversity conservation as a foundation for sustainable development. It underscores the need for policy integration, technological innovation, and community participation to ensure ecological balance and food security for future generations. By adopting a holistic and ecosystem-based approach, humanity can achieve sustainable growth that harmonizes productivity with environmental stewardship.

Keywords: Sustainable development, agriculture, biodiversity conservation, biotechnology, ecosystem management, climate resilience, genetic resources, food security.

PROBIOTIC ATTRIBUTES OF *LACTOBACILLUS* SPECIES ISOLATED FROM FERMENTED BAMBOO SHOOTS AND THEIR *IN VITRO* STIMULATION

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Fermented bamboo shoot products like soidon, soibum, soijin, lungsiej, and bamboo shoot pickle samples undergo natural fermentation by *Lactobacillus* sp. The present study was done for the isolation and identification of bacteria from fermented bamboo shoots soibum and soidon collected from the local market of Manipur, India. Pour plating in MRS agar by serial dilutions of both homogenized samples resulted in the isolation of 10 bacterial isolates each from both soidon and soibum. Preliminary identification of all 20 bacterial isolates with gram staining showed gram positive violet coloured rods which were all catalase negative. Sugar fermentation tests revealed homo and hetero-fermentative bacteria. Bacterial isolates were found to be able to tolerate different concentrations of NaCl, Phenol and different pH concentrations. Temperature 37 °C was observed as optimum temperature. Two bacterial isolates each from soibum and soidon showed growth with oxgall at 0.3% concentration. Different bacterial isolates from soibum and soidon showed hydrophobicity at different ranges. When observing *in vitro* stimulation of prebiotics/fibers, it was observed that pectin stimulated the growth of bacteria isolated from both soibum and soidon in comparison to inulin. The current research provides a foundation for future research on the biotechnological exploitation of lactic acid bacteria as natural food preservatives.

Keywords: Bamboo shoots; Fermentation; *Lactobacillus*; Probiotics; Prebiotics; Synbiotics

OPTIMIZATION OF CULTURE MEDIA FOR *IN VITRO* SEED GERMINATION AND PROTOCOL-LIKE BODIES FORMATION IN THE ENDANGERED ORCHID *EULOPHIA NUDA* LINDL

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Eulophia nuda Lindl., a terrestrial orchid native to tropical Asia, is an endangered species valued in traditional medicine for its anti-inflammatory and antimicrobial properties. In addition to its ethnobotanical importance, the species also holds considerable ecological significance as part of forest understorey communities. Although orchids constitute one of the most diverse families of flowering plants, many species are threatened by habitat loss, overexploitation and low natural seed germination due to the absence of endosperm and their dependence on specific mycorrhizal fungi for nutrient acquisition during the early developmental stages. Conventional propagation through seeds is highly unreliable in most orchids; hence, the development of *in vitro* techniques has become a vital tool for their large-scale multiplication and conservation. *In vitro* culture provides a controlled environment that supports the asymbiotic germination of seeds and the development of protocorm-like bodies (PLBs), independent of fungal association. The choice and composition of basal media play a critical role in determining the growth response, as variations in nutrient concentration and salt balance can directly influence embryo development and subsequent PLBs formation. Therefore, a systematic study was conducted to standardize culture media for efficient *in vitro* seed germination and protocorm-like bodies (PLBs) development. Six solid media formulations were compared: Murashige and Skoog (full and half strength), Lindemann (full and half strength) and Orchimax (full and half strength) media. The results revealed that Orchimax full strength solid medium supported the highest seed germination percentage (92.20 %) with the earliest germination observed at 66.60 days after culturing (DAC). PLBs were established earliest and most profusely on Orchimax full strength solid medium, achieving 91.12 per cent establishment within 80.10 DAC. The standardized protocol provides an efficient system for large-scale propagation and conservation of *E. nuda*.

Keywords: Conservation, endangered orchid, *in vitro* propagation, protocorm-like bodies, seed germination

A NOVEL APPROACH OF USING ASH GOURD AS A SUBSTRATE FOR ENHANCING LINGO-CELLULOLYTIC ENZYME PRODUCTION IN MONO AND CO-CULTURE OF TWO WHITE ROT FUNGI

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White rot fungi are known to degrade wood due to its ability to produce various lignocellulolytic enzymes. The synergistic effect of fungal coculture on lignocellulosic degradation is not much known. In the present study lignocellulolytic enzyme activity of *Irpex lacteus* and *Daedaleopsis confragosa* were compared in mono culture and coculture supplemented with various concentrations of Ash gourd (*Benincasa hispida* Cogn.). The result revealed that gradual increasing in the concentration of ash gourd from 1-10% leads to enhancement of enzyme activity but 5% concentration proved to be best for all the lignocellulolytic enzyme activity after that decline in the enzyme activity was noticed which was still higher than the activity in the control medium with no ash gourd. *I. lacteus* showed an absence of LiP enzyme activity throughout the present study. Both the monocultures and coculture showed an absence of cellulase enzyme activity in control as well as media supplemented with different concentrations of ash gourd pulp. LiP, MnP, Laccase, AAO and Xylanase activity enhanced in 5% ash gourd pulp in monoculture as well as in coculture of *I. lacteus* and *D. confragosa*.

Keywords: Ash gourd, lignocellulolytic enzymes, *Irpex lacteus* and *Daedaleopsis confragosa*

DIVERSITY AND BIOCONTROL POTENTIAL OF WOOD-ROTTING FUNGI (WRF) FROM THE WESTERN GHATS, KARNATAKA, INDIA: DISCOVERY OF THREE NOVEL SPECIES AND EVALUATION OF ECO-FRIENDLY ANTIFUNGAL AGENTS

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A systematic survey conducted from January 2023 to April 2025 across Shivamogga, Chikkamagaluru, and nearby forest areas yielded 148 WRF specimens (49 from Shivamogga, 47 from Chikkamagaluru, and 52 from forest zones). Morphological and ITS-based phylogenetic analyses identified 138 Basidiomycota, three Ascomycota, and three Myxomycota species across 15 orders and 36 families. Three novel taxa; *Ganoderma swietenium* sp. nov. (on *Swietenia mahagoni*), *Fulvifomes ficicola* sp. nov. (on *Ficus religiosa*), and *Lachnocladium sevyakrishnarum* sp. nov. were described. Seven representative fungi (*Trametes hirsuta*, *Schizophyllum commune*, *Pycnoporus sanguineus*, *Lenzites betulinus*, *Ganoderma applanatum*, *Oligoporus placentus*, and *Fomes meliae*) were tested for their wood-degrading ability on five tree species (*Artocarpus heterophyllus*, *Pterocarpus marsupium*, *Tectona grandis*, *Dalbergia latifolia*, and *Santalum album*). Methanolic extracts (2.5%) of *Lantana camara*, *Hyptis suaveolens*, *Parthenium hysterophorus*, and *Croton bonplandianus* were assessed for antifungal activity, along with *Trichoderma viride* and *T. harzianum* as antagonists. Maximum wood degradation occurred in *A. heterophyllus* (53.3%), *P. marsupium* (49.8%), and *T. grandis* (47.2%). *Trichoderma viride* and *T. harzianum* inhibited fungal growth by 91% and 98%, respectively. Plant extracts suppressed WRF growth by 95–100%, with *C. bonplandianus* and *H. suaveolens* showing complete protection. This study provides the first comprehensive insight into WRF diversity and demonstrates the efficacy of plant-derived extracts and antagonistic fungi as sustainable, eco-friendly alternatives to synthetic wood preservatives. The present study provides comprehensive insights into the diversity and wood-degrading ability of decay fungi from the Western Ghats and highlights the potential of plant-derived extracts and antagonistic fungi as eco-friendly biocontrol alternatives to conventional chemical preservatives. These findings contribute to the sustainable management of wood deterioration and reduction of storage losses in forest and timber industries.

Keywords: Wood-Rotting Fungi (WRF), Novel Species, Eco-friendly Preservation, Biocontrol, India

SUSTAINABLE URBAN AGRICULTURE: PRACTICES AND FUTURE STRATEGIES FOR RESILIENT CITIES

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The world is seeing an unprecedented rate of urbanization, which is causing serious problems like climate change, biodiversity loss and environmental degradation. Urban gardening plays an increasingly important role in enhancing the sustainability and livability of urban areas as their population increases and they become more crowded. By providing answers to many of the environmental problems that urban dwellers encounter, urban gardening contributes significantly to the ecological and social fabric of cities. Enhancing food security, biodiversity, and environmental sustainability all depend on urban horticulture. Many environmental issues, such as poor air quality, flooding, and the urban heat island effect, can be lessened in cities by integrating nature-based solutions like urban farms, vertical gardens, and green roofs into the urban landscape. By adding aesthetic value, boosting recreational areas, and encouraging community involvement through urban farming and gardening projects, green infrastructure also enhances the quality of life for people living in cities. This review covers a variety of sustainable urban horticultural techniques, including composting, rainwater gathering, rooftop gardening, hydroponics, aquaponics, and vertical farming etc. In order to promote sustainable green spaces in urban areas, it also highlights the significance of integrated pest management, intelligent irrigation systems, and urban agroforestry.

Keywords: Urban gardening, environmental sustainability, vertical farming, hydroponics, rooftop garden.

PHYTOREMEDIATION AND MICROBIAL SYNERGY IN CONTAMINATED SOILS

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Phytoremediation, the use of plants to extract, stabilize, or degrade contaminants, offers a sustainable and low-cost strategy for the restoration of polluted soils. However, its efficiency is often limited by factors such as low contaminant bioavailability, slow remediation rates, and plant stress under toxic conditions. Recent research highlights that integrating beneficial microorganisms particularly plant growth-promoting rhizobacteria (PGPR), mycorrhizal fungi, and endophytic bacteria can significantly enhance phytoremediation outcomes. This study investigates the synergistic interactions between plants and microbes in improving contaminant removal and soil health. Microbial inoculants play critical roles in rhizosphere modification through pH regulation, secretion of chelating agents, and biosurfactant production, thereby enhancing metal solubilization and organic pollutant degradation. Additionally, microbes produce phytohormones such as indole-3-acetic acid (IAA) and enzymes like ACC deaminase that mitigate stress and stimulate root growth, resulting in greater contaminant uptake. Case studies demonstrate that combined plant-microbe systems, such as *Brassica juncea* with *Pseudomonas putida* and *Vetiveria zizanioides* with arbuscular mycorrhizal fungi, exhibit superior performance in removing heavy metals, petroleum hydrocarbons, and persistent organic pollutants. The integration of omics tools and bioinformatics has further advanced understanding of molecular signaling and functional pathways governing these interactions. Despite promising results, large-scale applications are constrained by variable environmental conditions, microbial survivability, and inconsistent field performance. This study underscores the potential of microbial-assisted phytoremediation as a key component of sustainable soil restoration strategies. Future directions should focus on developing genetically optimized plant-microbe consortia, standardized inoculation protocols, and predictive models to enhance reliability and scalability. By combining ecological understanding with biotechnological innovation, phytoremediation and microbial synergy represent a transformative approach for achieving long term soil detoxification and ecosystem recovery.

Keywords: Phytoremediation, microbial synergy, rhizobacteria, heavy metals, soil restoration, plant-microbe interaction, PGPR

GREEN EXTRACTION APPROACHES FOR SILYMARIN FROM MILK THISTLE (*SILYBUM MARIANUM*) SEEDS AND ITS PROSPECTS IN NUTRACEUTICAL FORMULATIONS FOR METABOLIC DYSFUNCTION–ASSOCIATED STEATOTIC LIVER DISEASE (MASLD) MANAGEMENT

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Metabolic Dysfunction–Associated Steatotic Liver Disease (MASLD) (formerly Non-alcoholic fatty liver disease (NAFLD)), is emerging as one of the most common chronic liver disorders worldwide which is closely related with obesity, metabolic syndrome and lifestyle related factors. Current therapeutic strategies for combating MASLD are limited, highlighting the need of phytochemicals in preventive and supportive care. *Silybum marianum* (Milk Thistle) is a well-known medicinal plant containing bioactive compound, silymarin, a complex of flavonolignans, with well-established antioxidant and hepatoprotective potential. MASLD is primarily caused by hepatic fat accumulation linked to insulin resistance, oxidative stress and inflammatory responses. Existing preclinical and clinical evidence demonstrates that silymarin effectively alleviates oxidative stress, reduces insulin resistance and attenuates fibrogenic pathways, thereby promising a considerable approach in management of MASLD. However, conventional extraction techniques are often based on toxic solvents and energy-intensive conditions, raising concerns about sustainability and food-grade compatibility. In this context, recent literature highlights the potential of green extraction technologies, which are increasingly explored to ensure the efficient recovery of bioactive compounds while retaining their structural and functional integrity. Furthermore, due to constraints such as its low solubility, limited bioavailability and poor palatability, it remains a challenge to effectively translate silymarin into consumer-acceptable formats. The present work consolidates secondary evidence on the therapeutic role of silymarin in MASLD and outlines a conceptual framework for its sustainable extraction, laying the foundation for nutraceutical strategies in MASLD management and preventive healthcare.

Keywords: Milk Thistle, Green extraction technologies, Antioxidant and hepatoprotective activity, Nutraceutical development, Metabolic Dysfunction–Associated Steatotic Liver Disease (MASLD)

EXPLORING THE UTILITY AND RELEVANCE OF THE MULTIDIMENSIONAL PERSONALITY QUESTIONNAIRE IN CONTEMPORARY PSYCHOLOGY

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The Multidimensional Personality Questionnaire (MPQ) is a psychometric instrument designed to assess a broad spectrum of personality traits. Recent research in behavioral genetics has leveraged the MPQ to elucidate the interplay of genetic and environmental influences on personality development. This article reviews the structure and use of the MPQ, summarizes findings from genetic studies (including adoption-based designs), discusses genetic modeling and scoring approaches, and explores implications for understanding the neurobiological and psychological foundations of personality. The Multidimensional Personality Questionnaire (MPQ) is a comprehensive, normed instrument that captures a wide spectrum of personality traits across multiple domains, offering a robust framework for investigating the genetic and environmental architecture of personality. This study synthesizes contemporary findings from behavioral genetics with MPQ-based research to illuminate how heritable and non-heritable factors shape trait expression, development, and inter-trait organization. Leveraging two distinct samples—a general group and an orphan cohort—this work presents item-level MPQ data (155 items, plus aggregate scores) to examine trait distributions, intercorrelations, and potential sample-specific patterns that may reflect gene–environment interplay. The review articulates (i) MPQ structure and scoring paradigms, (ii) evidence from adoption- and family-based designs that infer genetic contributions to MPQ dimensions, (iii) methodological approaches for analyzing MPQ data in genetic contexts (e.g., heritability estimation, genetic correlations, structural equation modeling, and factor analyses), and (iv) implications for understanding the neurobiological substrates underlying personality. By integrating descriptive statistics from the two datasets with behavioral genetics concepts, the study provides a nuanced interpretation of how genetic propensities interact with environmental contexts to shape personality trajectories. The findings have implications for theoretical models of personality development, inform best practices for MPQ-based genetic research, and highlight avenues for future work, including longitudinal designs, adoption studies, and integration with neuroimaging and molecular genetic data. This synthesis advances the field by clarifying how MPQ-derived trait architectures can be harnessed to parse genetic and environmental influences on personality in diverse populations.

Keywords: Multidimensional Personality Questionnaire; behavioral genetics; genetic modeling; adoption studies; personality traits; heritability; polygenic scores; structural equation modeling

MODIFICATION OF NATURAL GUM-BASED POLYMER FOR CONTROLLED RELEASE OF BORON AND ZINC IN THE SOIL

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Conventional method of fertilizer application leads to loss of plant nutrient through leaching, run-off, volatilization, denitrification etc. These in turn affect the health of environment directly or indirectly. The use of controlled release fertilizers (CRFs) starts to evolve as a promising direction by offering an excellent means to improve management of nutrient and by reducing environmental threats. In this aspect, plant polysaccharides are of special interest as they are easily available, safe to environment and easy to modify. Adopting microwave assisted technique, prosopis gum based hydrogel loaded with boron and zinc was synthesized. The synthesized hydrogel was characterized by elemental analyzer, FTIR, EDX and SEM. Release patterns studied in water revealed that % cumulative release of boron and zinc during the span of 6 days were 51-58% and 59-68 % respectively. In the soil, it was found to be 62-74 % and 52-58% upto 20 days beyond which the release patterns were constant. The kinetics study revealed that both boron and zinc follow Fickian mechanism ($n < 0.5$) in water whereas in the soil it follows non-Fickian mechanism ($n > 0.5$). Sustained release of boron and zinc was achieved with a half-life of 33-57 days and 49-86 days respectively.

Keywords: prosopis, boron, hydrogel, polysaccharide, nutrient

CHITOSAN FROM *CUNNINGHAMELLA* SPP.: A SUSTAINABLE APPROACH FOR THE SYNTHESIS OF CHITOSAN NANOPARTICLES AND HARNESSING THEIR AGRICULTURAL POTENTIAL

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Cunninghamella species are promising biotechnological resources for producing bioactive polymers such as chitosan (CH), offering a sustainable alternative to crustacean-derived sources. In this study, eleven Zygomycetes cultures were screened for fungal chitosan (FCH) production, among which *C. echinulata* NCIM 691 and *Rhizopus oryzae* NCIM 1387 emerged as potential producers. Due to its underexplored potential, *C. echinulata* NCIM 691 was selected for scale-up and optimization using one-factor-at-a-time (OFAT), Plackett–Burman Design (PBD), and Box–Behnken Design (BBD). Optimized media (glucose 20 g/L, yeast extract 15 g/L, MgSO₄ 1 g/L) yielded 220.45 ± 4.72 mg FCH/g dry biomass—2.2-fold higher than unoptimized conditions. FCH was further utilized for synthesizing fungal chitosan nanoparticles (FCHNPs) via ionotropic gelation. Characterization (UV–Vis, FTIR, DLS, Zeta potential, SEM, NTA, XRD, NMR) confirmed nanosized particles (~144 nm) and high deacetylation (88.3%). FCHNPs exhibited potent antimicrobial activity against phytopathogens, notably *Fusarium* spp. and *Xanthomonas campestris*, major sugarcane pathogens, inhibiting fungal spore germination (61–90%) and distorting mycelial morphology at 200 µg/mL. Synergistic activity with rhamnolipid biosurfactant (RL-BS) further enhanced efficacy. These findings demonstrate *Cunninghamella*-derived chitosan nanoparticles as eco-friendly antimicrobial agents for sustainable agricultural applications.

Keywords: Rhamnolipid, Low-cost substrate, Optimization, Production.

CHITOSAN NANOENCAPSULATED EUGENOL AS ANTIMICROBIAL AGENT FOR SUSTAINABLE MANAGEMENT OF MOULD INDUCED BIODETERIORATION IN GROUNDNUT (*ARACHIS HYPOGAEA*)

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Groundnut (*Arachis hypogaea*) is a critical crop in global agriculture, providing essential nutrients and livelihood for millions. However, its post-harvest storage is frequently compromised by *Aspergillus flavus*, a fungus capable of producing aflatoxins which is highly toxic and carcinogenic secondary metabolites that threaten food safety and agricultural sustainability. Addressing fungal contamination with synthetic fungicides raises concerns about environmental impact, chemical residues and resistance development, necessitating innovative and eco-friendly solutions. This study investigates the application of chitosan-based nanoencapsulation to enhance the efficacy of eugenol, a natural antifungal phenolic compound extracted from clove essential oil, for the preservation of groundnut during storage. Chitosan, a biodegradable and biocompatible natural biopolymer, was employed to encapsulate eugenol by ionic gelation method and characterized by XRD, FTIR, and SEM. In vitro antifungal assessments revealed that the chitosan nanoencapsulated eugenol (CNEU) significantly inhibited the growth of aflatoxigenic *A. flavus* more effectively than free eugenol. Application of these nanoparticles on groundnut samples under storage conditions revealed significant protection of groundnut from fungal infestation, aflatoxin B₁ production and reduction of nutritional values i.e. carbohydrate, protein and lipids upto 60 days of storage. These findings indicate the potential of CNEU for sustainable post-harvest management of agricultural food commodities and enhanced food security.

Keywords: Eugenol, Chitosan, Nanoparticle, *Aspergillus flavus*, Aflatoxin B₁, Groundnut, Sustainable agricultural management.

EFFICACY OF SILKWORM PUPAL CHITOSAN AGAINST BACTERIAL DISEASES OF SILKWORM, *BOMBYX MORI* L.

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The research was conducted to evaluate the efficacy of silkworm pupal chitosan against bacterial diseases of silkworm, *Bombyx mori* L. during 2024-2025 at Department of Sericulture, College of Sericulture, Chintamani. The results of the *in-vitro* studies revealed that, chitosan at 5000 ppm produced notably larger inhibition zones, 1.19 cm against *Staphylococcus aureus* and 1.10 cm against *Bacillus thuringiensis*, than standard ampicillin (0.783 cm) and commercial chitosan (0.76 cm) at 1000 ppm. The most effective chitosan treatments against bacterial inhibition were selected for *in-vivo* studies, along with the controls. During rearing, immediately after the fourth moult, the silkworms were inoculated with *S. aureus* and *B. thuringiensis*. Thereafter, chitosan treatments were administered at different time intervals. The results found that, larvae treated with 5000 ppm chitosan demonstrated improved larval weight (33.35 g/10 nos.), cocoon weight (1.64 g) and shell weight (0.32 g), yielding a shell ratio of 19.57 percent. Other enhancements included an effective rearing rate of 73.56 per cent, disease incidence of 24.51 percent, pupation at 76.30 per cent and moth emergence at 81.98 percent. Reeling characteristics similarly benefited, with filament length extending to 936.41 m, filament weight reaching 0.27 g and filament denier recorded at 2.60. Although standard treatments generally outperformed pupal chitosan especially against *S. aureus* the latter still delivered significant benefits. Early administration of chitosan at 6 hours post-infection (hpi) outperformed delayed application at 30 hpi. Biochemically, treated silkworms exhibited daily increases in protein, carbohydrate, protease and amylase levels, correlating with reduced disease severity; in contrast, larvae exposed only to bacteria showed declines in these parameters. Lipid content dropped sharply as infection advanced, while lipase activity varied throughout the instar. These findings indicate that applying silkworm pupal chitosan at 5000 ppm within 6 hpi of bacterial exposure effectively mitigates bacterial infections in silkworms as a curative measure, particularly those caused by *S. aureus* and *B. thuringiensis*..

EFFECT OF CULTIVAR, MATURITY STAGE AND MOISTURE CONTENT ON DETACHMENT AND CUTTING FORCE OF CHILLI FRUITS

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The traditional method of harvesting chilli fruits, primarily hand-picking, is time-consuming and labor-intensive. Labor shortages during peak seasons often delay harvesting, leading to reduced product quality. Additionally, workers frequently miss red chilli fruits due to dense foliage and experience physical strain, particularly in the upper limbs, lower limbs, and spine. To address these challenges, this study investigated the detachment and cutting forces of chilli fruits under different maturity stages and moisture contents. The experiment evaluated three chilli varieties Arka Meghana, Mahyco Tejaswini, and Demon F₁ across five maturity stages i.e green, semired, red, semidry and dry. Measurements included fruit detachment force (pulling force), cutting force using a texture analyzer, and pulling force using a digital force gauge. The moisture content of the three varieties across maturity stages ranged from 19.52% to 87.13%, with significant differences observed between varieties. The holding force, measured via texture analyzer, varied from 1.93 to 18.78 N, showing significant differences among varieties and maturity stages. Similarly, detachment force measured with the texture analyzer ranged from 2.32 to 22.86 N, with significant variations across varieties and maturity stages. When measured with a digital force gauge, detachment force ranged from 2.62 to 10.15 N, exhibiting significant differences between varieties. Cutting force analysis revealed that Arka Meghana and Tejaswini required the highest forces (54.18 N and 51.76 N, respectively), followed by Demon F₁ (44.07 N). Among maturity stages, red chillies demanded the highest cutting force (70.23 N), followed by semi-red (62.91 N), green (55.08 N), semi-dry (42.07 N), and dry stages (19.80 N). These findings provide critical insights into the mechanical behavior of chilli fruits, aiding in the development of efficient harvesting technologies.

Keywords: Detachment force, Cutting force and Hand picking

DRUG DESIGN OF GLYPHOSATE TARGETING AROA IN KLEBSIELLA PNEUMONIAE: A DRUG DESIGN PROJECT FOCUSING ON (MDR) KLEBSIELLA PNEUMONIAE

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The emergence of multidrug-resistant (MDR) *Klebsiella pneumoniae* presents a significant threat to public health, necessitating novel antimicrobial strategies. The shikimate pathway, which is essential for bacteria but absent in humans, offers an attractive and selective target for drug development. This study focuses on a key enzyme in this pathway, aroA (EPSP synthase), and evaluates the herbicide glyphosate as a potential inhibitor using computational drug design methods. The objective was to computationally model and validate the interaction between glyphosate and the aroA protein from *K. pneumoniae*. This *in silico* study involved retrieving the 3D structure of aroA (PDB ID: 7TM5) and modeling it using AlphaFold. The protein model was prepared, refined using GalaxyRefine, and its stereochemical quality was validated using ProCheck. After identifying the active site, the glyphosate ligand was prepared and molecular docking was performed using PyRx (AutoDock Vina) to analyze binding interactions. The stability of the resulting protein-ligand complex was then assessed through a 1ns Molecular Dynamics (MD) simulation using GROMACS. Finally, the drug-likeness and ADMET properties of glyphosate were evaluated using SwissADME. The results confirmed the high quality of the modeled aroA protein and demonstrated stable binding of glyphosate within the enzyme's active site. MD simulation analyses, including Root Mean Square Deviation (RMSD) and Radius of Gyration (Rg) plots, further confirmed the stability of the docked complex. These computational findings validate glyphosate as a viable inhibitor of the *K. pneumoniae* aroA enzyme, supporting its potential for repurposing as an antibacterial agent to combat this resistant pathogen.

Keywords: Drug Design, Multidrug-Resistant (MDR), Glyphosate, aroA, *Klebsiella pneumoniae*, Molecular Dynamics (MD), GROMACS, AutoDock Vina

ADVANCES IN BRACKISHWATER AQUACULTURE: BIOLOGICAL AND ECONOMIC INSIGHTS FROM COBIA (*RACHYCENTRON CANADUM*) FARMING IN COASTAL WEST BENGAL

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The study meticulously inspects the production parameters and economic feasibility of Cobia (*Rachycentron canadum*) aquaculture in the Feeder-1 Pond at the Brackishwater Finfish hatchery cum training centre, Fraserganj, South 24 Parganas, West Bengal. Renowned for its rapid growth, substantial market value and adaptability, Cobia represents a promising candidate for commercial cultivation. The research suggests that Cobia culture within this brackishwater pond system can be technically viable and potentially lucrative, contingent upon the implementation of best management practices. Key production parameters encompass pond preparation, seed selection, stocking, feeding management, rigorous water quality control, and the attainment of survival rates between 60-70%. Economic assessments indicate that feed and seed expenditures constitute the most significant operational costs, comprising over 70% of total variable expenses. Revenue forecasts are contingent upon farm-gate prices and overall harvest biomasses, which are directly influenced by growth and survival metrics. Profitability indicators such as Net profit and Benefit-cost ratio highlight the venture's potential, provided that optimal production efficiency and market strategies are diligently upheld. Challenges such as cannibalism in early stages and disease management are also addressed, emphasizing the need for robust biosecurity. The study provides critical insights for sustainable expansion of Cobia farming in similar coastal regions, promoting livelihood diversification and regional food security.

Keywords: Aquaculture, economic feasibility, best management practices, benefit-cost ratio, livelihood diversification.

SMART HYDROGELS: TURNING WATER SCARCITY INTO CROP PROSPERITY

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Water scarcity in India affects more than 68% of the cultivated area, with over 40% of regions experiencing inadequate rainfall. To overcome this challenge and sustain crop productivity, hydrogels offer an eco-friendly and effective solution. Hydrogels are cross-linked, hydrophilic polymers capable of absorbing 400–1500 times their dry weight in water and gradually releasing up to 95% of the stored moisture during dry conditions. Their biodegradable, non-toxic and high water-retention properties make them highly suitable for agricultural and ornamental use. These are classified based on source, method of preparation, structure and charge. In arid and semi-arid regions, hydrogels act as water-saving soil conditioners that conserve moisture in the root zone by minimizing evaporation (rose, chrysanthemum, gerbera, marigold) deep percolation and runoff losses. They improve soil physical properties such as porosity, permeability and infiltration, reducing erosion and enhancing overall plant growth. Hydrogels also serve as carriers for nutrients and pesticides, enhance water and nutrient use efficiency (carnation, gladiolus and dahlia) and improve crop yield and quality. In ornamental plants, they promote better root growth, reduce irrigation frequency, dense foliage, prolonged flowering (rose, gerbera) and delayed wilting. In landscaping these are used in nursery production. Beyond agriculture, hydrogels are widely utilized in wound dressings, contact lenses, cosmetics, drug delivery, tissue engineering, biosensors, food industries and fire-fighting due to their cooling, moisturizing and stimuli-responsive characteristics. Hence, hydrogels represent a sustainable and versatile technology for conserving water, improving plant performance and supporting diverse industrial applications under water-limited conditions.

Keywords: Conserve moisture, Food industries, Hydrogel, Ornamentals, Soil conditioners

WRAPPED ROOTS, SUSTAINED LIFE: THE ART AND SCIENCE OF BURLAPPING

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Trees are vital components of the environment, offering numerous benefits such as noise reduction, shade provision, mitigation of the urban heat island effect, enhancement of biodiversity, improvement of mental health and reduction of atmospheric CO₂. One hectare of trees can absorb 6–8 tonnes of CO₂ annually and release 4–5 tonnes of oxygen. However, rapid urbanization, metro expansion and real estate development pose major threats to urban trees. India has only 28 trees per person and in Bengaluru alone, more than 9,000 trees have been felled for metro construction, with 2,000 more at risk in future phases. Due to increasing urbanization and global warming, people are now realizing the importance of urban green spaces. This is where tree transplanting, or “burlapping,” becomes a critical and sustainable intervention not only from an environmental perspective but also from a design standpoint. Burlapping is an age-old practice where mature trees are relocated instead of being cut down. It involves wrapping a tree’s root ball with burlap (a woven fabric) and sometimes wire or twine to protect it during transport. Two main techniques are followed: the bare-root method, used for deciduous trees with diameters below 2 inches and the balled-and-burlapped method, applied to larger trees above 2 inches. Thus, burlapping helps to preserve existing biodiversity by maintaining microhabitats for birds, insects, fungi and epiphytes. It also conserves rare and native species, supports nutrient cycles, prevents soil erosion and improves air quality. Transplanted mature trees preserve heritage value while providing immediate ecological and aesthetic benefits, enhancing public spaces, roadsides and urban landscapes. Thus, burlapping serves as a vital bridge between urban development and environmental conservation, ensuring that growth and greenery coexist harmoniously.

Keywords: Burlapping, biodiversity, bare root, balled and burlapped.

EFFECTS OF DIETARY CHITOSAN SUPPLEMENTATION ON GROWTH AND FEED UTILIZATION IN AQUACULTURE

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The study investigates the application of biopolymers derived from biodegradable sources such as chitosan, polyhydroxyalkanoates, and polysaccharides. The increasing demand for sustainable aquaculture practices has driven the exploration of novel feed solutions aimed at minimizing environmental impact and promoting fish health. Key findings show that biodegradable extraction and the use of chitosan can create sustainable fish feed that enhances feed quality and improves nutrient retention in aquatic species, making it eco-friendly. Since the biodegradable feed is environmentally compatible, it primarily focuses on antimicrobial properties that promote fish health. The study investigates the application of biopolymers derived from biodegradable sources such as chitosan, polyhydroxyalkanoates, and polysaccharides. The increasing demand for sustainable aquaculture practices has driven the exploration of novel feed solutions aimed at minimizing environmental impact and promoting fish health. Key findings show that biodegradable extraction and the use of chitosan can create sustainable fish feed that enhances feed quality and improves nutrient retention in aquatic species, making it eco-friendly. Since the biodegradable feed is environmentally compatible, it primarily focuses on antimicrobial properties that promote fish health.

Keywords: Biopolymers, Chitosan, Sustainable aquaculture, Fish feed, Antimicrobial properties

SYNTHESIS AND ANTIMICROBIAL ACTIVITY EVALUATION OF α -PHELLANDRENE ENCAPSULATED CHITOSAN NANOPARTICLE AS GREEN PRESERVATIVES FOR SUSTAINABLE MANAGEMENT OF PATHOGENIC MICROORGANISMS

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The bioactive compound α -phellandrene is commonly found in plant essential oils, and it was reported as a promising antimicrobial agent. However, its volatility and instability limit its practical applications. To overcome this, encapsulation of α -phellandrene in chitosan was undertaken to increase the stability, solubility and enhance the efficacy of antimicrobial property. This investigation was undertaken to evaluate the antimicrobial property of chitosan-encapsulated α -phellandrene (En- α P). The En- α P was prepared using the ionic gelation method and characterized by XRD, FTIR, and SEM analysis. The size of the En- α P ranged between 68 and 198 nm. The En- α P showed enhanced antibacterial activity against *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Streptococcus faecalis*, *Salmonella typhimurium*, and *Staphylococcus aureus* with a zone of inhibition ranging between 16.2-33.5mm at 20 μ Ldisc⁻¹. The antifungal activity was determined using the poisoned food technique against the fungi viz., *Aspergillus flavus*, *A. niger*, *Fusarium oxysporum*, *F. verticillioides*, *Penicillium chrysogenum*, and *Nigrospora* sp. En- α P also showed promising antifungal activity with percent mycelia inhibition ranging between 47.05-71.87% at 1 μ gmL⁻¹. The findings confirm the antimicrobial potency of En- α P; hence, it could be exploited as a lead compound for the development of eco-friendly antimicrobial agents for the management of pathogenic microbes in agriculture and food industries.

Keywords: α -phellandrene, chitosan, ionic gelation method, nanoencapsulation, antimicrobial activity.

PHYTOCHEMICAL PROFILING AND EVALUATION OF ANTIBACTERIAL, ANTIFUNGAL, AND ANTIOXIDANT ACTIVITIES OF *RAUVOLFIA VERTICILLATA* (LOUR.) BAIL.

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Objective: This study investigates the phytochemical composition, antimicrobial, and antioxidant properties of *Rauvolfia verticillata* extracts from leaf, stem, and root, using different solvents. **Methodology:** Sequential extraction of plant tissues was performed by Soxhlet extraction method using different solvents. Extract yields were calculated, qualitative and quantitative phytochemical (alkaloids, phenolics, flavonoids, saponins, tannins, and steroidal saponins) was estimated. Antimicrobial activity against Gram-positive and Gram-negative bacterial strains was evaluated by well diffusion and microtiter broth dilution, determining inhibition zones, MIC, and MBC values. and major Antifungal activity was carried out using well diffusion method against *Fusarium* and *Aspergillus*. Antioxidant activity was evaluated through phosphomolybdenum, CUPRAC, copper chelation assays. Alpha amylase activity was also carried out. **Results:** Methanolic leaf extract showed highest phenolics (36.57 mg GAE/g DW) and flavonoids (42.64 mg QE/g DW). All extracts demonstrated the presence of key secondary metabolites, with leaf tissues showing the richest profile compared to stem and root extract. Antibacterial assays revealed potent broad-spectrum activity, notably in leaf extracts, with inhibition zones up to 18.66 mm and MIC/MBC values ranging between 0.25–4 mg/mL. Antifungal assay showed marked inhibition of *Fusarium* and *Aspergillus*. Methanolic leaf extracts displayed highest antioxidant activity (phosphomolybdenum: 29.12 ± 1.69), while aqueous stem and leaf extracts showed strong cuprac reducing power compared to root. Copper chelation and alpha-amylase inhibition assays confirmed favorable IC₅₀ values for methanolic extracts over aqueous, indicating stronger chelating and enzyme inhibitory capacity respectively. **Conclusion:** *Rauvolfia verticillata* leaf extracts, especially in methanol, exhibit prominent phytochemical content and strong antimicrobial and antioxidant activities, establishing their promise for pharmaceutical and therapeutic applications.

Keywords: *Rauvolfia verticillata*, phytochemicals, antibacterial, antifungal, antioxidant, alpha-amylase.

STANDARDIZATION OF HARVESTING STAGE AND PRE-TREATMENT FOR DEHYDRATION OF TENDER JACK

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A study on the standardization of harvesting stage and pre-treatment for the dehydration of tender jackfruit was conducted during 2022–2023 at the College of Horticulture, Mudigere, under laboratory conditions. The experiment followed a Completely Randomized Design with 14 treatments and 2 replications. It evaluated two harvesting stages: 45 and 60 Days After Fruit Set (DAFS) and three pre-treatment chemicals: potassium metabisulphite (KMS) at (0.2 and 0.3%), citric acid at (0.2 and 0.3%) and potassium sorbate at (0.1 and 0.2%). Additionally, two control groups of untreated fruits were included. The results indicated that both the harvesting stage and pre-treatment significantly influenced the physico-chemical parameters during the dehydration process. Fruits harvested at 60 DAFS and pretreated with KMS at 0.3 per cent yielded the best results in terms of dry recovery (18.83%), dehydration ratio (0.24), crude fiber (3.28%) and protein content (2.26%). These treatments outperformed other combinations in terms of preserving quality and achieving optimal dehydration characteristics. Based on the findings, it was concluded that harvesting tender jackfruit at 60 DAFS and applying KMS at 0.3 per cent was the most effective combination for enhancing the dehydration process. This treatment resulted in superior quality and efficiency in the dehydration of tender jackfruit, making it the recommended approach for dehydration process.

Keywords: Dehydration, Tender Jack, KMS.

RNA-SEQ PROFILING OF ESTROGEN-RESPONSIVE GENES IN BREAST CANCER

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Estrogen receptor (ER) signaling plays a central role in breast cancer progression, prognosis, and therapeutic response. In this study, we analyzed publicly available RNA-seq data using R programming to investigate estrogen-responsive genes in breast cancer. Count matrices and metadata were processed for quality control, and differential gene expression analysis was performed using DESeq2, identifying a set of upregulated and downregulated genes distinguishing ER-positive from ER-negative samples. Filtering and prioritization allowed us to focus on biologically relevant DEGs strongly associated with estrogen signaling. Functional enrichment analysis (GO and KEGG) using clusterProfiler and pathview revealed enrichment in pathways related to cell proliferation, hormone signaling, and apoptosis. Clustering, heatmaps, and sample QC plots confirmed data integrity and clear transcriptomic differences between breast cancer subgroups. Transcription factor analysis using ChEA3 identified master regulators DLX3, FOXQ1, TFAP2C, FOXN1, HES2, and TP63 as key drivers of estrogen-responsive gene expression, while drug-gene interaction exploration via DGIdb suggested potential therapeutic targets and repurposing candidates. This study demonstrates that R-based transcriptomic analysis can effectively identify molecular mechanisms underlying ER-driven breast cancer. Beyond TF and drug insights, future extensions may include integration with multi-omics datasets (copy number, methylation, proteomics), assessment of tumor-immune interactions, and in silico validation of therapeutic predictions, providing deeper biological insights and translational relevance. Our findings emphasize the importance of estrogen-responsive gene expression in breast cancer and highlight potential regulatory and therapeutic targets that may contribute to improved personalized treatment strategies.

Keywords: Estrogen receptor, Breast cancer, Differential gene expression, Transcription factors, Drug-gene interactions

MYCORRHIZATION EFFECT ON GROWTH AND ACCLIMATIZATION OF MICROPROPAGATED *PASPALUM SCROBICULATUM* L. (KODO MILLET)

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Arbuscular mycorrhizal fungi (AMF) play a crucial role in enhancing plant growth and nutrient uptake. This study investigated the effects of two AMF species, *Rhizophagus fasciculatus* and *Glomus macrocarpum*, on the acclimatization and growth of micropropagated kodo millet (*Paspalum scrobiculatum* L.) plantlets. In vitro propagated plantlets were inoculated with either *R. fasciculatus* or *G. macrocarpum* during the hardening phase. Plant growth parameters, including shoot length, root length, number of leaves, and biomass, were measured after 30 and 60 days of acclimatization. Mycorrhizal colonization rates and nutrient uptake were also assessed. Results showed that AMF inoculation significantly improved plantlet survival, growth, and nutrient acquisition compared to non-inoculated controls. *R. fasciculatus* exhibited superior performance in promoting plant growth and nutrient uptake compared to *G. macrocarpum*. This study demonstrates the potential of AMF, particularly *R. fasciculatus*, in enhancing the acclimatization and establishment of micropropagated kodo millet plantlets, which could contribute to improved cultivation practices for this important millet crop.

Keywords: Arbuscular Mycorrhizal Fungi, Micropropagation, Kodo Millet, Acclimatization

SHEDDING LIGHT ON DARKNESS: SAFEGUARDING NOCTURNAL POLLINATORS FOR ECOSYSTEM SUSTAINABILITY AND HUMAN WELL-BEING

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Artificial light at night (ALAN) represents a critical threat to global biodiversity conservation, particularly affecting nocturnal Lepidoptera that provide essential ecosystem services supporting sustainable development goals. Moths, comprising over 160,000 species worldwide, function as vital nocturnal pollinators responsible for maintaining plant genetic diversity and supporting agricultural productivity worth billions annually. ALAN disrupts moth-mediated pollination networks through multiple pathways: spectral attraction causes population-level mortality with 47% caterpillar abundance reduction near artificial lighting; circadian disruption impairs reproductive success and foraging efficiency critical for plant-pollinator mutualisms; and altered community dynamics threaten specialized plant-moth relationships essential for biodiversity maintenance. Urban moth populations demonstrate rapid evolutionary responses, showing 30% reduced phototaxis compared to rural populations, yet these adaptations compromise dispersal capabilities essential for genetic connectivity and ecosystem resilience. Advanced monitoring technologies reveal that ALAN impacts extend beyond direct attraction to disrupt essential behaviours supporting pollination services and predator-prey dynamics. Given moths' critical roles as both pollinators and prey species supporting biodiversity networks, addressing ALAN through evidence-based lighting policies represents an essential pathway for achieving biological conservation objectives within sustainable development paradigms. The present research addresses the urgent conservation priority of protecting these ecosystem service providers to ensure sustainable terrestrial ecosystem functioning.

WHEN INSECTS MEET ALGORITHMS: INTERPRETING THE DEVELOPMENTAL LOGIC OF *DERMESTES MACULATUS*

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Dermestes maculatus (DeGeer, 1774), the hide beetle, is an important forensic indicator species that colonizes decomposing remains during advanced stages and commonly infests stored animal products. Accurate age estimation of immature stages is critical for reliable postmortem interval (PMI) determination in forensic casework. This study investigated the life cycle of *D. maculatus* under natural indoor conditions, with ambient temperatures fluctuating between 20.6–32.5°C and relative humidity between 43.3–72.0%. Mean total development time from egg to adult was 39.02 ± 3.37 days. Larval body length and width were continuously monitored to characterize growth patterns and establish developmental benchmarks. Results demonstrated that temperature and humidity variations significantly influenced developmental rate and larval growth dynamics. To enhance age estimation accuracy, we employed an Extreme Gradient Boosting (XGBoost) algorithm that incorporated morphometric measurements and environmental parameters. The model achieved exceptional performance with $R^2 = 0.99$, demonstrating high precision in developmental stage prediction. This research provides baseline data on *D. maculatus* development under fluctuating natural conditions. The integration of traditional entomological methods with machine learning approaches offers a robust framework for improving PMI estimation accuracy in forensic investigations.

SCENTED INNOVATIONS BY ADVANCED TECHNOLOGIES IN *SANTALUM ALBUM* LINN.F PLANTATION- A REVIEW

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Sandalwood (*Santalum album* L.), popularly known as the “green gold of India,” is one of the most valued tree species owing to its fragrant heartwood and essential oil with diverse cultural, medicinal, and economic applications. However, its cultivation has been constrained by slow growth, poor germination, host dependency, susceptibility to spike disease, illegal felling, and regulatory challenges. Recent advances in biotechnology, diagnostic tools, and digital monitoring systems have introduced innovative solutions to address these constraints. This review synthesizes developments in tissue culture and clonal propagation for quality planting material, electric resistance tomography for non-destructive heartwood assessment, gas elicitor treatments for accelerated heartwood formation, molecular diagnostics for early detection of Sandalwood Spike Disease, and biopriming for enhanced germination and seedling vigor. Additionally, IoT-enabled protection technologies such as Bluetooth sensors and microchip-based systems have emerged as effective measures against theft. The merits of these innovations lie in their ability to improve productivity, sustainability, and profitability, while challenges include high costs, technical complexity, and limited accessibility for small-scale farmers. By integrating traditional silvicultural knowledge with modern scientific advancements, these technologies offer a roadmap for sustainable sandalwood production, conservation of genetic resources, and enhanced economic returns. The study underscores the transformative role of innovation in revitalizing sandalwood cultivation and ensuring its long-term ecological and commercial viability.

Keywords: *Santalum album*, biotechnology, heartwood induction, disease management, biopriming, electric resistance tomography, IoT protection.

EVALUATION OF HEALTH BENEFITS FROM DIFFERENT VALUE-ADDED PRODUCTS OF HONEY PREPARED AT BEE RESEARCH CENTRE, TARGOD, SIRSI TALUK OF UTTARA KANNADA

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Honey, revered for its nutritional and therapeutic properties since ancient times, continues to offer vast potential through value addition. Honey exhibits efficacy in addressing liver, cardiovascular, and gastrointestinal issues. Approximately 80% of honey production is directly consumed, with 10% utilized in traditional medicine or ayurvedic preparations, and a mere 10% used in food products. The study was conducted at the Bee Research Centre in Targod, Sirsi, Uttara Kannada District, Karnataka, systematically evaluated the health benefits of various value-added honey products including Amla Ashwagandha Honey Mix, Honey Jam, Lemon Ginger Honey, and Bee Pollen Soap. The research involved surveys, interviews, and health assessments among local beekeepers, researchers, and community members engaged in apiculture. Nutritional analysis revealed rich contents of Vitamin C, minerals, and enzymatic activity in the products. Participants reported significant improvements in health attributes such as enhanced memory, reduced skin issues, controlled obesity, and relief from common colds and allergies. The findings highlight the medicinal potential and market viability of these honey-based formulations, supporting their role as natural health supplements. The study confirms the potential of honey-based formulations as natural health supplements with neurotherapeutic, anti-inflammatory, and dermatological benefits. Integrating traditional Ayurvedic ingredients such as *Amla* and *Ashwagandha* with honey augments its medicinal value. These findings advocate for promoting **value-added honey products** as functional foods in both rural and urban wellness markets.

Keywords: Value-added products, Amla Ashwagandha, Bee pollen soap, Medicinal properties

EFFECT OF MOISTURE CONTENT ON THE SEEDS DURING DEVELOPMENT, DESICCATION AND GERMINATION OF *CALOPHYLLUM APETALUM* WILLD., AN ECONOMICALLY IMPORTANT ENDEMIC TREE SPECIES OF WESTERN GHATS

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Conservation and regeneration of threatened tree species are decisive, and it is important to study their ecology, fruit and seed development, mode of seed dispersal, seed production, to sustain their genetic diversity. The multipurpose evergreen tree *Calophyllum apetalum* Willd, often referred to as “Poon spar of Travancore”, is endemic to Western Ghats, India. *C. apetalum* belongs to the vulnerable category on the IUCN Red List of Threatened Species. Studies on the physiology of *C. apetalum* fruits and seeds provide an overview of their growth, desiccation and germination. The seeds are recalcitrant. Analyzing the moisture content is a vital component in determining the category of seeds. According to the studies, the moisture content of *C. apetalum* seeds began to be high during their development. The content significantly declines after 45 DAA. The process of desiccation includes drawing the water out of the seeds. The moisture level of the seeds had been initially high after desiccation, yet it drastically dropped and the seeds lost their ability to thrive after 48 hours. The moisture content throughout germination had been greater than the moisture content during desiccating hours. This study aims to assist with species conservation by pinpointing the critical moisture content (CMC), which would enable us to speculate on how long seeds will remain viable. Seed is the only propagation tool for this species.

Keywords: Moisture content, desiccation, germination, Poon spar, development

IMPACT OF AGRI-NUTRI GARDEN ON FOOD, NUTRITION AND LIVELIHOOD SECURITY OF FARM FAMILIES

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A nutrition garden is viewed as an area surrounding the home where various vegetables and fruits can be cultivated. This practice fosters family self-sufficiency and ensures a safe and nutritious food supply that is readily available for use. Objective of the present study was to assess the impact of Agri-nutri garden on food, nutrition and livelihood security of farm families. The current study was conducted for 2 years in Harthale and Jeemaralli village, Nanjangud taluk, Mysuru. The farm families of 30 were randomly selected and made into three groups based on their family size; Large (6-8), Medium (4-6) and Small (2-4) where the total families were 5, 10 and 15 respectively. The total number of respondents was 180. The BMI classification resulted that most of the respondents (74.00 %) were within the normal BMI range, few of them were suffering from malnutrition and morbidity conditions. The farm families were selected on the availability of the area, water and willingness of farm women to maintain the garden in all the seasons. Along with the vegetable seed kits perennials, fruit crops and medicinal plants were also provided. On campus training programme was conducted on establishment of agri-nutri garden and importance of balanced diet and micro-nutrients for all age groups. The nutritional composition of Recommended Dietary Allowance (RDA) was computed using Nutritive Value of Indian Foods and compared the same with the standard nutrient intake. The per cent adequacy for nutrients revealed that there was an increase in per cent of quantity of nutrients intake like proteins (8.17%), fibre (9.69 %), vitamin C (24.98 %), Iron (22.13 %) and Calcium (2.36 %) after introduction of agri-nutrition garden, the consumption of vegetables increased in the daily diet which contributed towards the upliftment of the food, nutrition and livelihood security of the farm families.

Keywords: Agri-nutrigarden, Farm families, Malnutrition, Nutritional status, Livelihood security

ASSESSMENT OF RESOURCE USE EFFICIENCY AND EMPLOYMENT GENERATION POTENTIAL IN RICE-BASED CROPPING SEQUENCES UNDER IRRIGATED INCEPTISOLS (MATASI)

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Crop diversification is thought to boost gain, cut back pests, detached labour uniformly, cut back risks from aberrant weather by totally different planting and gather time and supply of high price product from new crops (Reddy and Suresh, 2009). Hence, choice of element crops must be properly planned to reap the synergism among them towards economical utilization of resource base and to extend overall productivity (Anderson, 2005). Crop sequencing may also intensify synergistic interactions among crops (Tanaka et al., 2005). The importance of extremely intensive crop sequence is well recognized to fulfill the growing demand of ever-increasing population. An intensive cropping that isn't solely extremely productive and profitable however conjointly stable over the of your of time and conjointly maintains soil fertility is of utmost importance in today's conditions. An intensification of cropping sequences is crucial reckoning on the requirement of the world. Oilseeds and pulses as well as vegetables receiving additional attention attributable to higher costs to augmented demand. Inclusion of those crops in a very sequence changes the economics of the cropping sequences (Tomar and Tiwari, 1990). In this view the field experiment was conducted on "Diversification of rice-based cropping system for enhancing productivity, resource use efficiency and economics under irrigated condition" at Research cum Instructional farm, Pt. SKS College of Agriculture and Research Station, IGKV, Surgi Rajnandgaon during the *kharif*, *rabi* and *zaid* seasons of 2018-2019 and 2019-2020. The texture of experimental soil was sandy loam (*Inceptisol*), locally known as "*Matasi*" and neutral in pH and having low organic carbon and low available nitrogen, phosphorus and medium in available potassium. The experiment was laid out in randomized block design with three replications. Treatment comprised ten different rice based cropping system viz., T₁- rice - rice - fallow, T₂ - rice - chickpea - fallow, T₃ - rice - wheat - greengram, T₄ - rice - sweet corn + cowpea (1:1) - clusterbean, T₅ - rice - chickpea (veg.) - sesame, T₆ - rice - garlic - cowpea, T₇ - rice - coriander (leaf) - sweet potato, T₈ - rice - pea - okra, T₉ - rice - onion + coriander (leaf) (3:1) - greengram and T₁₀ - rice - potato - blackgram. The system profitability and relative economic efficiency were significantly highest under rice - sweet corn + cowpea (1:1) - clusterbean (T₄) cropping system. The system productivity and relative production efficiency registered significantly maximum under rice - potato - blackgram (T₁₀) cropping system. Whereas, the production efficiency, employment generation efficiency and nutrient use productivity were highest under rice - coriander (leaf) - sweet potato (T₇) cropping system on the basis of two years data. Economics and energy parameters of different rice-based cropping systems i.e. net return, system energy output, energy input : output ratio, system energy use efficiency and system energy intensity recorded maximum under rice - sweet corn + cowpea (1:1) - clusterbean (T₄) cropping system. Whereas, the highest gross returns and energy input were registered under rice - potato - blackgram (T₁₀) on the basis of mean of two years data. The physio-chemical properties of soil were not affected significantly due to different rice-based cropping systems for *inceptisols* under irrigated condition.

SUGARCANE IN CRISIS: AN URGENT CALL FOR POLICY REFORM IN ANDHRA PRADESH

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Sugarcane cultivation in Andhra Pradesh has declined sharply over the past decade, with the area decreasing from 1.25 lakh hectares in 2014–15 to 0.40 lakh hectares in 2023–24, and production falling from 15.38 million tonnes to 2.10 million tonnes. The number of operational sugar factories has reduced from 34 to 5 during the same period. This study examines the downward trends in area, production, yield, and factory operations, and highlights the resulting 82% production deficit in meeting the state's annual sugar requirement of 11.55 million tonnes of cane. The state also faces a significant shortfall in sugarcane availability for achieving 20% ethanol blending targets, requiring 8.58 million tonnes annually. Key factors contributing to the crisis include high input costs, labor scarcity, mill closures, poor adoption of improved varieties, and lack of policy support. The study proposes targeted interventions such as revival of closed mills, expansion of area under high-yielding varieties, timely farmer payments, and ethanol-linked industrial incentives to restore sugarcane cultivation and strengthen the agro-industrial ecosystem in Andhra Pradesh.

Keywords: Andhra Pradesh agriculture, Agro-industrial revival, Policy intervention and Ethanol blending

STREAM LIT-POWERED FRAMEWORK FOR REAL-TIME NETWORK TRAFFIC MONITORING WITH PYTHON IN AGRICULTURE

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Considering the escalating prevalence of cyber threats, data breaches and unauthorized access incidents, the implementation of real-time network monitoring has become imperative for the enhancement of cyber-security protocols in different sectors. The objective of this research was to strengthen cyber-security by delivering real-time traffic visualization with packet classification (TCP, UDP, ICMP) units and automated anomaly detection capacity. The integration of digital technologies in agriculture has increased the reliance on real-time data exchange for market intelligence, precision farming and value chain management. Thus the study developed a real-time network traffic monitoring dashboard utilizing Python and Stream-lit, which effectively captures, analyzes and visualizes network traffic to facilitate improved threat detection. The methodology involved Network monitoring, analysis process, real time visualization, anomaly detection and logging which involved online real time monitoring and offline storage repository for archival and analysis where significant research deficiency is identified in the realms of scalability and adaptive anomaly detection. With the growing adoption of Internet of Things (IoT) devices, drones and cloud-based platforms, network traffic monitoring has become critical to ensure reliability, security and efficiency in agricultural operations. Leveraging open-source Python libraries, the framework provides a user-friendly dashboard with low computational overhead, making it accessible to rural and resource-constrained settings. Results demonstrate the feasibility of real-time monitoring for enhancing data security, minimizing downtime and improving the resilience of digital agriculture systems. Moreover, the consoles architecture will be optimized to handle even the largest networks and highest traffic volumes ensuring it remains effective and efficient, even in the most demanding environments such as monitoring of agricultural value chains efficiency.

Keywords: Agricultural production, Anomaly Detection, Intrusion Detection, Packet Capture, Python, Real-Time Network Monitoring, Stream lit

DIVERSITY ANALYSIS AND ANTAGONISTIC CHARACTERIZATION OF SOIL ACTINOMYCETES FROM HORTICULTURE CROP RHIZOSPHERE

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Actinomycetes are the potential producers of secondary metabolites. They are being continuously used in antibiotic industries to derive semi synthetics in controlling animal and plant diseases. In this regard, an investigation was carried out to isolate the agriculturally important actinomycetes from major Banana, Ginger and Arecanut rhizosphere samples and to know their potential antagonistic activity against pest and disease throughout Karnataka. About 100 actinomycetes strains were isolated. Isolated were subjected to biochemical and molecular characterization. Further the isolates were characterized for their culture purity on different media like Potato dextrose agar, Corn meal agar, Kenknight Munaire media and Actinomycetes Isolation agar. Later, isolates were checked for their antagonistic activity by dual culture assay. Among them about 54 were found to be having antagonistic activity against fungal plant pathogens. ie., against *Curvularia*, *Fusarium* and *Sclerotium* sp. The potential isolates were subjected to genomic DNA isolation followed by PCR amplification of 16S rRNA. The amplicons of expected size 1.46 Kb were sent for sequencing for the identification of actinomycetes isolates. 16S rRNA amplification confirmed that majority of the strains closely belong to genera *Streptomyces* with an average of 95% homology.

Keywords: Actinomycetes, Secondary metabolites, Diversity, 16S rRNA, Biocontrol

3D FOOD PRINTING: PRINTING THE FUTURE OF FOODS

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3D food printing refers to the process in which edible materials are solidified under computer control to create three-dimensional food structures derived from additive manufacturing technology. The concept was initially focused on pasta extrusion and has since evolved toward the bio-printing of food and the fabrication of nutritionally customized meals. The 3D food printing technique offers unique advantages in terms of texture control, ingredient precision, and compatibility, along with significant benefits such as mass customization, food fabrication flexibility, printing accuracy, and personalized nutrition. Future research aims to design intelligent systems that integrate individual dietary and health data with algorithmic representations of traditional recipes, enabling the automated preparation of meals tailored to personal needs. Statistical data suggest that industrial and business-grade 3D machines account for approximately 19.9% of the 3D food printing sector, indicating a growing role in commercial-scale food production. Within this sector, food printing has emerged as a key driver of innovation and development. In this emerging domain, algorithmic modeling plays a crucial role. Algorithms must map the input parameters of a dish—such as crispiness, tenderness, and flakiness to the process parameters of the printing recipe. Achieving such precision will not only enhance food texture and structure but also enable the replication of complex 3D designs for both artistic and functional presentations. This perspective underscores the importance of physics and material science in shaping the future of 3D food printing. By adopting a physics-driven approach, it will be possible to optimize texture formation, heat transfer, and material behaviour, unlocking the full potential of this disruptive technology. Ultimately, 3D food printing is poised to revolutionize how we produce, customize, and experience food, offering sustainable and health-oriented solutions for future generations.

Keywords: Bio-printing, 3D food Printing, Food texture, Personalized nutrition, sustainable

EFFECT OF SALICYLIC ACID ON MORPHOLOGICAL AND BIOCHEMICAL PARAMETERS OF *WITHANIA SOMNIFERA* L.

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Withania somnifera (Ashwagandha), a medicinal plant of the Solanaceae family, is widely recognized for its therapeutic properties. This study explores the impact of salicylic acid (SA), a plant hormone known for its role in stress tolerance and growth regulation, on the morphological and biochemical traits of *W. somnifera*. Seeds were treated with SA concentrations of 0.25 mM, 0.5 mM, and 1 mM, and monitored over nine weeks. Morphological parameters such as shoot and root length, leaf number, biomass, and leaf area were recorded. Biochemical estimations included chlorophyll, proline, and phenol content. Micromorphological features like stomatal and trichome indices were also analyzed. The 0.5 mM SA treatment yielded the most significant improvements in growth and metabolite production. Plants treated with this concentration showed increased leaf number, shoot and root length, biomass, and leaf area. Enhanced chlorophyll content indicated improved photosynthetic efficiency, while elevated phenol and proline levels suggested better stress resilience and metabolic activity. Microscopic analysis revealed higher stomatal and trichome indices, supporting the physiological benefits of SA application. These findings suggest that 0.5 mM SA is an optimal concentration for promoting growth and secondary metabolite synthesis in *W. somnifera*. This study highlights the potential of SA as a sustainable growth enhancer and elicitor of bioactive compounds in medicinal plants, with implications for agricultural and pharmaceutical applications.

Keywords: *Withania somnifera*, salicylic acid, plant growth, secondary metabolites, chlorophyll, proline, phenol

PHYTOCHEMICAL PROFILING AND BIOACTIVE POTENTIAL OF *CORDIA DICHOTOMA* G. FORST AQUEOUS LEAF EXTRACT

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Cordia dichotoma G. Forst, commonly known as Indian cherry, is a medicinally valuable member of the Boraginaceae family known for its diverse phytoconstituents and traditional therapeutic uses. This study examines the phytochemical composition, antioxidant efficacy, antibacterial potential, and cytotoxic activity of *C. dichotoma*'s aqueous leaf extract. Phytochemical screening confirmed the presence of saponins, glycosides, tannins, flavonoids, phenolic compounds, phytosterols, carbohydrates, and proteins, while alkaloids were absent. Quantitative analyses revealed a Total Phenolic Content (TPC) of 10.56 ± 0.25 mg GAE/g and a Total Flavonoid Content (TFC) of 0.0049 ± 0.0013 mg QE/g, indicating the dominance of phenolic compounds. Antioxidant assays demonstrated moderate radical scavenging activity with IC_{50} values of 946.3 μ g/mL for DPPH and 64.37 μ g/mL for ABTS, highlighting the extract's potential in mitigating oxidative stress. Antibacterial evaluation through the agar well diffusion method revealed notable inhibition zones against *Streptococcus pneumoniae* (24 mm), *Klebsiella pneumoniae* (18 mm), and *Micrococcus luteus* (19.6 mm) at 60 mg/mL, suggesting significant antibacterial efficacy. Fourier-transform infrared spectroscopy (FTIR) confirmed the presence of aliphatic, alcoholic, ether, and phosphate functional groups with characteristic peaks at 2973.34, 1380.15, 1087.46, and 1045.69 cm^{-1} , respectively. LC-MS analysis further identified key bioactive compounds, including curcumin and vinpocetine. Cytotoxic assessment using the MTT assay on THP-1 cell lines revealed an IC_{50} value of 317.3 μ g/mL, indicating mild cytotoxicity and potential therapeutic safety. These findings demonstrate that *C. dichotoma* possesses diverse bioactive phytochemicals, which contribute to its antioxidant, antibacterial, and cytoprotective properties. The study highlights its potential as a natural source for developing bioactive formulations in pharmaceutical and healthcare applications.

Keywords: Phytochemicals, antioxidant activity, antibacterial potential, cytotoxicity, FTIR

IN-SILICO IDENTIFICATION AND FUNCTIONAL EVALUATION OF ANTIMICROBIAL PEPTIDES FROM *PIPER NIGRUM* (BLACK PEPPER) AS POTENTIAL BIOCONTROL AGENTS AGAINST PHYTOPATHOGENS

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Antimicrobial peptides (AMPs) are emerging as sustainable alternatives to chemical fungicides in agriculture. This study aimed to identify and experimentally validate AMPs from *Piper nigrum* through a combination of computational screening and laboratory-based evaluation, and to assess their efficacy against *Phytophthora capsici*. The central hypothesis proposed that plant-derived AMPs predicted using machine-learning models could exhibit potent antimicrobial and antifungal activity, further enhanced through conjugation with metal oxide nanoparticles. A deep learning-based AMP predictor developed in collaboration with IIT Jammu was employed to predict novel peptide candidates from the PiperPep database. The top-ranked peptide was synthesized using solid-phase peptide synthesis and characterized by LC–MS and FT–IR spectroscopy, confirming its α -helical conformation. The peptide showed significant antibacterial activity, with inhibition zones of 1.8 cm against *E. coli* and 1.6 cm against *S. aureus*. Molecular docking and molecular dynamics simulations with the *P. capsici* RxLR effector protein revealed a stable complex mediated by hydrogen bonding, with a binding free energy of -128.39 kJ/mol. To enhance efficacy, Ag and Cu doped ZnO nanoparticles were synthesized and conjugated with the AMP, resulting in markedly improved antifungal activity in *P. nigrum* leaves. Infection assays and Trypan blue staining confirmed reduced lesion size and hyphal invasion compared to controls. Overall, the study establishes an integrated computational–experimental framework for developing *P. nigrum*-derived AMPs as effective, nanoparticle-enhanced biocontrol agents for sustainable crop protection.

Keywords: Antimicrobial peptides, *Piper nigrum*, molecular docking, *Phytophthora capsici*, deep learning, ZnO nanoparticles

UTILIZATION OF *MORUS ALBA* (SILK MULBERRY) IN WOOD–POLYMER COMPOSITES PROCESSED BY BLENDING AND INJECTION MOLDING: INVESTIGATION OF PHYSICAL, MECHANICAL PROPERTIES, TERMITE RESISTANCE WITH MORPHOLOGICAL FEATURES.

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Growing concerns about global warming, largely driven by deforestation, have intensified the search for sustainable alternatives to conventional wood-based materials that promote efficient use of natural resources. Among these alternatives, natural fibers such as jute, flax, and sisal have gained significant attention for their favorable mechanical, physical, and morphological properties. In this study, agricultural biomass, specifically silk mulberry wood particles, was explored as a reinforcing material in polymer composites for sustainable material development. Composites were fabricated through blending and injection molding processes, incorporating varying proportions of polypropylene (PP) and high-density polyethylene (HDPE) matrices with silk mulberry particles. The effects of particle loading on mechanical, physical, termite resistance, and morphological characteristics were systematically evaluated. Results revealed that the inclusion of silk mulberry particles in the PP matrix enhanced key mechanical and physical properties, including tensile strength, flexural strength, and density, up to an optimal reinforcement level. These findings highlight the potential of utilizing agricultural waste as a renewable and eco-friendly resource for polymer composite fabrication, contributing to sustainable materials engineering and waste valorization.

Keywords: *Morus alba* (Siriculture mulberry) particles, PP HDPE, WPC pellets morphology feature Termite resistant.

FRAMEWORK-BASED EVALUATION OF ENVIRONMENTAL PERFORMANCE INDICATORS IN THE TEXTILE SECTOR OF BANGALORE FOR SUSTAINABLE RESOURCE MANAGEMENT

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The present study aims to evaluate and enhance the environmental performance of textile industries in the Bangalore region, encompassing wet-processing units (washing, dyeing, and printing) and cut-and-sew operations, with a particular emphasis on sustainable resource management and pollution mitigation. The textile sector is recognized as one of the most resource-intensive industries, exerting considerable environmental pressure through excessive consumption of water, energy, and chemicals during various wet-processing stages, leading to elevated water and carbon footprints. To address these challenges, a framework-based environmental performance assessment was developed to identify, measure, and analyze key Environmental Performance Indicators (EPIs) of textile industries. The framework incorporates six core indicators energy consumption, water usage, wastewater discharge and characteristics, air emissions, chemical management (RSL and MRSL compliance), and solid waste generation aligned with global sustainability standards such as the Higg Facility Environmental Module (Higg FEM) and Zero Discharge of Hazardous Chemicals (ZDHC) guidelines. Systematic data collection was conducted through field inspections, structured surveys, process observations, and secondary data analysis across multiple textile processing facilities. The assessment revealed significant opportunities for improvement through the adoption of advanced technologies, including Effluent Treatment Plants (ETPs), Sewage Treatment Plants (STPs) integrated with Industrial Reverse Osmosis (RO) and Zero Liquid Discharge (ZLD) systems, as well as energy-efficient and air pollution control equipment. The findings demonstrate that such interventions can substantially reduce greenhouse gas emissions, water pollution, and overall resource consumption. The study underscores that adopting sustainable manufacturing practices is both an ecological imperative and a strategic opportunity, supporting the transition toward a low-carbon, water-resilient and globally responsible textile industry in India.

Keywords: Environmental Performance Indicators, Zero Discharge of Hazardous Chemicals, Zero Liquid Discharge

EXPLORING THE ROLE AND IMPORTANCE OF ROOT EXUDATES IN SUSTAINABLE AGRICULTURE

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Root exudates, the diverse array of organic and inorganic compounds secreted by plant roots, represent a pivotal yet often overlooked component of the soil-plant interface. These exudates act as biochemical mediators in the rhizosphere, influencing soil structure, nutrient dynamics, microbial activity, and overall ecosystem resilience. The present review synthesizes recent findings on the multifaceted roles of root exudates in promoting sustainable agriculture. Studies reveal that exuded organic acids and enzymes enhance phosphorus and iron solubilization, while biological nitrification inhibitors (BNIs) such as sorgoleone and sakuranetin regulate nitrogen cycling, reducing fertilizer losses and greenhouse gas emissions. Root exudates also foster symbiotic associations with rhizobia and mycorrhizal fungi, improving nutrient uptake and plant health. In soil aggregation, polysaccharides like mucilage and xyloglucan act as natural binding agents, enhancing soil stability and water retention. Furthermore, allelochemicals such as benzoxazinoids and phenolics exhibit pest suppression and weed control potential, offering eco-friendly alternatives to synthetic agrochemicals. Under abiotic stresses, root exudates modulate microbial interactions, chelate toxic ions, and stimulate antioxidant mechanisms, improving plant tolerance to drought, salinity, and temperature extremes. Collectively, these findings demonstrate that harnessing root exudation mechanisms can improve nutrient use efficiency, enhance soil fertility, and reduce environmental footprints, offering a biological pathway toward resilient and sustainable agricultural systems.

Keywords: Root exudates, Rhizosphere ecology, Nutrient cycling, Biological nitrification inhibitors, Soil aggregation, Abiotic stress tolerance, Sustainable agriculture

SYNERGISTIC EFFECTS OF *TRICHODERMA* AND *PSEUDOMONAS* CONSORTIUM ON GROWTH PROMOTION OF *ABELMOSCHUS ESCULENTUS* (OKRA)

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Biocontrol agents (BCAs) play a pivotal role in organic and sustainable agriculture by promoting plant growth and managing soil-borne diseases in an eco-friendly manner. The present study aimed to evaluate the effects of *Trichoderma* sp., *Pseudomonas* sp. and their consortium on the growth performance of *Abelmoschus esculentus* (okra) under both in vitro and pot conditions. Microbial strains were mass-cultured on suitable broth media, and a 1:1 consortium was prepared under sterile conditions. All treatments exhibited germination by the seventh day; however, *Trichoderma* (T1), *Pseudomonas* (T2) and the consortium (T3) achieved 100% germination. The consortium (T3) showed the highest seedling vigor index (2628) and superior root (8.116 cm) and shoot (18.178 cm) lengths, indicating a synergistic interaction between the two microorganisms. In pot experiments, *Trichoderma* (T1) promoted maximum shoot (30.68 cm) and root growth by the 35th day, while *Pseudomonas* (T2) enhanced leaf development. Overall, the microbial consortium was most effective during early plant development, whereas *Trichoderma* supported long-term vegetative growth. These results highlight the potential of combining BCAs to enhance crop growth, vigor, and yield sustainably.

Keywords: Biocontrol agents, *Trichoderma* sp., *Pseudomonas* sp., *Abelmoschus esculentus*, consortium.

TAXONOMIC REEVALUATION OF *POEKILO CERUS PICTUS* (FABRICIUS, 1775) THROUGH MORPHOLOGICAL AND MITOCHONDRIAL GENE ANALYSES

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Poekilocerus pictus (Fabricius, 1775), commonly known as the painted or gaudy grasshopper, is an aposematic representative of the family Pyrgomorphidae and one of the most vividly colored Orthopterans of the Indian subcontinent. Despite its long-standing recognition in Indian entomological literature, the species' taxonomy has largely relied on classical morphological and phallic-organ characters, while molecular data remain extremely limited. The present study aims to reassess and refine the taxonomic status of *P. pictus* by integrating traditional morphological evidence with new mitochondrial DNA sequence data. We hypothesized that geographically separated populations of *P. pictus* may exhibit detectable genetic divergence due to regional isolation and habitat-specific adaptation. Adult specimens were collected from Calotropis-dominated habitats in Karnataka, India, and examined morphologically following established taxonomic keys. The mitochondrial cytochrome oxidase subunit I (COI) and 16S rRNA genes were sequenced and compared with all available *Poekilocerus* accessions in the NCBI database, including *P. pictus* (MT011520) and *P. bufonius* (MK514102). Phylogenetic relationships were reconstructed using Maximum Likelihood and Neighbor-Joining algorithms implemented in MEGA X. The resulting trees revealed that Karnataka populations form a distinct subclade within the broader *P. pictus* lineage, separated from other regional representatives by moderate mitochondrial divergence (1.5–2.8%). Morphological and genitalic traits remain congruent with classical descriptions, confirming its species-level integrity. However, the observed molecular differentiation suggests possible incipient population-level structuring. This integrative analysis demonstrates the value of combining morphology with mitochondrial phylogenetics in resolving complex orthopteran lineages. The study contributes new genetic data for *P. pictus*, provides baseline information for future phylogeographic work, and underscores the need for expanded molecular sampling across India to better understand population connectivity, speciation, and evolutionary history within Pyrgomorphidae.

Keywords: *Poekilocerus pictus*; Pyrgomorphidae; Taxonomy; Cytochrome oxidase 1; 16S rRNA; Morphology; Phylogeny; India

INTEGRATED EFFECT OF INDIGENOUS PGPR CONSORTIUM ON GROWTH AND YIELD OF WHEAT IN THE SAURASHTRA REGION

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The present study investigates the synergistic effect of an indigenous plant growth-promoting rhizobacteria (PGPR) consortium on the growth and yield of wheat (*Triticum aestivum* L.) cultivated in the semi-arid Saurashtra region of Gujarat, India (21.867°N, 70.8120°E). A microbial consortium was developed from native rhizosphere isolates and co-inoculated with exotic *Azotobacter chroococcum* to evaluate its impact on wheat performance. Seven bioactive bacterial strains were isolated from three districts of the region, among which *Pseudomonas putida*, *Pseudomonas aeruginosa*, *Acinetobacter* sp., and *Erwinia* sp. exhibited promising synergistic activity. Experimental results demonstrated that the PGPR consortium, both with and without *Azotobacter* supplementation, significantly enhanced growth attributes compared to the uninoculated control. At 60 days after sowing (DAS), notable improvements were observed in the number of tillers (32.5%, 9.5%), shoot height (8.4%, 5.2%), dry shoot weight (38.6%, 4.11%), and flowering cone number (34%, 16%). Furthermore, the consortium positively influenced yield components, including 1000-seed weight (31.44%, 25.6%), spikelets spike⁻¹ (29.26%, 14.6%), spikes plant⁻¹ (14.79%, 13%), and overall grain yield (24.4%, 11.28%). These findings highlight the potential of native PGPR consortia, in synergy with *Azotobacter*, as a sustainable bioinoculant strategy to improve wheat productivity in semi-arid agroecosystems.

Keywords: PGPR, Consortium, Wheat, *Azotobacter*

ANALYZING PRICE SIGNALS ACROSS SMALL ONION MARKETS IN TAMIL NADU AND KERALA

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This research analyzed the price behaviour and spatial market integration of small onion markets in Tamil Nadu and Kerala. The main objective was to develop policy recommendations that could reduce price instability and ensure fair benefits for all stakeholders in the supply chain. India ranks as the world top onion producer, with Maharashtra alone accounting for about 42.5 percent of the country production. In Tamil Nadu, small onions constitute nearly 75 percent of total onion cultivation. However, despite the expansion in production, price fluctuations continue to pose serious challenges, impacting farmer's income, consumer welfare and even political stability. The study utilized secondary data from NHRDF office, NHB website, and AGMARKNET website and Regulated markets, covering monthly market arrivals and prices in Dindigul, Chennai, Coimbatore markets in Tamil Nadu and Idukki, Palakkad market in Kerala from 2014 to 2023. The findings revealed a general upward trend in prices across all markets, with the steepest rise recorded in Idukki and Palakkad markets. While market arrivals declined in Tamil Nadu, but increased in Idukki and Palakkad markets. Seasonal analysis indicated that prices were lowest during the peak arrival months (March-April) in Tamil Nadu. High price volatility was evident across all markets, with Coimbatore experiencing the greatest fluctuations. Granger causality results indicated that Dindigul, Coimbatore, and Chennai markets in Tamil Nadu had a significant influence on Idukki and Palakkad markets. Moreover, Idukki market achieved short-run equilibrium through dynamic adjustment, with approximately 48 percent of the disequilibrium (equivalent to 14 days) corrected within a month. The study suggested a range of policy interventions to stabilize prices such as promoting crop diversification in major producing regions like Trichy and Perambalur to reduce market gluts during peak periods, introducing weather-based crop insurance schemes and strengthening regulatory mechanisms to curb speculative trading. It also recommended using MGNREGA labours for onion cultivation and harvesting to address labour shortages. Collectively, these measures are expected to enhance the efficiency, stability and equity of the small onion market in Tamil Nadu and Kerala, ensuring sustainable benefits.

Keywords: Price Instability, Seasonal Index, Cointegration, Granger Causality Test.

EFFECT OF EMS (ETHYL METHANESULFONATE) ON PHENOTYPIC VARIATIONS OF CHINA-ASTER (*CALLISTEPHUS CHINENSIS* (L.) NEES) VAR. ARKA KAMINI

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Ethyl methanesulfonate is a widely used mutagen to induce variability and identify desirable traits in ornamentals. Therefore, a study was carried out through dipping of China aster (*Callistephus chinensis* L.) var. Arka Kamini seedlings into EMS at 0%, 0.15%, 0.30%, and 0.45% concentrations for 1, 2, and 3 hours to induce the variability. Significant differences were observed in survival, vegetative growth, floral traits, yield, and biochemical properties during entire investigations. However, survival was highest in controls and declined with increasing EMS dose and duration. Moderate EMS doses significantly improved China aster traits, with plant height (42.82 cm) at 0.15% for 1 h, plant spread (N–S 18.88cm, E–W 21.63cm) at 0.15% for 2 h, flower number (9.98) at 0.15% for 3 h, flowering duration (37 days) and yield (16.56 g/plant) at 0.30% for 1 h, vase life (11.33 days) at 0.15% for 2 h, chlorophyll (8.479 mg/g) and anthocyanin (2.696 mg/g) at 0.15% for 1 h, sugars (25.48%) at 0.45% for 2 h, and antioxidant activity (SOD 0.529 Units/mg) at 0.45% for 2 h, highlighting the effectiveness of moderate treatments in enhancing growth, flowering, and yield.

Keywords: China aster, EMS, survival percentage, vegetative traits, floral traits

EFFECT OF BIO-BASED FORMULATIONS ON THE ANTHOCYANIN CONTENT OF RED LEAFY LETTUCE. (*LACTUCA SATIVA* L.)

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The current study, titled “Effect of bio-based formulations on the anthocyanin content of red leafy lettuce (*Lactuca sativa* L.) was performed at the Agricultural Research Field of Lovely Professional University, Phagwara, Punjab, during the rabi season from October 2024 to January 2025. The experiment aimed to evaluate the impact of various bio-based formulations on anthocyanin accumulation in the red leafy lettuce variety ‘Lolla Rosa’. The study utilised a Randomised Block Design (RBD), featuring various treatments that included both individual and combined applications of bio-formulations. There were big differences in anthocyanin content between the treatments. Treatment 11 (Arka Vegetable Special + Seaweed Extract) had the highest concentration of anthocyanins. The findings show that incorporating bio-based formulations, specifically the combination of Arka Vegetable Special and Seaweed Extract, can significantly enhance the anthocyanin content and nutritional value of red lettuce in field conditions.

Keywords: Bio-formulations; Anthocyanin; Red leafy lettuce.

VERTICAL GARDENING WITH ORGANIC WASTE COMPOST: AN INNOVATIVE APPROACH FOR SUSTAINABLE URBAN AGRICULTURE

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Urbanization has reduced cultivable space while increasing organic waste generation. This study developed a vertical gardening model integrating organic waste composting for sustainable urban food production and waste recycling. The experiment was conducted at the Urban Horticulture Research Unit, University of Agricultural Sciences, Bangalore, using modular PVC pipe systems (1.5 m height) equipped with micro-drip irrigation. Three potting media were evaluated: M₁ (soil + coir pith 1:1), M₂ (soil + compost 1:1), and M₃ (soil + compost + coir pith 1:1:1) for the growth of *Spinacia oleracea* and *Coriandrum sativum*. Among the treatments, M₃ recorded the highest germination (93.6%), leaf area (152.4 cm² plant⁻¹), and fresh biomass yield (340 g m⁻²), exceeding the control (M₁) by 46.8%. Organic carbon content increased by 28.5%, while irrigation water use was reduced by 38% compared with conventional beds. Each vertical unit recycled about 18 kg of biodegradable household waste monthly into nutrient-rich compost. The system also reduced ambient temperature by 2.4 °C and improved micro-climate and air quality. These findings demonstrate that integrating waste composting with vertical gardening enhances productivity, conserves resources, and promotes circular urban agriculture aligned with Sustainable Development Goals (SDGs 2, 11, 12, 13).

Keywords: Vertical gardening, organic waste compost, sustainable urban agriculture, circular economy, resource efficiency

A COMPARATIVE STUDY ON THE BIOCHEMICAL RESPONSE UPON SEED NANOPRIMING WITH PHYTO-FABRICATED ZNO NPS

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Nanotechnology is an applied technology that manipulates the materials to nanosized particles. Due to the versatility of physicochemical characters, the NPs are widely utilized in large number of agricultural practices. In the present study, ZnO NPs have been biosynthesized by using *Syzygium samarangense* and *Santalum album* leaf extracts, which act as reducing as well as capping agent. The characterization of synthesized plants was done by UV-Vis spectrophotometer, Dynamic Light Scattering, zeta potential, energy dispersive spectroscopy, Scanning Electron Microscopy, X-ray diffraction studies, and Fourier Transform Infrared Spectroscopy. The synthesized ZnO NPs were used as a nanopriming agent to analyse biochemical responses in paddy seedlings. Deionized water and chitosan solution was used as a dispersion medium. Both the solutions and these medium with ZnSO₄ was used as negative and positive control. Total proline, total phenolics, total flavonoids, and total soluble sugar content were analyzed on 0th, 3rd, 5th, and 7th day of germination. Chlorophyll and carotenoid content present in the seedlings were determined on 14th day of germination. A great difference was observed between seeds treated with different concentrations of ZnO NPs. In this present work, ZnO NPs synthesized from *Syzygium samarangense* at a concentration of 25 ppm and 75 ppm have shown good biochemical responses as compared to the ZnO NPs synthesized from *Santalum album*.

Keywords: Nanoparticles, phytosynthesis, nanoparticle characterization, priming, biochemical response,

SURVEY OF MANGO PROCESSING INDUSTRIES IN GUJARAT

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Mangifera indica L., commonly known as “Mango” is an important tropical fruit- crop of India valued for its high nutritional, commercial, and socio-economic significance. The Gujarat state of western India has five different agro-climatic zones supporting the growth and cultivation of numerous mango varieties and thus is a one of leading fruit-producer state of the country. In the present study, a survey was carried out on the mango-based industries in 33 districts and one union territory of this state. The study's objectives were to identify the mango varieties used by processing industries for various mango based products, the variety-procurement location and the waste-management strategies followed by industries. Firstly, online commercial platforms like TradeIndia, Indiamart, ExportersIndia, and the Indian Yellow Pages were used to gather secondary data on 233 industries manufacturing mango-based products. After that, a systematic telephone survey was carried out to gather primary data. Out of 233 industries contacted, 48 industries (20.6%) from 14 different districts has responded. The findings showed that Rajapuri is the most favoured variety for pickles and other raw mango based goods, while for ripe mango-based products such as pulp, puree, and canned-slices etc, varieties such as Kesar, Hafuz (Alphonso) and Totapuri is mostly utilised. The fruit procurement by the industries is mostly through the localised Agricultural Produce Market Committee (APMC) markets while only some industries sourced fruits from southern Indian states. Regarding waste management practices, it varies amongst industries due to differences in their production scale and available resources. The survey indicated that mango peel waste is generally used as fertilizer, biogas production or cattle feed etc. or otherwise discarded. The leftover seeds are mostly used in nursery for propagation or the production of mouth freshner (Mukhwas). Thus, these results indicate that there is further great potential for systematic and efficient waste valorization to support environmental sustainability and the circular bioeconomy within Gujarat's mango-processing sector.

Keywords: Mango based-industries, Mango Varieties, Industrial Survey, Waste-management, Valorisation.

GEOSPATIAL MODELLING OF ABOVEGROUND BIOMASS AND CARBON STOCK USING FIELD MEASUREMENTS AND REMOTE SENSING IN THE BUNDELKHAND REGION OF INDIA

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Accurate estimation of forest biomass and carbon stock is essential for assessing ecosystem productivity and supporting carbon sequestration initiatives in semi-arid landscapes. The present study integrates field-based measurements with geospatial modelling to quantify and map aboveground biomass (AGB) and carbon stock across the Bundelkhand region of India. Stratified random sampling was carried out based on NDVI-derived vegetation strata, and 0.1 ha plots were established for tree inventory and biomass estimation using species-specific allometric equations. The AGB values were scaled to per-hectare units and correlated with AWiFS-derived spectral indices including NDVI, SAVI, and EVI. Among the regression models tested, the Random Forest model showed the highest predictive accuracy ($R^2 = 0.82$, RMSE = 18.6 Mg ha^{-1}) compared to linear regression ($R^2 = 0.65$). The spatially modelled AGB across Bundelkhand ranged from 12.4 to 186.7 Mg ha^{-1} , with a mean of 74.3 Mg ha^{-1} , corresponding to an estimated carbon stock of $37.1 \text{ Mg C ha}^{-1}$. Higher biomass values were concentrated in forested zones of Panna and Chitrakoot, while degraded scrublands exhibited low carbon density. The study demonstrates the potential of integrating field and satellite data to generate spatially explicit carbon maps, which are crucial for regional carbon budgeting, land degradation monitoring, and climate mitigation strategies.

Keywords: Aboveground Biomass, Carbon Stock, Remote Sensing, Random Forest, AWiFS, NDVI, Bundelkhand, Semi-Arid Region, Geospatial Modelling, Carbon Mapping

THE INTERPLAY OF HAPPINESS, SPIRITUAL WELL-BEING, AND LIFE SATISFACTION AMONG ELDERLY POPULATIONS: A COMPARATIVE STUDY OF COMMUNITY AND OLD-AGE HOMES

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The aging population is increasing globally, bringing attention to the psychological well-being of elderly individuals. This study examines the interrelationship between happiness, spiritual well-being, and life satisfaction among elderly populations, comparing those living in community settings with residents of old-age homes. Employing a comparative cross-sectional design, the study collected data from 450 elderly participants (225 from each residential context) using standardized tools: the Oxford Happiness Questionnaire, the Spiritual Well-Being Scale, and the Satisfaction with Life Scale. Descriptive statistics, Pearson correlation, and t-tests used to analyze the data. Findings revealed that elderly residents in old-age homes reported significantly higher levels of happiness and spiritual well-being than their community-dwelling counterparts, while life satisfaction scores showed no significant difference across residential settings. Correlation analyses highlighted a surprising negative relationship between spiritual well-being and life satisfaction, particularly among institutionalized elderly, suggesting that increased spiritual engagement may serve as a coping response to lower satisfaction with life. Among community dwellers, no significant correlations were found between the three variables. These results challenge conventional assumptions that community-based living is inherently more favourable for psychological well-being in old age. Instead, they underscore the importance of structured support, social engagement, and spiritual programming—commonly present in institutional settings—as key contributors to emotional and spiritual health. The study highlights the need for context-sensitive interventions and policy measures that support elderly individuals' psychological well-being in both community and institutional environments. It contributes to gerontological literature by providing nuanced insights into how living arrangements shape subjective well-being in later life.

Keywords: Elderly well-being, Happiness, Spiritual well-being, Life satisfaction

YIELD AND ECONOMIC ASSESSMENT OF DESI PADDY VARIETY SIDDASANNA IN SEED PRODUCTION

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A Front Line Demonstration (FLD) on seed production in the desi paddy variety Siddasanna was conducted during 2024–25 by ICAR JSS KVK, Suttur, at farmers' fields to assess its yield potential, agronomic performance, and economic feasibility compared with the local check (paddy variety Jyothi). The demonstration recorded an average yield of 48.6 q/ha, showing a 3% increase over the check yield of 47 q/ha. The gross and net returns of the Siddasanna variety were ₹1,70,100 and ₹1,13,875 per hectare, respectively, with a B:C ratio of 3.03, while the check variety Jyothi recorded ₹1,26,900 and ₹72,025 (B:C 2.3). The superior performance of Siddasanna was attributed to a higher number of tillers (16 per plant), longer panicle length (26 cm), greater plant height (149.5 cm), and higher straw yield (4.5 t/ha). Farmers appreciated the variety for its good cooking quality, higher grain and straw yield, and lower disease incidence. However, lodging in some fields was reported as a minor constraint.

Keywords: Frontline demonstration, Paddy, Desi variety, Siddasanna, Jyothi

ADVANCING ALGAL BIOETHANOL PRODUCTION: EMERGING STRATEGIES IN FERMENTATIVE MICROORGANISM ENGINEERING

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The search for sustainable energy alternatives has brought algal bioethanol into focus as a promising renewable fuel. Algae are particularly attractive feedstocks due to their rapid growth, year-round availability, cultivation on non-arable land, and significant CO₂ sequestration capacity. **Objective:** This review aims to examine the role of fermentative microorganisms in algal carbohydrate conversion and highlight recent advances that address the biological and technical challenges in bioethanol production. **Hypothesis:** It is proposed that genetic and metabolic engineering can overcome the limitations of conventional microorganisms in utilizing diverse algal sugars and tolerating harsh process conditions. **Methodology:** A critical review of current studies was carried out, evaluating the performance of yeasts, bacteria, and fungi in fermentation, and assessing innovations in metabolic engineering and synthetic biology. **Key findings:** Traditional fermentative organisms such as *Saccharomyces cerevisiae* are reliable for simple sugar fermentation but cannot efficiently metabolize pentoses or degrade complex polysaccharides. *Zymomonas mobilis* offers higher ethanol yields but is restricted to a narrow range of substrates, while fungi contribute valuable enzymatic hydrolysis yet often act slowly against complex algal cell walls. Emerging strategies, including engineered sugar transporters, expanded pentose utilization, improved inhibitor tolerance, and the incorporation of polysaccharide-degrading enzymes, have shown notable success. Synthetic biology further enables system-level optimization to enhance robustness and efficiency. **Conclusion:** The development of engineered microbial strains represents a critical pathway to overcoming current barriers, thereby unlocking the full potential of algal bioethanol as a scalable and sustainable biofuel. This review underscores the transformative impact of microbial engineering in shaping next-generation renewable energy solutions.

Keywords: Algal bioethanol, fermentative microorganisms, metabolic engineering, synthetic biology, microbial fermentation, renewable energy

ASSESSMENT OF NEW HORSEGRAM VARIETY CRHG-19 IN MYSURU DISTRICT

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A Front Line Demonstration (FLD) on Horse gram (var. CRHG 19) was conducted during 2023–24 and 2024–25 by ICAR JSS KVK, Suttur, at farmers' fields to assess the performance of the improved variety under local agro-climatic conditions. The demonstration aimed to evaluate yield potential, economic returns, and farmer perceptions compared with the local check variety. The results revealed that the mean seed yield of CRHG 19 was very low (0.75 q/ha) in 2023–24 due to low precipitation. In 2024–25, the yield was 3.04 q/ha, recording an average increase of 21.6–25% over the check. The gross and net returns from the demonstration were ₹21,280 and ₹14,490 per hectare, respectively, with a B:C ratio of 3.13, compared to ₹15,000 and ₹9,800 (B:C 2.9) for the check. The improved variety performed better in terms of the number of pods per plant, seed weight, and maturity duration, indicating its suitability for seed production. Farmer feedback highlighted that CRHG 19 produced bold seeds and higher yields, although drought stress reduced yield potential, and lack of uniform seed color was noted as a constraint.

Keywords: Frontline demonstration, Horsegram, Improved variety, CRHG-19, Yield

SUSTAINABLE ENHANCEMENT OF WADI SYSTEMS THROUGH LOW-GRAVITY TRICKLE IRRIGATION FOR IMPROVED NUTRITION AND FARMER LIVELIHOODS IN TRIBAL REGIONS

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Wadi-based integrated farming systems are vital for improving nutritional security and livelihoods of tribal farmers, yet their productivity is often constrained by water scarcity and uneven terrain. This study explores the application of a low-gravity (water tank) operated trickle irrigation system as a cost-effective and sustainable solution for efficient water management in Wadi development. Field implementation demonstrated enhanced water-use efficiency, improved crop yield and fruit quality, and diversification of nutritional crops. The system reduced irrigation losses by up to 35% and increased annual farmer income by 25–30% compared to conventional practices. These findings highlight that adopting low-gravity trickle irrigation can significantly strengthen the sustainability and resilience of Wadi systems, promoting nutritional security and socio-economic development in tribal regions. The tribal peoples of Rajnandgaon district mainly engage in agriculture. Around 60% of the population lives in villages, with tribals accounting for 65% of the total population. The majority of farmers lack adequate resources. As a result, individual farmers are unable to meet the resource requirements for commercial vegetable growing and selling. Most farmers have a wadi in their backyard, yet they used to do vegetable gardening for sustenance. Farmer FIRST Programme scientist, SKS. College of Agriculture and Research Station Rajnandgaon (C.G.) established a scientific vegetable cultivation model in their homesteads in participatory mode, taking into account the district's physical, social, and economic restrictions. Usually, wadis are tiny in size. It ranged from 0.15 to 0.5 acres. The majority (56%) of farmers have an average wadi holding of 0.30 acre. Only 25% of farm families have a wadi holding of 0.30 acres. The majority of farmers plant vegetables in wadi virtually all year and earn extremely good economic returns. Farmers with wadi were selected for scientific vegetable farming. A total number of 15 wadi were selected from four newly selected villages in Mohala-Manpur-Ambagarh Chowki district: Maldongri, Khursipar, Bharritola, and Chikhali in the year of 2024-25. The Farmer FIRST Programme educated wadi farmers on scientific vegetable gardening through trainings and intervention, as well as providing enhanced and hybrid vegetable seeds. Farmer FIRST Programme scientist supervised the operations from time to time. Technology enabled farmers to begin scientific vegetable farming.

Keywords: Wadi cultivation, Nutritional security, Income

EVALUATION OF RED RICE VARIETIES FOR YIELD AND ECONOMICS UNDER DUAL SEASON CULTIVATION IN SOUTHERN KARNATAKA

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An on-farm assessment was conducted in Mysuru district during 2023-24 of Kharif and Summer seasons to evaluate red rice varieties as alternatives to the locally popular but disease-prone variety *Jyothi*. The varieties tested included *Sahyadri Kempu Mukthi*, *KMP-220*, and *Pournami*, along with *Jyothi* as a check. The evaluation focused on grain yield, gross and net returns, and benefit-cost ratio across both seasons. The results indicated that *Sahyadri Kempu Mukthi* recorded the highest grain yield (2700 kg/ha) compared to *Jyothi* (2600 kg/ha). Correspondingly, *Sahyadri Kempu Mukthi* also achieved higher gross returns (₹1,70,565/ha) and net returns (₹63,565/ha) with a benefit-cost ratio of 2.41, outperforming *Jyothi* (1.99). Farmers' feedback highlighted that *Sahyadri Kempu Mukthi* and *KMP-220* performed well in terms of yield, grain quality, and market acceptance, with fewer incidences of pest and disease stress. The study concludes that *Sahyadri Kempu Mukthi* is a promising alternative to *Jyothi* for both Kharif and Summer seasons in the Mysuru region due to its superior yield potential, economic returns, and adaptability under local agro-climatic conditions.

Keywords: On-farm assessment, Paddy, Red rice varieties, *Sahyadri Kempu Mukthi*, *Jyothi*

PHYSICOCHEMICAL CHARACTERISATION OF SOIL COLLECTED FROM IBUDHOU MARJING SACRED GROVE AND ITS ADJOINING HEINGANG RESERVE FOREST IN INDO-BURMA BIODIVERSITY HOTSPOT: A COMPARATIVE STUDY

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Soil physicochemical properties can be regarded as a crucial tool for assessing soil health and play a significant role in soil conservation, particularly within sacred groves that serve as repositories of rich biodiversity. The present study was conducted to analyse the soil properties in Ibudhou Marjing Sacred Grove (Site A) and its adjoining areas of Heingang Reserved Forest (Site B). Soil samples were collected from different depths, viz. 0-15 cm and 15-30 cm from both sites. Physicochemical analysis included soil texture, soil moisture, water-holding capacity, bulk density, pH, electrical conductivity, soil oxidizable carbon, available nitrogen, phosphorus, and potassium, as well as total nitrogen and potassium. The soil of the selected areas was recorded as sandy clay loam. Correlation analysis revealed that soil organic carbon (SOC), total nitrogen (TN), and total potassium (TK) exhibited strong negative correlations with depth ($r = -0.93$ to -0.95 , $p < 0.01$), indicating a decline in nutrients with increasing depth. At both sites, SOC exhibited significant positive correlations with available nitrogen and potassium ($r = 0.87-0.96$, $p < 0.01$), highlighting the interlinked dynamics of these nutrients. Soil pH negatively correlated with available phosphorus ($p < 0.05$), while conductivity and available nitrogen were positively related ($p < 0.01$). Overall, stronger correlations observed in the sacred grove suggest greater nutrient stability and retention compared to the adjoining forest, reflecting the ecological importance of protected vegetation in maintaining soil fertility.

Keywords: Sacred groves, physicochemical analysis, nutrient correlation, soil fertility.

FLORISTIC STUDY AND CONSERVATION STRATEGIES OF MANGROVE ECOSYSTEM OF COASTAL KARNATAKA

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Mangrove vegetation as vital intertidal forest communities, play a crucial role in coastal protection, nutrient cycling, and supporting diverse flora and fauna. A detailed survey was conducted across major estuarine regions including the Netravathi-Gurupura, Gangavali, Aghanashini, Mulki Pavanje and Sharavathi estuaries to document mangrove diversity, distribution, and associated vegetation. The study recorded both true mangrove and associate species, highlighting dominant genera such as *Avicennia*, *Rhizophora*, *Sonneratia*, and *Bruguiera*. Variations in species composition were observed due to differences in salinity gradients, tidal amplitude, and anthropogenic pressures. The findings reveal that rapid urbanization, aquaculture expansion, and pollution are major threats leading to habitat degradation and biodiversity loss. Conservation efforts such as community-based mangrove restoration, sustainable coastal management, and awareness programs are essential to safeguard these fragile ecosystems. The study emphasizes the importance of integrating traditional ecological knowledge with modern conservation practices to ensure long-term resilience of the mangrove ecosystems of coastal Karnataka. Overall, this floristic assessment provides baseline data crucial for monitoring ecological changes and implementing effective conservation strategies.

Keywords: Plant Diversity, Mangrove Ecosystem, Fragile Vegetation, Conservation, Coastal Karnataka

MYCO-REMEDIATION: A SUSTAINABLE TECHNIQUE FOR REMEDIATION OF PESTICIDE CONTAMINATED SOIL

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Pesticide contamination has become one of the most alarming environmental issues resulting from intensive agricultural practices. The continuous use of pesticides leads to the accumulation of toxic residues in soil, which adversely affects soil microorganisms, reduces fertility, contaminates groundwater, reduce food quality and poses serious health risks to humans and wildlife by entering in food chain. Soil remediation techniques are essential to decrease these adverse effects and restoring soil health. Soil remediation involves physical, chemical, and biological process. Physical and chemical process like soil washing, chemical oxidation, thermal desorption, stabilization process are often expensive, energy-intensive, disturb soil structure and may generate secondary pollutants. Therefore, there is need for cost-effective, eco-friendly, and sustainable remediation approaches. Mycoremediation, is a novel and eco-friendly technology which utilizes fungi to degrade and detoxify pesticide residues in soil. Compared to other microorganisms, fungi have strong morphology, extensive hyphal network, adaptation to extreme environment and stress condition. The natural ability of fungi to secrete extracellular enzymes capable of degrading a wide range of toxic element. Fungi produce enzymes such as laccases and peroxidases that can break down complex pesticide molecules into simpler, non-toxic forms. Several fungal species including *Pleurotus ostreatus*, *Trametes versicolor*, *Aspergillus niger* and *Phanerochaete chrysosporium* have efficiency in degrading various classes of pesticides such as organochlorines, organophosphates, and carbamates. In addition to pollutant removal, mycoremediation contributes to the restoration of soil biodiversity and fertility, making it a dual-benefit strategy for environmental cleanup and sustainable agriculture. The degradation process is influenced by factors like pH, temperature, moisture content, and nutrient availability. Mycoremediation represents an eco-friendly, low-cost, and sustainable approach to pesticide remediation, offering promising prospects for future agricultural and environmental management.

Keywords: Cost-effective, Eco-friendly, Extracellular enzymes, Fungi, Mycoremediation, Pesticide, Sustainable agriculture, Toxic residues.

POSTBIOTICS AND PARAPROBIOTICS: SCIENTIFIC ADVANCEMENT TOWARDS SMART NUTRITION

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Advancement of microbiome science has led to the development of postbiotics which is non-viable bacterial strains with their metabolites and paraprobiotics inactivated microbial cells that retain functional properties as next-generation functional ingredients. These innovative approaches offer enhanced mechanistic precision including the improved stability and safety, making them a promising tool in the field of smart nutrition. The review delves to highlights the current findings associated with multiple biological activities, along with its therapeutic potential in combating immune modulation, gut health and chronic disorders. Several clinical researches have demonstrated that microbial metabolites such as short-chain fatty acids, neuroactive compounds, bioactive peptides and exopolysaccharides exert vital form of bioactivities including alteration in inflammatory signalling, improvement in intestinal epithelial integrity, regulates gut-brain axis. Beyond their multiple health benefits, postbiotics and paraprobiotics possess technological attributes such as thermal stability, compatibility with several food matrices and prolonged shelf-life that tends to facilitates its incorporation into functional foods. Collectively, these attributes signify a transformative shift towards functional food science, integrating biotechnology, microbiology, nutritional perspectives for promoting safe and individualised dietary strategy.

Keywords: Bioactivities, Nutrition, Postbiotics, Paraprobiotics, Stability.

PHYTOREMEDIATION: A PROMISING APPROACH FOR HEAVY METAL REMEDIATION OF SOIL

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Soil Pollution by heavy metal has emerged as a serious environmental issue in the current world. It threatens public health, agriculture, food chain, and the overall ecosystem. Heavy metals are non-biodegradable and accumulate in environment. This accumulation of heavy metal in soil causes toxic effects on the plant growth and soil microbes, which may lead to decrease in their activities. Source of heavy metals in soil is from natural and anthropogenic activities. Natural cause includes weathering, volcanic activities, erosion and acid rain. While anthropogenic source includes mining, industrialization and excessive use of agrochemicals. Heavy metals have adverse effects on environment therefore it deserves special attention. Chemical and physical methods for soil remediation, such as excavation, chemical leaching, and solidification are often expensive, energy-intensive, change soil properties, destruction of micro flora and may generate secondary pollution. In contrast, phytoremediation has gained attention as eco-friendly and sustainable and cost-effective technology for the removal, stabilization and detoxification of heavy metal in contaminated soil. This green approach utilizes specific plant species to clean up contaminated soil. Phytoremediation includes several mechanisms such as phytoextraction (metal accumulates in shoots), Phyto filtration (sequestration of metals from surface), Rhizodegradation (breakdown of metal by rhizospheric organisms), Phytodegradation (enzymatic breakdown of metal within plant tissue), Phyto stabilization (restricts metal availability and mobility in soils by roots). Heavy Metal uptakes affected by many factors such as plant genotype, soil characteristics, climatic condition and properties of pollutant. Phytoremediation also suffers from some limitations such as slow growing and adaptation to various environment condition. therefore, improving plant performance is a critical step for developing high effective phytoremediation. Fortunately, recent advancements in genetic engineering modify plants with desired traits such as fast grow, high biomass production, high heavy metal tolerance and accumulation, and good adaption to various climatic and geological conditions. Use of plant associated microorganisms and heavy metal bioavailability is another important strategy to improve the efficiency of phytoextraction.

Keywords: Detoxification, Eco-friendly, Genetic engineering, Heavy metal, Phytoextraction, Phytoremediation, Phyto stabilization, Rhizodegradation, Soil pollution.

ROLE OF APEX PREDATORS IN MAINTAINING FOREST ECOSYSTEM BALANCE

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Apex predators play a pivotal role in maintaining the structure, function, and resilience of forest ecosystems. By regulating the abundance and behavior of herbivores and mesopredators, apex predators influence trophic cascades that determine vegetation dynamics, biodiversity, and ecosystem health. Studies have shown that the presence of large carnivores such as tigers (*Panthera tigris*), leopards (*Panthera pardus*), wolves (*Canis lupus*), and jaguars (*Panthera onca*) maintains herbivore populations at sustainable levels, preventing overgrazing and promoting regeneration of woody plant species. For example, in India's Sundarbans and Western Ghats, tiger presence is associated with higher sapling survival rates and increased plant species diversity. Apex predators also regulate mesopredator populations, indirectly benefiting smaller prey species and maintaining balanced food webs. Loss of apex predators often leads to "mesopredator release," overabundance of herbivores, habitat degradation, and decline in biodiversity. Additionally, apex predators influence nutrient cycling by modifying prey behavior and carcass distribution, which enhances soil fertility and supports scavenger species. Conservation strategies aimed at protecting apex predators not only ensure species survival but also stabilize forest ecosystems, sustain ecological services, and enhance resilience against anthropogenic pressures. Effective ecosystem management requires integrating predator conservation with habitat protection, community engagement, and mitigation of human-wildlife conflict.

Keywords: Apex predators, trophic cascade, forest ecosystem, biodiversity, ecological balance, mesopredator release

MOLECULAR DIVERSITY ASSESSMENT OF *TRICHODERMA* ISOLATES COLLECTED FROM COPPER MINING AREAS OF UTTARAKHAND

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A total of 49 *Trichoderma* strains were isolated and purified using serial dilution and pour plate technique from the rhizosphere soil samples collected from copper mining area of Uttarakhand. PCR analysis of all the 49 isolates using ITS-1 and ITS-4 regions (primers) revealed no inter or intra species length diversity. This is due to fact that 5.8S r RNA gene is known to be highly conserved at genus level and this confirmed that all the collected isolates belonged to the single genus *Trichoderma*. Molecular diversity of 49 *Trichoderma* isolates was performed using eight ISSR markers. Based on UPGMA cluster analysis, 49 *Trichoderma* isolates were grouped into cluster I and cluster II at 30 per cent similarity. Cluster I comprise of 28 isolates, was further subdivided into three sub clusters, each of which was further subdivided. Cluster II comprising of 21 isolates, further subdivide into two sub clusters 2a, 2b. Sub cluster 2a was subdivided into two clusters 2a', 2b'; 2a' comprised of 15 isolates while 2b' contain 3 isolates. Sub cluster 2b had only one group of three isolates. Among all the isolates highest genetic similarity (minimum diversity) was observed between isolates TCMS 46 and TCMS 71 (0.67), while minimum genetic similarity (highest diversity) was observed between TCMS 1 and TCMS 79 (0.294). Results showed high diversity among the isolates of *Trichoderma*. The potential strains may further be screened for their antagonistic potential and used for sustainable management of crop diseases.

Key words: Biological control, Taxonomy, Molecular Markers, Diversity, Sustainability

ECONOMIC EVALUATION OF INSECTICIDAL TREATMENTS AGAINST GRAM POD BORER (*HELICOVERPA ARMIGERA*) IN CHICKPEA BASED ON INCREMENTAL BENEFIT COST RATIO

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An economic evaluation of various insecticidal treatments against the gram pod borer on chickpea was conducted during the *Rabi* season of 2023-2024, focusing primarily on the Incremental Benefit-Cost Ratio (IBCR). The IBCR values clearly highlighted the cost-effectiveness of different insecticidal interventions. Among all treatments, Indoxacarb 14.5% SC recorded the highest IBCR of 7.2:1, followed closely by Emamectin benzoate 5% SG (7.0:1) and Chlorantraniliprole 18.5% SC (4.6:1), indicating superior profitability per unit cost of protection. Fipronil 5% SC also demonstrated an acceptable IBCR of 4.0:1, reflecting a good economic return. In contrast, botanical treatments exhibited comparatively lower cost-effectiveness, with Neem Seed Kernel Extract (NSKE) 5% showing a moderate IBCR of 2.1:1, while Neem oil 2% and Karanj oil 5% recorded only 1.5:1 and 1.2:1, respectively. The results revealed that synthetic insecticides, particularly Indoxacarb and Emamectin benzoate, provided the best balance between cost of application and economic gain. The study emphasizes that treatments with higher IBCR values are more economically viable for farmers, offering greater financial returns relative to input costs. Hence, Indoxacarb, Emamectin benzoate, and Chlorantraniliprole can be considered the most efficient insecticidal options for managing gram pod borer in chickpea cultivation under sustainable pest management programs.

Keywords: Chickpea, Gram pod borer, IBCR, Indoxacarb

POLLINATOR SAFETY ASSESSMENT OF NEWER INSECTICIDES ON THE WESTERN HONEY BEE (*APIS MELLIFERA* L.)

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The intensive use of insecticides in modern agriculture has raised serious concerns about their impacts on pollinators, especially the Western honey bee (*Apis mellifera* L.), which is essential for crop pollination and ecosystem stability. Evaluating the safety of newer insecticide molecules is therefore critical for pollinator conservation. This study aimed to assess the acute and residual toxicity of selected newer insecticides acephate, sulfoxaflor, chlorantraniliprole, flupyradifurone, pyriproxyfen, pyriproxyfen, flonicamid, and afidopyropen against *A. mellifera* under laboratory conditions. **Methodology:** The dry film bioassay method was employed, wherein worker bees (n=10) were exposed to insecticide residues at 0, 12, and 24 hours after film formation. Mortality was recorded up to 48 hours post-exposure, and treatments were replicated thrice. **Key Findings:** Toxicity varied significantly among insecticides and exposure intervals. Acephate and sulfoxaflor were highly toxic, causing 100% mortality within 12–24 hours. Chlorantraniliprole exhibited delayed but considerable toxicity (up to 95.23% mortality at 48 h). Flupyradifurone, pyriproxyfen, pyriproxyfen, flonicamid, and afidopyropen were relatively safer, showing low to moderate mortality (7–71%). Residual toxicity declined over time, highlighting the importance of exposure timing in determining risk to bees.

Conclusion: Acephate and sulfoxaflor pose the greatest hazard to honey bees, whereas flupyradifurone and other newer chemistries appear comparatively bee-safe. Integrating pollinator-friendly insecticides and scheduling sprays to minimize bee exposure are essential for sustainable pest management and pollinator protection.

Keywords: *Apis mellifera*, insecticide toxicity, pollinator safety, sulfoxaflor, flupyradifurone, integrated pest management

FARMING FOR THE FUTURE: PRECISION AGRICULTURE'S ROLE IN CLIMATE CHANGE MITIGATION

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The climate change is looming, and agriculture plays a significant role in greenhouse gas emissions, accounting for 24% of global emissions. Inefficient agricultural practices like excessive fertilizer and pesticide use and poor land management have significantly increased greenhouse gases emissions. As agriculture not only contributes to but is also highly vulnerable to the effects of climate change, urgent actions are needed to mitigate emissions and reduce their impact on our changing climate. Precision Agriculture (PA), also known as precision farming, offers an effective approach to making agriculture more climate-smart by minimizing its environmental impact. This farming strategy uses the proper management practices at the right time and location by capturing the land's variability on a minute scale. As a climate-smart agricultural approach, PA has the potential to not only reduce agriculture's environmental but also address food insecurity in developing nations, making it a vital solution for modern agriculture's challenges.

Keywords: Greenhouse gas, Precision Agriculture, Climate change and Climate smart.

COFFEE HUSK DEGRADATION BY POTENTIAL LITTER HARBORING FUNGI *MUCOR CIRCINELLOIDES GL1* THROUGH SOLID-STATE FERMENTATION

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Coffee Husk is the coffee processing by-products, obtained in an excessive amount every year. The applications of Coffee Husk are extremely restricted, as it is a bulky product. The abundance of lignin, tannins and caffeine reduces the palatability of these husks by animals. Despite this promising potential, little work has been done with microorganisms specially to degrade the husks. The present study was undertaken to study the efficiency of litter harboring fungi namely *Mucor circinelloides GL1* in degrading the coffee husk through solid-state fermentation. After fermentation process, the lignocellulosic residues left over were evaluated for their physico-chemical studies and degradation pattern of cell wall constituents along with the activity of enzymes. During the decomposition, the initial pH was found to change from near-neutral to acidic pH. Significantly increased loss of total organic matter and organic carbon content was also observed. The total nitrogen, crude protein, total phosphorus and total potassium contents of were increased with the progress of time. The study indicated that the degradation patterns of lignin and holocellulose were more effective from 20 to 120 days after fungal inoculation with respect to their loss between the different harvesting intervals. During decomposition process, the fungi produced the ligninolytic enzymes namely laccase, manganese peroxidase (MnP) and lignin peroxidase (LiP)] and carboxymethyl cellulase (CMCase) on the coffee husk substrate. In concern with the present environmental problems, the present study suggested that these potential ligninolytic fungi can be utilized successfully for the management of agricultural wastes and reuse of their residues in the forest soil conservation system to eliminate the harmful effects of the crop residue burning. Thus the reusing of these agro residues is an ecological need as well as, in a nation like India, is economical too.

Keywords: Coffee husk, Fungi, Ligninases, Biodegradation, Lignocelluloses

MULTIVARIATE GENETIC ANALYSIS OF EARLY-STAGE GROWTH TRAITS FOR SELECTING HIGH-YIELDING ACCESSIONS OF *DENDROCALAMUS STOCKSII* (MUNRO)

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Dendrocalamus stocksii is a strong and robust bamboo species with vigorous growth and high potential. In this study, 22 accessions were evaluated for early growth traits to identify superior accessions. ANOVA revealed significant differences for all traits except culm length. Genetic variability analysis showed high values for several genetic parameters, and correlation studies indicated that clump height and diameter, number of culms per clump, number of shoots, culm length, basal diameter, and fifth internodal diameter were positively associated with increased culm yield. Cluster analysis grouped accessions into four clusters with Clusters I and II, showing moderate intra-cluster variability suitable for selection, while Clusters III and IV exhibited high inter-cluster divergence ideal for hybridization. Basal diameter, clump diameter, and fifth internodal diameter contributed most to genetic divergence. Path analysis identified clump diameter, number of shoots, culm length, and internodal traits as major direct contributors to culm number, with minor indirect environmental effects. PCA confirmed that the first three components explained over 78% of the variation. These findings provide a basis for targeted selection, breeding, and conservation of superior *D. stocksii* accessions.

Keywords: *Dendrocalamus stocksii*, Genetic diversity, Principal Component Analysis (PCA), early growth traits, breeding

TOXIC EFFECTS OF PESTICIDE TRIFLUMEZOPYRIM ON TESTICULAR TISSUE OF GOAT (*CAPRA HIRCUS*)

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Pesticides use has become an essential practice for improving crop-fields and safeguarding the plants from pests including weeds, fungi, insects, and rodents. The majority of used pesticides contaminate natural areas like the air, water, or soil by means of plants, wind, or water that causes a significant amount of pollution and affects the health of non-target organisms, including mammals. Triflumezopyrim (TFM), is a mesoionic pesticide that binds and inhibit the nicotinic acetylcholine receptor (nAChR) with high-performance against the small brown planthopper (SBPH), *Laodelphax striatellus*, which are resistant to imidacloprid. Present study is designed to elucidate the mechanisms of TFM induced gonadal toxicity (*In Vitro*) using male goat (*Capra hircus*) as model organism. For this, testicular tissue of goat was exposed to various sublethal concentrations TFM for different time interval. The histological findings (photomicrographs) indicate that TFM causes various deformities in the goat testis including karyorrhexis, pyknotic nuclei, vacuolization, tubular degeneration, and karyolysis even on exposure of its sublethal concentrations. This investigation clearly indicates that TFM induces gonadal toxicity in male goat leading to impaired spermatogenesis and ultimately resulting in decreased fertility.

ADVANCING SOIL MOISTURE MONITORING: REMOTE SENSING AND MACHINE LEARNING INTEGRATION IN INDIAN STATES

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One of the most important variables in the water and energy cycles is soil moisture, which has an impact on several processes including transpiration and evaporation. More generally, interception, runoff, waterlogging, and drought conditions are all negatively impacted by soil moisture. A greater comprehension of research and prediction models for floods, droughts, and other climatic occurrences results from an awareness of soil moisture. On the one hand, remote sensing techniques enable the acquisition of soil moisture data at ground level, which is otherwise challenging. Remotely sensed data and modelled data of enough temporal continuity and inaccessible areas are available through platforms such as Google Earth Engine. The current investigation was carried out in a select few Indian states. Down scaling the coarse-scale satellite soil moisture data is the aim of this investigation. Among methods used (CART), (GTB), and Random Forest (RF) with highest R value 0.95 and lowest RMSE 0.028 RF shows the best results. The downscaled soil moisture mapped helps in detecting and visualizing the spatiotemporal variation in moisture condition as well as severity of agricultural drought in the region.

Keywords: Google Earth Engine; SMAP; Soil moisture; spatial downscaling

BLOCKCHAIN APPLICATIONS IN HONEY TRACEABILITY FOR SUSTAINABLE FOOD ENGINEERING AND APICULTURAL SYSTEMS

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Ensuring the safety, authenticity, and sustainability of honey and other apiculture products has become a global priority due to complex supply chains, susceptibility to contamination, adulteration, and mislabeling. Conventional traceability systems often fail to provide real-time, tamper-proof records, leading to reduced consumer trust and inefficiencies in supply chain management. This study explores the integration of blockchain technology into honey traceability, emphasizing the synergistic roles of food engineering and entomological taxonomy. Food engineers optimize honey processing, storage, and packaging to maintain quality, prevent spoilage, and ensure safety, while entomologists and taxonomists verify bee species, floral sources, and geographic origin to authenticate products and preserve biodiversity. The proposed framework integrates blockchain with IoT sensors and QR-code labeling, capturing key data on production, processing, storage, and distribution. Transactions are securely recorded on a distributed ledger using smart contracts and consensus mechanisms, providing immutable, transparent, and real-time traceability. This approach enhances supply chain efficiency, prevents adulteration, and promotes sustainability, aligning with the United Nations Sustainable Development Goals (SDGs 2, 12, 15) for zero hunger, responsible consumption, and life on land, as well as India's National SDG targets for sustainable agriculture, food safety, and biodiversity conservation. Blockchain-enabled honey traceability demonstrates the transformative potential of integrating food engineering and entomology to create transparent, reliable, and sustainable apicultural systems.

Keywords: Blockchain, Honey traceability, Apiculture products, Food Traceability, Supply Chain, Sustainability, Transparency

INTENSITY OF FRUIT DROP STUDIES IN EXOTIC APPLE VARIETIES UNDER HIGH DENSITY PLANTATION

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Fruit drop studies were carried out on thirteen exotic cultivars of apple grafted on M9 T337 rootstock under HDP system having age of four years planted at Experimental Farm of Division of Fruit Science, SKUAST-K, Shalimar campus (J & K). Observations were recorded on flowering, fruiting and yield related parameters. The results showed that highest bloom density was observed in cultivar Mitch Gala (14.68) whereas maximum number of clusters/branch was observed in cultivar Red Braeburn (24.27), number of flowers/cluster was recorded in Red Velox (5.56). Maximum number of fruits/cluster was recorded in cultivars Fuji Zehn Aztec (5.00). Maximum fruit set (91.97%), fruit retention (79.43%) and minimum cumulative drop (20.57%) were recorded in cultivar Super Chief Sandidge whereas minimum fruit set (80.35 %), fruit retention (66.18 %) and maximum fruit drop (33.82 %) was registered in Red Chief. Early drop (Post-pollination drop) was recorded maximum in cultivar Red Chief (26.66%), while minimum in cultivar Pinova (7.95%) whereas June drop was highest in cultivar Red Velox (9.81%) and lowest in cultivar Elstar (3.20%). Pre-harvest fruit drop was maximum in cultivar Pinova (10.15%) while lowest in cultivar Mitch Gala (0.52%) and Gala Redlum (0.52%). Cultivar Golden Delicious Reinders recorded highest fruit yield per plant (30.01 kg/plant) however lowest fruit yield was recorded in Red Braeburn (11.80 kg/plant).

ANTIOXIDANTS PROTECTION AGAINST CLOTHIANIDIN-INDUCED OXIDATIVE STRESS IN *DROSOPHILA MELANOGASTER*: A STUDY ON ENZYMATIC AND FLUORESCENT BIOMARKERS

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Clothianidin ((E)-1-(2-chloro-1,3-thiazol-5-ylmethyl)-3-methyl-2-nitroguanidine) is a systemic neonicotinoid pesticide widely used in Indian agriculture to protect crops such as rice, maize, cotton, and sugarcane from sucking pests (aphids, jassids, whiteflies) and chewing pests (stem borers, beetles, caterpillars). Despite its effectiveness, Clothianidin poses significant risks to non-target organisms, including honeybees, monarch butterflies, springtails, and crayfish. *Drosophila melanogaster* (fruit fly) is a preferred model organism in toxicology due to its short life cycle, high fecundity, and genetic similarity to humans. The current study aimed to evaluate the protective effects of Vitamin C, Vitamin E, and Curcumin when co-administered with Clothianidin. Biochemical assays revealed a significant reduction in Catalase activity, indicating elevated reactive oxygen species (ROS) generation in the Clothianidin-treated group. Thioredoxin reductase (TRxR) activity was also decreased, reflecting redox imbalance in proteins. Furthermore, reduced Glutathione (GSH) levels, a key cofactor of peroxidase, correlated with increased ROS production. DCFDA fluorescence imaging confirmed elevated ROS levels, while DAPI staining revealed DNA fragmentation. Nile Red staining demonstrated increased lipid peroxidation and fat accumulation. Importantly, co-treatment with each antioxidant significantly mitigated these toxic effects, normalizing enzyme activities and improving fluorescence-based biomarkers. Overall, the findings indicate that Vitamin C, Vitamin E, and Curcumin effectively reduce Clothianidin-induced cellular, biochemical, and molecular toxicity in *D. melanogaster*.

Keywords: *Drosophila melanogaster*, Clothianidin, Oxidative stress, Dietary antioxidant, Fluorescence biomarkers

EVALUATION OF FOREST DEGRADATION ACROSS DIFFERENT FOREST TYPES IN YELLAPUR FOREST DIVISION, UTTARA KANNADA DISTRICT

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The present study was conducted to quantify the extent of degradation and assess changes in forest biomass and carbon stock. The study area comprised three dominant forest types' dry deciduous, moist deciduous and semi-evergreen forests representative of the tropical forest ecosystem of the Western Ghats. Permanent plots were established in each forest type following a Randomised Block Design (RBD) with three treatments and seven replications. Field measurements included tree height, girth at breast height, and records of dead or damaged trees. Tree volume, above-ground biomass (AGB), and below-ground biomass (BGB) were estimated using standard allometric equations, and total carbon stock was computed by multiplying total biomass by a conversion factor of 0.47 as per IPCC (2007) guidelines. Results revealed a marked variation in the degree of degradation among forest types. The dry deciduous forests exhibited the highest level of degradation, with a decline of 33 stems ha⁻¹, 12.95 m³ ha⁻¹ in volume, 13.03 t ha⁻¹ in biomass, and 6.14 t ha⁻¹ in carbon stock. Moist deciduous forests showed moderate degradation, while semi-evergreen forests were the least affected. Major degradation indicators included tree cutting, uprooting, termite attacks, and disease infestation. The observed reductions in biomass and carbon stock reflect the combined impact of anthropogenic pressures such as selective logging, grazing, and unsustainable extraction, along with natural stress factors like drought. The study highlights the vulnerability of dry deciduous forests to degradation and underscores the need for continuous monitoring through remote sensing techniques and field-based assessments. Sustainable management interventions are crucial to restore forest productivity, maintain biodiversity, and enhance carbon sequestration potential in the Yellapur forest division.

Keywords: Degradation, Dry deciduous forest, Volume, Biomass.

ROLE OF VERMICOMPOST IN ENHANCING PLANT GROWTH AND SOIL MICROBIAL ACTIVITY

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The vermicompost which is prepared because of various activities by earthworms in organic waste. It is referred to as the natural fertilizer because it improves the soil fertility and improves the plant growth. It is high in nutrients and beneficial microbial communities including some of nitrogen fixation bacteria (nitrobacter, azotobacter etc.) hydrolytic enzyme producing bacteria. The vermicompost improves the soil structure; improve the water holding capacity of the soil. The vermicompost is prepared by the biological process of earthworms and microbes. *Eisenia fetid* is widely used earthworm species for the process of vermicompost because it has some of useful microbes present in gut of it. Vermicompost also requires some process to follow for best vermicompost product including right moisture content, moderate temperature of 18-25 centigrade, pH, salinity and aeration and bedding (organic material). The vermicompost consists of diverse variety of microbe communities including bacteria (bacillus, pseudomonas, nitrobacter, azotobacter, and rhizobium) and some of fungi (ascomycetes and basidiomycetes). These microbial communities support and benefit in plant growth promotion, nutrient cycling, promote the plant growth, vermicompost enhance the plant growth by providing essential nutrients, plant hormones (auxin, gibberellin and cytokinin), and humic acid, identifying the bacteria that is beneficial for plant growth, enhance the nutrient cycling and improve soil fertility.

Keywords: vermicompost, earthworms, plant growth enzymes, microbes of vermicompost

PROTECTED CULTIVATION OF GERBERA (*GERBERA JAMESONII* B) VARIETIES FOR SUSTAINABLE LIVELIHOOD ENHANCEMENT

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Horticulture plays a vital role in enhancing farmer income, ensuring nutritional security and rural livelihood through the cultivation of high-value crops under protected conditions. Gerbera (*Gerbera jamesonii*) is one of the most important cut flower crops with strong domestic and export demand, offering significant livelihood opportunities for small and marginal farmers. The present study was carried out during 2023–2024 at the Hi-Tech Horticulture Unit, Saidapur Farm, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, to evaluate newly introduced gerbera varieties under a naturally ventilated polyhouse for their growth, yield, and quality performance. This evaluation aims to enhance productivity, profitability, and ultimately contribute to improving farmers' livelihoods. The experiment was laid out in a Randomized Block Design with four replications and seven varieties they are Figaro, Ritmo, Intense, Memphis, Snowball, Forbes and Atlanta. Significant differences were observed among the gerbera varieties in terms of growth, yield and quality traits. Among them, the variety **Forbes** exhibited the highest performance, recording maximum plant height (45.61 cm), vase life (11.57 days), field life (24.19 days) and the greatest flower yield per plant (10.85) and per square meter (102.54), followed by **Snowball** and **Memphis**. These varieties demonstrated superior potential for cut flower production and economic returns under polyhouse conditions. The results indicate that the adoption of appropriate gerbera varieties combined with protected cultivation techniques can substantially enhance productivity and profitability, ensuring a consistent year-round income. This study emphasizes floriculture as a sustainable livelihood strategy that strengthens economic resilience and empowers rural communities, especially women and youth engaged in horticultural activities. Furthermore, it highlights that growing suitable gerbera varieties under protected conditions can be an effective means of income generation and livelihood improvement for farmers in both peri-urban and rural areas.

Keywords: *Gerbera jamesonii*, Naturally ventilated polyhouse, livelihood, Yield, Growth

3D FOOD PRINTING: NOVEL APPROACH TO SUSTAINABLE, PERSONALIZED AND NUTRIENT-ENRICHED FOODS

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3D food printing (3DFP) is an advanced additive manufacturing technology that fabricates complex, customized food structures directly from digital designs. Originally developed for industrial applications, 3DFP has rapidly expanded into the food sector, enabling nutrient-rich, personalized, and sustainable products. Techniques such as extrusion, inkjet, binder jet, and selective laser sintering create layered foods products using materials including chocolate, dairy, dough, millets, and fruits. Printing success depends on optimized formulations, rheological properties, moisture content, nozzle diameter, and extrusion speed. Applications of 3DFP include dietary fibre-enriched chocolate, milk-based sweets with rheology modifiers, and millet-fruit bio-inks, which improve texture, sensory quality, stability, and nutritional value. Additionally, the technology facilitates the valorization of agri-food waste into edible or biodegradable products, contributing to a circular economy. Beyond product innovation, 3DFP addresses challenges such as food security, malnutrition, and the development of functional foods tailored to individual dietary needs. Despite on-going challenges in standardization, microbial safety, and reliable food-ink development, 3DFP offers a transformative approach to sustainable food processing, functional product development, and personalized nutrition. Its integration with advanced food engineering and circular economy principles positions it as a key technology for future food systems, bridging innovation, nutrition, and environmental sustainability.

Keywords: 3D Food Printing, Nutrient-Enriched Foods, Circular Economy, Food Waste Valorization, Functional Foods

IMPACT OF NANO-FERTILIZERS ON SOIL MICROBIAL DIVERSITY

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Nano fertilizers are most trending fertilizers now a days due to its highest specific surface area, nutrient use efficiency, reduction in nutrient loss and indirectly the lesser cost of cultivation. Many scientists all over the country reported the beneficial effect of nano-fertilizers on yield of various crops, crop quality as well as soil health. The major cause of least conventional fertilizer use efficiency is the gap between crop demand for nutrient and its application. So, many authors reported that nano fertilizers are very effective for precise nutrient management in precision agriculture with matching the crop growth stage for nutrient and may provide nutrient throughout the crop growth period. Soil biochemical processes are greatly influenced by the microorganisms. The organic matter decomposition and nutrient cycling are completely depending upon soil microbial diversity. Therefore, microbial diversity in the soil indirectly indicates the quality and overall health of the soil, reported by many scientists. There are many studies which advocate that fertilizer management greatly influences the soil microbial diversity. However, the impact of nano-fertilizers on microbial properties is still not evident. Some studies reported that the introduction of nano-fertilizers into the natural environment may pose threat to beneficial microbial communities. The impact of nano-fertilizers on microbial activity could be determined through measurement of soil respiration and enzymatic activities. Certain studies reported that specific microbial groups, including Actinobacteria, Bacteroides, and Proteobacteria, were present in abundance along with soil microbial biomass carbon when combined use of nano-fertilizers and conventional fertilizers has been done. Some scientific studies reported that nano-fertilization increased soil nutrients, improved soil ecological environment, and increased soil microbial quantity. According to the study conducted by some scientists, TiO₂ and CuO nanoparticles decreased soil microbial biomass and enzymatic activities, affected on their community structures in flooded paddy soil. So, it can be concluded that the soil application of nano-fertilizers have both its positives and negatives in the case of soil microbial diversity.

Keywords: Microorganisms, Nano fertilizers, precision agriculture, soil health

ROLE OF ORGANIC FARMING IN CLIMATE CHANGE MITIGATION

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The climate change is one of the major global issue due to its direct impact on human health, food security, water availability and ecosystem and Agriculture is a significant contributor to greenhouse gas emission. Organic farming is an alternative agricultural system that can help to mitigate climate change. Carbon sequestration involves capturing carbon dioxide from the atmosphere and storing it in the soil. In organic farming, crop residue management is performed in ecofriendly and economic manner, so the incorporation of crop residues in the form of organic nutrient sources can reduce carbon emission in an efficient way. Organic farming practices such as crop rotation, cover cropping and zero tillage enhances soil carbon sequestration compared to conventional farming and also reduce dependence on fossil fuels. Synthetic fertilizers and pesticides are significant sources of greenhouse gases. Natural nutrient cycling, composting and biological nitrogen fixation in organic farming result in lower emission of methane and nitrous oxide. IFOAM reported that the sustainability of agriculture and food systems needs climate change mitigation as prime factor. Organic farming practices deliver solutions for a wide range of sustainability challenges, such as biodiversity, climate change adaptation, eutrophication and socio-economic benefits. Furthermore, organic farming system promote ecological balance and resource efficiency, which are crucial for long term sustainability. Inter By adopting organic farming practices, significant positive results has been found by various authors towards mitigating climate change and also promoting sustainable and environmentally friendly agricultural system.

Keywords: Carbon sequestration, Climate change, Greenhouse gas, Organic farming

IMPACT OF BIOCHAR ON SOIL HEALTH

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Biochar, a fine grained, carbon-rich, porous material produce from pyrolysis process of biomass under limited oxygen condition. The agricultural process disturbs the natural soil systems including nutrient cycle and the release and uptake of nutrients. In India, open field burning of crop residues and waste after harvesting to boost soil fertility in term of phosphorous and potassium is a common practice and it reduces the cost of cultivation too, but it leads to loss of other nutrients and organic matter and causes air pollution as well as contribute towards global warming. The burning of crop residues adds large amount of carbon dioxide to the atmosphere. Efficient use of crop residue-based amendment is important strategy to improve soil health. Biochar contain stable carbon and after adding to the soil, this carbon remains sequestered for longer period and reduces greenhouse gas emissions. Biochar can enhance physical, chemical and biological properties of soil. Physically, its porous structure and high surface area contribute to improve soil aggregation, reduce bulk density and enhance water infiltration. Chemically, biochar increase cation exchange capacity, improves soil PH, enhance nutrient retention and reduce leaching loss. Biologically, it creates favourable habitat for soil microorganisms, stimulates beneficial microbial activity and supports nutrient cycle. These improvements contribute to higher crop productivity and resilience to environmental stress. Biochar is multifunctional soil amendment with significant implications for soil health and agroecosystem sustainability.

Keywords: Biochar, Crop residues, Greenhouse gases, Pyrolysis, Soil health

EVALUATION OF WATER QUALITY INDEX (WQI) OF DRINKING WATER OF JAGATSINGHPUR DISTRICT, ODISHA, INDIA

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To evaluate the Water Quality Index (WQI) of drinking water of Jagatsinghpur district, water samples from nine different locations were collected spreading over a period of one year from April-2024 to March-2025. This evaluation was made in three different seasons of the year (2024-2025) namely post monsoon, winter and summer season. The quality of water was evaluated by testing various physico-chemical parameters such as pH, Total Hardness (TH), Alkalinity, Total Dissolve Solid (TDS), Dissolve Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Magnesium, Calcium, Fluoride, Chloride, Sodium, Potassium, Sulphate and Iron content. The average WQI values among three seasons is maximum in the sampling station JSP-7 is 158.21 and the average value of JSP-2 is 20.95 is minimum. Analysis of these water samples indicate that the one sampling area belong to excellent, four are good, two are poor, one is very poor and one is unsuitable for drinking with fish culture where proper treatment required for any kind of usage.

WQI: A water quality index is a weighted average of selected ambient concentration of pollutants usually linked to water quality classes. **Seepage:** The slow movement of water through small openings and spaces in the surface of unsaturated soil into or out of a body surface or subsurface water. **Aquifer:** An aquifer is an underground layer of water bearing permeable rock or unconsolidated materials (gravels, sand or silt) from which ground water can be usually extracted using water well. **ION-EXCHANGE:** Ion exchange is an exchange of ions between two electrolytes or between an electrolyte solution and a complex. In most cases the term is used to denote the processes of purification, separation and decontamination of aqueous and other ion containing solution with solid polymeric or mineralic ion exchangers.

Tributary: A tributary is a stream or river that flows into a main stem (or parent) river or a lake.

Rating scale: A rating scale is a set of categories designed to elicit information about a quantitative or a qualitative attribute.

Keywords: Water Quality Index (WQI); Pollution, Drinking Water; Jagatsinghpur District.

SUPPORTING OF ECOSYSTEM HAVING REDUCE DISASTER WITH CLIMATE CHANGE: ROLE OF MANGROVES A REVIEW

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On this Planet one among the most productive and biologically important ecosystem for providing vital ecosystem, goods and services are "Mangroves". In the coastal belt of Orissa, the mangrove forest rich in varied resources of ecosystems with support livelihood of lakhs of people living adjacent to these forests. They act as refuge against cyclones, storms and tidal surges which is recurrent in this area. Apart from a major source of fuel, fodder and timber, mangrove wetlands harbour fishes, crabs and serve as an ideal habitat for prawn farms the soil being fertile mangrove forests are cleared for agriculture purpose. Other minor uses of mangrove include collection of medicinal plants, collection of molecules, shells for lime making, etc. Mangroves protect and maintain a rich marine biodiversity in the tropics and subtropics and are crucial carbon sinks. The present study thus analyses mangroves' role as ecosystem-based technique to reduce disaster risk and adapt to climate change. The Indian mangroves are categorized into six different types on the basis of their habitat. The Deltaic /Estuarine Mangrove: Generally these mangroves exist in the east coast of India. These are abundant in the deltaic region of the river Ganga, Mahanadi, Krishna, Godavari etc. Maximum areas of mangroves come under this category. **The Island Mangroves:** - These are considered the second dominant and best mangrove zone of the country. It is scattered distributed in the Andaman and Nicobar Islands. **Coastal Mangroves:** - This category exists in the coastal areas of Karnataka, Goa, Maharashtra and Gujarat states. **Mangroves of marshy back water:** - The mangroves of Kerala coastal areas come under this category. **Mangrove on the Gulf:** - These mangroves are distributed in the Gulf of Cambay and Kutch. **The Mangroves of coral reef:** - The mangroves scattered in the Lakshadweep and Minicoy Islands of Arabian Sea comes under this category.

Keywords: Mangroves, Ecosystem-based solution, Disaster risk reduction, Climate change adaptation

CELLULASES AND ITS APPLICATIONS

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Lignocellulosic materials mostly contain cellulose (40-50%), hemicelluloses (25-30%), and lignin (15-20%). Polysaccharide-degrading enzymes, such as cellulases, hemicellulases, and ligninases, are present in many microbial systems, including bacteria, fungi, actinomycetes, algae, and plants. Fungi are the most effective source of extracellular cellulases for biological cellulose breakdown. Cellulose, a linear polysaccharide composed of glucose residues with 1, 4-glycosidic linkages, is the most prevalent biomass on the earth. Cellulase is a widely utilized enzyme for processing cellulosic materials. Cellulases are enzymes that function in three categories. Endoglucanases randomly hydrolyze β -1, 4-glycosidic bonds along a cellulose chain. Exoglucanases release cellobiose from cellulose, whereas β -glucosidases convert it to glucose. Cellulases are a promising study topic for both academic and corporate entities. Biotechnological conversion of cellulosic biomasses offers a sustainable method to developing new bioprocesses and products. Cellulase has become a popular biocatalyst due to its complicated structure and numerous industrial uses. Cellulases were initially studied for biomass conversion, but have since expanded to industrial applications such as waste management, bio-ethanol production, animal feed, textiles, paper and pulp, wine and brewing, food processing, olive oil extraction, carotenoid extraction, pharmaceutical and medical sciences, and analytical sciences.

Keywords: Lignocellulose, Fungi, Endoglucanases, Exoglucanases and β -glucosidases.

ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE AGRICULTURE: BOOSTING EFFICIENCY AND MINIMIZING ENVIRONMENTAL IMPACT

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In the twenty-first century, agriculture is faced with the twin challenges of reducing its environmental impact and supplying the expanding global population's food needs. In order to solve these problems, sustainable agriculture-which places a strong emphasis on resource conservation, a decrease in chemical inputs and an improvement in ecosystem health-becomes essential. Artificial Intelligence (AI) integration in sustainable agriculture offers a large potential to improve productivity and lessen environmental impact. AI has the potential tolerance food production and supply chains, track soil conditions, identify pests and diseases and raise crop yields. Farmers are able to make data-driven decisions to support sustainable practices and guarantee food security in the face of population growth and climate change by utilizing AI tools such as drones, sensors and predictive analytics. The goal of AI is to create ecologically friendly AI systems that will reduce the carbon footprint of AI technologies and help society move toward a more sustainable future. All things considered, the application of AI to sustainable agriculture not only increases output and efficiency but also significantly reduces environmental impact and fosters long-term sustainability. A variety of technologies, such as machine learning, computer vision and predictive analytics are included in AI and can be used to optimize different agricultural practices. Precision farming, which enables the precise application of pesticides, fertilizers and water sophisticated crop monitoring systems, which can identify health problems early on. Not with standing, there exist certain obstacles to the implementation of these technologies, such as the availability of data, the requirement for extensive training for farmers and the need to attend to ethical and social concerns. Technologies powered by AI can predict yield, assess crop health and provide insights into field conditions. AI is useful for tracking livestock behavior, predicting crop yields, detecting pests, optimizing fertilizer use and monitoring and controlling irrigation systems. AI can also be used to evaluate soil data and make decisions about when and where to plant as well as which seeds to use in different areas of a field.

Keywords: Artificial Intelligence, Boosting, Crop Monitoring, supplying, Sustainable Agriculture

ASSESSMENT OF PLASTIC DEGRADING BACTERIA FROM TERRESTRIAL AND AQUATIC ECOSYSTEMS

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Plastics are used everywhere and do not break down easily, when thrown to soil or water they turn into microplastics and keep building up in the environment which cause pollution to the environment causing harm to human and aquatic lives and nature as well. The present study focuses on the isolation and characterization of plastic degrading bacteria from both soil and water samples collected from dumping and sewage sites from the localities of Punjab. The purpose of this study is to isolate bacteria that can degrade plastics like polythene and polythene terephthalate (PET) naturally. The methodologies include collection of water and soil sample and isolation of bacteria and culturing them in nutrient media (LB) and MSM (Minimal salt medium) -providing sole carbon source for at least 4 weeks under optimized laboratory conditions and then to measure the weight of the sample to check how much plastic have been degraded by which microbes. Usage of advance instruments like SEM (Scanning electron microscope) to see cracks or holes on the surface of plastic and FITR (Fourier transform infrared spectroscopy) and XPS (X- ray photoelectron spectroscopy) to study the degradation process. The study highlights the promising role of naturally occurring bacteria in the bio- degradation of plastics and supports the development of ecofriendly, microbial based approach in mitigating plastic pollution.

Keywords: Degradation; infra-red; microplastics; photoelectron; spectroscopy.

RHEOLOGICAL AND TEXTURAL INSIGHTS INTO FETA-TYPE CHEESE PREPARED FROM THE ADMIXTURE OF GOAT AND COW MILK

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Feta, a white, soft-ripened cheese, is the most renowned and traditional Greek cheese, exclusively made from goat's milk or a combination of goat and sheep milk. The global Feta cheese market size was predicted to grow from \$14.52 billion in 2024 to \$15.45 billion in 2025 at a compound annual growth rate (CAGR) of 6.4%. However, the limited availability of goat and sheep milk poses challenges in meeting this increasing demand. Therefore, it is necessary to explore the admixture of milk from different species to optimize Feta-type cheese production. In this context, the present study was aimed to evaluate the effects of admixing goat (G) and cow (C) milk in different proportions (G100, G70:C30, G60:C40, G50:C50, and C100) on the rheological and textural properties of Feta-type cheese. The rheological results revealed that at the initial temperatures of 5-40°C, the storage modulus was dominant ($G' > G''$), indicating a more elastic behaviour in all Feta-type cheese samples. However, Feta-type cheeses prepared from G60C40 and G50C50 showed the transition from elastic to liquid-like behaviour at 60°C and 45°C respectively. While the other samples such as G100, G70C30 and C100 exhibited this transition ($G'' > G'$) at a higher temperature ($>60^\circ\text{C}$), indicating a shift towards more viscous behaviour. The textural characteristics of the resulting Feta-type cheeses from admixture of goat and cow milk demonstrated that hardness increased progressively with the increased proportion of cow milk and ranged from 20.01 ± 2.07 N in the G100 Feta-type cheese to 31.04 ± 0.60 N in C100 Feta-type cheese with the admixture combination of G50C50 having the highest hardness (28.83 ± 0.55). Fracturability and adhesiveness significantly decreased with higher proportion of cow milk ($P < 0.05$). G100 exhibited the highest fracturability (10.24 ± 0.62 N) and adhesiveness (-17.09 ± 0.36 N.s), indicating increased brittleness and sticky texture. In contrast, C100 had the least fracturability (4.82 ± 0.46 N) and adhesiveness (-4.43 ± 0.17 N.s), suggesting a firmer and dried texture with reduced stickiness. Compared with G100, Feta-type cheeses containing higher proportion of cow milk showed remarkably increase in springiness, which was most pronounced in G100 (69.5%) followed by G70C30 (64.4%), G60C40 (59.3%) and G50C50 (52.5%), respectively.

Keywords: Feta-type cheese, storage modulus, elastic modulus, texture, hardness

REMOTE SENSING AND GIS-BASED EVALUATION OF AGRICULTURAL LAND USE CHANGE IN NAVSARI, GUJARAT

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Land Use and Land Cover (LULC) analysis is an essential approach for assessing the interaction between human activities and natural resources, particularly in regions undergoing rapid urbanization, agricultural transformation, and environmental pressures. The present study examines LULC changes in Navsari district, Gujarat, India, over a 26-year period (1989–2015) using multi-temporal Landsat satellite imagery. Navsari, situated in the southern coastal plains of Gujarat, is characterized by fertile agricultural land and expanding urban settlements, making it suitable for spatial-temporal LULC analysis. Satellite datasets from Landsat TM, OLI, and TIRS sensors for the years 1989, 1995, 2000, 2008, 2011, and 2015 were processed using IGIS and ArcGIS software. Pre-processing operations such as geometric rectification and spectral calibration were carried out, followed by both supervised and unsupervised classification techniques. Five LULC categories were delineated: agricultural land, barren land, built-up land, forest, and water bodies. Post-classification comparison was employed to assess spatial-temporal dynamics. The results reveal a significant decline in agricultural land, which reduced from 1764.70 km² (79.81%) in 1989 to 1535 km² (69.43%) in 2015. This decline of nearly 229.70 km², equivalent to more than 10% of the district area, reflects extensive farmland conversion into urban and industrial uses. The reduction highlights the growing pressure of urban expansion on agricultural landscapes, particularly in peri-urban zones. This study demonstrates the utility of remote sensing and GIS in monitoring land cover dynamics and provides critical insights into agricultural land shrinkage. The findings emphasize the urgent need for sustainable land and water management strategies to balance development with food security and environmental conservation in southern Gujarat.

Keywords: Land Use Land Cover (LULC), Remote Sensing, GIS, Navsari, Landsat, Agriculture, Spatial-Temporal Analysis, Watershed Management

ASSESSMENT OF PHYSICOCHEMICAL PARAMETERS IN SPRING WATER OF INDIAN HIMALAYAN REGION, MAHARAJA VALLEY, KULLU

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This study focuses on the physicochemical assessment of spring water in the Maharaja Valley, a part of the Indian Himalayan region. The main aim is to evaluate the quality, safety, and suitability of spring water for domestic and drinking purposes by analyzing key physical and chemical parameters. In villages where there is no municipal supply water through pipe, so spring water serves as the sole source of drinking water. Himachal Pradesh, nestled in the pristine Himalayas of India, is renowned for its breath-taking landscapes and abundant natural resources. Mountain springs are the main source of water for the rural households in the region. Around 60% of the population is entirely dependent on spring water due to limited availability or inaccessibility of the alternative surface water sources. As the demand for clean and safe drinking water grows, it becomes crucial to assess the quality of spring water in Himachal Pradesh. Therefore, in this study, we have assessed physico-chemical properties such as pH, EC, total dissolved solid (TDS), hardness, chloride, sodium, potassium, nitrate, sulphate of 10 spring samples from different altitudinal sites of Maharaja valley region in Kullu district of Himachal Pradesh. Analytical results were compared with prescribed BIS potability 2012 parameters for drinking purposes. Overall results for the assessed parameters are within the permissible limits for most of the sites with few exceptions for locations. S1Khalogi I, SKhalogi II, and S3Muthal I, showed high magnesium content (108.2378 to 183.1601) more than BIS permissible limit of 100mg/L. and S3 showed high EC i.e., 456µS/cm which is more than permissible limit of 400 µS/cm. A correlation matrix has been created to analyse and observe the significance of the factors on spring water quality assessment. The value of 0.98 indicates high positive correlation between EC and TDS. The drinking water quality index ranged from 15.64 to 49.39, indicating that the majority of valley springs have excellent to good water quality. Hence the spring waters in the study area are safe for drinking as well as for irrigation. Overall, the study suggests that the water in Kullu Valley is generally good, but there are concerns about anthropogenic interventions and the need for treatment prior to drinking.

EMERGING TRENDS IN AGRICULTURAL WASTE MANAGEMENT & CIRCULAR ECONOMY IN SELECTED VILLAGES OF MEERUT DISTRICT (UTTAR PRADESH)

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Purpose- This paper studied the current and emerging trends related to agricultural waste management and circular economy in selected villages of Meerut District (Uttar Pradesh). **Methodology-** The paper employed the exploratory research design in the initial stage for identifying the key trends and furthermore descriptive research design to analyze the primary data. The sample unit was the farmers of 10 villages of Meerut District conveniently selected in different villages under study. ***Findings-** The findings of the study revealed that most of the respondents are educated and seeking the help of young educated people for utilizing latest techniques to reduce the wastage with application of appropriate waste management techniques impacting the circular economy as a whole. **Practical Implication-** The study was highly practical being 'Agricultural Waste Management' had been the most sought transformation in recent times and every social unit was responsible for the same. Farmers nowadays collectively thinking for circular economy practices at ground level and impacting the agricultural economy in a better way. **Originality/Value-** The study was highly valuable because the entire world had been stepping towards the environment consciousness through waste management and circular economy and the paper was original as it was based on primary data as till date such study has not been conducted yet in this area.

Keywords: Agriculture, Circular economy, Farmers, Meerut District, Recycle, Waste management

THE ONCOGENIC ROLE OF MIR-21 IN PROSTATE CANCER: LINKING DYSREGULATION TO APOPTOTIC RESISTANCE

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Background: MicroRNAs are small, non-coding RNA molecules that regulate important cellular processes such as tumorigenesis, cell proliferation, and apoptosis. Cancer stem cells are a subset of cells that control metastasis and cell proliferation. In this study, we focus on the roles of miR-21 and their correlation with genes in the apoptotic pathway and cancer stem cells in different stages of PCa. **Methods:** In total, 40 patients, each group with Benign prostatic hyperplasia (BPH), localised PCa, and metastatic PCa, were recruited. MicroRNA and gene expression were estimated through quantitative polymerase chain reaction (qPCR). Flow cytometry was used to characterise prostate cancer stem cells (PCSCs), estimate reactive oxygen species (ROS), and apoptosis, and chemiluminescent immunoassay was used to estimate prostate-specific antigen (PSA), and testosterone. **Results:** The fold change mean expressions of miR-21, Cytochrome C, and B-cell lymphoma 2 (BCL-2) were significantly upregulated in localised and metastatic PCa compared with BPH. In contrast, the mean fold change expressions of, Bcl-2-associated X protein (BAX), Caspase-3, Caspase-9, and Second mitochondria-derived activator of caspase (SMAC) were lower in localised and metastatic PCa compared to BPH. The levels of PSA and testosterone also showed a significant increase while apoptosis was significantly decreased in both localized PCa and metastatic PCa as compared with BPH. Our study also found a high expression of CD44⁺/CD24⁻ and CD44⁺/CD133⁺ in localised and metastatic PCa compared with BPH. **Conclusion:** Our findings suggest miR-21 may target apoptotic genes involved in PCa pathogenesis and could be used as biomarkers for the diagnosis of PCa.

Keywords: miRNAs expression, Prostate cancer, stem cell, apoptotic pathway mRNA expression.

ENHANCING MAIZE PRODUCTION IN THE CATCHMENT AREAS OF ETHANOL INDUSTRY CLUSTERS IN ANDHRA PRADESH

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An analysis was drawn through the evaluating the impact of improved maize hybrids and best management practices (BMPs) demonstrated to enhance maize productivity and profitability in the catchment areas of ethanol industry clusters in Andhra Pradesh. This initiative supports the national objective of increasing ethanol blending in fuel by diversifying feedstock from traditional crops like sugarcane to maize, a more water-efficient and high-starch alternative. Large-scale field demonstrations of high-yielding hybrids (*Kharif* hybrids: **Super 6**, and **BIO 9766, DHM 117, DHM 121, DKC 9133, PAC 751, PAC 741, GENOMIX-305**, and *Rabi* hybrids: P 3567 and P 3312) were conducted across the *Kharif* 2024 and *Rabi* 2024–25 seasons, **covering 100 acres for each season** across districts like Kakinada, Krishna, and East Godavari. Results showed that the adoption of improved technologies significantly **increased average yields** by up to **6.9% (*Kharif*)** and **3.3% (*Rabi*)** compared to local checks. Economically, improved practices delivered a better **Benefit-Cost (B:C) ratio of 1.6** (versus 1.3 for local checks). Analysis of the technology index (12–22%) revealed a substantial unrealized yield potential, suggesting that continued farmer capacity building and the rigorous adoption of BMPs are essential. The study concludes that the strategic introduction of improved maize varieties and scientific management is an effective model for sustainably enhancing farmer livelihoods and securing a reliable, locally-sourced supply chain for the state's ethanol industry.

Keywords: Ethanol, Maize hybrid, Productivity, Profitability, Technology Index.

UNRAVELING TRAIT INTERACTIONS FOR SEED YIELD IMPROVEMENT IN COWPEA

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Seed yield in cowpea (*Vigna unguiculata* L. Walp.) is a complex trait governed by several interrelated yield components. The present study evaluated sixty five cowpea genotypes in *Rabi* at the College of Agriculture, Navile, Shivamogga, to assess the association among yield and its contributing traits through correlation and path coefficient analysis. Correlation analysis revealed that seed yield per plant had a significant positive association with number of clusters per plant ($r = 0.82$), number of pods per plant ($r = 0.79$), number of pods per cluster ($r = 0.75$), number of primary branches per plant ($r = 0.66$), number of seeds per pod ($r = 0.59$), pod length ($r = 0.57$), and number of secondary branches per plant ($r = 0.50$), indicating that improvement in these traits would effectively enhance seed yield. Conversely, days to 50 per cent flowering ($r = -0.28$) and days to maturity ($r = -0.25$) exhibited negative associations with yield, suggesting that early flowering and maturity favor higher productivity. Path coefficient analysis further revealed that the number of clusters per plant exerted the highest positive direct effect on seed yield (1.2885), followed by number of pods per plant (0.3104), number of primary branches per plant (0.1191), and number of secondary branches per plant (0.0211), while pod length (-0.7991), plant height (-0.1174), number of seeds per pod (-0.0444), and test weight (-0.0035) showed negative direct effects. Hence, selection based on number of clusters per plant, number of pods per plant, and number of primary branches per plant would be most effective for improving seed yield in cowpea.

Keywords: Cowpea, seed yield, correlation, path coefficient analysis, yield components, genetic improvement, selection

ORGANIC AND INORGANIC FARMING PRACTICES IN EAST KHASI HILLS DISTRICT, MEGHALAYA
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Agriculture is the primary livelihood source for the people of Meghalaya, where different climatic conditions and rich soils support colorful husbandry systems. Traditionally, growers have rehearsed organic styles similar as mixed cropping, composting, crop gyration, and the use of beast ordure to maintain soil fertility and ecological balance. These practices have sustained original biodiversity and assured long- term soil health. still, with adding population pressure and the demand for advanced yields, numerous growers have shifted toward inorganic husbandry styles involving chemical diseases, fungicides, and cold-blooded seeds. While inorganic husbandry has helped in perfecting short- term productivity, it has also led to soil nutrient loss, water pollution, and reduced soil microbial exertion. In discrepancy, organic husbandry preserves environmental quality, improves soil structure, and promotes sustainable husbandry, though it may yield lower originally. The concurrence of both systems in Meghalaya reflects an agrarian transition driven by modernization and request requirements. Government enterprise similar as organic instrument, planter training programs, and the creation of bio- fertilizers are encouraging a shift back toward sustainable practices. An intertwined approach that combines traditional organic knowledge with ultramodern scientific ways can balance productivity with environmental safety. This study examines the relative impact of organic and inorganic husbandry practices in Meghalaya on soil quality, crop productivity, and ecological sustainability. It emphasizes the need for region-specific, eco-friendly agrarian models that enhance food security while conserving the state's rich natural terrain.

Keywords: Organic farming, Inorganic farming, Meghalaya, Soil quality, Sustainability.

EVALUATION OF CLUSTER BEAN (*CYAMOPSIS TETRAGONOLOBA* L.) GENOTYPES FOR GROWTH, YIELD AND QUALITY TRAITS

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Cluster bean is a legume crop that is used for vegetable and industrial purposes. Cluster bean genotypes must be evaluated in order to engage in selection of genotypes for further breeding programme. The present study on 'Evaluation of Cluster bean (*Cyamopsis tetragonoloba* L.) genotypes for growth, yield and quality traits' was carried out at Department of Horticulture, College of Agriculture, University of Agricultural Sciences, GKVK, Bengaluru during 2023. The twenty-seven genotypes including one check variety were evaluated by following Randomised Block design with two replications to generate and interpret information on mean performance of genotypes for growth, yield and quality parameters. The analysis of variance exhibited highly significant differences among the genotypes for all the characters under the study. According to mean performance, the genotypes IC-11501 (146.54 q/ha), IC-41170 (140.46 q/ha), IC-11376 (134.81 q/ha) and Bidar Local (134.78 q/ha) recorded higher yields. In addition to yield, the highest crude protein content was observed in genotypes IC-41177 (21.36 %), Bellary Local (19.99 %), IC-11427 (19.85 %) and Mysore Local (19.81 %), whereas genotypes Bidar Local, Bellary Local, and Kodagu Local have more than 8 days of shelf life indicating that such genotypes can be used in trait-specific breeding programs.

Keywords: Cluster bean, Growth, Yield, Quality, Mean performance

CLIMATE CHANGE AND AGRICULTURE: ADAPTIVE STRATEGIES FOR RESILIENT FARMING SYSTEMS

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CRA refers to the application of mitigation, adaptation, and other agricultural methods that improve the system's ability to withstand harm and bounce back swiftly from a variety of climate-related disruptions. Such perturbations and disturbances can include events such as drought, flooding, heat/cold wave, erratic rainfall pattern, long dry spells, insect or pest population explosions and other perceived threats caused by changing climate. In short it is the ability of the system to bounce back. Climate resilient agriculture includes an in-built property in the system for the recognition of a threat that needs to be responded to, and also the degree of effectiveness of the response. CRA will essentially involve judicious and improved management of natural resources viz., land, water, soil and genetic resources through adoption of best bet practices.

Keywords- Climate, Climate resilient agriculture, drought and cold wave

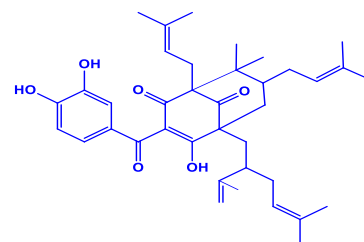
GARCINOL – A PROBABLE DRUG CANDIDATE

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Garcinol is a natural product found in *Garcinia indica* (commonly known as kokum), belonging to the Clusiaceae family (mangosteen family), *G. indica* is a fruit-bearing tree that has culinary, pharmaceutical, and industrial uses. *G. indica* has been used in traditional medicine to treat inflammation, dermatitis, and diarrhea, and to promote digestion. *G. indica* has antioxidant, anti-obesity, anti-arthritis, anti-inflammatory, antibacterial, cardioprotective, antidepressant and anxiolytic effects both in vitro and in vivo¹. Garcinol and its semi synthetic derivatives as epigenetic tools that alter histone acetyl transferases (HAT) activity², a histone butyrylation with adipogenesis³.



Keywords: Garcinol, *Garcinia indica*, histone acetyl transferases

LITERATURE AND BIODIVERSITY CONSERVATION: NARRATIVE AS ESSENTIAL PRACTICE IN ENVIRONMENTAL GOVERNANCE

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Biodiversity loss accelerates despite unprecedented scientific documentation of ecological mechanisms and conservation strategies. The gap between scientific knowledge and conservation action reveals that environmental challenges are fundamentally narrative and cultural problems requiring engagement with human meaning-making and community participation. This paper argues that literature constitutes essential infrastructure for biodiversity conservation by accomplishing what empirical science cannot: translating abstract ecological data into narratives that mobilize community participation, shape policy outcomes, and foster ethical commitment to nonhuman life. Through analysis of Rachel Carson's *Silent Spring* (1962) and Robin Wall Kimmerer's *Braiding Sweetgrass* (2013), this paper demonstrates how narrative succeeds in generating conservation outcomes when scientific documentation alone has failed. The paper concludes that biodiversity professionals and conservation governance institutions require integration of literary perspectives to accomplish effective conservation aligned with contemporary environmental challenges.

Keywords: Biodiversity conservation, narrative epistemology, Rachel Carson, Robin Wall Kimmerer, community engagement, policy change, environmental literature

IN SILICO VALIDATION OF BIOACTIVE COMPOUNDS FROM LEUCAS ASPERA METHANOLIC EXTRACT USING MOLECULAR DOCKING AND GC-MS INTEGRATION: A BIOINFORMATICS APPROACH TO SUSTAINABLE ANTIMICROBIAL DEVELOPMENT

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In an era of escalating antimicrobial resistance and climate-induced crop losses, *Leucas aspera* (Lamiaceae) a resilient Indian ethnomedicinal weed emerges as a beacon of sustainable bioprospecting. This study presents a **hybrid wet-dry lab framework** integrating empirical antimicrobial validation with cutting-edge bioinformatics to unlock its therapeutic and agro-protective potential. Methanolic leaf extract, prepared via Soxhlet-assisted dry extraction, yielded 1.44 g of crude bioactive matrix. Qualitative phytochemical screening revealed a rich arsenal of **alkaloids, flavonoids, tannins, saponins, terpenoids, and phenols**. Agar well diffusion assays demonstrated **broad-spectrum efficacy**, with zones of inhibition spanning **14–23 mm** across Gram-positive (*Staphylococcus aureus*, *S. haemolyticus*) and Gram-negative (*Escherichia coli*, *Pseudomonas aeruginosa*) pathogens peaking at **23 mm** against *S. aureus* (120 µL). GC-MS profiling unveiled **12 high-abundance phytoconstituents**, dominated by a signature peak at **RT 17.44**. Molecular docking via **CB-Dock** elucidated atomic-level interactions: top ligands exhibited **binding affinities of –6.8 to –8.2 kcal/mol** against critical bacterial targets **DNA gyrase (*S. aureus*)**, **FabH (*E. coli*)**, and **LasR (*P. aeruginosa*)** mediated by hydrogen bonds and π - π stacking. **In vitro–in silico correlation** confirmed predictive accuracy ($R^2 > 0.87$). This **open-source, cost-effective pipeline** transforms *L. aspera* into a **dual-purpose bio-resource**: a **natural antibiotic alternative** and **eco-friendly biopesticide**, reducing synthetic chemical dependency in healthcare and climate-smart agriculture. Aligned with **SDG 2 (Zero Hunger)** and **SDG 15 (Life on Land)**, it empowers rapid screening of native flora for **resilient, sustainable disease management**.

Keywords: *Leucas aspera*, GC-MS, molecular docking, bioinformatics, sustainable biopesticide, antimicrobial resistance, climate-resilient agriculture

ADVANCED PH RESPONSIVE LIPOSOME FOR NUTRACEUTICAL APPLICATIONS

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Proteins and peptides, rich in bioactive compounds, are increasingly recognized for their health benefits and potential in nutraceutical applications. The study addresses the challenges associated with peptide stability, release profile and production costs by exploring the encapsulation of bioactive peptides using advanced pH responsive liposomes. Liposomes offer a versatile platform for encapsulating both hydrophilic and hydrophobic substances but suffer from stability issues and high release rates. pH responsive liposomes delivery represents a cutting-edge strategy to maximize the nutraceutical efficacy of bioactive peptides. This research investigates the efficacy of pH responsive liposomes for peptide delivery, focusing on optimizing chitosan concentration to enhance liposomal stability and control peptide release. An optimal chitosan concentration of 0.4% (w/v) was identified, achieving 82% encapsulation efficiency. Characterization techniques and stability studies, including thermo gravimetric analysis and *in vitro* pH and storage stability assessments, confirmed that chitosan coating significantly improved the physical stability and structural integrity of liposomes. Comparative studies demonstrated that pH responsive liposome outperformed conventional liposomes in controlling peptide release, indicating their potential for sustained therapeutic effects. Chitosan coats liposomes through electrostatic interaction and, owing to its pH-dependent protonation, imparts pH sensitivity that enables stable coating in acidic environments and controlled drug release at neutral/alkaline pH. These findings highlight pH responsive liposomes as a promising delivery system for enhancing peptide stability and functionality, with implications for advancing pharmaceutical and biomedical applications.

Keywords: Liposome, chitosan coating, pH responsive liposome, encapsulation efficiency, release profile, stability study

AN INVESTIGATION ON NITROGEN METABOLISM IN *NOSTOC SPONGIAEFORME* AND ITS MUTANT STRAIN

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Cyanobacteria are pivotal photosynthetic microorganisms in aquatic ecosystems but are susceptible to herbicides like pretilachlor. The herbicide Pretilachlor has been widely utilized in agriculture to control weeds, yet its impact on non-target organisms, particularly cyanobacteria, remains underexplored. This study investigates resistance mechanisms of Pretilachlor in *Nostoc spongiaeforme* and its mutant strain and explores their implications for nitrogen metabolism, the effects of Pretilachlor exposure on nitrogen metabolism, including nitrogen fixation, assimilation, and utilization pathways. Respiration and nitrogen assimilation processes were influenced by pretilachlor, with *Nostoc spongiaeforme* bearing the brunt of the impact. The frequency of heterocysts increased in both strains, while nitrogenase activity was initially inhibited but eventually recovered in Ns(MHR). Notably, pretilachlor had a more significant impact on glutamine synthetase (GS) in *N. spongiaeforme* compared to Ns(MHR). Nitrate uptake was negatively affected in *N. spongiaeforme* but remained unscathed in the herbicide-resistant Ns(MHR). Our findings shed light on the intricate interplay between herbicide exposure, cyanobacterial physiology, and nitrogen dynamics in aquatic and terrestrial ecosystems.

Keywords: Cyanobacteria, glutamine synthetase, nitrogen metabolism, *Nostoc spongiaeforme*, Pretilachlor.

TRANSCRIPTOME ANALYSIS OF *RAUVOLFIA SERPENTINA* REVEALS TISSUE-SPECIFIC EXPRESSION OF RESERPINE BIOSYNTHESIS GENES

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Rauvolfia serpentina, often referred to as Indian snakeroot, is a fascinating medicinal plant that has garnered significant attention in the pharmacological world, primarily because it produces reserpine. This indole alkaloid is known for its neuroactive properties and is used to treat conditions like hypertension and various neurological disorders. However, despite its importance in medicine, we still have a lot to learn about how this plant specifically synthesizes its alkaloids in different tissues. In our study, we took a closer look by conducting a comparative transcriptome analysis of the root and leaf tissues, utilizing publicly available RNA-seq datasets (PRJNA223168) to pinpoint the genes involved in reserpine biosynthesis. We carefully checked the quality of the raw sequencing reads, trimmed them, and quantified the data using Salmon against the assembled transcriptome. For the differential gene expression analysis, we used DESeq2 in R, and we also performed functional enrichment through GO and KEGG pathway analyses. Our findings highlighted a clear tissue-specific expression pattern, showing that key enzymes in the indole alkaloid biosynthesis pathway like tryptophan decarboxylase and strictosidine synthase were significantly more active in the roots than in the leaves. The functional enrichment analysis further supported this, revealing an overrepresentation of terms related to tryptophan metabolism, monoterpenoid biosynthesis, and secondary metabolite processes. These insights lay a molecular foundation for understanding how reserpine biosynthesis is localized and regulated in *R. serpentina*, which could inform efforts in metabolic engineering and the sustainable production of important pharmacological alkaloids. This study showcases the power of transcriptome-level analysis in bridging traditional medicinal knowledge with molecular mechanisms, emphasizing the potential of *R. serpentina* as a model for exploring neuroactive plant metabolites.

Keywords: *Rauvolfia serpentina*, RNA-seq, reserpine, differential expression, alkaloid biosynthesis, neuropharmacology

ASSESSMENT OF FOUR CHICKPEA (*CICER ARIETINUM* L.) CULTIVARS CULTIVATED IN THE SEMI-ARID ZONE OF SIRSA, HARYANA

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Chickpea (*Cicer arietinum* L.) is one of the highly nutritious pulse crops contributing considerably to global food security, especially in semi-arid areas. Chickpea is an excellent source of vitamins (A, C, E, K, B-complex) and minerals (Fe, Zn, Mg, and Ca), all of which are crucial for human health, including perhaps being advantageous to diabetics. The present research presents a thorough morphological and biochemical description of four chickpea cultivars, HC-6, HC-7, GNG-2171, and CSS-151, grow in Sirsa, Haryana, India. The study employed a randomised complete block design and collected data on key biochemical and agronomic traits, including protein content, mineral content, antioxidants, and anti-nutritional components, as well as Height of the plant, amount of pods, and days till blooming. There was major variation across cultivars for morphological and biochemical traits. GNG-2171 was the most nutritionally high-value genotype, having the most crude protein (31.28%), mineral content, and antioxidant activity, whereas CSS-151 was the lowest in nutritional value and held the largest level of anti-nutritional chemicals. PCA and correlation matrix analysis also showed substantial inter-relationships among characteristics, notably between plant height and nutritional quality. The results show the usefulness of GNG-2171 as a candidate for biofortification and breeding programmes to boost production, nutritional content, and tolerance to semi-arid agro-climatic conditions.

Keywords: Chickpea, *Cicer arietinum*, morphological characterization, biochemical analysis, genetic diversity, breeding

GENETIC DIVERSITY ANALYSIS AMONG *SOLANUM TUBEROSUM* GENOTYPES UNDER INDO-GANGETIC PLAIN

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A Research, titled “Genetic diversity analysis among *Solanum tuberosum* genotypes under Indo-Gangetic plain” was conducted at the Potato Research Farm, TCA Dholi, Bihar, during the Rabi season of 2023-2024. Understanding the nature and extent of genetic divergence helps plant breeders in selecting and hybridizing suitable parents to develop superior genotypes with improved quality traits. The primary objective was to assess the genetic diversity and identify genotypes with superior traits for various breeding programs. The material consisted of 26 *tuberosum* genotypes used in a RBD with 3 replications. Tocher’s method of clustering grouped the 26 *tuberosum* genotypes into seven distinct clusters. Cluster I contained the more number of genotypes (13), followed by Cluster III with 5 genotypes, while Cluster II had three genotypes. Clusters V, VI, and VII were mono-genotypic. Clusters I and V has the lowest inter-cluster distance (196.41) whereas between cluster IV and VII highest inter cluster distance 1180.82 was governed. Maximum contribution to total genetic diversity was recorded for the number of tubers per plant. Cluster III of the *tuberosum* genotypes showed the highest mean values for important traits such as tuber yield, number of compound leaves per plant, and plant height. CP1215, CP1157 and CP1596 genotypes from Cluster II can be used for the early maturing variety breeding programs. Genotypes such as CP2298, CP3674, and CP4404 from Cluster III were used as potential donor parents for hybridization programs aimed at improving potato yield under Indo-Gangetic plain conditions.

Keywords: Cluster analysis, Genetic diversity, *Solanum tuberosum*, Selection and Tuber yield.

MARINE-DERIVED *BACILLUS SUBTILIS* OS40 FROM INDIA'S WEST COAST: A MULTIFUNCTIONAL PROBIOTIC CANDIDATE FOR SUSTAINABLE AQUACULTURE AND ANTIMICROBIAL RESISTANCE MITIGATION

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Antimicrobial resistance (AMR) in expanding aquaculture necessitates environmentally safe, host-adapted alternatives to antibiotics under One Health frameworks. India's monsoon-upwelling West coast harbours unique marine microbiomes that may yield specialised probiotic candidates with enhanced functionality for aquatic systems. Gut-associated bacteria were isolated from three wild marine species: *Sardinella longiceps*, *Rastrelliger kanagurta*, and *Loligo duvaucelii*. A total of 177 bacterial isolates were comprehensively screened for probiotic characteristics, including enzymatic activity, pathogen antagonistic activity, co-aggregation, biofilm formation, acid/bile tolerance, antibiotic susceptibility, haemolytic activity and gnotobiotic *Artemia* survival assay and LC-MS analysis of BLIS. Strain OS40 revealed $\geq 99\%$ identity with *Bacillus subtilis* (GenBank: PV685121), a GRAS bacterium, exhibited exceptional multifunctional capabilities, accompanied by substantial enzyme production. Time-dependent pathogen co-aggregation reached $43.5 \pm 2.2\%$ with *Vibrio vulnificus* and $40.2 \pm 1.9\%$ with *Aeromonas salmonicida* at 24 hours. Biofilm formation ($OD_{570} = 0.82 \pm 0.04$) was comparable to *Lactobacillus acidophilus*. Mass spectra showed major ions (m/z 421.3, 684.5, 754.6, 1167.8) eluting between Retention Times (RT) 2.1–7.6 min, suggestive of BLIS-like antimicrobial peptides typical of *Bacillus* spp. Complete antibiotic sensitivity across 13 antibiotics and γ -haemolytic behaviour confirmed a safe profile. *Bacillus subtilis* OS40 represents a promising multifunctional probiotic candidate addressing both digestive enhancement and pathogen biocontrol in aquaculture. OS40's complete antibiotic sensitivity profile supports AMR mitigation. Further studies involve genome mining, in vivo assessment of *Bacillus subtilis* OS40 in the *Oreochromis niloticus* model.

Keywords: fish gut microbiota, *Bacillus subtilis*, antimicrobial resistance, aquaculture sustainability

EFFECT OF PARTIAL REPLACEMENT OF FISH MEAL WITH DE-OILED SILKWORM (*BOMBYX MORI*) PUPAE MEAL ON GROWTH PERFORMANCE, IMMUNE RESPONSE, DISEASE RESISTANCE, HAEMATOLOGY AND GUT HISTOLOGY IN RUPCHANDA (*Piaractus brachypomus*)

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Aquaculture is one of the fastest-growing food production sectors and is key in meeting global protein needs. Reliance on fishmeal poses sustainability challenges due to rising costs and limited availability. Insects, especially de-oiled silkworm pupae meal (*Bombyx mori*), are emerging as sustainable alternatives because of their rich protein, balanced amino acids, and bioactive compounds. This study evaluated the partial replacement of fishmeal with silkworm pupae meal in rupchanda (*Piaractus brachypomus*) diets, focusing on growth, immunity, disease resistance, haematology, and gut histology. A 90-day trial was carried out with four diets: control (T0, 0% SWPM) and treatments replacing fishmeal at 25% (T1), 50% (T2), and 75% (T3). All diets had 30% crude protein and were tested in triplicate. Growth performance, immune response, disease resistance against *Aeromonas hydrophila*, haematology, and gut histology were assessed. The study showed that replacing 50% of fishmeal with silkworm pupae meal (T2) gave the best results, with the highest weight gain, better FCR, and improved protein use. Although the 75% group (T3) also improved growth, it slightly reduced haemoglobin and WBC counts. Immune response was stronger in all treated groups, with T3 showing the highest lysozyme activity and full survival after bacterial challenge. Gut histology revealed taller and wider villi in all treatments, suggesting better nutrient absorption. Overall, silkworm pupae meal can safely replace up to 50% of fishmeal in *Piaractus brachypomus* diets, supporting good growth, stronger immunity, and healthier gut structure, making it a sustainable alternative for aquaculture.

SPAWN DEVELOPMENT AND PURE CULTURE ESTABLISHMENT OF *TUBER RUFUM* (TRUFFLE): TOWARD SUSTAINABLE DOMESTICATION AND CONSERVATION

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Edible wild mushrooms are valuable forest resources with significant nutritional, ecological, and socio-economic importance. Among them, the truffle species *Tuber rufum*, found in forest habitats, is highly regarded for its unique flavor, commercial potential, and contribution to rural livelihoods. However, its availability is constrained by seasonal wild collection and the absence of reliable cultivation and spawn production protocols, leading to overexploitation and threats to its natural populations. In this study, pure culture of *Tuber rufum* were successfully initiated from fruiting bodies collected in the field and evaluated on different media. Malt Extract Agar (MEA), Potato Dextrose Agar (PDA), and Malt Yeast Extract Agar (MYEA) were compared for mycelial growth. PDA proved to be the most effective medium, enabling rapid and consistent mycelial growth with complete colonization of Petri plates within 15 days. Growth on MEA and MYEA was comparatively slower and less dense. Sorghum grains were selected as the substrate for spawn development owing to their high nutritional content and ability to support vigorous colonization. The spawn was successfully established and stored under controlled for future cultivation trials. The results demonstrate that PDA medium is optimal for pure culture establishment, while sorghum grains serve as an efficient substrate for spawn production. These findings provide a foundation for systematic domestication of *Tuber rufum*, promoting sustainable cultivation practices. Beyond cultivation, such efforts are vital for conserving natural populations, reducing dependency on wild harvesting, enhancing nutritional security, supporting livelihoods, and safeguard biodiversity for future generations.

Keywords: Wild edible mushrooms; pure culture; spawn production; sustainable use; biodiversity conservation.

PRODUCTIVITY ENHANCEMENT IN COWPEA THROUGH NUTRIENT MANAGEMENT, BIOFERTILIZERS, AND FOLIAR FERTILIZATION UNDER SEMI-ARID CONDITIONS

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Sustainable intensification of pulse-based systems is critical for ensuring food and nutritional security in semi-arid regions. A field experiment on Integrated Nutrient Management (INM) in summer cowpea (*Vigna unguiculata* L.) was conducted during summer 2025 at Hisar to evaluate the effect of fertilizer dose, seed inoculation with biofertilizers, and foliar nutrition on productivity and resource-use efficiency. The study compared 100% and 75% recommended dose of fertilizers (RDF), seed inoculation with *Rhizobium* + Biophos + Biozinc or NPKZn microbial consortia, and foliar sprays of NPK (19:19:19 @ 2%), Nano-DAP (0.4%), Nano-Urea (0.4%), and water at pre-flowering and pod initiation stages. Results revealed that 100% RDF produced the highest seed yield (716.6 kg/ha) and biological yield (5793.7 kg/ha). Among inoculation treatments, *Rhizobium* + Biophos + Biozinc significantly enhanced seed yield (705.67 kg/ha) and biological yield (5764.4 kg/ha) over control, indicating the potential of microbial consortia in reducing chemical fertilizer dependence. Foliar application of NPK (19:19:19) @ 2% at pre-flowering and pod initiation recorded the highest seed yield (721.1 kg/ha) and harvest index (13.0%), outperforming water spray and nano-fertilizer treatments. The findings highlight that integrating reduced fertilizer dose with bio-inoculants and balanced foliar feeding can maintain yield levels while minimizing chemical inputs. Such INM practices not only improve nutrient-use efficiency but also support sustainable crop production under resource-constrained and climate-vulnerable environments. Hence, adopting INM in cowpea holds promise for strengthening climate-smart and sustainable crop production systems, especially in resource-constrained semi-arid regions.

Keywords: Cowpea, Integrated Nutrient Management, Biofertilizers, Foliar nutrition, Sustainable

XYLANASE POTENTIAL OF SCREENED FUNGI FROM INDIGENOUS LITTER

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Fungi are key decomposers in our ecosystem. They play a significant role in the breakdown of biological organic compounds such as cellulose, hemicelluloses, and lignin by secreting extracellular enzymes into their environment. In the present study thirty-three fungal species were isolated, identified, and tested for xylanase producing abilities using the well diffusion method with 1% oat spelt xylan as the sole carbon source. Out of them, only twenty four fungal species i.e. *Ascochyta graminicola*, *Aspergillus flavipes*, *Aspergillus flavus*, *Aspergillus fischeri*, *Aspergillus fumigatus*, *Aspergillus japonicus*, *Aspergillus nidulans*, *Aspergillus niger*, *Aspergillus terreus*, *Aspergillus tamarii*, *Chaetomium salami*, *Cladosporium sphaerospermum*, *Curvularia lunata*, *Emericella nidulans*, *Fusarium oxysporum*, *Gibberella zeae*, *Mucor hiemalis*, *Paecilomyces variotii*, *Pestalotiopsis mangiferae*, *Penicillium chrysogenum*, *Penicillium decumbens*, *Rhizopus stolonifer*, *Scopulariopsis brumptii* and *Trichoderma viride* were recorded to have xylanolytic activity. The highest xylanase activity index was found with *Rhizopus stolonifer* and several parameters such as incubation period, temperature, pH, carbon and nitrogen sources were optimized for maximum xylanase production under solid state fermentation using wheat bran and corn cobs as substrates.

Keywords: Fungi, Litter, Solid State fermentation, Xylanase.

COMPARATIVE EVALUATION OF QUANTITATIVE AND QUALITATIVE ANALYSIS OF KODO MILLET SEEDS, WITH GC-MS PROFILING OF ITS MICROGREENS

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Kodo millet (*Paspalum scrobiculatum* L.) is an underutilized cereal grain known for its rich nutritional composition and resilience under harsh agroclimatic conditions. The present study aimed to evaluate the quantitative and qualitative changes in bioactive compounds and antioxidant potential of Kodo millet seeds and their microgreens, with special emphasis on phytochemical profiling through gas chromatography–mass spectrometry (GC–MS). Seeds were subjected to soaking and germination under controlled conditions to obtain microgreens, which were subsequently analyzed for primary and secondary metabolites. The results revealed a marked enhancement in total phenolics, flavonoids, and antioxidant activity in microgreens compared to ungerminated seeds, suggesting biosynthesis and accumulation of bioactive constituents during germination. GC–MS profiling of microgreens identified a wide range nutraceutical potential of Kodo millet, positioning its microgreens as a promising functional food source.

Keywords: Kodo millet, microgreens, antioxidant activity, phytochemical profile, GC–MS, bioactive compounds.

EFFECTS OF MYCORRHIZAL BIOFERTILIZER ON ENHANCING YIELD OF *LENS CULINARIS* MEDIK

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The present experiment investigated the effects of *Rhizobium* and mycorrhizal fungal spores on two different varieties of *Lens culinaris* (Narendra Masoor-1 and Shekhar-2). Lentil varieties were cultivated in the research field of Bipin Bihari College, Jhansi, Uttar Pradesh. Lentil seeds have been inoculated separately and in combination with *Rhizobium* and mycorrhizal spores. Plant height, weight, number of root nodules and pods, amount of chlorophyll, leaf area, and total yield were all measured after germination. This data was collected 30 days, 45 days, 60 days, 75 days, 90 days, and 120 days after seeding. These tests revealed that mycorrhiza and *Rhizobium* had a positive impact on the growth and yield of the lentil plant. The results are better when *Rhizobium* and mycorrhiza are inoculated together than when they are inoculated separately.

Keywords: *Lens culinaris*, Mycorrhiza, *Rhizobium*, Biofertilizer

INTEGRATED ANTIOXIDANT AND CULTURE CONDITION STRATEGIES FOR CONTROLLING LETHAL BROWNING IN BANANA TISSUE CULTURE

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Banana tissue culture is an advanced clonal propagation technique that enables rapid, large-scale multiplication of genetically uniform and pathogen-free plantlets. However, lethal browning remains a major bottleneck, severely compromising explant viability and regeneration. This phenomenon is primarily caused by enzymatic oxidation of phenolic compounds, leading to melanin formation, growth inhibition, and eventual tissue death. To address this challenge, the present study evaluated three approaches: pre-soaking treatments, antioxidant supplementation in media, and optimized culture conditions. Pre-soaking explants in a combined solution of potassium citrate and citric acid (4:1 ratio) significantly reduced tissue browning compared to citric acid, potassium citrate, or ascorbic acid alone. In the culture medium, supplementation with 40mg/L ascorbic acid, 30 mg/L cysteine, or 50 mg/L potassium citrate effectively minimized browning symptoms relative to other tested concentrations. Furthermore, maintaining culture room conditions at 23°C, with 1600 lux light intensity and media pH 5.7, provided an optimal environment to alleviable stress-induced browning. The integration of these strategies not only controlled lethal browning but also improved explant survival, growth, and culture establishment rates. Importantly, these protocols will be highly beneficial for the mass production of banana plantlets through tissue culture, thereby enhances multiplication efficiency, reduces losses during subculturing, and strengthens both commercial macropropagation.

Keywords: Banana micropropagation; lethal browning; antioxidants; phenolic oxidation; tissue culture optimization.

HARNESSING ENDOPHYTES AS BIO-ALLIES FOR DROUGHT STRESS RESISTANCE IN CROPS

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Drought stress is one of the most severe abiotic challenges limiting agricultural productivity worldwide. Conventional breeding and genetic engineering approaches have improved drought tolerance in crops to some extent, but sustainable, eco-friendly solutions are urgently needed. Endophytes - symbiotic fungi and bacteria residing inside plant tissues without causing harm are emerging as powerful allies in enhancing plant resilience to drought. Endophytes contribute to drought stress tolerance through multiple physiological, biochemical, and molecular mechanisms. They improve root architecture and water uptake efficiency, enhance osmolyte accumulation (proline, sugars, glycine betaine), and stimulate antioxidant defense systems that mitigate oxidative damage under stress. Certain endophytes produce phytohormones such as auxins, cytokinins, and abscisic acid, fine-tuning drought-responsive pathways. Moreover, the production of ACC deaminase by bacterial endophytes reduces ethylene levels, alleviating drought-induced growth inhibition. At the molecular level, endophyte colonization modulates the expression of stress-responsive genes, activating both ABA-dependent and independent signalling cascades. Fungal endophytes like *Piriformospora indica* significantly enhance drought tolerance in cereals, while bacterial endophytes from genera such as *Bacillus* and *Pseudomonas* improve yield stability in maize, rice, and legumes under water deficit conditions. With advances in omics technologies, endophyte-mediated stress tolerance mechanisms are being unraveled, paving the way for the development of bio-inoculants and microbial consortia tailored to drought-prone regions. The potential of harnessing endophytes as bio-allies in achieving climate-smart agriculture. Their application offers a sustainable and environmentally friendly strategy to enhance drought resistance, safeguard crop productivity, and ensure global food security.

Keywords: Drought, Endophytes, Proline, Betains, Bacillus, Pseudomonas.

TLC-BIOAUTOGRAPHY-GUIDED ANTIMICROBIAL ACTIVITY AND CHARACTERIZATION OF ACTIVE COMPOUND OF *SCHOUWIA PURPUREA* (FROSSK.) SCHWEINF

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Background: *Schouwia purpurea* (Forssk.) Schweinf. is one of the xerophytic plant found in arid and semiarid regions of tropics and subtropics of Asia and Africa. Reports on pharmacological activities of *S. purpurea* indicates that the plant possess various pharmacologically active compounds. Aim: This study was aimed to investigate antibacterial activity of leaves of *S. purpurea* against human bacterial pathogens. Materials and methods: The present study focuses on antimicrobial property of ethanolic and ethyl acetate leaves extract of *S. purpurea* (Brassicaceae) against *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* by using TLC-DB (Thin Layer Chromatography-Direct Bioautography) method. For characterisation of the active compound GC/MS analysis was used. Results: Various solvent combinations were used to standardize maximum separation of compounds from both the solvent extracts. Chromatogram bands with Rf 0.085, 0.15, 0.3, 0.4, 0.5, 0.49, 0.48 (ethyl acetate extract) and 0.45, 0.48 and 0.44 (ethanolic extracts) exhibited inhibition zones. Further, the bioautogram developed against all the four test microorganisms revealed that majority of the solvent combinations used, showed similar Rf value i.e. 0.48 at which clear zones of inhibition were observed indicating the active antimicrobial compound. Hence, the compound with Rf 0.48 was characterized by GC-MS and identified as 9, 12-Octadecadienoic acid (Z, Z)- also known as Linoleic acid. Conclusion: This study opens way to further investigate on other pharmacological activities along with study of mechanistic action on pathogens of the above compound which may lead to prove it as potential antimicrobial agent and may help in developing antimicrobial drug against resistant microbes.

MORPHOLOGICAL AND GENETIC VARIABILITY STUDIES IN SPONGE GOURD [*LUFFA CYLINDRICA* (L.) ROEM.] GENOTYPES

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The investigation on “Morphological and Genetic variability studies in Sponge Gourd [*Luffa cylindrica* (L.) Roem] Genotypes” was carried out during 2023–24 at the Department of Horticulture, University of Agricultural Sciences, Bangalore. In this study, 16 sponge gourd genotypes were evaluated to assess their morphological traits, mean performance, and genetic variability. Significant variations were observed among genotypes for traits such as cotyledon size, leaf shape along with differences in growth rate, fruit characteristics, and flowering time. The genotype Mundagod Local recorded the highest yield (26.06 t/ha) and excelled in chlorophyll content, number of branches, and fruit yield. The phenotypic (PCV) and genotypic (GCV) coefficients of variation were highest for leaf area index (35.79% and 35.74%, respectively). High heritability coupled with genetic advance indicated that selection for growth and yield traits would be highly effective. Fruit yield per hectare and fruit yield per plot showed perfect positive correlations ($r = 1.00$), emphasizing their direct and proportional relationship. Strong positive correlations were also recorded with number of fruits per vine (0.93), number of primary branches (0.84), vine length (0.76), and days to final harvest (0.75). Overall, the findings reveal considerable genetic potential among sponge gourd genotypes, with Mundagod Local excelling in yield and Rajasthan Local showing superior shelf-life. These results can be effectively utilized in future breeding programs aimed at improving yield and specific desirable traits in sponge gourd.

Keywords: Sponge gourd, Genotypes, Morphology, Heritability and Genetic advance

MONOCROTOPHOS INSULTED COMPROMISED REPRODUCTIVE FITNESS IN FEMALE *DROSOPHILA MELANOGASTER*

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Reproduction is a necessary feature of all living beings for the survival and continuity of life on earth. It facilitates pass on the genetic material from one generation to the next. However, reproduction is regulated by several biochemical, cellular interactions. It chiefly governed by different genetic, hormonal, environmental, and behavioral factors. Monocrotophos (MCP), a widely used pesticide is used predominantly in cotton, paddy, potato and tomato fields. Current study focuses on the effects of MCP exposure on reproductive performance in *Drosophila melanogaster*, a well-established model for toxicology, nutritional biology, molecular biology and many other fields. The specific as well as critical studies in invertebrate model are still underexplored. At first freshly hatched 1st instar larvae were reared to sub-lethal concentrations of MCP via dietary intake till adulthood and male flies were taken for assessment. Interesting findings has been observed viz., compromised gonadal health and reproductive enzyme levels after chronic treatment with MCP. ROS induced abnormalities were found in ovaries, suggesting gonadal toxicity. In addition, ROS induced altered biochemical homeostasis and genotoxicity were also observed. Since *Drosophila melanogaster* shares significant genetic, biochemical and developmental homologies with higher vertebrates thus, the present study can be extrapolated to the other non-target organisms.

Keywords: Monocrotophos, *Drosophila melanogaster*, Reactive oxygen species, Genotoxicity

EVALUATION OF MUSKMELON (*CUCUMIS MELO* L.) GENOTYPES FOR DROUGHT TOLERANCE: A STEP TOWARD CLIMATE-RESILIENT AND SUSTAINABLE HORTICULTURE

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Muskmelon (*Cucumis melo* L.) is a nutritionally rich and economically significant cucurbitaceous crop cultivated worldwide. It serves as a valuable source of vitamins, minerals, antioxidants, and essential fatty acids, contributing to human nutrition and food security. Beyond its dietary value, muskmelon cultivation supports rural livelihoods and preserves agricultural biodiversity. However, climate change-induced drought stress poses a major challenge to its growth, productivity, and fruit quality. Enhancing drought tolerance is therefore essential to ensure sustainable muskmelon production under water-limited conditions. This study evaluated fifteen muskmelon genotypes for drought tolerance under controlled polyhouse conditions at the University of Agricultural Sciences, Bengaluru. Seeds were sown in a soil: sand: FYM (2:1:1) medium, and drought stress was imposed 30 days after sowing by withholding irrigation for 15 days. Growth and physiological traits, including shoot and root length, leaf number, fresh and dry biomass, chlorophyll content and stress tolerance indices were measured. Significant genotypic variation was observed in response to drought stress. Among the tested genotypes, Chamarajnagar local, Muskmelon round, and Kerala 2 showed superior drought tolerance, maintaining higher stress tolerance indices and stable chlorophyll content, while Muskmelon local and Banaspathre were more susceptible. These findings highlight the importance of harnessing genetic diversity in muskmelon for developing climate-resilient cultivars. Identifying and utilizing drought-tolerant genotypes not only improve crop adaptability and yield stability but also advance biodiversity conservation and sustainable horticultural systems. Such efforts directly support global objectives in climate change mitigation, nutritional security, and sustainable agriculture.

Keywords: Climate Resilience, Drought Tolerance, Genetic Diversity, Muskmelon, Sustainable Horticulture

COMPARATIVE BIOCHEMICAL PROFILING OF RIPENING-ASSOCIATED ENZYMES IN EIGHT BANANA (*MUSA SPP.*) CULTIVARS

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Banana (*Musa spp.*) is one of the most economically significant tropical fruit crops, valued for its nutritional quality and commercial importance. The present study investigated eight cultivars—Yellakki, Nendra, Mysore/Naati, Robusta, Rasabale, Karpuravalli, Red Banana, and Raw Banana—to evaluate biochemical variations in ripening-associated enzymes. Protein profiling was performed using gradient polyacrylamide gels, followed by zymographic analysis to detect the activity of pectinase and cellulase, key enzymes involved in fruit softening and post-harvest changes. Pectinase activity corresponded with pectin degradation, while cellulase activity was linked to cellulose hydrolysis and tissue softening during ripening. Distinct enzymatic banding patterns and activity levels were observed across the eight cultivars, revealing notable varietal differences in their biochemical and physiological ripening behaviour. The results suggest that variations in enzyme activity could serve as biochemical indicators of fruit texture, ripening rate, and storage stability. These findings provide a molecular and enzymatic framework for understanding banana ripening and could guide post-harvest management strategies aimed at minimizing losses and improving industrial utilization of select cultivars.

Keywords:

Banana cultivars, Pectinase, Cellulase, Zymography, Post-harvest physiology

CLIMATE-SMART ADAPTATION IN OILSEED CROPS: INTEGRATING AGRICULTURAL AND ECOLOGICAL STRATEGIES FOR RESILIENCE

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South Asia, home to diverse agro-ecologies and a large agrarian population, is highly vulnerable to climate change impacts. Oilseed crops such as groundnut (*Arachis hypogaea*), mustard (*Brassica juncea*), sesame (*Sesamum indicum*), soybean (*Glycine max*), safflower (*Carthamus tinctorius*) and sunflower (*Helianthus annuus*) are particularly sensitive to climatic variability, with yield losses driven by erratic rainfall, terminal heat stress, recurrent droughts, and episodic flooding. Given their central role in edible oil security and rural livelihoods, developing climate-resilient strategies for oilseed production is a critical regional priority. Climate-smart agriculture (CSA) provides a robust framework to address these challenges through the adoption of conservation tillage, stress-resilient genotypes, efficient water and nutrient management, and diversification of oilseed-based cropping systems. Advances in genomics-assisted breeding and molecular marker technologies have enabled the development of drought- and heat-tolerant oilseed varieties, while precision irrigation and nutrient management enhance input-use efficiency under variable climates. Complementary ecological approaches—including soil organic carbon enrichment, integrated pest management, watershed restoration, and agroforestry-based intercropping—strengthen ecosystem services vital for oilseed productivity, such as pollination, natural pest suppression, and microclimate stabilization. The integration of CSA with agroecological principles is particularly relevant for South Asian smallholders, who rely heavily on rainfed oilseed cultivation. Remote sensing, GIS-based climate forecasting, and decision-support tools can guide adaptive practices at farm to landscape scales, while participatory seed systems and community-based natural resource management enhance local adaptive capacity. Policy support is essential to scale these interventions, including targeted investments in climate-resilient infrastructure, weather-indexed crop insurance, and incentives for sustainable land-use practices. By converging agricultural innovations with ecological resilience, South Asian oilseed systems can buffer climatic shocks, sustain productivity, and contribute to regional food and nutritional security. This integrated approach aligns with the Sustainable Development Goals and offers a pathway toward climate-resilient oilseed production in one of the world's most climate-vulnerable regions.

Keywords: Adaptation, Oilseed, Climate-smart agriculture, Stress-resilient, Nutritional security

UNSTEADY OF TWO-PHASE FLOW OF BLOOD WITH MAGNETIC DUSTY PARTICLES IN CYLINDRICAL REGION

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Biomagnetic fluid dynamic (BFD) is a new area in fluid mechanics. It focuses on the usage of the magnetic particles as drug carriers in magnetic drug targeting, cancer tumor treatment and many more. The Biomagnetic fluid occurs in all living organisms and for its investigation, the BFD model was initially recommended. The present study is focused on the unsteady two-phase flow of blood in a cylindrical region. Blood is taken as a counter-example of Brinkman type fluid containing magnetic (dust) particles. The oscillating pressure gradient has been considered because for blood flow it is necessary to investigate in the form of a diastolic and systolic pressure. The transverse magnetic field has been applied externally to the cylindrical tube to study its impact on both fluids as well as particles. The system of derived governing equations based on Navier Stoke's, Maxwell and heat equations has been generalized using the well-known Caputo–Fabrizio (C–F) fractional derivative. The considered fractional model has been solved analytically using the joint Laplace and Hankel (L&H) transformations. The effect of various physical parameters such as fractional parameter, Gr , M and μ on blood and magnetic particles has been shown graphically using the Mathcad software. The fluid behaviour is thinner in fractional order as compared to the classical one.

Keywords: Two-phase blood flow; dusty fluid; Brinkman type model; magnetic dusty particles; heat transfer; C–F derivative

SURVEY FOR OCCURRENCE OF WILT COMPLEX IN GINGER

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Ginger (*Zingiber officinale* Rosc.) is a widely cultivated crop throughout the world. To know the intensity of wilt incidence and pathogen associated with wilt complex, a roving survey was undertaken during *Kharif* and *Rabi* 2024–25 in major ginger growing areas of Chamarajanagara, Mysuru and Hassan districts of Karnataka. Soil and root samples were collected from 83 locations and analyzed for the presence of plant parasitic nematodes and associated pathogens. The study revealed a widespread incidence of the wilt complex, ranging from 17.28% in H.D. Kote to 37.26% in Piriapatna taluk. Among the surveyed villages, Chickkanerale recorded the highest incidence (55.65%), followed by N. Shettihalli (51.00%). The predominant nematode species identified were *Meloidogyne incognita*, *Radopholus similis*, *Pratylenchus coffeae* and *Helicotylenchus multicinctus*. Pathogen isolation revealed consistent association of *Fusarium* sp., *Rhizoctonia* sp. and *Ralstonia* sp., often occurring in complex interactions. Among the cultivars, 'Rio-de-Janeiro' recorded the highest wilt incidence (30.8%), while 'Himachal' exhibited the least (16.0%). Disease severity was higher in red sandy soils compared to black soils. The findings confirm that the wilt complex of ginger in Karnataka is a multifactorial disease caused by synergistic interactions between fungi, bacteria and nematodes.

Keywords: *Zingiber officinale*, wilt complex, *Meloidogyne incognita*, *Fusarium* sp., *Ralstonia* sp., survey, Karnataka.

GENETIC ARCHITECTURE OF ANTHRACNOSE RESISTANCE IN MUNGBEAN REVEALED THROUGH GENERATION MEAN ANALYSIS

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The study investigated the genetic basis of anthracnose resistance in mungbean (*Vigna radiata* L.) using a six-parameter generation mean model to elucidate the nature of gene action and its implications for breeding. Anthracnose, caused by *Colletotrichum* spp., is a major foliar disease limiting mungbean productivity. Parental lines were selected based on field screening during the *kharif* 2022, where DGGV 2 was highly susceptible, Samrat showed resistance response. Crosses between resistant and susceptible lines were attempted in both straight and reciprocal format and obtained six generations (P_1 , P_2 , F_1 , F_2 , $BC_1 P_1$, and $BC_1 P_2$). All the six generations were evaluated for anthracnose resistance during *kharif* 2024. The six generations mean data were analysed for per cent disease index (PDI) to partition genetic effects. Results revealed that susceptibility was dominant over resistance, and F_2 deviations from Mendelian ratios suggested polygenic inheritance. Castle-Wright's estimates indicated the presence of approximately four effective genes controlling resistance in both straight and reciprocal crosses. Scaling and joint scaling tests showed significant deviations from the additive-dominance model, highlighting the involvement of epistasis. Generation mean analysis revealed significant additive (d), dominance (h), and interaction components (i, j, l), with duplicate epistasis. The dominance of susceptibility and the prevalence of duplicate epistasis suggest restricted utility of simple selection in early generations. Instead, recurrent selection in bi-parental populations is recommended to accumulate favourable alleles and overcome non-fixable genetic components. The study represents the first report on gene action governing anthracnose resistance in mungbean, providing valuable insights for designing efficient resistance breeding strategies.

Keywords: Anthracnose, Duplicate epistasis, Gene action, Mungbean, Resistance

ADVANCING SUSTAINABLE FARMING THROUGH AN AUTOMATED SPOT TILLAGE AND SEED SOWING SYSTEM

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Rising labor costs and the migration of rural youth to urban areas have created a shortage of agricultural labor, making manual farm operations increasingly difficult. For small farms, mechanization is often limited, yet automation is essential to make agriculture more attractive, sustainable and efficient. Minimum tillage practices, particularly spot tillage, help conserve soil structure, prevent erosion, save time and energy and reduce input costs. To harness these benefits, an automatic spot tillage and seed planting machine was designed and developed. The machine combines drilling, seed sowing and covering of soil that are driven by DC motors and controlled through programmable logic controllers (PLCs). A timing-based ladder logic algorithm was programmed to automate operations. During operation, the machine moves along a straight path, stops at designated sowing points, drills holes to the required depth, plants seed with precision, covers them with soil and then advances automatically to the next location. The prototype was evaluated in both laboratory and field conditions using maize and castor crops. Performance was assessed based on operational efficiency, soil covering quality and seed germination. Results indicated that the machine performed satisfactorily across different soil conditions, with seed germination comparable to traditional sowing methods. The automated process reduced the need for manual intervention, ensured accurate seed placement and enhanced efficiency, particularly in widely spaced crops where greater field capacity was achieved. Overall, the developed machine offers a sustainable, efficient and reliable solution for small-scale farmers, demonstrating the potential of automation in improving agricultural practices.

Keywords: Spot tillage, seed sowing, automation, sustainable farming, programmable logic controller (plc), precision sowing, farm mechanization

FED BATCH STRATEGY FOR WHEY ETHANOL PRODUCTION WITH INDIGENOUS YEAST CO-CULTURE

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Bioethanol is renewable ethanol produced from various biological materials. Utilizing industrial waste products like whey and molasses for the bioprocess of bioethanol production presents a sustainable alternative. Preliminary analysis of substrates showed total sugars of 5.6% in whey and 51.2% in molasses. Compatibility studies were conducted showing synergistic relations between the cultures. The response surface methodology optimized primary fermentation of whey with *Kluyveromyces marxianus* for 32°C at 9% inoculum concentration for 4.5 days. Ethanol concentrations of 1.79% (v/v) were achieved with 1.65 g/100, 0.025 g/100mL residual total and reducing sugars. For whey-molasses mixture fermentation with *Saccharomyces cerevisiae* (MK680910), the optimal fermentation conditions were 6.5% inoculum concentration with 20% molasses at 31°C, and for 4.5 days. Ethanol yield of 10.5% (v/v) was recorded with residual total and reducing sugars of 2.09 g/100 mL and 0.71 g/100 mL, was respectively. Fractional distilling of the fermented product at 78.3°C, resulted in 39.48% ethanol yield and 1.26% acidity. The research was validated at 7L scale with ethanol yield of 10.95%, attaining 42.6% ethanol concentration and 1.35% acidity after fractional distillation. GC-MS analysis confirmed ethanol as the predominant volatile compound, with reduced levels of other volatiles in the final bioethanol product. This study underscores the effectiveness of combining *K. marxianus* and *S. cerevisiae* in optimizing bioethanol production from renewable biomass sources, whey and molasses, offering a viable and economically sustainable approach for bioethanol generation.

Keywords: Bioethanol, distillation, ethanol, fermentation, molasses, optimization, whey.

CURRENT STATUS OF FISH CATCH FROM PONG RESERVOIR AND GOBIND SAGAR RESERVOIR, HIMACHAL PRADESH, INDIA

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Pong Reservoir has been created by damming river Beas in year 1975, Gobind Sagar Reservoir has been created in year 1963, by damming River Sutlej at Bhakra. Fish catch data of year 2023-24 was obtained from State fisheries department of Himachal Pradesh Govt. and this data was analyzed. During April, July and August months of year 2023 no fish catch was from these reservoirs. During year 2023-24, total fish catch from Gobind Sagar reservoir was 191.2 tons and from Pong Reservoir was 329.5 tons. Catch of *Cyprinus carpio* was 63.9 tons from Gobind Sagar reservoir 16.5 tons from Pong Reservoir, during year 2023-24. *Hypophthalmichthys molitrix* was 67 tons from Gobind Sagar reservoir and 0.05 tons from Pong Reservoir. *Sperata seenghala* was 40.2 tons and 182.75 tons from Gobind Sagar reservoir and Pong reservoir respectively. *Wallago attu* was 2.49 tons from Pong reservoir only. *Ctenopharyngodon idella* was not in catch from Pong Reservoir, and *Wallago attu* was not in catch of Gobind Sagar reservoir. Fish catch in Pong reservoir was dominated by *Sperata seenghala* (182.75 tons) followed by *Labeo rohita* (45.13 tons) and *Cirrhina mrigala* (41.86 tons). Contribution of *H. molitrix* dominated the fish catch from Gobind Sagar reservoir followed by catch of *Cyprinus carpio*. Fishing was done by licensed fishermen only. These fishermen have organized themselves into fisheries co-operative societies. Seed stocking is being done by state department of fisheries. Fish species caught, mainly belongs to *Catla catla*, *Tor putitora*, *Labeo rohita*, *Labeo dero*, *L. calbasu*, *Cirrhina mrigala*, *Channa sp.*, *Cyprinus carpio*, *Hypophthalmichthys molitrix*, *Sperata seenghala*. Fisheries is being managed scientifically, conservation measures are also being adopted regularly.

Keywords- Fish Conservation, Fishermen, Seed Stocking and Fish Species

RECENT ADVANCES IN THE EXTRACTION AND FUNCTIONAL APPLICATIONS OF SEED-DERIVED POLYSACCHARIDES IN FISH SURIMI

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Seed-derived polysaccharides have gained increasing attention as natural biopolymers with significant functional potential in fish surimi processing. Recent advances in extraction technologies such as ultrasound-assisted, enzymatic, and microwave-assisted methods have improved yield, purity, and structural integrity of these polysaccharides. Their incorporation into surimi enhances gel strength, water-holding capacity, and textural stability while reducing protein denaturation and lipid oxidation during processing and storage. Additionally, seed polysaccharides act as natural cryoprotectants and emulsifiers, improving the functional and nutritional quality of surimi-based products. The molecular interactions between these polysaccharides and myofibrillar proteins contribute to the formation of a stable three-dimensional gel network, resulting in improved product quality and consumer acceptability. This review summarizes the latest progress in extraction methods, structural characterization, and techno-functional applications of seed-derived polysaccharides, highlighting their promising role as sustainable, clean-label ingredients in surimi production and seafood processing industries.

Keywords: Seed-derived polysaccharides, Fish surimi, Functional properties, Cryoprotectants, Gelation and textural stability

FIRST REPORT ON THE ISOLATION AND IDENTIFICATION OF *PARADENDRYPHIELLA ARENARIA* CAUSING FRUIT ROT IN POMEGRANATE (*PUNICA GRANATUM* L.) AND IN VITRO EVALUATION OF THE ANTIFUNGAL ACTIVITY OF AQUEOUS GARLIC AND GINGER EXTRACTS

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Pomegranate (*Punica granatum* L.) is a commercially and nutritionally significant fruit crop, but its cultivation is increasingly threatened by rot disease, which leads to substantial reductions in yield, fruit quality, and market value. This study aimed to isolate and identify the fungal pathogens associated with rot disease in pomegranate and to evaluate the antifungal efficacy of aqueous garlic (*Allium sativum*) and ginger (*Zingiber officinale*) extracts as potential biological control agents. Fungal isolates were isolated, identified and characterized as *Paradendryphiella arenaria* based on morphological features and molecular identification using internal transcribed spacer (ITS) regions of rDNA. The plant extracts were assessed for their antifungal activity using standard in vitro assays. The findings revealed key pathogenic fungi involved in rot disease and demonstrated significant antifungal effects of both garlic and ginger extracts against the isolated pathogens. These results suggest that garlic and ginger extracts could serve as effective, eco-friendly alternatives for managing rot disease in pomegranate, contributing to the development of sustainable disease control strategies.

Keywords: Pomegranate, Heart rot disease, *Paradendryphiella arenaria*, *Allium sativum*, *Zingiber officinale*.

GC-MS ANALYSIS AND INVESTIGATION OF PHARMACOLOGICAL PROPERTIES OF PHYTOCHEMICALS PRESENT IN LEAF AND ROOT EXTRACTS OF *OBERONIA VERTICILLATA* WIGHT

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The present study investigates the phytochemicals and their pharmacological active principles present in Methanol and Acetone extracts of leaf and root of *O. verticillata* through GC-MS analysis. The shade dried leaves and roots were extracted with Methanol and Acetone solvents, by cold extraction method. The four extracts namely leaf Methanol(LM), leaf Acetone(LA), root Methanol (RM) and root Acetone(RA) were subjected to GC-MS analysis and the results showed the presence of 98, 75, 76 and 88 phytoconstituents respectively. All the four extracts showed the presence of some important common phytochemicals viz. Vanillin, .gamma.-Tocopherol, Vitamin E, Ergosta-5,22-dien-3-ol,(3.beta.,22E,24S), Campesterol, Stigmasterol, gamma.-Sitosterol, which have pharmacological properties. Vanillin has antimutagenic activity, .gamma.-Tocopherol is a form of Vitamin E, an effective antioxidant, Ergosta-5, 22-dien-3-ol, (3.beta.,22E,24S) antifungal, antiviral and anti-inflammatory potentials, Campesterol has anti-inflammatory and anticancer properties. Hence the plant can be recommended for the formulation of novel drugs.

Keywords: Antimicrobial, Anti-inflammatory, Bioactive compounds, *Oberonia verticillata*, phytochemicals.

ASSESSMENT OF NUTRIENT CONTENT IN RICE VARIETIES AS INFLUENCED BY VARIOUS ZINC FERTILITY LEVELS

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The two year field experiment was conducted during *kharif* season of the year 2023 and 2024 at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari under South Gujarat to evaluate the influence of zinc application rates and methods on nutrient content in rice varieties. The field trial was laid out in Randomized Block Design with Factorial concept (FRBD) and was replicated thrice. The experiment consisted of two factors, the first factor was Variety having two levels namely, V_1 : GNR 3 and V_2 : GR 15 and the second factor was zinc fertility levels having nine levels viz., F_1 : Control, F_2 : Soil application (SA) of $ZnSO_4$ at 12.5 kg ha^{-1} , F_3 : SA of $ZnSO_4$ at 25.0 kg ha^{-1} , F_4 : Foliar application (FA) of $ZnSO_4$ at 0.5 %, F_5 : FA of $ZnSO_4$ at 1 %, F_6 : SA of $ZnSO_4$ at 12.5 kg ha^{-1} + FA of $ZnSO_4$ at 0.5 %, F_7 : SA of $ZnSO_4$ at 12.5 kg ha^{-1} + FA of $ZnSO_4$ at 1 %, F_8 : SA of $ZnSO_4$ at 25 kg ha^{-1} + FA of $ZnSO_4$ at 0.5 % and F_9 : SA of $ZnSO_4$ at 25 kg ha^{-1} + FA of $ZnSO_4$ at 1 %. The soil application of zinc was given at time of transplanting while, foliar application was given at tillering and panicle initiation stage. The results revealed that the GNR 3 variety recorded significantly higher P content in the brown rice, hull and straw as well as Fe content in brown rice and hull. In contrast, the GR 15 variety resulted in maximum K and Zn content in brown rice, hull and straw. For the fertility levels, N, P, K and Fe content in brown rice, hull and straw showed non-significant difference. However, the Zn content in brown rice, hull and straw was significantly superior with F_9 treatment and at par with F_8 and F_7 treatments. The interaction effect for the Zn content brown rice, hull and straw was only significantly higher with V_2F_9 treatment and was at par with V_2F_8 . It can be concluded the combined soil application of $ZnSO_4$ at 25 kg ha^{-1} with foliar application of $ZnSO_4$ at 0.5 % twice at tillering and panicle initiation enhanced the nutrient content particularly zinc in the rice variety GR 15.

Keywords: Brown rice, hull, *Kharif*, Nutrient content, Rice, Zinc

CONTINUOUS OHMIC HEATING: ENZYME INACTIVATION IN PINEAPPLE JUICE AND ITS KINETIC MODELLING

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Continuous ohmic heating (COH) is a promising electrothermal technique that ensures uniform and rapid heating through the direct passage of electric current, offering an efficient alternative to conventional thermal processing. This study investigates the effect of COH on enzyme inactivation in standardized pineapple juice, focusing on key quality-related enzymes such as polyphenol oxi/dase (PPO) and peroxidase (POD). The experiments were conducted at controlled electric field strength (EFS: 30-40 V/cm), temperature (T: 70-90 °C) and treatment times (t: 0-60 s) to evaluate the extent of enzyme inactivation and to develop kinetic models describing the inactivation behaviour. Statistical parameters and Akaike information criteria were used to compare different kinetic models. Results demonstrated that COH effectively inactivated PPO (68.2%) and POD (82.2%), which are primarily responsible for enzymatic browning and quality deterioration, while maintaining significant quality parameters like vitamin C and colour. The Weibull distribution model was the most suitable model for explaining the inactivation kinetics of PPO ($R^2 > 0.99$; RMSE < 0.0101) and POD ($R^2 > 0.98$; RMSE < 0.042), which was also supported by the better accuracy factor (A_f) and bias factor (B_f) in predicting the enzyme inactivation accuracy. Akaike increment ($\Delta_i < 2$) also supported the suitability and accuracy of the Weibull model. Overall, the findings from the above studies demonstrated the effectiveness of COH in achieving efficient enzyme inactivation and possess tremendous potential for sustainable food processing in an industrial set-up.

Keywords: Continuous ohmic heating, Polyphenol oxidase, Peroxidase, Pineapple Juice, Kinetic modelling

THE EFFECTS OF MILD SURGICAL LIMB AMPUTATION ON THE EARLY IMMUNE RESPONSES OF THE FRESHWATER CRAB *OZIOTELPHUSA PARAKKAI*

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Freshwater crabs represent a diverse and ecologically important group of decapod crustaceans that have adapted to various aquatic environments. In aquatic ecosystems, they are constantly exposed to various stresses which may be either internal or external factors, resulting in immune system alterations and result in increasing susceptibility to diseases. In decapods, voluntary limb loss can be triggered in response to predator attacks, physical entrapment and environmental stress. Postinjury, various immune responses are immediately activated to prevent hemolymph loss, including clot formation and melanization response that seal the amputation site. Though, considerable information exists on the immune responses after autotomy or surgical amputation in marine decapods, there is a dearth of information on freshwater decapods. In the present study, we investigated the effects of mild surgical amputation (one limb-third walking leg) on the early immune responses of the freshwater crab, *Oziotelphusa parakkai*. The light microscopic examinations revealed significant effects on differential hemocyte count, morphology of hemocytes and prophenoloxidase activity following amputation (30, 60, 90, 120 minutes). The dense-granulocytes demonstrated a reduction in the differential count and an increase in the cell size at 30 and 60 minutes post-amputation. At 30 minutes post-amputation, a few dense-granulocytes developed pseudopodia and exhibited initial signs of degranulation, characterized by the peripheral arrangement of cytoplasmic granules. Hyalinocytes proportion increased ensuing 30 60, 90 and 120 minutes of amputation. Morpho-cytological changes in dense-granulocytes indicate signs of degranulation and cytoplasmic vacuolization at 60 minutes postamputation. Notably, dense granulocytes exhibited maximum degranulation at 90 min postamputation with intense cytoplasmic vacuolization and clot formation (coagulation). Dense-granulocytes were observable with a slight increase in their proportion and intense cytoplasmic vacuolization at 120 minutes amputation. We could observe the effect of surgical limb amputation on the activity of prophenoloxidase. Compared to control individuals, prophenoloxidase activity decreased in experimental individuals following amputation, indicating rapid enzymatic deployment for immune responses. Collectively, our findings indicate the crucial role of dense-granulocytes during early immune responses after surgical limb amputation in freshwater crabs.

Keywords: Early immune response, Freshwater crab, surgical limb amputation, *Oziotelphusa parakkai*

REMOTE SENSING AND GIS-BASED ANALYSIS OF DROUGHT VULNERABILITY IN PAURI GARHWAL, UTTARAKHAND

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Drought is one of the most complex natural hazards affecting ecosystem stability, water resources, and livelihoods, especially in mountainous regions like Pauri Garhwal, Uttarakhand. The region's diverse topography, variable rainfall patterns, and dependence on forest-based resources make it highly sensitive to climatic fluctuations. This study aims to assess the spatial and temporal patterns of drought vulnerability in Pauri Garhwal using Remote Sensing (RS) and Geographic Information System (GIS) techniques. Multi-temporal satellite datasets were analyzed to derive vegetation and moisture indices such as NDVI, VCI, and SPI, which were further integrated with climatic variables including rainfall and temperature to develop a Drought Vulnerability Index (DVI). The analysis highlights zones of varying drought intensity, revealing that lower-altitude areas experience moderate to high vulnerability due to deforestation and anthropogenic pressures, whereas higher elevations show seasonal stress linked to precipitation variability. The results were validated using ground-based meteorological data and statistical correlation techniques. The generated vulnerability maps provide valuable insights for regional drought monitoring, early warning, and sustainable forest management planning. This study demonstrates the potential of geospatial technology for climate resilience assessment in Himalayan ecosystems.

Keywords: Drought vulnerability, Remote Sensing, GIS, Pauri Garhwal, Vegetation Index, Climate resilience

HR-LCMS PROFILING OF PHYTOCHEMICAL CONSTITUENTS OF *BIGNONIA MAGNIFICA* AND EVALUATION OF ANTIMICROBIAL, ANTIOXIDANT, ANTI-INFLAMMATORY, AND ANTICANCER POTENTIALS

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Bignonia magnifica W.Bull is an ornamental plant with novel, underexplored medicinal potential. This study investigated its phytochemical constituents and pharmacological activities. We focused on evaluating the antimicrobial, antioxidant, anti-inflammatory, and anticancer properties of leaf extracts, particularly the ethyl acetate fraction, using thin-layer chromatography and column chromatography techniques. The *in vitro* biological activities of the leaf extracts were assessed to determine their antibacterial and antifungal properties through disc and well diffusion methods. The results demonstrated notable inhibition against several microorganisms, including *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and various pathogenic fungi. The highest inhibition zone was recorded at 16±0.45 mm against *Pseudomonas aeruginosa*, with MIC values ranging from 10 to 60 mg/ml. Antioxidant activity was analyzed using DPPH and ABTS assays, where the ethyl acetate extract demonstrated potent radical scavenging activity (EC₅₀ values 10µg/ml and 87µg/ml) and the highest inhibition (88.17% and 89.78%) against DPPH and ABTS radicals, respectively. Anti-inflammatory activity, assessed via membrane stabilization assay, showed moderate anti-inflammatory effects, inhibiting heat-induced and hypotonic-induced hemolysis by 36% and 39% at 300µg/ml, respectively. Additionally, the ethyl acetate extract exhibited anticancer potential, demonstrating cytotoxic activity against HepG2 liver cancer cells, with an IC₅₀ of 210.6 µg/ml. High-resolution liquid chromatography mass spectrometry analysis identified major bioactive compounds, including quinidinone, allamandin, 3, 4', 5, 6, 8-pentamethoxyflavone, 3-hydroxymugineic acid, cimifugin, α -tocopherols, phytosphingosine, schleicherastatin 6, 1,20-eicosanediol, and lucidenic acid M. These findings suggest that *B. magnifica* possesses significant bioactive constituents, supporting its potential as a source for new therapeutic and pharmaceutical applications.

EFFICACY OF *AMPELOMYCES QUISQUALIS* AND *TRICHODERMA HARZIANUM* CONSORTIUM IN MANAGING POWDERY MILDEW OF BETELVINE (*PIPER BETLE* L.)

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Powdery mildew caused by *Erysiphe betae* is a serious foliar disease of betelvine (*Piper betle* L.) leading to severe yield loss and reduction in leaf quality. The present study evaluated the efficacy of *Ampelomyces quisqualis* and *Trichoderma harzianum*, individually and in consortium, for the biological control of the disease under laboratory and field conditions. Microscopic observations confirmed that *A. quisqualis* parasitized the conidiophores and conidia of *E. betae*, resulting in their collapse within 72 hours. In greenhouse experiments, foliar application of *A. quisqualis* (1×10^7 conidia/mL) and *T. harzianum* (1×10^8 CFU/mL) reduced disease severity by 61.3% and 57.8%, respectively, compared to the untreated control. The combined application of both biocontrol agents exhibited a consortial effect, achieving a 78.4% reduction in percent leaf area covered by the pathogen and a 23.6% increase in leaf yield. Enhanced chlorophyll content (2.65 mg/g FW) and improved plant vigor were also observed in the consortium-treated plants. Field evaluation further confirmed the superior performance of the combined treatment over individual applications. The results clearly indicate that the integration of *A. quisqualis* and *T. harzianum* provides an effective and eco-friendly strategy for sustainable management of powdery mildew in betelvine, minimizing the reliance on chemical fungicides and supporting environmentally safe crop protection practices.

Keywords: Piper betle, Erysiphe betae, *Ampelomyces quisqualis*, *Trichoderma harzianum*, biological control, consortium, powdery mildew

ESTIMATION OF GENETIC VARIABILITY, CHARACTER ASSOCIATION AND PATH ANALYSIS FOR YIELD AND YIELD TRAITS IN SUMMER SESAME (*SESAMUM INDICUM* L.)

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Sesame (*Sesamum indicum* L.) is an indigenous oilseed crop valued for its superior oil quality, high oil content and remarkable resistance to oxidation. Improving productivity requires knowledge of genetic variability and trait associations, which are vital for breeding superior cultivars. The present study was conducted during summer 2025 at AICRP on Sesame and Niger, Main Agricultural Research Station, UAS, Dharwad, using 49 sesame genotypes which included 43 advanced mutant lines and six check varieties. The material was evaluated in a randomized complete block design with two replications and observations were recorded on twelve yield and yield related traits. Analysis of variance indicated highly significant differences among genotypes for all traits, confirming sufficient variability for selection. High genotypic and phenotypic coefficient of variation were observed for number of capsules per plant and seed yield per plant, while moderate values were noted for number of primary branches and capsules on the main stem. High heritability coupled with high genetic advance was recorded for number of primary branches, capsules on main stem, total capsules per plant and seed yield, indicating predominance of additive gene action. Correlation analysis revealed strong positive association of seed yield with number of primary branches, capsules per plant, seeds per capsule, capsule length and 1000 seed weight. Path analysis showed positive direct effect of capsules on main stem, seeds per capsule, height to first capsule, capsule length, days to 50% flowering and oil content on seed yield, whereas plant height and days to maturity exerted negative direct effects. Overall, the study revealed presence of genetic variability and identified key yield contributing traits, providing valuable insights for developing high yielding and superior sesame cultivars.

Keywords: Genetic variability, heritability, genetic advance as parent of mean, correlation and path analysis

ISOLATION AND CHARACTERIZATION OF AUCUBIN AND AGNUSIDE IN *IN VIVO*, *IN VITRO* AND CALLUS REGENERATED PLANTLETS OF *VITEX AGNUS-CASTUS* L.

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Vitex agnus-castus, is an aromatic medicinal shrub belongs to the family Lamiaceae. The plant is native to Southern Europe and the orient is widely cultivated. The plant is now naturalized in most of the Eastern and Southern United States, in the tropics and warm temperate regions of the both hemispheres. The *In vivo*, *In vitro* regenerated plantlets and callus were subjected for the isolation and characterization of aucubin and agnuside. The HPLC analysis of *V. agnus castus in vivo*, *in vitro* plantlets and calli revealed the presence of aucubin and agnuside. The results indicated presence of same compound in both *in vivo* and *in vitro* extracts. HPTLC fingerprints of *In vitro* plantlets, *In vivo* plantlets and callus shows variation which is observed in the spectrogram detected in UV 254 nm and anisaldehyde spray. The Retention Time (RT) of aucubin was at 7.8 min. Peak corresponding to aucubin was present in all the samples. The aucubin content in the *in vitro*, *in vivo* plantlets and

callus was 0.4%, 0.3% and 0.04% respectively and RT of agnuside was at 8.8 min. The peak corresponding to agnuside content in the *in vitro*, *in vivo* plantlets and callus was 0.8%, 0.6% and 0.08% respectively.

Keywords: *Vitex agnus-castus*, Lamiaceae, aucubin, agnuside, HPLC, HPTLC

ASSESSMENT OF RURAL LIVELIHOOD DIVERSIFICATION THROUGH SUGARCANE-BASED FARMING IN WESTERN UTTAR PRADESH

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Sugarcane is a leading commercial crop in Western Uttar Pradesh, not just to the agrarian economy of the state but also influencing the socio-economic composition of rural households. In this study, the extent to which sugarcane-based farming systems contribute to diversifying rural livelihoods and improving income security is evaluated. Drawing on a mix of primary survey evidence and secondary sources, this study analyses trends in crop diversification, practices in intercropping, off-farm opportunities generated through sugarcane production, and how they collectively affect household income, employment, and the use of resources. The results show that sugarcane farming is an important safety net for marginal and small farmers through ensuring constant cash inflow, generating seasonal employment opportunities, and allowing access to allied activities like jaggery-making, dairy, and contract farming. However, challenges such as delayed payments, increasing costs of inputs, and over-reliance on sugar mills restrict its sustainability in the long term. The research emphasizes policy support for facilitating effective resource utilization, enhancing farmer cooperatives, and promoting integrated farming systems to provide livelihood resilience to sugarcane-dominated areas of Western Uttar Pradesh.

Keywords: Sugarcane-based farming, livelihood diversification, rural economy, intercropping, income security.

EXTRACTION AND CHARACTERISATION OF CELLULOSE DERIVED FROM BAGASSE FOR THE SYNTHESIS OF HYDROGEL, INFUSED WITH AZOLLA EXTRACT AND ITS EFFECT ON THE GROWTH OF MAIZE (ZEA MAYS L.)

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The increasing global demand for sustainable agricultural practices calls for innovative, eco-friendly alternatives to conventional fertilizers and water management techniques. This study focuses on the extraction of cellulose from sugarcane bagasse, an abundant agro-industrial waste, and its application in synthesizing a cellulose-based hydrogel infused with *Azolla* extract, a natural source of nitrogen and micronutrients, to develop a slow-release biofertilizer system for maize (*Zea mays* L.). Cellulose was extracted through sequential alkaline, acid, and bleaching treatments and characterised using Fourier Transform Infrared Spectroscopy (FTIR), confirming the removal of lignin and hemicellulose. Five hydrogels were synthesized with cellulose concentrations of 0.11, 0.22, 0.32, 0.43, and 0.54 wt% using acrylic acid as the monomer, ammonium persulfate (initiator), and N, N'-methylenebisacrylamide (crosslinker) through free-radical polymerization at 60 °C for 45 minutes. The hydrogels were oven-dried at 60 °C for 12 hours to achieve structural stability. *Azolla* extract was prepared by boiling 500 g of fresh biomass in 1 L of distilled water for 45 minutes, filtering, and diluting the extract before storage at 4 °C. Dried hydrogels were then infused with the *Azolla* extract in a 1:1 ratio for 48 hours under controlled conditions and re-dried to constant weight. Pot experiments were conducted using loamy soil under six treatments: Control (C) without hydrogel, and H1–H5 containing 4 g of hydrogel (0.11–0.54 wt%) per 2 kg of soil. Each pot was sown with one maize seed and irrigated with 300 mL of water every three days. Growth parameters including plant height, stem diameter, leaf area, number of leaves, root length, and chlorophyll content were recorded after 21 days. Results indicated that H4 (0.43 wt%) and H5 (0.54 wt%) significantly enhanced shoot growth and chlorophyll accumulation, while H3 (0.32 wt%) promoted greater root elongation. The findings highlight the potential of *Azolla*-infused cellulose hydrogels as biodegradable, nutrient-rich biofertilizers that improve plant growth, reduce chemical fertilizer dependency, and enhance water-use efficiency for sustainable agriculture.

Keywords: Bagasse, FTIR, Cellulose-based Hydrogel, Azolla Extract, Azolla-infused hydrogel, Maize (*Zea mays L.*), Plant Growth.

METAGENOMIC PROFILING AND FUNCTIONAL ASSESSMENT OF ACTINOMYCETES FROM JAMNAGAR MANGROVES: IMPLICATIONS FOR MICROBIAL DIVERSITY AND AQUATIC ECOSYSTEMS

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Mangrove ecosystems are reservoirs of unique and bioactive microorganisms, particularly *Actinomycetes*, whose ecological functions and biotechnological potential remain largely untapped. The proposed research aims to conduct a comprehensive investigation of *Actinomycetes* in the mangrove soils of Jamnagar, Gujarat, employing a suite of integrative techniques. Initial assessment will characterize the physico-chemical properties of sediment samples, establishing environmental parameters influencing microbial diversity. Next, high-throughput metagenomics and targeted 16S rRNA gene sequencing will be used to unravel the community structure, taxonomic diversity, and functional potential of *Actinomycetes*. Subsequent GC–MS and chemical analysis will identify key metabolites and bioactive compounds produced by these microbes. Antibiotic screening assays will assess the potential of isolated *Actinomycetes* to produce novel antimicrobial agents. Beyond discovery, this research explores how shifts in *Actinomycete* populations may influence nutrient cycling and water quality within these coastal ecosystems. By examining microbial interactions underlying these processes, the work aims to reveal links between microbial diversity and ecosystem health, offering insights into how microbial communities can sustain and enhance aquatic life without shifting focus from their core functional relevance.

Keywords: *Actinomycetes*, mangrove soils, Jamnagar, metagenomics, GC–MS, nutrient cycling, aquatic ecosystem

SEED PRIMING WITH CHITOSAN IMPROVES THE MORPHO-PHYSIOLOGICAL AND BIOCHEMICAL ATTRIBUTES OF VIGNA MUNGO (L.) HEPPER UNDER SALT STRESS

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Salinity is one of the most significant abiotic stresses that reduce the growth, development and yield of plants. It can significantly cause negative impacts on the morpho-physiological and biochemical traits of plants. So, the present study was aimed to investigate the effects of chitosan (CS) to mitigate salinity stress in urad bean (*Vigna mungo L.*) plant. In this experiment, seeds of urad bean (IPU-13-01 variety) were pretreated with CS (0.1 mM and 0.5 mM) for 3h before sowing. Salt stress was applied as irrigation NaCl (100 mM and 200 mM) solutions to the soil. We further examined morphological-physiological, and biochemical parameters in 30-day-old plants (subjected to SA pretreatment and NaCl induced salinity stress). Higher concentrations of salinity (200 mM) affected the growth and development of urad bean plants more adversely as compared to its lower concentrations (100 mM), while seeds primed with 0.1 mM CS showed an improvement in these attributes compared to 0.5 mM CS. Salinity stress increased electrolyte leakage, MDA accumulation, proline accumulation and antioxidant activity in plant leaves, while decreased the photosynthetic attributes and protein content. Pretreatment of CS decreased electrolyte leakage and MDA accumulation while increased in proline accumulation and higher antioxidant (APX and CAT) activity in stressed plants. Also, in CS treated leaves reduced ROS accumulation occurred which was observed from the histochemical localization of H₂O₂ through DAB staining and O₂[•] through NBT staining. Conclusively, CS ameliorated the adverse effects of salinity stress to a significant extent. However, lower concentration (0.1 mM) of CS pretreatment proved to be more effective to salinity stress compared to higher concentration (0.5 mM). Overall, CS seed priming could potentially be widely introduced as an innovative, sustainable approach to mitigate the effects of salinity and other abiotic stress conditions in legume crop plants.

Keywords: Abiotic stress, Antioxidant activity, Chitosan, Salinity stress, Seed priming, Urad bean

SEASONAL VARIATION IN THE DIVERSITY OF ARCTIINAE MOTHS (LEPIDOPTERA: EREBIDAE) IN SOLAN, HIMACHAL PRADESH

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Moths represent a highly diverse group within the order Lepidoptera, playing vital roles in ecosystems as pollinators, prey species, and indicators of environmental health. Among them, the subfamily Arctiinae (Lepidoptera: Erebidae) comprises ecologically important moths that serve as bioindicators of habitat quality and seasonal variation, reflecting changes in vegetation, climate, and habitat conditions. To investigate seasonal diversity patterns, moths of subfamily Arctiinae were collected from Solan, Himachal Pradesh, during April and October using a light-trap method and by using opportunistic daylight captures. During the April, 12 species were documented, whereas 21 species in October, reflecting a notable increase in diversity during the post monsoon. The post-monsoon (October) samples showed greater species richness and abundance, likely influenced by favorable humidity, vegetation growth, and host plant availability following the rainy season. Species belonging to the genera like *Spilosoma*, *Nyctemera*, *Lemyra*, and *Barsine* were among the most frequently encountered. The results reveal a clear seasonal fluctuation in Arctiinae diversity, with October supporting a richer assemblage than April. These findings emphasize the importance of conducting multi-seasonal sampling to understand the ecological dynamics of moth communities in the mid-Himalayan landscape.

Keywords: Lepidoptera, Arctiinae, Seasonal Variation, Diversity.

OPTIMIZING INTEGRATED ORGANIC MANAGEMENT STRATEGIES FOR IMPROVING FRUIT QUALITY IN BITTER GOURD (*MOMORDICA CHARANTIA* L.) VAR. 'PUSA AUSHADHI'

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The organic growing of bitter gourd is gaining popularity as a sustainable and health-conscious activity. In contrast to traditional methods, this approach makes use of natural inputs such as farmyard manure, vermicompost, and biofertilizers to improve soil health, crop development, and nutritional quality. The present investigation entitled "Optimizing integrated organic management strategies for improving fruit quality in bitter gourd (*Momordica charantia* L.) var. Pusa Aushadhi" was carried out during *rabi* season in the year 2021-2022 at P.G research farm, College of Horticulture, Rajendranagar, Hyderabad. Sri Konda Laxman Telangana State Horticultural University. The experiment was carried out with twenty (20) treatments in Randomized Block Design with three (3) replications i.e. T₁: Farmyard manure (25 t/ha) + AMC (12.5 kg/ha), T₂: Farmyard manure (25 t/ha) + VAM (10 kg/ha), T₃: Farmyard manure (30 t/ha) + AMC (12.5 kg/ha), T₄: Farmyard manure (30 t/ha) + VAM (10 kg/ha), T₅: Vermicompost (10 t/ha) + AMC (12.5 kg/ha), T₆: Vermicompost (10 t/ha) + VAM (10 kg/ha), T₇: Vermicompost (12 t/ha) + AMC (12.5 kg/ha), T₈: Vermicompost (12 t/ha) + VAM (10 kg/ha), T₉: Poultry manure (6 t/ha) + AMC (12.5 kg/ha), T₁₀: Poultry manure (6 t/ha) + VAM (10 kg/ha), T₁₁: Poultry manure (8 t/ha) + AMC (12.5 kg/ha), T₁₂: Poultry manure (8 t/ha) + VAM (10 kg/ha), T₁₃: Neem cake (1 t/ha) + AMC (12.5 kg/ha), T₁₄: Neem cake (1 t/ha) + VAM (10 kg/ha), T₁₅: Neem cake (2 t/ha) + AMC (12.5 kg/ha), T₁₆: Neem cake (2 t/ha) + VAM (10 kg/ha), T₁₇: RDF (40: 80: 50 NPK kg/ha) + AMC (12.5 kg/ha), T₁₈: RDF (40: 80: 50 NPK kg/ha) + VAM (10 kg/ha), T₁₉: RDF (40: 80: 50 NPK kg/ha), T₂₀: Absolute control. Different treatment combinations of RDF and organic manures along with bio fertilizers have a significant influence on quality. The results on quality parameters indicated that among all treatments, T₁₁: Poultry manure (8 t/ha) + AMC (12.5 kg/ha) recorded significantly lowest fruit pH (6.54), highest TSS (5.18 °Brix), highest ascorbic content (107.11 mg/100g) and highest chlorophyll content (1.59) compared to the other treatments.

Keywords: Bitter gourd, Farmyard manure, Vermicompost, Poultry manure, Neem cake, AMC, VAM, Pusa Ausadhi.

ROLE OF BEE ATTRACTANTS IN ENHANCING BOTTLE GOURD PRODUCTION

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A field investigation was carried out to study the effect of bee attractants on pollinator activity and the production of bottle gourd. The experiment was conducted at Horticulture Farm, Sriniketan, during Kharif 2022 in a randomized block design with three replications. The treatment consists of eight indigenous bee attractants (jaggery solution at 10%, sugar solution at 10%, sugarcane juice solution at 10%, honey solution at 10%, cumin seed oil at 0.5%, fennel seed oil at 0.5%, dill seed oil at 0.5%, and rose water) and a control were sprayed at the 30%, 50%, and 75% flowering stages. Jaggery at 10% plots showed the early emergence of male (49.3) and female flowers (57.0) and also the days to male-to-female flowering (7.7). Application of jaggery at 10% showed the maximum number of fruits per plot (29.3), fruit length (8.1 cm), fruit diameter (15.9 cm), and fruit yield per plot (32.4 kg). Maximum fruit yield ha^{-1} (216q) was registered in 10% jaggery-treated plots, followed by sugar solution (10%)-treated plots (213.2q). Fragrant oils (cumin, fennel, and dill seed oil), honey, rosewater, and sugarcane juice-treated plots showed mixed responses for yield traits but mostly were superior to the control. Application of jaggery (10%) or sugar (10%) solution thrice (at 30%, 50%, and 75% flowering stage) can be suggested to the bottle gourd growers of the Red and Laterite Zone of West Bengal for yield enhancement.

Keywords: Bee attractants, bottle gourd, jaggery, sugar and yield

NUTRITIONAL AND ANTIOXIDANT RETENTION IN DEHYDRATED LEAFY VEGETABLES

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Dehydration is one of the most effective methods for preserving surplus leafy vegetables, extending their shelf life, and maintaining nutritional quality during seasonal scarcity. However, the extent of nutrient and antioxidant retention depends on the drying method, temperature, and pre-treatment. In this context, dehydration studies on spinach (*Spinacia oleracea*), amaranth (*Amaranthus tricolor*), fenugreek (*Trigonella foenum-graecum*), and drumstick leaves (*Moringa oleifera*) have shown wide variation in retention levels of key nutrients and bioactive compounds. Blanching prior to drying significantly reduces enzymatic degradation, improving color and nutrient stability. For example, in spinach, blanching followed by cabinet drying at 55 °C retained 83–88 % of total chlorophyll and 72–80 % of β -carotene, compared to only 54–60 % retention in sun-dried samples. Microwave drying preserved 90 % of ascorbic acid and 85 % of total phenolic content, whereas hot-air drying at 60 °C retained ~70 % and 65 %, respectively. In *Moringa* leaves, antioxidant activity measured by DPPH assay was maintained at 82–88 % under freeze-drying compared with 58–62 % in open-sun drying. Similar trends were recorded for *Amaranthus* and *Fenugreek* leaves, where total flavonoid retention ranged from 75–92 % under low-temperature or microwave drying, indicating superior preservation of antioxidant potential. Nutrient density of rehydrated leafy powders also remained high, with protein, iron, and calcium retention of 80–90 %, 75–85 %, and 78–92 %, respectively, depending on species and drying regime. Although energy-intensive, controlled dehydration techniques such as cabinet, tray, or freeze-drying effectively conserve both macro- and micronutrients, minimize color degradation, and preserve functional quality. Therefore, optimizing dehydration parameters offers a sustainable approach for year-round nutritional security, especially in rural and peri-urban areas where post-harvest losses of perishable greens can exceed 25–30 % under open conditions.

Keywords: Dehydration, leafy vegetables, nutrient retention, antioxidant activity, β -carotene, ascorbic acid, phenolics

ROLE OF CRYOTHERAPY IN PATHOGEN ERADICATION AND GERMPLASM CONSERVATION IN HORTICULTURAL CROPS

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There are several uses for cryotherapy in biotechnology, horticulture, agriculture, and plant breeding initiatives. It is a useful substitute technique for conserving a variety of crop species. Cryopreservation, which uses extremely low temperatures, helps eradicate plant diseases while also enabling long-term germplasm storage. This strategy holds great promise for protecting endangered plant species' genetic resources. In order to improve the elimination of pathogens from afflicted tissues, many horticultural crops, such as fruits, vegetables, and ornamentals, have developed cryopreservation techniques that can be used directly or modified for cryotherapy. Cryotherapy has been used to successfully eradicate pathogens from a variety of crops, including potatoes, sweet potatoes, apples, bananas, citrus, grapevines, *Prunus* species, and raspberries. For large-scale propagation, cross-regional germplasm exchange, and quarantine programs, disease-free plant material is essential. For long-term conservation, gene banks also need to keep their collections free of pathogens. Through the efficient removal of pathogens, cryotherapy presents a novel and promising approach to guaranteeing healthy germplasm. This paper outlines several cryopreservation methods and illustrates how they aid in the eradication of pathogens in the protection of plant germplasm.

Keywords: Pathogen, Cryotherapy, Germplasm, Horticultural crops, Viruses

ASSESSMENT OF WATER QUALITY USING STANDARDIZED SAMPLING TECHNIQUES IN BHOSGA RESERVOIR, KARNATAKA

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The present study focuses on the assessment of water quality in Bhosga Reservoir, located in Karnataka, by employing standardized sampling techniques to ensure accurate and representative data collection. Water samples were collected from multiple predetermined locations within the reservoir, including the inlet, central, and outlet zones, to cover spatial variations in water characteristics. Standard procedures recommended by the American Public Health Association (APHA) were followed during the collection, preservation, and analysis of samples. The samples were analyzed for a range of physico-chemical parameters, including pH, temperature, turbidity, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), hardness, alkalinity, chlorides, nitrates, and phosphates. The results were compared with Bureau of Indian Standards (BIS) and World Health Organization (WHO) permissible limits for drinking water to evaluate the quality status of the reservoir. Spatial variations were observed across the sampling sites, indicating the influence of anthropogenic activities such as agricultural runoff, domestic discharge, and seasonal fluctuations. The findings highlight areas of concern that require attention for sustainable management and pollution control of the reservoir. This study provides essential baseline data that can support future monitoring, conservation strategies, and policy-making for maintaining the ecological balance and safe utilization of the Bhosga Reservoir water resources.

Keywords: Bhosga Reservoir, Water Quality Assessment, Standardized Sampling Techniques, Physico-Chemical Parameters, APHA Methods, BIS Standards, WHO Guidelines, Dissolved Oxygen, BOD, COD, Nutrient Analysis, Water Pollution, Environmental Monitoring, Karnataka.

NATURAL FARMING INTERVENTIONS FOR LONG-TERM SOIL FERTILITY: A SUCCESS STORY FROM KALLAM SRINIVASA REDDY'S FIELD, GUNTUR DISTRICT, ANDHRA PRADESH

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The growing concerns over declining soil fertility, high input costs, and ecological imbalance due to chemical-based agriculture have renewed interest in sustainable and natural farming systems. This paper documents the successful transition of Mr. Kallam Srinivasa Reddy, a progressive farmer from Guntur district, Andhra Pradesh, who adopted integrated organic and natural farming practices under the Paramparagat Krishi Vikas Yojana (PKVY) and Out Scaling of Natural Farming initiatives, supported by Krishi Vigyan Kendra (KVK), Guntur. Through systematic capacity building, he diversified his farm with over 20 rare turmeric varieties, intercropped papaya, banana, and vegetables, and integrated livestock to create a circular nutrient cycle. Key interventions such as green manuring, trash mulching, biofertilizers (PSB, KRB, Rhizobium), Jeevamrutha, Panchagavya, and drip fertigation substantially improved soil organic matter, microbial activity, and productivity. His enterprise now generates an annual gross income exceeding ₹10 lakhs, with benefit-cost ratios up to 7.5:1 for papaya and 5:1 for colocasia. The synergistic integration of crops, livestock, and natural resource management illustrates a replicable model for resilient and eco-friendly agriculture. This case underscores the effectiveness of the *National Mission on Organic and Natural Farming (NMONF)* in empowering farmers to achieve economic viability while ensuring long-term soil health and biodiversity conservation.

Keywords: Natural farming, organic agriculture, soil fertility, biodiversity conservation, entrepreneurship, sustainable agriculture, PKVY, Andhra Pradesh.

CHEMICAL LIFE CYCLE ANALYSIS IN ORGANIZATIONS: AN INTEGRATED ASSESSMENT AT BITS PILANI HYDERABAD CAMPUS

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This study presents a comprehensive cradle-to-grave life cycle assessment (LCA) of chemical flows within the organizational units of the BITS Pilani Hyderabad Campus. The objective was to systematically quantify and characterize inputs, usages, outputs, and disposal pathways for key chemicals across the domains of chemical engineering, chemistry, pharmacy, biological sciences, civil engineering, and residential sectors. Using ISO 14040/44-compliant methodologies, the research team employed a mixed-method approach, integrating qualitative interviews, on-site process audits, and quantitative inventory analysis to construct a robust life cycle inventory (LCI) for each department. This process included cataloging chemical types, hazard classifications in accordance with Material Safety Data Sheets (MSDS), and mapping disposal routes such as effluent discharge, landfill, thermal incineration, and recovery operations. The impact assessment highlighted significant risks associated with untreated chemical effluents, landfill leachate, and sub-optimal segregation practices, which may elevate human toxicity and ecosystem eutrophication potentials. Analysis of the existing disposal protocols revealed regulatory gaps in hazardous chemical segregation, especially for legacy waste managed via municipal drains rather than certified handlers. Based on outcome metrics addressing resource efficiency, toxicity, and regulatory compliance, the study recommends phased implementation of best-practice waste minimization technologies, expansion of institutional hazardous waste registers, and compulsory staff training for chemical handling and disposal. These technical interventions are deemed critical for aligning campus waste management systems with sustainable chemical product stewardship and for minimizing long-term eco-toxicological burdens. The study underscores the necessity for continuous monitoring and reporting systems that utilize digital traceability platforms to ensure real-time compliance and adaptive management. Further integration of life cycle impact data with risk assessment tools could enable more precise prediction of potential exposure pathways and cumulative effects, facilitating proactive mitigation planning and engagement with both internal and external stakeholders.

Keywords: life cycle assessment, hazardous waste, chemical inventory, environmental impact, regulatory compliance
PHYTOCHEMICAL ANALYSIS AND ANTIMICROBIAL ACTIVITY OF *CENTRATHERUM PUNCTATUM* ESSENTIAL OIL FOR SAFE STORAGE OF *CAJANUS CAJAN*

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Centratherrum punctatum belonging to the family Asteraceae is widely spread over the southern part of India. The leaves of *C. punctatum* are known for their pleasant aroma and are used as a natural herb for haircare and snake bites in the regional areas. The present study evaluates the phytochemical composition and antimicrobial activity of essential oil of *Centratherrum punctatum* (CpEO) against seed-borne pathogens of *Cajanus cajan* (Pigeon peas). The CpEO was obtained using the hydrodistillation method and its chemical composition was determined by GC-MS analysis. The test fungi were isolated from the seeds of *Cajanus cajan* using Standard seed blotter method. The antimicrobial activity was evaluated using agar well diffusion and poison food techniques. The obtained results revealed that a total of 28 different phytoconstituents were identified from CpEO using GC-MS, among which Caryophyllene (16.70%) and Cubebene (10%) were identified as major compounds. The extracted CpEO also shows significant antimicrobial activity against plant pathogenic fungi viz., species of *Aspergillus*, *Fusarium*, *Penicillium* and *Alternaria*, and human pathogenic *Escherichia coli* and *Staphylococcus aureus* at 5 μ L/mL concentration. The obtained results confirm broad spectrum antimicrobial activity of *Centratherrum punctatum*, hence it could be exploited as a source of antimicrobial agent for management of pathogenic microbes during storage of agricultural foodstuffs.

Keywords: *Centratherrum punctatum*, Essential oil, *Cajanus cajan*, Plant pathogenic fungi

NUTRIENT UPTAKE AND SOIL CHEMICAL PROPERTIES OF SOIL AS INFLUENCED BY FOLIAR APPLICATION OF NANO FERTILIZERS IN MAIZE (*ZEAMAYS* L.)

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The present study was undertaken to investigate the influence of nano fertilizers on nutrient uptake and soil chemical properties in maize (*Zea mays* L.) under field conditions. The field experiment was conducted during the late *Kharif* season of 2024 at the College of Agriculture, Navile, Shivamogga, Karnataka, located in the Southern Transitional Zone of Karnataka. The experiment was laid out in a Randomized Complete Block Design (RCBD) with thirteen treatments and three replications. Foliar applications of nano fertilizers were tested at different stages of crop growth. The results indicated that nano fertilizers, particularly the combined applications of nano DAP and nano Zn at 30 and 45 DAS (T₁₃), significantly enhanced nutrient uptake compared to conventional fertilization. Maximum nitrogen (213.55 kg ha⁻¹), phosphorus (44.09 kg ha⁻¹), potassium (104.19 kg ha⁻¹) and zinc (104.19 g kg⁻¹) uptake were recorded in T₁₃, followed by T₁₂. Conversely, the lowest nutrient uptake values were observed in the control (T₁). The improvement in uptake efficiency was attributed to the nano scale properties of fertilizers, which facilitated enhanced absorption, translocation and partitioning of nutrients within plant tissues. Soil chemical properties such as pH, electrical conductivity (EC) and organic carbon (OC) were not significantly affected by nano fertilizer application, although available soil nutrients (N, P₂O₅, K₂O and Zn) decreased under nano fertilizer treatments due to higher plant uptake. These findings demonstrate the potential of nano fertilizers to enhance nutrient use efficiency and crop productivity while minimizing nutrient losses, thereby serving as a sustainable alternative to conventional fertilizers in maize production systems.

Keywords: Nano fertilizers, Maize, Nutrient uptake, Foliar application, Soil chemical properties, Nutrient use efficiency

PHYTOCHEMICAL ANALYSIS AND BIOLOGICAL ACTIVITIES OF *MEDINILA MALABARICA* (MELASTOMATACEAE) - A POTENTIAL MEDICINAL PLANT OF WESTERN GHATS

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Medinilla malabarica was evaluated for its phytochemical composition, total phenolic and flavonoid contents, as well as antioxidant and antimicrobial activities using chloroform, methanol, and aqueous extracts of leaf and stem. Phytochemical screening revealed a diverse distribution of secondary metabolites, with alkaloids, terpenoids, glycosides, and tannins detected across most extracts. Flavonoids and phenolics were predominantly present in methanolic extracts, while saponins, steroids, and proteins exhibited selective distribution depending on the solvent and plant part. Quantitative analysis demonstrated that methanolic leaf and stem extracts contained the highest total phenolic (39.63 and 34.12 mg GAE/g extract, respectively) and flavonoid contents (69.90 mg QE/g extract), highlighting the efficiency of polar solvents in metabolite extraction. Methanolic extracts also exhibited superior antimicrobial activity against bacterial strains, including *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Bacillus subtilis*, and *Escherichia coli*, with the lowest MIC values (0.625-1.25 mg/ml), and showed notable antifungal activity against *Candida albicans*, *Fusarium oxysporum*, *Aspergillus niger*, and *Fusarium moniliforme*. Antioxidant assays, including DPPH radical scavenging and reducing power, confirmed that methanolic extracts possessed the highest free radical scavenging capacity and electron-donating potential, correlating with their elevated phenolic and flavonoid content. Collectively, these findings demonstrate that *M. malabarica* is a rich source of bioactive compounds with significant antioxidant and broad-spectrum antimicrobial potential, with methanol identified as the most effective solvent for extracting its phytochemicals.

OPTIMIZATION OF SURFACE STERILIZATION METHOD AND CULTURE MEDIA FOR ISOLATION OF ENDOPHYTIC FUNGI FROM *NOTHAPODYTES NIMMONIANA* AND *SARCOSTIGMA KLEINII* LEAF EXPLANTS

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Endophytic fungi are microorganisms that live inside healthy plant tissues without causing any visible harm. They are important sources of natural compounds with antimicrobial, antifungal, and anticancer properties. One such important compound is camptothecin, a well-known anticancer alkaloid that inhibits DNA topoisomerase I and is used in drugs like topotecan and irinotecan to treat various cancers. Camptothecin is mainly obtained from *Camptotheca acuminata* and *Nothapodytes nimmoniana*, but overexploiting of these plants has reduced their availability. Hence, endophytic fungi from camptothecin-producing plants and related species are being explored as alternative sources for these valuable compounds. The present study focuses on *Sarcostigma kleinii* is a woody climbing shrub (liana) and *Nothapodytes nimmoniana* is a small deciduous tree, two medicinally important plants belonging to the family Icacinaceae. Both the species are rich in bioactive metabolites and are potential hosts for endophytic fungi with medicinal value. An attempt was made to standardize the surface sterilization protocol and culture media for leaf explants of these species to obtain contamination-free samples for isolating endophytic fungi. Different sterilizing agents such as ethanol, sodium hypochlorite, and mercuric chloride were tested in various concentrations and exposure times. Among them, the optimized treatment produced the best results by removing external contaminants and allowing maximum recovery of endophytes. This standardized protocol will help in the isolation, purification, and characterization of endophytic fungi capable of producing important bioactive compounds like camptothecin and other metabolites with antibiotic and anticancer potential. Further studies will include screening and molecular identification of these isolates. The findings support sustainable approaches to drug discovery by using endophytes as alternative sources of plant-based therapeutics.

Keywords: Endophytic fungi, Mercuric chloride, *Sarcostigma kleinii*, *Nothapodytes nimmoniana*, Icacinaceae, camptothecin

DESTINATION WISE GROWTH PERFORMANCE AND INSTABILITY ANALYSIS OF FLOWERS EXPORT FROM INDIA

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In current scenario Floriculture is one of the important commercial trades in Agriculture due to its importance and increasing demand in world. India is the second largest in the world next to the China in terms of area under floriculture. According to APEDA in 2023-24 India produced 2,931,113.9 MT of flowers and export 9107.52 MT with its tremendous marketing potential. This paper highlighting the current scenario of total flowers export from India and represent the growth and instability in terms of quantity, value and price of flowers export over a study period from 2013-14 to 2023-24. The data collected from secondary sources were analysed by using exponential function and Cuddy Dela Valle index along with calculation pattern of export. The results of selected top countries on the basis of past 10 years performance in value of export revealed that major importer of flowers from India are United States of America, United Kingdom, United Arab Emirates, Malaysia and Singapore. The total growth of quantity (-5.89%), value (-5.08%) and price (0.86%) of flowers export showed slow decline but stable growth of flower exports. Nepal and Spain showed significant growth in quantity, value and price of it. The Della Valle Instability Index of quantity (28.38%), value (26.10%) and price (6.63%) of flowers export were indicated different levels of stability due to effect of some factors like market fluctuations and trade conflicts. Singapore was a stable market in terms of export quantity and value while in terms of price United States of America were stable one.

Keywords: Export, Flowers, Growth rate, Instability index, Destination pattern.

RESIDUAL CONSEQUENCES OF ORGANIC AND INORGANIC INPUTS ON GROWTH, QUALITY, YIELD, AND NUTRIENT STATUS OF GLADIOLUS (*GLADIOLUS GRANDIFLORUS* L.) CV. PUSA KIRAN UNDER MARIGOLD-GLADIOLUS CROPPING SYSTEM

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Residual consequences of organic and inorganic inputs stimulate the growth, quality, yield, and nutrient status in gladiolus under marigold-gladiolus cropping system. A field trial was conducted to assess the residual influences of nutrients on growth, quality, yield, and nutrient status of gladiolus. Marigold seedlings cv. Pusa Narangi Gaiinda were transplanted in the respective treatment plots as summer crop followed by gladiolus corms cv. Pusa Kiran on the same plot as winter crop without disturbing the nutrient status of the treatment combinations. Residual nutrients influenced significantly the gladiolus attributes, nutrient uptake as well as its use efficiency. FYM @ 25t/ha + Vermicompost @ 5t/ha + Mustard oil cake @ 5t/ha + Dolomite @ 222 kg/ha responded highest plant height (60.40 cm), earliness in spike initiation (59.40 days), enhanced rachis length (55.28 cm) and spike length (92.98 cm), maximum number of florets/spike (17.07). The treatment combinations, FYM @ 25t/ha + Vermicompost @ 5t/ha + Mustard oil cake @ 5t/ha + Dolomite @ 222 kg/ha also boosted nitrogen uptake in leaves, flowers, spikes, roots (3.45 kg/ha, 2.11 kg/ha, 5.40 kg/ha, 0.44 kg/ha), phosphorus uptake (1.16 kg/ha, 0.67 kg/ha, 2.62 kg/ha, 0.09 kg/ha) and potassium uptake (2.22 kg/ha, 1.10 kg/ha, 4.66 kg/ha, 0.29 kg/ha). In contrast, increased nutrient use efficiency (19.45 kg/kg, 106.57 kg/kg, 66.61 kg/kg), nutrient uptake efficiency (0.030 kg/kg, 0.076 kg/kg, 0.089 kg/kg), apparent nutrient recovery (2.64%, 6.25%, 5.98%) was recorded to be highest in the treatment Vermicompost @ 5t/ha followed by treatment combinations, FYM @ 25t/ha + Vermicompost @ 5t/ha + Mustard oil cake @ 5t/ha + Dolomite @ 222 kg/ha. The study shows the great potential of residual consequences of organic and inorganic inputs for significant performance on growth, quality, yield, as well nutrient characters in gladiolus under marigold-gladiolus cropping system without compromising quality and yield.

Keywords: apparent nutrient recovery, organics, growth, quality, gladiolus, nutrient uptake, nutrient use efficiency, residual nutrient, yield

NANOTECHNOLOGY-ENABLED PRECISION AGRICULTURE: BRIDGING BIO-NANOTECHNOLOGY WITH GREEN TECHNOLOGIES

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The convergence of bio-nanotechnology and green technology is catalyzing a paradigm shift in sustainable agriculture through precise molecular-level interventions and eco-friendly practices. Bio-nanotechnology leverages engineered nanomaterials such as nanoscale fertilizers, nanopesticides, and nanocarriers for targeted delivery of agrochemicals, enhancing bioavailability and reducing off-target effects. These nanostructures enable controlled release mechanisms and improved uptake efficiency, minimizing environmental contamination and resource wastage. Simultaneously, green technology integrates renewable energy systems, biodegradable nanomaterials, and phyto-remediation techniques to complement these innovations and maintain agro-ecosystem integrity. Advanced nanosensors and nanobiosensors facilitate real-time monitoring of soil physicochemical properties, pathogen presence, and crop stress biomarkers at molecular resolution, guiding precision agronomic interventions. Structural elucidation of nanoparticle-plant interactions at the cellular and molecular levels via cutting-edge imaging and spectroscopic techniques informs the rational design of biocompatible nanodevices. This multidisciplinary approach addresses critical challenges in nutrient management, pest and disease control, and environmental sustainability. By bridging nanoscience with green agritech, these technologies offer scalable solutions to enhance crop yield, resilience, and soil health, contributing to global food security and sustainable agricultural development.

Keywords: Nanocarriers, Phytoremediation, Controlled release, Biodegradable nanomaterials, Nanoparticle-plant interactions

INTEGRATED APPROACHES TO BIODIVERSITY MONITORING AND CONSERVATION

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Biodiversity is threatened by habitat loss, pollution, overexploitation, invasive species and climate change. Therefore, there is a growing need for integrated approaches to biodiversity monitoring and conservation. It includes sustainable environmental management which help in understanding, protecting and restoring the natural system. It helps in early detection of ecological changes and assessment of ecosystem health. Different monitoring methods support in conservation planning and help in monitoring ecological balance by assessing the diversity, abundance and distribution of species and ecosystem. The present study explores various methods and strategies used to identify, document, and monitor biodiversity, with the aim of ensuring its effective conservation and protection. Biodiversity monitoring comprises different strategies as traditional methods, remote technology-based methods, and hybrid & historical approaches. Traditional methods include field survey & direct observation, photograph and e-DNA sampling. Remote technology-based methods are remote sensing, acoustic methods and artificial intelligence to analyse large data. Hybrid and historical approaches use historical records like old maps, photographs and written accounts to understand past biodiversity pattern and how they changed. Conservation of biodiversity is significant in understanding ecological, economical. Social and ethical perspectives. Different tools used in conservation of biodiversity include both in-situ and ex-situ approaches. Modern tools involve the Geographical Information system and remote sensing which map the habitat, monitor land use changes and managing protected areas. DNA barcoding, genetic analysis, bioinformatics, as well as the use of drones and camera traps, serve as significant modern tools for biodiversity conservation and monitoring. Ultimately, integrating diverse monitoring and conservation methods ensures the sustainability of ecosystems and the continued survival of countless species.

Keywords: Biodiversity, Conservation, Geographical Information system, Remote sensing, DNA barcoding

GREEN SYNTHESIS AND CHARACTERIZATION OF SILVER NANOPARTICLES FROM *CRYPTOCARYA WIGHTIANA* THW. LEAVES AND THEIR ANTIBACTERIAL ACTIVITY

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The present study demonstrates the green synthesis of silver nanoparticles (AgNPs) using the methanolic extract of *Cryptocarya wightiana* Thw. leaves, obtained through Soxhlet extraction. Among the solvents used, methanol yielded the highest extractive value (29.2%) and was rich in flavonoids, phenols, alkaloids, tannins, and saponins. Phytochemical screening revealed that polar solvents extracted a broader range of bioactive compounds than nonpolar ones. Gas chromatography mass spectrometry (GC-MS) analysis of the methanolic extract identified 45 phytoconstituents, including hexadecanal, n-hexadecanoic acid, 9,12-octadecadienoic acid, stigmast-5-en-3-ol, and oleate, known for their antimicrobial and antioxidant properties. The total phenolic and flavonoid contents were 838.78 ± 21.75 mg GAE/g and 518.75 ± 23.73 mg QE/g, respectively, indicating strong antioxidant potential. Characterization studies confirmed the successful synthesis of AgNPs. The UV-Vis spectrum showed a surface plasmon resonance (SPR) peak at 420 nm, while FTIR analysis revealed characteristic functional groups (O-H, C=O, C-H, and C-O), confirming the involvement of phytochemicals in nanoparticle formation. EDX analysis verified the presence of elemental silver. The biosynthesized AgNPs exhibited significant antibacterial activity against *Xanthomonas campestris* and *Staphylococcus aureus*, with inhibition zones (mm $\pm$ SD) of 10.5 ± 0.7 , 11.5 ± 0.4 , 12.5 ± 0.4 , and 15.5 ± 0.5 for *X. campestris*, and 11.5 ± 0.6 , 12.5 ± 0.4 , 16.0 ± 0.4 , and 33.0 ± 0.5 for *S. aureus* at 25, 50, 100 μ g/mL, and standard, respectively. Overall, *C. wightiana* serves as an effective bioreductant for AgNP synthesis, producing stable nanoparticles with potent antibacterial activity and promising biomedical applications.

Keywords: *Cryptocarya wightiana*, phytochemicals, GC-MS, silver nanoparticles, characterization, antibacterial activity

IMPACT OF EGG DENSITY ON CANNIBALISM, FEEDING, AND REPRODUCTION IN *COCCINELLA TRANSVERSALIS* FABRICIUS (COLEOPTERA: COCCINELLIDAE)

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The present study investigates the influence of varying egg densities on the cannibalistic behaviour, feeding efficiency, and reproductive performance of the predatory ladybird *C. transversalis*. Experiments were conducted under two distinct exposure conditions physical and chemical across five egg density levels (0, 5, 10, 20, and 30 eggs). The parameters evaluated included egg cannibalism, aphid consumption rate, and oviposition potential. Under physical conditions, egg cannibalism showed a positive correlation with increasing egg density, indicating density-dependent behavioural regulation possibly driven by nutritional compensation or intraspecific competition. Aphid consumption ranged from 6.5 to 8.6 aphids per day, with the highest feeding efficiency observed at moderate egg densities (10-20 eggs). Correspondingly, oviposition peaked at 56 eggs, suggesting that limited cannibalism enhances reproductive success through improved nutrient assimilation and energy allocation. Conversely, chemical treatments completely inhibited egg cannibalism across all densities, implying a deterrent or toxic influence of chemical exposure. Both aphid consumption and oviposition rates were markedly reduced compared to physical treatments, reflecting sublethal physiological effects of chemical stress on metabolism and oogenesis. Overall, the study demonstrates that environmental conditions significantly modulate self-regulatory behaviour and reproductive strategies in *C. transversalis*. While physical conditions promote optimal feeding and reproductive efficiency, chemical stress impairs both behavioral and physiological functions. These findings contribute valuable insights into predator ecology and support the development of sustainable, environmentally compatible biological control programs.

Keywords: Egg density, cannibalism, aphid consumption, oviposition, chemical stress, *Coccinella transversalis*, predator ecology, biological control

DIVERSITY AND DISTRIBUTION OF MOTHS (LEPIDOPTERA: HETEROCERA) IN DISTRICT SOLAN, HIMACHAL PRADESH, INDIA

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Insects constitute a major component of global biodiversity, and the moths referable to order Lepidoptera play crucial ecological role as pollinators, herbivores and bio-indicators. The monitoring of their diversity provides valuable insights into ecosystem health and habitat stability, particularly in ecologically sensitive regions such as the Western Himalayas. The present study is carried out with the aim to document and assess the diversity of moth fauna across various localities of District Solan, Himachal Pradesh, to establish a baseline for biodiversity monitoring and conservation planning. It was hypothesized that the district's diverse altitudinal gradients and vegetation types support a rich and varied moth assemblage. The sampling was carried out by using light trapping methods in April 2025 (pre-monsoon season) across representative habitats. The sampled material was sorted and identified with the help of relevant literature. A total of 103 species belonging to 91 genera, 14 families, and 9 superfamilies were recorded, with families Erebidæ and Geometridæ showing the highest diversity, each with 31 species, followed by Crambidae (9), Noctuidæ (8) and several less represented families. The checklist highlights the ecological significance of Solan District offering a thorough inventory of the moth fauna of the area, and emphasizes the necessity of ongoing biodiversity monitoring and integrated conservation initiatives to protect Himalayan ecosystem.

Keywords: Moth, Diversity, Solan, Himachal Pradesh, Lepidoptera.

NATURE'S NIGHTLIGHTS: BIOLUMINESCENT FLOWERS IN MODERN LANDSCAPES

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Bioluminescence, the natural emission of light by living organisms through luciferin-luciferase reactions, is one of nature's most remarkable biochemical phenomena, traditionally observed in marine organisms, fungi and fireflies (*Photinus pyralis*). This trait is now being explored in ornamental plants, offering exciting opportunities in landscaping. Gene transfer using luciferase from fireflies, bacteria (*Vibrio fischeri*) and fungi (*Neonothopanus nambi*) has produced transgenic plants such as *Arabidopsis thaliana*, *Nicotiana tabacum* and *Petunia*, which emit faint visible light. In modern floriculture, bioluminescent traits in crops like roses, chrysanthemums, orchids and petunias could revolutionize landscape design, creating naturally illuminated "glow gardens". For example bioluminescent petunias expressing fungal luciferase, emit a soft greenish glow, while "glowing roses" have been proposed using bacterial *lux* operons for decorative and commercial purposes. In landscaping, bioluminescent flowers can be planted along pathways, water features, garden borders, green roofs, vertical gardens and public spaces to create self-illuminating environments. Their soft glow enhances night time visibility, complements thematic designs with color variations and reduces reliance on artificial lighting, promoting sustainable and energy-efficient urban planning. Subtle luminescence can be tailored blue-green for aquatic gardens or soft yellow for tropical displays offering designers new artistic freedom while improving psychological well-being by connecting people with nature. Beyond aesthetics, these plants can attract nocturnal pollinators such as moths and bats, enhancing pollination efficiency and supporting biodiversity. Along with, plants can serve as environmental biosensors, where variations in light intensity may indicate physiological stress, nutrient deficiencies, or pollution levels. The advances in synthetic biology, CRISPR-Cas9 genome editing and promoter engineering enable precise control of luminescent colour, intensity and duration, allowing applications in eco-friendly lighting and environmental bio-sensing. Thus, integrating bioluminescent pathways into flower crops bridges art and science, fostering innovation in ornamental breeding, sustainable landscaping, ecological adaptation, and biotechnology.

Keywords: Bioluminescence, Floral bioluminescence, Genetic engineering, Ornamental crops, Synthetic biology, Environmental biosensors

BIO-EFFICIENCY OF *TRICHODERMA* SPP. AGAINST RICE ROOT KNOT NEMATODE (*MELOIDOGYNE GRAMINICOLA*)

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The rice root-knot nematode (*Meloidogyne graminicola*), is one of the most devastating pests in rice growing fields that causes significant yield reduction annually. Present study was conducted to work out the effectiveness of different isolates of *Trichoderma* against this serious pest. Study consisted of 34 isolates of *Trichoderma*. All the isolates showed their effectiveness against root knot nematode. Minimum number of galls/plant was recorded in S13 (0) and S32 (0) isolates of *Trichoderma*, and its maximum number was recorded in S31 () followed by S21 (6.00), S23 (6.00) and S16 (5.66). The inoculated isolates increased shoot as well as root length over control. Maximum shoot length S35 (31.72cm) and root length S37 (14.00cm) were recorded in isolates of *Trichoderma*. Minimum shoot length S36 (18.92cm) and root length S34 (4.11 cm) were recorded in isolates of *Trichoderma*. Thus, the results of present study indicated that the use of *Trichoderma* isolates could be a better option in integrated nematode management programme (INM) which will reduce environmental pollution.

Keywords: Root knot nematode, rice, *Trichoderma*, isolate

ECOSYSTEM RESTORATION AND LANDSCAPE-LEVEL APPROACHES: POST-MINING LAND REHABILITATION AND BIODIVERSITY ENHANCEMENT OF SHAHDOL DIVISION MADHYA PRADESH

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Post-mining landscapes present severe ecological degradation but also large opportunities for biodiversity recovery if restoration is planned and implemented at a landscape scale. We present a multidisciplinary experimental restoration framework applied across three degraded opencast coal mine sites Amlai Mine ,Dhanpuri and Burhar No 3 in central India Shahdol Madhya Pradesh . The restoration framework integrates soil amelioration, native species reintroduction, microtopography design, and a matrix of habitat refugia connected by ecological corridors. We describe standardized monitoring protocols for vegetation, soil, fauna, remote sensing and present illustrative results from the first three years of restoration monitoring. Hypothetical outcomes show rapid increases in native plant cover from 8% baseline to 35 % at Year 3 , soil organic carbon gains from 0.4% to 1.1%, and colonization by pollinators and small mammals. We discuss lessons learned, the importance of landscape connectivity, adaptive management, and socio-ecological co-benefits (livelihoods, ecosystem services). This framework is scalable and suitable for post-mining rehabilitation programs aiming for biodiversity enhancement and ecosystem function recovery. **Keywords:** Post-mining rehabilitation, Ecosystem restoration, Landscape ecology, Biodiversity enhancement, Soil amelioration, Monitoring framework.

AVIFAUNA AND ITS ECOLOGICAL IMPLICATIONS OF SURYAPET DISTRICT, TELANGANA

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The present study conducted in Suryapet district of Telangana recorded diverse faunal species, documenting 112 species among various taxa. Avifauna being the focused taxa in the study recorded 81 species. Other taxa included butterflies (17 species), dragonflies (6 species), reptiles (3 species), and one species each of Amphibians, damselflies, grasshoppers, moths, mushrooms, spiders, and wasps respectively. Birds belonging to 17 orders with Passeriformes being the most dominating, followed by Passeriformes and Pelecaniformes. Among these, Ardeidae is the most dominant family, followed by Rallidae, Columbidae, and Cisticolidae. From the birds sighted in this study, The Wild Life Protection Act, 1972 classified 76 birds in Schedule II, 3 in Schedule I, and 2 as 'Not Protected'. For endemism, analysis revealed 11 species are Endemic to the Indian Subcontinent. According to IUCN Red List, 2 species are Near Threatened. The migratory pattern showed that out of the 61 birds, 6 are winter migrants, and there are few under other migratory categories. Habitat specialization included Wetland birds-21 and Open Habitat-17. Diet guilds of birds highlighted 33 as invertebrates, 15 omnivores, 15 Plant & Seed feeders and 14 Vertebrate & Carrion feeders. Abundance of birds strongly correlated with the availability of food and roosting habitats; wetland birds were more visible seasonally. **Keywords:** Telangana, Faunal species, taxa, Endemic, wetland birds

NUTRIENT OMISSION: ITS EFFECT ON YIELD, WATER PRODUCTIVITY AND NUTRIENT USE EFFICIENCY OF RABI SORGHUM UNDER RAINFED AND IRRIGATED CONDITIONS

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A field experiment was conducted to study response of rabi sorghum to nutrient omission under rainfed and irrigated conditions during 2020 at All India Coordinated Research Project on Sorghum, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. The experiment was laid out in split plot design having two main plots and 9 sub plots using CSV - 29 R variety of sorghum. The results indicated that significantly higher yield (44.87 q ha⁻¹), stover yield (8.52 t ha⁻¹), water productivity (2.90) and higher agronomic use efficiency (29.73) and physiological use efficiency (33.63) of nitrogen of rabi grain sorghum were recorded under irrigated condition. Among nutrient omissions, application of 50:25 kg NP ha⁻¹ + FYM @ 3 t ha⁻¹ + ZnSO₄ @ 15 kg ha⁻¹ recorded significantly grain yield (49.56 q ha⁻¹), stover yield (9.55 t ha⁻¹), water productivity (2.56) and higher agronomic use efficiency (34.58) and application of 50 kg N ha⁻¹ + ZnSO₄ @ 15 kg ha⁻¹ + FYM @ 3 t ha⁻¹ observed physiological use efficiency (38.18). Among interactions application of 50:25 kg NP ha⁻¹ + FYM @ 3 t ha⁻¹ + ZnSO₄ @ 15 kg ha⁻¹ recorded significantly grain yield (54.73 q ha⁻¹), stover yield (10.80 t ha⁻¹), water productivity (3.55) and higher agronomic use efficiency (38.66) and application of 50 kg N ha⁻¹ + ZnSO₄ @ 15 kg ha⁻¹ + FYM @ 3 t ha⁻¹ observed physiological use efficiency (40.01) under irrigated condition.

PROTECTIVE INTERPLAY OF VITAMINS C AND E AGAINST ACEPHATE-MEDIATED REPRODUCTIVE DISRUPTION IN DROSOPHILA MELANOGASTER

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Besides the classical genetics experiments, *Drosophila melanogaster* has owned the crown in many other fields of biological sciences including biomedical sciences, developmental biology, toxicology, neurobiology and behaviour. In the present study *D. melanogaster* has been used as a model for the study of reproductive toxicity induced by a widely used organophosphate insecticide acephate. Based upon the previously determined LC₅₀ value of acephate (8.71 µg/mL) in *D. melanogaster* experimental setup was designed. Additionally, two common dietary antioxidants Vitamin C and E were co-administered with acephate, individually and in combination at safe doses to assess their protective efficacy against acephate induced toxicity. After chronic sub-lethal exposure to acephate both male and female flies demonstrated notable reproductive tissue damage in their testes and ovary. Biochemical estimations reflected lower level of vitellogenin, mitoferrin, angiotensin converting enzyme and NAD linked malate dehydrogenase enzyme activity. Oxidative stress marker parameters demonstrated significant rise in lipid peroxidation and protein carbonylation following acephate exposure. Genotoxicity study by comet assay depicted prominent appearance of comet tails in germ cells of only acephate exposed male and female flies. In compared to only acephate exposed category antioxidant co-administered groups revealed significant reduction in tissue damage, oxidative stress and genotoxic effects. Reproductive protein level and enzyme activity were also reflected near normal value in antioxidant supplemented category. Thus, in summary it can be concluded that, co-administration of Vitamin C and Vitamin E can protect the *D. melanogaster* flies from acephate-induced reproductive toxicity. Furthermore, these findings may also be extrapolated to other non-target organisms, suggesting broader ecological implications.

Keywords: *Drosophila melanogaster*, Acephate, Reproduction, Oxidative stress, Genotoxicity, Antioxidants.

HARNESSING PEDIOCOCCUS IN FOOD PRODUCT DEVELOPMENT: AN ANTI-INFLAMMATORY THERAPEUTIC APPROACH

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Pediococcus species are lactic acid-producing bacteria commonly associated with food fermentation and biopreservation for decades. These properties are also favourably utilized by the food industries as a starter culture. Specifically, as a promising probiotic bacteria with anti-inflammatory effects. Several in vitro and in vivo studies are evident that some strains of *Pediococcus acidilactici* suppress the pro-inflammatory cytokines (e.g., IL-1 β , IL-6, TNF- α), inhibit inducible nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2), and downregulate key signaling pathways including NF- κ B, MAPK, and STAT1. For example, an exopolysaccharide fraction of *Pediococcus pentosaceus* has been shown to reduce colonic inflammation and protect mucosal integrity, potentially treating inflammatory bowel disease. Furthermore, a synbiotic composed of inulin and *P. acidilactici* exhibits preventive and therapeutic effects on DSS-induced colitis in mice by enhancing antioxidant activity and alleviating inflammation. Thus, the incorporation of *Pediococcus* species or their metabolites e.g., EPS, bacteriocins, into food products to reduce inflammatory effects. Future studies can focus on developing consumer-acceptable foods using these strains with regulated safety rules and their gut survivability.

Keywords: *Pediococcus*, Anti-Inflammatory, Food product, *Acidilactici*, *Pentosaceus*

ROLE OF PROTECTED CULTIVATION IN VEGETABLE PRODUCTION AT KOSHI ZONE OF BIHAR

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Protected cultivation with drip fertigation systems have allowed many countries around the world to grow high-value vegetables, such as tomatoes, Cheri, Broccoli etc. year round, particularly under adverse edaphoclimatic conditions. Protected cultivation promotes efficient resource utilization, including water and fertilisers and minimizing weed infestation. This information evaluates the feasibility of tomato and different types of vegetables cultivation in Bihar, a commercial farm in agricultural institute, under a protected cultivation system with drip fertigation. The yield, water use efficiency, establishment and maintenance costs, and the average return per hectare of production were analysed. Additionally, economic feasibility indicators were estimated using the discount factors of 6.5% and 11%. Results showed that the annual yield of tomatoes was higher than other. The water use efficiency (WUE) and product water use (PWU) of these two crops in this study were less efficient compared to what was observed in other states, as indicated by the value of the respective WUE and PWU: 8.38 kg/m³ and 0.12 m³/kg for tomatoes while 5.31 kg/m³ and 0.19 m³/kg for capsicum. Despite the high initial establishment cost, all economic feasibility parameters indicated that the system is profitable, having a BCR ratio of more than 2, and feasible under protected conditions, mostly due to the high market price. Thus, this system of cultivation could be an option for growing high-value vegetables in Bihar. The present investigation was carried out to identify the performance of protected cultivation in production of vegetables. Protected cultivation is a process of growing crops in a controlled environment. Study revealed that Greenhouse farming with drip irrigation for vegetable production can save. Overall it can be concluded that vegetable cultivation under polyhouse condition significantly differ in various quality aspects than the ones cultivated in open condition and are found to be superior in terms of quality. Thus we may say that growing environment is an important factor that could reflect on the quality characters of the vegetable; however, this is the first attempt to understand the economic feasibility of the drip fertigation system under a protected structure and is valuable information to encourage local investors

Keywords: Protected cultivation, drip fertigation; economic feasibility; tomato; vegetable.

GENETIC VARIABILITY AND CORRELATION STUDIES IN PERSIMMON (*DIOSPYROS KAKI* THUNB.) FROM GANDERBAL DISTRICT OF KASHMIR VALLEY

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Ganderbal district of Kashmir valley was explored and surveyed for selection of elite persimmon genotypes and ninety three accessions were marked to study their growth, foliage, floral and fruit quality parameters and the results revealed vast diversity among persimmon accessions. Highest GCV and PCV values were observed for astringency index (41.04 and 41.06%) and titratable acidity (33.76 % and 35.37 %) whereas lowest for ascorbic acid (5.62 & 6.14%). Genetic variability study revealed that high heritability in broad sense was observed for astringency index (99.89%), male flower (99.20%), fruit weight (99.14%), tannin content (98.48%), leaf area (91.91%), leaf width (91.28%), titratable acidity (91.07%), fruit breadth (89.26 %), fruit length (87.48%), leaf length (85.42%), female flower (83.92%), ascorbic acid (83.83%) whereas medium heritability was observed for total soluble solids (76.40%), total sugars (75.63%) and low heritability was recorded in number of clusters/branch (31.80). Similarly, genetic gain was maximum for astringency index (84.50%) followed by fruit weight (68.88%) and minimum genetic gain was observed for ascorbic acid (10.61%). Highly significant correlation coefficient was observed among fruit and yield parameters. Fruit set showed highly positive correlation with fruit yield ($r = 0.331$), fruit length ($r = 0.314$), yield efficiency ($r = 0.231$), fruit weight ($r = 0.211$) and TSS ($r = 0.205$). Tannin content showed highly and significant positive correlation with astringency index ($r = 0.397$).

FLORAL AROMA ENGINEERING: ENHANCING FRAGRANCE AND VOLATILE COMPOUNDS

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Floriculture, a vital branch of horticulture, encompasses cut and loose flowers, foliage, dry flowers and potted plants, with roses, gerberas, gladiolus, marigold, jasmine and tuberose being major crops used for cultural and decorative purposes. To meet the increasing consumer demand, the floriculture industry seeks cultivars with superior traits such as novel colours, floral fragrance, extended vase life and stress resistance. Among these, floral fragrance remains a highly valued trait due to its sensory and emotional appeal. Historically, floral scents have been used by ancient civilizations for perfumes, medicines and rituals, reflecting their social and therapeutic importance. Floral aroma engineering, an emerging interdisciplinary field, aims to enhance fragrance through manipulation of volatile organic compounds (VOCs) such as terpenoids, phenylpropanoids and fatty acid derivatives synthesized in floral tissues like glandular trichomes and osmophores. These VOCs play crucial roles in pollinator attraction, defense and ecological balance while contributing to the economic value of flowers in perfumery, cosmetics and aromatherapy. Their biosynthesis involves key pathways of mevalonate (MVA), methyl erythritol phosphate (MEP), shikimate, and oxylipin regulated by genetic and physiological factors including developmental stage, temperature and transcription factors like *ODO1*, *PhABCG1* and *JsWRKY51*. Breeding methods such as hybridization, mutation and genetic or metabolic engineering have enhanced fragrance by introducing genes like *LIS*, *BEAT* and *BAMT* in ornamentals including petunia, carnation, rose and lisianthus. Henceforth, there is a need for future research on pathway optimization and transcriptional regulation to develop fragrant cultivars combining aesthetic, commercial and ecological excellence.

Keywords: Floriculture, floral aroma engineering, volatile organic compounds, terpenoids, phenylpropanoids, genetic engineering, floral scent biosynthesis.

PARASITIZATION AND CLEPTOPARASITISM IN MEGACHILE LANATA NESTS BY MELITTOBIA SP. NR MEGACHILIS AND EUASPIIS CARBANORIA

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Abstract: A study was conducted during 2024-25 at Agricultural Research Station, Vijayarai, Andhra Pradesh, to observe the nesting behavior of solitary bees and assess parasitization by natural enemies. Trap nests made from bamboo nodes and *Saccharum spontaneum* sticks were used to attract *Megachile lanata*. Observations revealed 100% parasitization by *Melittobia sp. nr megachilis* in laboratory conditions, while *Euaspiis carbonaria* cleptoparasitized 40% of nests, mainly targeting the first brood cell. The study highlights the impact of parasitization on solitary bee development and the importance of monitoring for pollinator conservation. **Methodology:** Data was collected from three different pollinator sheds located at the Agricultural Research Station, Vijayarai (Latitude: 16.838177, Longitude: 81.042973), Andhra Pradesh. The site is situated at an elevation of 52 meters above mean sea level and receives an average annual rainfall of approximately 1100 mm. Trap nests were constructed using bamboo nodes and *Saccharum spontaneum* sticks. These were arranged in stacked bundles of 25 sticks each, with diameters ranging from 0.5 to 1.5 cm and a uniform length of 3–4 feet. The trap nests were installed in the pollinator sheds across three locations within the research station. Daily inspections were conducted to monitor nest occupancy and parasitization. Occupied tubes containing solitary bee nests and parasitized cells were carefully collected and transferred to the laboratory for detailed observation and further study.

Key Findings: The wasp species *Melittobia sp. nr. megachilis* acts as a parasitoid, with its larvae feeding on the grubs, prepupae, or pupae of host bees after hatching. Due to its high reproductive capacity, this species can rapidly overpopulate bee brood cells, producing hundreds of eggs across multiple generations. *M. sp. nr. megachilis* parasitized only the grubs of *M. lanata*. No parasitization was observed in *M. disjuncta*. Parasitization by *M. sp. nr. megachilis* was significantly higher under laboratory conditions compared to the field, with **100% parasitization**. Multiple adult *M. sp. nr. megachilis* individuals emerged from a single brood cell of *M. lanata*. The cleptoparasitic bee *Euaspiis carbonaria* was also recorded as a significant brood parasite of *M. lanata*. It laid its eggs primarily in the **first brood cell near the nest entrance**. A **40% parasitization rate** by *E. carbonaria* was recorded in both bamboo and *Saccharum spontaneum* trap nests of *M. lanata* in field conditions. Eggs of *E. carbonaria* were morphologically distinguishable from those of *M. lanata*, being laid **parallel to the provisioned pollen and nectar food**, while *M. lanata* laid its eggs at a **slanted angle** within the provision. The eggs of *E. carbonaria* also differed in color from those of the host bee, aiding identification. *E. carbonaria* typically completed its life cycle before *M. lanata* suggesting that it may have **removed the host egg** before laying its own, consistent with its cleptoparasitic strategy. **Conclusion:** The study at Agricultural Research Station, Vijayarai, revealed significant parasitization of *Megachile lanata* by *M. megachilis* and the cleptoparasite *Euaspiis carbonaria* using bamboo and *Saccharum spontaneum* trap nests. *M. megachilis* showed 100% parasitization in lab conditions, preventing *M. lanata* from completing its life cycle. *E. carbonaria* mainly targeted the first brood cell, often replacing the host egg, with a 40% parasitization rate. These findings highlight the complex interactions between solitary bees and their parasites, and the importance of monitoring for effective pollinator conservation by designing trap nests for controlling these parasites and predators on Megachilids.

Keywords: *Megachile lanata*, *Melittobia sp. nr megachilis*, *Euaspiis carbonaria*, Trap Nests, Parasitization, Solitary Bees, Cleptoparasite, Pollinator Conservation.

SURVEY, CHARACTERIZATION AND DIVERGENCE STUDIES IN PERSIMMON (*DIOSPYRUS KAKI* THUNB.) FROM THE GANDERBAL DISTRICT OF KASHMIR

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The present investigation entitled “Survey, Characterization and Divergence studies in Persimmon (*Diospyros kaki* Thunb.) from the Ganderbal district of Kashmir” was carried out in four villages of district Ganderbal viz., Safapora, Lar, Kharnihama and Repora during the year 2023. Ninety-three accessions were selected the objectives to assess their vegetative, floral and physico-chemical characters and to select the elite genotypes from these accessions for further multiplication and distribution. Among studied accessions, early vegetative bud burst was recorded from 7th April to 11th April in six accessions and late bud burst was noticed in fourteen accessions from 10th April to 16th April. Among the accessions, plant growth habit was classified as erect (24), drooping (38) and spreading (31) types. Highest plant height was recorded in accession GKP-10 (7.83 m) and lowest in the accession GRP-22 (4.39 m) whereas maximum plant spread was registered in accession GKP-19 (5.97 m) and minimum in accession GLP-02 (3.03 m). Trunk girth ranged from 16.30 cm (GRP-24) to 55.60 cm (GLP-03) whereas TCSA varied between 21.15 cm² (GRP-24) and 246.13 cm² (GLP-03). Maximum fruit yield/plant was recorded in accession GRP-18 (48.00 kg) and minimum in accession GKP-15 (18.00 kg) whereas, yield efficiency varied from 0.143 kg/cm² (GSP-09) to 1.324 kg/cm² (GRP-24). Foliage parameters unveil that leaf length varied between 10.70 cm (GKP-19) to 17.60 cm (GLP-08) however leaf width varied between 6.37 cm (GSP-02) to 13.10 cm (GLP-09) whereas leaf area varied between 51.72 cm² (GKP-19) to 158.41 cm² (GSP-08). Meanwhile elliptic (36), obovate (13) and ovate (44) type of leaf shape were observed in the studied accessions. Flowering parameters revealed that flowering time perceived from 4th May to 12th May in two accessions whereas flowering was started late on 10th May and ended on 20th May in four accessions. Number of clusters/branch varied between 4.00 (GSP-06) to 7.75 (GRP-22), number of flowers/cluster varied between 19.00 (GKP-02) to 34.75 (GLP-06) however number of fruits/cluster varied between 11.00 (GKP-20) to 26.25 (GLP-13). More male flowers were recorded in accession GLP-04 (80.00 %) and lowest in accession GKP-02 (52.63 %) whereas maximum female flower were observed in accession GKP-02 (47.36 %) and minimum in accession GLP-04 (20.00 %). Maximum fruit set was recorded in GRP-19 (77.86 %) and minimum in GKP-20 (53.01 %). Duration of flowering ranged between 7.00 to 12.00 days among different accessions. Flower colour was yellow and yellowish white in 41 and 52 accessions, respectively. Fruits were harvested during 1st week (17 accessions), 1st-2nd week (30 accessions), 2nd week (28 accessions), 2nd-3rd week (14 accessions) and 3rd week (04 accessions) of November. Fruit physical parameters revealed that highest fruit weight, fruit length and fruit breadth were recorded in accessions GRP-05 (199.63 g), GSP-19 (84.57 mm) and GSP-08 (77.61 mm) whereas minimum was recorded in accessions GKP-17 (48.41 g), GRP-23 (52.31 mm) and GLP-14 (38.29 mm), respectively. Fruit firmness varied between 6.94 (GRP-16) to 11.74 lb/inch² (GKP-15). Meanwhile fruit shape was observed as elliptic (36 accessions), ovate (31 accessions) and circular (26 accessions), fruit skin colour as light yellow (20 accessions), yellow (17 accessions), yellow orange (25 accessions), red orange (12 accessions) and orange (19 accessions) whereas fruit flesh colour was found as red orange (13 accessions), orange (11 accessions), yellow (35 accessions), yellow orange (27 accessions) and chocolate brown (07 accessions). Maximum total soluble solids, titratable acidity, total sugars, ascorbic acid, tannins and astringency index was observed in GRP-05 (18.00°B), GKP-15 (0.38 %), GRP-08 (13.90 %), GKP-15 (31.83 mg/100g), GLP-19 (0.77 mg/g DW) and GSP-06 (3.74), respectively however minimum total soluble solids, titratable acidity, total sugars, ascorbic acid, tannins and astringency index was observed in GRP-19 (12.00°B), GKP-04 (0.12 %), GLP-09 (8.30 %), GRP-15 (25.37 mg/100 g), GSP-10 (0.22 mg/g DW) and GRP-08 (0.320). Number of seeds per fruit varied between 2.67 (GSP-06) to 4.67 (GSP-24). Highest GCV and PCV values were observed for astringency index (41.04 % and 41.06 %) and titratable acidity (33.76 % and 35.37 %) whereas lowest for ascorbic acid (5.62 % & 6.14 %). Genetic variability study revealed that high heritability in broad sense was observed for astringency index (99.89 %), male flower (99.20 %), fruit weight (99.14 %), tannin content (98.48 %), leaf area (91.91 %), leaf width (91.28 %), titratable acidity (91.07 %), fruit breadth (89.26 %), fruit length (87.48 %), leaf length (85.42 %), female flower (83.92 %), ascorbic acid (83.83 %) whereas medium heritability was observed for total soluble solids (76.40 %), total sugars (75.63 %) and low heritability

was recorded in number of clusters per branch (31.80). Similarly, genetic gain was maximum for astringency index (84.50 %) followed by fruit weight (68.88 %) and minimum genetic gain was observed for ascorbic acid (10.61 %). Highly significant correlation coefficient was observed among fruit and yield parameters. Fruit set showed highly positive correlation with fruit yield ($r = 0.331$), fruit length ($r = 0.314$), yield efficiency ($r = 0.231$), fruit weight ($r = 0.211$) and TSS ($r = 0.205$). Tannin content showed highly and significant positive correlation with astringency index ($r = 0.397$). Path analysis concluded that astringency index exhibited maximum direct positive effect on tannin via ascorbic acid (0.5901) and maximum indirect negative effect on tannin via total sugar (-0.538). PCA revealed maximum variance in PC1 (15.90 %) and the major variation contributing parameters was number of fruits/cluster, number of flowers/cluster, female flowering, male flowering and fruit set. Genetic divergence study consisted of formation of non-euclidean clusters resulted in formation of five cluster of different size measured as (D^2) value viz. Cluster-I (22), Cluster-II (15), Cluster-III (18), Cluster-IV (11) and Cluster-V (27). Maximum intra-cluster distance resulted in Cluster III (6.73) whereas minimum in cluster V (5.63). Maximum inter-cluster resulted between Cluster IV and Cluster V (8.26) whereas minimum in Cluster I and Cluster II (6.63). Based on fruit weight, total soluble solids, astringency index and tannins, accessions GSP-04, GSP-09, GSP-14, GLP-03, GLP-04, GKP-03 and GRP-08 were identified as promising. These accessions may be subjected for further evaluation, multiplication and breeding programmes to enhance, the production of elite genotypes persimmon in UT of Jammu and Kashmir.

Keyword: Persimmon, accession, survey, variability, astringency, tannin

EDIBLE FLOWERS: A NATURAL SOURCE OF NUTRITION

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With rapid urbanization and changing lifestyles, people are increasingly dependent on fast and processed foods, leading to poor nutrition and rising chronic diseases such as diabetes, obesity and cardiac disorders. This shift has created growing interest in natural bioactive compounds that promote health beyond basic nutrition i.e., **edible flowers**, defined as blossoms or flower parts suitable for human consumption, are gaining attention as functional and dietary supplements due to their rich source of nutritional and medicinal properties. Historically, flowers were used as food and medicine since Ancient Greece and Rome; roses, calendula and saffron, added to dishes for flavour, colour and health benefits. Edible flowers are rich sources of antioxidants, flavonoids, polyphenols, vitamins and essential oils. Nutritionally, flowers consist of three key components: **petals**, rich in minerals and vitamin A (e.g., dandelion, tulip, rose); **pollen**, a high-protein source with amino acids and flavonoids; and **nectar**, containing sugars, phenolic compounds and alkaloids beneficial for preventing degenerative diseases. Various flowers show specific health-promoting properties viz., hibiscus, marigold and nasturtium exhibit antioxidant, anti-obesity, hepatoprotective and neuroprotective effects. **Hibiscus** contains flavonoids, anthocyanins and organic acids with antihypertensive and anti-inflammatory activity. **Calendula** provides carbohydrates, lipids and minerals, while **lotus** is enriched with alkaloids like nuciferine and liensinine with antidiabetic, diuretic and hepatoprotective effects. Incorporating edible flowers such as rose (gulkand, tea, syrup) and hibiscus (juice, jam, tonic) into diets provides natural nutrients and functional benefits, making them valuable additions to modern dietary and nutraceutical applications.

Keywords: Antioxidants, Bioactive compounds, Edible flowers, Flavonoids, Nutraceuticals

PREDOMINANT ROLE OF TEACHERS IN IMPARTING KNOWLEDGE IN ENVIRONMENTAL EDUCATION SENSITIZATION FOR SUSTAINABLE DEVELOPMENT

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Teachers play a predominant role in imparting knowledge and sensitizing the students and society about the environment. They help to tackle the various environmental issues. Environmental problems have increased tremendously because environment is being abused beyond its capacity by human beings. Issues related to environmental problems have become a major concern for the international community particularly for educational policy makers and curriculum developers. Environmental Education is a powerful sensitization tool for the conservation of Environment, its biodiversity and the sustainable use of natural resources. Teachers are the potential change agents and are capable of generating a workforce of enlightened, skilled and motivated learners using formal and non-formal channels of education. It is now even more critical than ever before for mankind as a whole to have a clear understanding of environmental concerns and to follow sustainable development practices. Teachers should be actively involved in the implementation of environmental education programs. Several measures and strategies have been considered to intervene. Among these is the use of school curriculum by teachers to impart knowledge to protect and preserve environment for sustainable development.

Keywords: Teachers, Environmental Education, Sustainable Development, Sensitization

ENHANCING CARBON SEQUESTRATION AND GREENHOUSE GAS REDUCTION: STRATEGIES FOR A SUSTAINABLE FUTURE

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The escalation of greenhouse gas emissions and their impact on global warming necessitate exploring sustainable strategies to mitigate their effects. Carbon sequestration the process of capturing and storing atmospheric carbon dioxide plays a crucial role in addressing climate change. This paper explores methods to enhance carbon sequestration and reduce greenhouse gas (GHG) emissions across different ecosystems. The objective of this research is to evaluate the potential of natural and technological solutions, such as afforestation, reforestation, soil carbon storage, and carbon capture and storage (CCS), to reduce GHG emissions. The methodology includes a comprehensive review of existing literature, analysis of case studies, and the application of empirical data from ongoing projects. Key findings indicate that integrated approaches combining biological, physical, and technological methods are essential for optimising carbon storage capacity. Furthermore, the research highlights the importance of policy frameworks and global cooperation to promote carbon sequestration initiatives. The conclusion emphasises the need for increased investment in sustainable practices and research to achieve long-term GHG reduction goals.

Keywords: Carbon Sequestration, Greenhouse Gas Reduction, Climate Change, Sustainable Practices, Emission Mitigation

ANTIFUNGAL EFFICACY OF GREEN SYNTHESIZED ZINC OXIDE NANOPARTICLES AGAINST *FUSARIUM* WILT OF TOMATO

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Fusarium wilt, caused by *Fusarium oxysporum* f. sp. *lycopersici* (Fol), is a devastating soil-borne disease of tomato (*Solanum lycopersicum* L.) that severely reduces yield and quality. Conventional management largely depends on chemical fungicides, which are increasingly limited by environmental risks, health concerns, and the emergence of resistant pathogen strains. In this study, zinc oxide nanoparticles (ZnO NPs) were biosynthesized using mast tree (*Azadirachta indica* L.) leaf extract via a green route and evaluated for their antifungal activity. The nanoparticles were characterized through UV-Vis spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, and Scanning Electron Microscopy (SEM) confirmed the successful formation of ZnO NPs. Further, the synthesized ZnO NPs were tested against Fol at four different concentrations (10 ppm, 50 ppm, 100 ppm and 150 ppm). Among these, 150 ppm concentration of synthesized nanoparticles exhibited more inhibition against the Fol. Hence, the result suggests that the green synthesized ZnO NPs could be an effective alternative to chemical fungicides.

Keywords: Zinc oxide nanoparticles; Green synthesis; *Polyalthia longifolia*; *In vitro* efficacy

SPEAKING FLOWERS VIA FLORAL PRINTING

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The concept of “Speaking Flowers via Floral Printing” explores the innovative integration of **botany, biotechnology and digital design** to transform flowers into interactive, communicative displays. This approach uses **floral printing techniques** to apply **edible or biocompatible dyes, responsive pigments and bioengineered molecules** onto petals, enabling flowers to display messages, patterns, or colour transitions. By incorporating **stimuli-responsive elements** such as pH-sensitive pigments, fluorescent markers, or bioluminescent proteins, flowers can react to environmental cues like touch, temperature, or chemical signals, effectively “speaking” visually or biologically. These dynamic responses have diverse applications in **ornamental horticulture, personalized gifting, educational demonstrations and scientific exhibits**, combining aesthetic appeal with functional communication. Key floriculture species suited for this concept include **roses** (colour-changing petals and printed messages), **orchids** (bioluminescent or fluorescent patterns), **gerberas** (edible dye or UV-reactive designs), **tulips** (light- or temperature-responsive colour shifts), **chrysanthemums** and **lilies** (nighttime bioluminescence), **marigolds** (printed text/logos) and **jasmynes** (fragrance-triggered colour changes). For example, a smart rose equipped with a **microcontroller, microphone and LED petals** can respond to guests by **lighting up and playing greetings** or telling short stories, creating a **multi-sensory interactive experience**. Similarly, **smart lilies** announce birthdays, **interactive orchids** in museums that share plant facts and **potted talking flowers** at home that respond to voice commands. Thus, flowers printed with **custom messages or designs** can serve as unique gifts, while interactive floral displays in gardens, hotels and theme parks enhance **visitor engagement**. Together, these species demonstrate the versatility of floral printing technologies and stimuli-responsive pigments for creating **interactive, visually dynamic and personalized floral products**. Overall, this technology exemplifies the potential to transform **passive floral aesthetics into dynamic, responsive and interactive plant systems**, opening new horizons in **horticulture, biotechnology and creative design**.

Keywords: Speaking flowers, floral printing, bioluminescence, stimuli-responsive pigments, interactive horticulture, bio-communication.

SUSTAINABLE BEAUTY: THE RISE OF DRY FLOWER TECHNOLOGY IN GLOBAL FLORICULTURE

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Dry flower technology is a sustainable branch of floriculture that focuses on preserving natural flowers and plant parts in dried form for decorative, aesthetic and commercial uses. Unlike fresh flowers, dried flowers are long-lasting, lightweight and easy to handle. They retain their natural beauty, shape and colour for months or years, making them ideal for regions where fresh flowers are costly or scarce. The global dried flower market was valued at **USD 1.76 billion in 2024** and is projected to reach **USD 2.85 billion by 2033** (CAGR ~5.5%), major countries viz., **the Netherlands, China, India, the United States, Japan and the United Kingdom**, which lead in production, processing and export due to advanced preservation techniques and strong consumer demand. (%). India alone exports over **500 varieties** of dried flowers to more than **20 countries**, reflecting its growing contribution to the global trade. This eco-friendly technology adds value to surplus or off-season blooms, reducing post-harvest losses and offering a profitable venture for small and medium floriculture enterprises. This technology encompasses various drying techniques include air drying, sun drying, press drying, oven drying, microwave and silica gel drying, each tailored to flower type and moisture content to preserve colour, shape and texture. Flowers like; **rose which is** excellent shape, fragrance and colour retention; **chrysanthemum, marigold and zinnia** widely used for their vibrant hues and durable petals that hold their form; **statice, globe amaranth and strawflower** are often referred to as “everlasting flowers” because of their papery texture and excellent colour stability, making them highly suitable for long-lasting floral arrangements, wreaths and wall decorations. **Additionally, hydrangea, lotus and gerbera**, add unique textures and natural forms to decorative displays, with lotus pods being especially valued in interior designs and handicrafts. Fragrant flowers like **jasmine, tuberose and lavender** are preferred for potpourri and aromatic crafts, while **eucalyptus leaves, ferns, palms and seed pods** add texture to arrangements. Hence, promoting resource efficiency, export potential and artistic creativity, dry flower technology bridges sustainability with entrepreneurship. It ensures year-round availability of floral products and plays a vital role in advancing the ornamental horticulture and floral design industry worldwide.

Keywords: Dry flower technology, preservation, desiccation, value addition, floriculture, ornamental products

CO-ENCAPSULATION OF MULTI-STRAIN PROBIOTICS: INNOVATIVE STRATEGY FOR GUT MICROBIOTA MODULATION

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Co-encapsulation of multi-strain probiotics is an emerging strategy for enhancing gut microbiota modulation by improving the bacterial strains survivability, synergistic effects and target delivery. Recent evidences have promoted the formulation and an encapsulation technique that shows a positive impact on enhancing the viability of probiotics in foods and within the gastrointestinal tract, thereby ensuring more live bacteria reach the colon in an active form. This review outlines the importance of co-encapsulation that restores microbial strains, suppress pathogenic bacteria and enrich the probiotic species of *Lactobacillus* and *Bifidobacterium*. It also emphasis on the formulation of multi strain probiotics with different prebiotics. However, this system demonstrates a promising effect on functional food applications through certain synergistic activities offering multiple health benefits such as gut barrier integrity, balancing immune homeostasis and other chronic disorders. It also highlights the opportunities associated with technological optimization and formulation strategies that could enhance the efficacy and commercial feasibility of probiotic-enriched functional foods.

Keywords: Synergistic, Bacteria, Co-encapsulation, Probiotics, Functional.

INFLUENCE OF ROL GENES IN FLOWER CROPS

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In the modern floriculture, Genes play a fundamental role in shaping the morphological, physiological and biochemical characteristics of flower crops by enhancing ornamental traits such as flower colour, fragrance, shape, size, flowering time, vase life and stress tolerance. With advances in molecular biology and biotechnology, these genetic insights not only enhance the aesthetic appeal and commercial value of ornamental plants but also contribute to the development of cultivars with improved adaptability, resilience and post-harvest performance. Flower coloration, one of the most important traits influencing consumer preference, primarily governed by genes involved in the anthocyanin, carotenoid and flavonoid biosynthetic pathways, such as *CHS*, *DFR* and *ANS* regulate the synthesis and accumulation of pigments in petals that leads to diverse colour patterns in rose, petunia and chrysanthemum. In blue carnations, through the introduction of the *F3'5'H* gene from *Viola* species. Fragrance, another critical trait in ornamental crops, is controlled by a complex network of genes regulating volatile organic compound biosynthesis. Genes such as *RhNUDX1* in roses influence monoterpene production, while *BEAT* in *Clarkia* species controls the synthesis of benzyl acetate, a key aromatic compound. Manipulation of these genes through genome editing techniques like CRISPR-Cas has allowed improvement in intensity and quality, catering to both aesthetic preferences and demand in the perfume industry. Flowering time and morphogenesis is genetically regulated by *FT*, *AP1*, *LFY* and *SOC1*. These genes coordinate the transition from vegetative to reproductive growth, thereby determining flowering duration and synchrony. In crops like chrysanthemum and gerbera, modulation of these flowering genes enables breeders to produce varieties with controlled blooming periods suited for market requirements and seasonal production cycles. Furthermore, genes influencing ethylene biosynthesis and signalling play, such as *ACS*, *ACO* and *ETR1* regulate senescence and flower abscission. Downregulation or silencing of these genes has successfully delayed senescence and extended vase life in species such as carnation and orchid, improving their shelf life and economic value. Overall, the gene function in flower crops has significantly transformed modern floriculture to create ornamental plants with enhanced colour, fragrance, stress tolerance and longevity through molecular breeding, transgenic approaches and gene-editing tools.

Keywords: Flower crops, ornamental traits, flower colour, floral fragrance, flowering time, gene regulation.

BROCCOLI MICROGREENS: EFFECT OF DIFFERENT MEDIA ON GROWTH

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Microgreens are small, microscopic vegetable and herb seedlings that are picked when the first pair of genuine leaves emerges and the cotyledons are fully expanded. Depending on the crop and other environmental factors, these microgreens typically germinate 7–14 days after being planted and range in height from 2.5–7.6 cm. A soft stem, a unique scent, a mild, earthy flavor and a high concentration of vitamins (A, C, E and K), minerals, antioxidants and the healthy chemical sulforaphane are characteristics of broccoli microgreens. This study was conducted to evaluate the growth performance of broccoli microgreens in four different growing media as a substitute of hydroponics systems. These media were (i) sandy loam soil (M_1), (ii) vermi-compost (M_2), (iii) coco peat (M_3) and (iv) mixture of above three in the ratio of 2:1:1 (M_4). First germination day was observed for microgreens grown in different media. Additionally height of microgreens and root length were measured, yield noted and duration of harvesting recorded. The results indicate that M_2 and M_4 outperformed the other two growing media. In comparison to other media, M_2 exhibited quicker germination days (4.3 ± 1.15), superior height (6.6 ± 0.17) and root length (10.5 ± 1.37). M_4 produced the best yield (124.9 ± 20.28) and microgreens harvesting time (8.00 ± 0.00) was the shortest. It can be concluded that vermi-compost media can be used to improve the growth and shorten the duration of microgreens harvesting for use by human beings as functional foods.

Keywords: Broccoli, Coco Peat, Germination, Microgreens, Vermicompost, Yield.

NATURAL PRESERVATIVES: INFLUENCE OF ESSENTIAL OILS ON ENHANCING POSTHARVEST LONGEVITY OF GLADIOLUS

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An experiment was conducted to evaluate the effect of different natural preservatives on the vase life and quality parameters of *Gladiolus* var. *Arka Amar* at Dept. of Floriculture and Landscape Architecture, College of Horticulture, Mysuru during September 2025. Fifteen preservative treatments were tested, including combinations of sucrose, essential oils (clove, cinnamon, lemongrass, neem, turmeric), vinegar, lemon juice and boric acid. Analysis of variance (CD = 1%) revealed significant effects of treatments on most quality attributes except for solution uptake on the 1st, 4th, and 6th day, floret flowering on the 3rd, 5th and 7th day and overall water uptake. Maximum solution uptake was recorded in treatment T5 (Cinnamon 2 mL + Sucrose 2 g) and T6 (Cinnamon 2 mL), while the greatest spike-weight difference (23.25g) was noted in T2 (Sucrose 2 g). The highest number of fresh florets (5.00) at termination was observed in T12 (Clove oil 2 mL), followed by T5 and T8, whereas the least number of damaged florets (1.5 each) occurred in T12 and T11. Vase life varied significantly from 7.0 to 11.5 days, with T12, T11, and T10 (Clove oil 2 mL, Clove + Sucrose and Neem oil 2 mL) exhibiting the longest durations. The enhanced vase life in essential oil treatments may be attributed to their strong antimicrobial and antioxidant properties, which reduce microbial blockage and delay senescence, while sucrose supplementation provided an external energy source supporting floret opening and maintenance. Thus, clove oil, alone or in combination with sucrose, proved most effective in improving vase life and maintaining postharvest quality of gladiolus spikes.

Keywords: Clove oil, Essential oils, Postharvest quality, Preservative solutions, Sucrose, Vase life

DETECTION, LOCATION AND SEED TRANSMISSION OF *MACROPHOMINA PHASEOLINA* (TASSI) GOID IN NIGER

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Niger is commonly known as “birdseed”. The crop is vulnerable to number of fungal, viral, bacterial and nematode diseases. Among them root-rot caused by *Macrophomina phaseolina* the disease reduces the seed germination, oil quality and yield up to 10-50%. A total of 132 seed samples were collected from farmers, retail shops, fields and APMC markets and were subjected to SBM, PDA, Water agar and 2,4,D methods. Five seed samples showing higher incidence of *M. phaseolina* in SBM and were selected for location and seed transmission of the pathogen in departmental experimental plots. The collected seed samples, fields and farmer’s samples show a higher incidence of *M. phaseolina* and other fungi. The SBM method is more superior for isolating the *M. phaseolina* and other fungi than PDA, water agar and 2,4, D methods. The results revealed that the kharif - 2023 shows *M. phaseolina* (8-21%) in the SBM method. The pathogen ranged from (0-9%) in seed coat, (0-5%) in cotyledons, while (0-0%) in embryonic axis. In kharif-2024, *M. phaseolina* (11-23%) in the SBM method. The pathogen ranged from (3-13%) in seed coat, (1-11%) in cotyledons, while (0-5%) in embryonic axis. The harvested seeds favor for the more number of *M. phaseolina* and other pathogens in the seed coat & cotyledons than in the other components. The transmission of *M. phaseolina* was (12.6%) in kharif 2023 and in kharif 2024, the transmission was (21.2%) in all the tested five seed samples. The present study reveals that the disease transmission is more during kharif-2024 season than 2023, hence the *M. phaseolina* is a causal agent of root-rot disease of niger crop.

Keywords: Bird seed, location, Transmission, *M. phaseolina*, SBM Test, root-rot.

GLOBAL WARMING AND CLIMATE CHANGE MITIGATION AND ADAPTATION: CHALLENGES, STRATEGIES AND SOLUTIONS

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Global warming and climate change represent some of the most pressing environmental challenges of the 21st century, driven primarily by human-induced greenhouse gas emissions and unsustainable resource consumption. Rising global temperatures, melting ice caps, extreme weather events, and disrupted ecosystems are profound indicators of the crisis, posing significant threats to biodiversity, food security, and human livelihoods. This paper explores the dual approaches of mitigation and adaptation as essential strategies to address these challenges. Mitigation focuses on reducing emissions through renewable energy adoption, energy efficiency, afforestation, carbon capture technologies, and sustainable transportation systems. Adaptation, on the other hand, emphasises resilience-building measures such as climate-smart agriculture, water resource management, disaster risk reduction, and infrastructure redesign to cope with unavoidable climatic impacts. Despite advancements in technology and policy frameworks, substantial challenges persist, including inadequate international cooperation, financing constraints, political inertia, and socio-economic disparities that hinder implementation at local and global levels. The paper also underscores the importance of integrating traditional ecological knowledge with modern innovations to formulate context-specific and inclusive climate strategies. Furthermore, global initiatives such as the Paris Agreement, the UN Sustainable Development Goals (SDGs), and regional climate action plans play pivotal roles in steering collective efforts toward sustainability. Ultimately, combating climate change requires a holistic, multidisciplinary, and participatory approach that bridges science, policy, and community engagement. Strengthening governance, promoting green innovation, and fostering behavioral change are crucial for achieving a low-carbon and climate-resilient future. This synthesis emphasizes that timely, equitable, and coordinated global action is imperative to safeguard planetary health and ensure sustainable development for future generations.

Keywords: Global warming; Climate change; Mitigation; Adaptation; Greenhouse gas emissions; Renewable energy; Sustainability; Climate resilience.

IMPORTANCE VALUE INDEX AND IUCN STATUS OF SOME PLANT SPECIES OF KARJIKOPPA RESERVE FOREST, CENTRAL WESTERN GHATS OF KARNATAKA

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The Karjikkoppa Reserve Forest, located in the central Western Ghats of Karnataka, forms an integral part of one of the world's major biodiversity hotspots. The present study evaluated the Importance Value Index (IVI) of selected plant species and assessed their conservation categories based on the IUCN Red List. Vegetation sampling was carried out using the belt transects method, wherein parameters such as species density, frequency, and basal area were recorded to compute IVI values. The results revealed that species including *Holigarna grahamii* and *Tetrapilus dioicus* exhibited the highest IVI values, underscoring their ecological dominance and structural importance within the forest community. In contrast, species such as *Albizia amara* and *Mappia nimmoniana*, recorded comparatively lower IVI values, reflecting their restricted abundance in the study site. The IUCN assessment indicated that while most dominant species are classified as Least Concern (LC), certain less abundant taxa fall under the Vulnerable (VU) category, thereby emphasizing priority areas for conservation attention. This study underscores the necessity of continuous monitoring of biodiversity and phenological patterns across dominant, common, and rare species to promote long-term biodiversity conservation, ecological stability, and sustainable management of the Karjikkoppa Reserve Forest. It further emphasizes the importance of establishing intra- and inter-regional research networks linking tropical forest ecosystems within India and globally, thereby facilitating comparative ecological assessments and collaborative conservation initiatives.

Keywords: Reserve Forest, Importance value index, IUCN Status, Central Western Ghat.

PHYTOCHEMICAL ANALYSIS AND BIOLOGICAL ACTIVITIES OF CAESALPINIA BONDOC METHANOLIC EXTRACT: EMPHASIS ON ANTIMICROBIAL AND ANTIOXIDANT PROPERTIES

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The present study investigates the phytochemical composition, antioxidant potential, and antimicrobial properties of the methanolic extract of *Caesalpinia bonduc*, a plant widely recognized in traditional medicine. The plant material was collected and taxonomically authenticated using the eFlora of Indian database. Extraction was performed by cold maceration using methanol as the solvent. Phytochemical screening confirmed the presence of phenols, flavonoids, terpenoids, steroids, glycosides, and carbohydrates. Antioxidant activity was assessed using the DPPH radical scavenging assay, where the extract exhibited a concentration-dependent effect with an IC_{50} value of approximately 58 $\mu\text{g/mL}$, compared to ascorbic acid ($IC_{50} \approx 6 \mu\text{g/mL}$). Antimicrobial activity was evaluated against six bacterial pathogens (*Staphylococcus aureus*, *Salmonella typhi*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Enterococcus faecalis*) and two fungal species (*Candida albicans* and *Aspergillus niger*) using agar well diffusion and minimum inhibitory concentration (MIC) assays. The extract demonstrated moderate antibacterial activity, with inhibition zones reaching up to 12 mm, while antifungal activity was limited, except for *A. niger*. MIC values ranged from 312.5 to 1250 $\mu\text{g/mL}$, indicating significant antibacterial potential. These findings substantiate the traditional medicinal use of *C. bonduc* and highlight its promise as a natural source of antioxidant and antimicrobial compounds. Further phytochemical and pharmacological investigations are warranted to isolate and characterize the bioactive constituents responsible for these effects.

Keywords: *Caesalpinia bonduc*, Phytochemistry, Antioxidant activity, Antimicrobial assay, Methanolic extract.

ASSESSMENT OF THE GROWTH AND YIELD ATTRIBUTES OF DIFFERENT INTERCROPS UNDER MAHOGANY BASED AGROFORESTRY SYSTEM

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The experiment was conducted during the year 2024-25 at farmer's field located at Kusr village of Mundgod taluk, Uttara Kannada district. Total area of field is one acre. The average annual rainfall is 2200 mm. To study Tree-Crop performance of Mahogany based Agroforestry system the experiment was laid out in Factorial Randomized Block Design with 7 treatments and three replications with two environments (Mahogany and open). Seven intercrops are selected viz., Cowpea, Blackgram, Greengram, Horsegram, Chickpea, Mothbean and Lentil. Various growth and yield parameters were recorded for both trees and crops. The performance of intercrops grown under Mahogany were recorded. The performance of seven pulses under open conditions and in association with *Swietenia macrophylla* (Mahogany) in an Agroforestry system. In the Mahogany-based Agroforestry system, Cowpea (7.59 q/ha, HI 36.90 per cent, RGYI 12.38 per cent) and Blackgram (7.48 q/ha, HI 35.88 per cent, RGYI 15.24 per cent) emerged as the most productive and shade-tolerant intercrops. Overall, these pulses Cowpea and Blackgram, are the most suitable options for sustaining yield, harvest efficiency, and adaptability in *Swietenia macrophylla*. Based on the findings of the study, it can be concluded that all seven pulse varieties demonstrated superior performance under open field conditions when compared to their growth under the Mahogany-based Agroforestry system. However, within the constraints of the agroforestry environment and intercrops such as cowpea and blackgram emerged as the most promising options. These crops showed comparatively higher seed and biological yields than the other varieties evaluated, making them suitable candidates for cultivation under tree-based systems like *Swietenia macrophylla*.

Keywords: Mahogany, Agroforestry system, Intercrops, yield, shade tolerant, efficiency, adaptability

NANOOMICS: ADVANCED APPROACHES FOR SUSTAINABLE AGRICULTURE, POTENTIAL ALTERNATIVE FOR PLANT DISEASE MANAGEMENT AND INCREASING YIELD

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Agriculture is the primary food source and fundamental for human survival. Plant diseases are caused by various pathogenic microorganisms, important to substantial commercial losses and food insecurity global. Plant diseases are responsible for nearly each year 20%–40% of all crop losses brought by insect pests and microbial pathogens, which have a significant negative impact on agricultural production. Present plant disease management relies mainly on toxic pesticides that are potentially harmful effects on human health and generated environmental pollution. There is increasing attention in developing sustainable and ecofriendly alternatives to control plant diseases. Therefore, there is an urgent need for novel methods to address these concerns. Nanoomics, an interdisciplinary field intersecting nanotechnology and agronomy, addresses crucial challenges in global agriculture. With a focus on increasing yield amidst population growth, climate change, and lessening arable land and nanoomics integrates nanoscale materials into agricultural practices. Nanotechnology can stop crop losses by managing specific diseases from soil, plants, and hydroponic systems. The application of both metallic and organic nanoparticles offers innovative solutions for disease prevention, early detection, and effective control. This review focuses on the nanoparticles against different phytopathogens also highlights the advantages of using nanopesticides, such as reduced environmental toxicity, increased biodegradability, and the potential to manage pesticide resistant pathogens and increasing yield. Most studies have focused on reducing, delaying, or eliminating bacteria, fungi, viruses, and nematodes in plants. Nano-based formulations enhance the efficiency of pesticides, fungicides, and antibacterial agents, reducing chemical usage and minimizing environmental impact. The use of nanoparticles can improve the efficiency of agricultural chemicals and reduce the pollution caused by the use of agricultural chemicals.

Keywords: Nanotechnology, Plant pathogens, Sustainable agriculture, Nanopesticides, Nanofertilizers, Disease management, Plant defense system.

GREEN NANOMATERIAL ASSISTED DEGRADATION AND RAMAN BASED DETECTION OF PESTICIDE RESIDUES

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Pesticide contamination in agricultural produce and the environment poses a serious threat to human health and ecological balance. Rapid detection and effective degradation of these residues are critical for sustainable agriculture. In this study, a green synthesis approach was adopted to develop Raman active nanoparticles using plant-derived reducing agents for the degradation and Raman-based detection of pesticide residues. The synthesized nanoparticles were characterized using TEM (to observe morphology and particle size), FTIR (to identify functional groups involved in capping and stabilization), and XRD (to confirm crystallinity and phase structure). The nanomaterial exhibited strong surface-enhanced Raman scattering (SERS) activity, enabling highly sensitive detection of pesticide residues at trace levels. Degradation efficiency was evaluated through time-course Raman spectral monitoring, revealing a significant decrease in the characteristic peaks of selected pesticides (e.g., chlorpyrifos, imidacloprid, and malathion) over time, confirming their structural breakdown. The process was further supported by UV-Vis spectral shifts and chemical transformations observed in Raman spectra before and after degradation. This study demonstrates the dual role of green-synthesized nanoparticle as both an efficient catalyst for pesticide degradation and an ultrasensitive Raman substrate for residue detection. The approach provides a sustainable, cost-effective, and rapid analytical pathway for monitoring pesticide pollution in environmental and food matrices.

Keywords: Pesticide degradation, Raman spectroscopy, SERS, green synthesis, nanomaterials, environmental monitoring.

FRUIT CRACKING IN MAJOR FRUIT CROPS AND IT'S MANAGEMENT

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Fruit cracking is a major physiological disorder affecting various fruit crops, including, pomegranate, citrus, sweet cherry, litchi, and others. It occurs due to multiple factors, including genetic susceptibility, environmental conditions, improper orchard management, and nutrient deficiencies (Khadivi-Khub, 2015). High water content in fruit, especially after sudden rainfall following dry periods, is a primary cause of cracking. Other contributing factors include fluctuations in temperature, wind, moisture stress, and nutrient deficiencies, particularly calcium and boron (Manzoor *et al.*, 2024). Cracked fruits lose their market value, making them suitable only for processing, and are more prone to postharvest diseases, leading to significant economic losses (Pal *et al.*, 2017). Several factors influence fruit cracking, including genetic predisposition, environmental conditions, and orchard management practices. High temperatures, combined with dry spells and sudden rainfall, significantly contribute to cracking in fruits such as pomegranates and citrus (Juan and Jiezhong, 2017). Orchard soil type, inadequate irrigation, and nutrient deficiencies, especially in boron and calcium, exacerbate cracking. The shape and firmness of the fruit also affect susceptibility, with firmer fruits being more prone to cracking than softer ones. Various control measures can mitigate fruit cracking. These include proper site selection, moisture conservation, mulching, planting windbreaks, and rain cover protection (Jubeir *et al.*, 2025). Additionally, chemical treatments such as calcium and boron sprays and hormonal applications like gibberellins and auxins have shown promise in reducing fruit cracking (Zhang *et al.*, 2024). Understanding the physiological and environmental triggers of fruit cracking can help mitigate losses and improve fruit quality and marketability.

Keywords: Fruit cracking, physiological disorder, pomegranate, citrus, litchi, sweet cherry, calcium deficiency, boron deficiency, environmental stress, orchard management, growth regulators, fruit quality.

Laccase-Producing Extremophiles from Hypersaline Environments: A Review of Enzyme Diversity, Adaptation, and Biotechnological Applications

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The metabolically and taxonomically unique extremophiles found in hypersaline environments have developed specialized molecular adaptations, including salt-stable proteins, osmolyte accumulation, and modified membranes, which allow them to survive and catalyze under extreme ionic and osmotic stress. Because the enzymes in these halophilic microorganisms remain stable and active in the face of extreme salinity, pH, and temperature, they are becoming more and more acknowledged as promising sources of strong biocatalysts for industrial and environmental applications. Laccases (multicopper oxidases; EC 1.10.3.2) are particularly interesting because they can use molecular oxygen as the terminal electron acceptor to catalyze the one-electron oxidation of a variety of phenolic and non-phenolic substrates. Particularly, halophilic and halotolerant bacterial laccases show exceptional stability in saline, alkaline, and solvent-rich environments, which makes them appropriate for treating saline industrial effluents like wastewater from tanneries and textiles. Their potential for pollutant remediation and dye degradation is highlighted by recent reports from marine and halophilic bacteria. Significant ecological and geographic gaps still exist in the bioprospecting of saline habitats in spite of these advancements. Despite its rich microbial diversity and potential for the discovery of novel enzymes, the White Rann of Kachchh (Gujarat, India), a distinctive hypersaline desert, is still largely unexplored for laccase-producing microorganisms. The present understanding of laccase-producing extremophiles from hypersaline environments is compiled in this review, with a focus on enzyme diversity, adaptive mechanisms, and biotechnological applications. Therefore, investigating the White Rann ecosystem may produce new biocatalysts and aid in the development of sustainable methods for the remediation of saline wastewater.

Keywords: Halophilic microorganisms, Laccase, Hypersaline environments, White Rann of Kachchh, Bioremediation

EFFECT OF GRADED FERTILIZER LEVELS ON FORAGE QUALITY AND BIOMASS YIELD OF MULTI-CUT FORAGE SORGHUM [SORGHUM BICOLOR (L.) MOENCH] GENOTYPES

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Sorghum belongs to the family Poaceae, having a diploid chromosome number ($2n=20$). It is the most widely grown forage crop in India (2.6 million hectares) with single- and multi-cut sorghums accounting for 0.6 and 2.0 million hectares, respectively (Prabhakar Babu, 2018). Efficient fertilizer management in fodder crops enhances forage quality, preserves soil health, and optimizes herbage yield per unit area and time. Among nutrients, nitrogen (N) plays a pivotal role, followed by phosphorus (P) and potassium (K). While chemical fertilizers have significantly boosted crop production, a balanced nutrient supply is essential for sustainable agriculture (Kaloo, 2003). The field experiment was conducted during the (*khari*) season of 2023 at Forage Section Research Farm, CCS Haryana Agricultural University, Hisar, India. The experiment was conducted in split plot design, consisted of four fertilizer levels in main plot viz., 0% RDF (recommended dose of fertilizer), 50% RDF, 100% RDF (150 kg N+45 kg P₂O₅+45 kg K₂O/ha), 150% RDF and three multi cut forage sorghum genotypes in sub plot (V₁ - SPH 1988, V₂ – CSH 43MF and V₃ – CSH 24MF). The soil of the experimental field was low in available nitrogen and medium in available phosphorus and potassium. Among genotypes, the maximum total green fodder and dry matter yields (3 cuts) were recorded with CSH 43MF (723.68 and 216.46 q/ha), which was on par with SPH 1988. Maximum BC ratio (1.77) was fetched in CSH 43MF, followed by SPH 1988 (1.72). The estimated HCN content was below the critical limit (200 µg/g on a fresh weight basis) in all the genotypes tested at 30 days after sowing. Among fertilizer levels, maximum total green fodder and dry matter yield (3 cuts) was recorded with the application of 150% RDF (806.17 and 243.71 q/ha), which was on a par with the 100% RDF but significantly superior to the 50% RDF and control. Maximum BC ratio (1.89) was fetched with application of 100% RDF followed by 150% RDF (1.87). Application of 100% RDF significantly improved the fodder yield of multi-cut fodder sorghum as sorghum is a very exhaustive crop.

Keywords: Sorghum, multi-cut, fodder yield, fertilizer levels, HCN and B: C.

PHYLOGENETIC ANALYSIS OF GENUS *JUNONIA* HÜBNER, [1819] (INSECTA: LEPIDOPTERA: NYMPHALIDAE: NYMPHALINAE) ON THE BASIS OF COI GENE

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Butterflies serve as vital pollinators and bioindicators of ecosystem health. The present study aims to investigate the phylogenetic relationships among Indian species of the genus *Junonia* using mitochondrial Cytochrome Oxidase I (COI) gene sequences. The objectives were to assess genetic divergence, analyze nucleotide composition, and infer phylogenetic relationships among species. Specimens of five *Junonia* species *J. orithya*, *J. lemonias*, *J. iphita*, *J. almana*, and *J. hierta* were collected from northern India, while additional sequences were retrieved from GenBank. DNA was extracted using Qiagen DNeasy Kit and amplified with universal COI primers (LCO1490/HCO2198). Phylogenetic reconstruction was performed in MEGA 12 using the Neighbor-Joining (NJ) method under the Kimura-2-Parameter model with 1000 bootstrap replicates. A total of 54 COI sequences representing 31 species across two genera were analyzed. The dataset contained 483 nucleotide sites, with 341 conserved and 142 variable positions, indicating high gene conservation. The nucleotide composition exhibited A+T bias (69.42%), typical of insect mtDNA. Intraspecific divergence among Indian species ranged from 0–0.8%, while interspecific divergence ranged from 0.1–11.9%. Phylogenetic analysis resolved six major clades, grouping conspecifics together with strong bootstrap support. Closely related taxa such as *J. hierta* and *J. orithya* formed sister clusters, consistent with earlier studies. The study concludes that COI gene barcoding is an efficient molecular tool for resolving phylogenetic relationships and confirming species identity in *Junonia* butterflies.

NITROGEN AND HUMUS DYNAMICS OF CONVENTIONALLY AND ORGANICALLY MANAGED SOILS UNDER DIFFERENT CROPS OF SOUTH GUJARAT

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An experiment was carried out during 2021-22 to 2023-24 during pre and post monsoon to find out the N and humus dynamics of conventionally and organically managed soil under different crops of south Gujarat. Soil samples were collected separately from conventionally and organically managed (organic certified) soil under paddy, mango and sugarcane cultivation at two sampling depth i. e., 0-22.5 cm and 22.5 to 45.0 cm. In mango and sugarcane, two sampling has done at before monsoon and after monsoon in Large Plot Technique (Analyzed in Two sample t test assuming equal variance). The samples were analyzed for N and humus fractions by using standard analytical methods. The Ammoniacal N found significantly higher in conventionally managed soil in the year 2022 and 2023 as well as average of all the three years of experiment at surface depth in in paddy, mango as well as sugarcane. A non-significant result was observed in the sub surface sampling for Ammoniacal Nitrogen in all the three crops. The Nitrate N differed significantly with conventional and organic farming practices in the year 2024 and organically managed soil contained significantly higher amount of Nitrate-N in paddy, mango and sugarcane. The mineralizable N was found significantly higher in conventionally managed soil at surface depth of sampling in all the three crops. The organic soil contained significantly higher amount of available N and OC at both the depth of sampling in paddy, mango and sugarcane. The humic acid and fulvic acid was recorded significantly higher under organically managed soil under paddy, mango and sugarcane at both depth of sampling and humus fractions showed decreasing trend from surface to subsurface depth of sampling under conventionally and organically managed soils under all the crops. From the experiment, it is concluded that the except Available N, OC and humus fractions all other N fractions namely Ammoniacal N, Nitrate N and Mineralizable N content was significantly higher in conventionally managed paddy, mango and sugarcane cultivated soils of South Gujarat.

Keywords: Ammoniacal N, Nitrate nitrogen, Mineralizable N, Sampling

ROLE OF BIORATIONAL PESTICIDES IN SUSTAINABLE AGRICULTURE SYSTEM: STRATEGIES AND INNOVATIONS

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Biorational pesticides are manmade or natural substances found in animals, plants, microorganisms, and minerals, or their derivatives. Biorational pesticides include the microbiological pesticide *Bacillus thuringiensis* (Bt), neonicotinoids, avermectins, phenylpyrazoles, spinosyns, pyrroles, oxadiazines, and a variety of insect growth regulators. These compounds are efficient against the target pest, yet they are less harmful to natural adversaries and environmentally friendly. Biorational insecticides are gaining favor in this era of environmental knowledge and concern. The use of biorational products for insect pest. New techniques to pest control include the discovery of novel drugs that disrupt specific processes in insects, such as chitin synthesis inhibitors, juvenile hormone mimics, and ecdysone agonists. Furthermore, efforts have been made to develop compounds that selectively act on groups of insects by inhibiting or enhancing biochemical sites such as respiration (difenthiuron), nicotiny acetylcholine receptors (imidacloprid and acetamiprid), GABA receptors (avermectins), sucking pest salivary glands (pymetrozine), and others. Pesticides' severe environmental consequences, along with a resistance dilemma, have fueled demand for alternative pest management methods.

Keywords: Pesticides, microbes, environment, pest control

NATUROPATHY AND YOGA, THE INDIAN SYSTEM OF MEDICINES FOR SUSTAINABLE DEVELOPMENT- A HOLISTIC APPROACH FOR HUMAN AND ENVIRONMENTAL HEALTH

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Naturopathy and Yoga, formally recognized by the Ministry of AYUSH, Government of India, represent integral components of India's traditional medical systems. Naturopathy is grounded in the belief that the human body possesses an inherent ability to heal itself when supported by favourable environmental and lifestyle conditions. Its core principles, including the emphasis on nutrition encapsulated in the motto "food is the best medicine" support the promotion of organic agriculture and sustainable food systems. Moreover, naturopathy institutions often contribute to biodiversity conservation by cultivating medicinal and indigenous plant species within their premises. Yoga, as a mind-body discipline with ancient roots, extends beyond physical well-being to influence mental clarity, behavioural discipline, and ecological consciousness. It fosters a heightened awareness that indirectly supports environmental health, aligning personal health practices with broader ecological values. This review critically examines the foundational principles of Naturopathy and Yoga in the context of sustainable development. It explores their contributions to key United Nations Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action). This review article also incorporates case studies and emerging scientific literature to evaluate the efficacy and applicability of these systems in contemporary health and environmental frameworks. By integrating traditional knowledge systems with modern sustainable development paradigms, Naturopathy and Yoga offer a holistic, low-cost, and preventive healthcare approach. This integrative model underscores the interdependence of human and environmental health and positions these practices as viable contributors to a resilient, sustainable, and health-promoting society.

Keywords: Naturopathy and Yoga, SDG, AYUSH, Environmental health

KNOWLEDGE AND ATTITUDE OF THE RESPONDENTS REGARDING PRADHAN MANTRI FASAL BIMA YOJNA (PMFBY) SCHEME IN PRAYAGRAJ DISTRICT OF UTTAR PRADESH

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The Study was conducted in Prayagraj district of Uttar Pradesh to access the Knowledge & Attitude respondents regarding Pradhan Mantri Fasal Bima Yojna (PMFBY) scheme. A total no. of 360 respondents (240 beneficiaries and 120 non-beneficiaries) were selected purposively selected from 12 villages under 4 blocks (Chaka, Karchana, Jasra, Meja) based maximum no. of respondents in PMFBY scheme. The Data were collected through interview method by using pre-structured interview schedule and letter on appropriate statistical analysis was done for logical conclusions. The findings revealed that socio-economic status of the terms Age Majority (76.11 per cent) of respondents were found in middle age group, Majority (53.05 per cent) of the respondents had medium family size, Majority (65.00%) of the respondents had medium (Rs. 91677 to 234924/-)annual incomes annually. The majority of the respondents (52.78 per cent) had grown only two crops a that most (63.06 per cent) of the respondents, had medium level of knowledge about Pradhan Mantri Fasal Bima Yojana followed by 18.88 per cent of respondents had low level of knowledge and 18.06 per cent had high level of knowledge about Pradhan Mantri Fasal Bima Yojana. that most (64.72 per cent) of the respondents had medium level of attitude about Pradhan Mantri Fasal Bima Yojana followed by 18.62 per cent of respondents had low level of attitude and 16.66 per cent had high level of attitude about Pradhan Mantri Fasal Bima Yojana.

Keywords: Socio economic, Knowledge, Attitude & PMFBY Scheme.

BEHAVIOURAL AND BIOCHEMICAL RESPONSES OF *CYPRINUS CARPIO HAEMATOPTERUS* TO SALINITY-INDUCED STRESS

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A 60-day experimental study was conducted to evaluate the biochemical and behavioural responses of Amur carp *Cyprinus carpio haematopterus* (Linnaeus, 1758) fingerlings to varying salinity levels in inland saline waters of Haryana, India. A total of 300 fingerlings (initial mean weight: 8.10 g) were randomly allocated to five salinity treatments Control (0 ppt), T1 (3 ppt), T2 (6 ppt), T3 (9 ppt), and T4 (12 ppt) with three replicates per treatment. Water temperature, pH, and dissolved oxygen showed no significant variation among treatments; however, increasing salinity resulted in elevated concentrations of ammonia, nitrite, total dissolved solids (TDS), and conductivity. Survival was highest at 3 ppt and decreased progressively with increasing salinity, with marked behavioural alterations such as reduced swimming activity and appetite at 9 and 12 ppt. At higher salinities, behavioural manifestations including restlessness, erratic swimming, and loss of equilibrium indicated osmotic stress and dehydration. Biochemically, serum glucose levels declined significantly (from 64.67 to 46.00 g dl⁻¹), suggesting increased energy expenditure for osmoregulatory functions. Alkaline phosphatase (ALP) activity increased (from 43.00 to 73.67 g dl⁻¹), indicative of physiological adaptation, while elevated aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels particularly AST reflected tissue damage and metabolic stress. Overall, the results suggest that Amur carp fingerlings can tolerate salinities up to approximately 5 - 6 ppt with minimal adverse effects, whereas higher salinities (≥ 9 ppt) impair behaviour, metabolic performance, and survival.

Keywords: Amur carp, behavioural responses, biochemical changes, salinity tolerance, survival

IMPACT OF OVERUSING FUNGICIDES ON VEGETABLE CROPS

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The excessive application of fungicides in vegetable production systems represents a significant agricultural concern with multifaceted ecological and health implications. Recent data indicates that fungicide use in vegetable crops has increased by approximately 21% over the past decade, primarily in response to climate change-induced disease pressure. This intensification has prompted investigations into the unintended consequences of fungicide overuse. Studies demonstrate that repeated fungicide applications at rates exceeding manufacturer recommendations can reduce beneficial soil microbiota by 30-45%, particularly disrupting mycorrhizal fungi associations critical for nutrient uptake. Field trials comparing standard and excessive fungicide regimens show vegetable crops under high-fungicide conditions experience a 15-25% reduction in nutrient absorption efficiency, particularly for phosphorus and micronutrients. Beyond soil ecology, fungicide overuse has accelerated resistance development. Monitoring programs have documented resistance to strobilurin fungicides in 68% of *Alternaria* populations in tomato-growing regions, compared to 37% five years ago. Similarly, triazole resistance in powdery mildew affecting cucurbits has emerged in 52% of tested isolates, significantly higher than historical baselines. Plant physiological responses to fungicide accumulation include documented reductions in photosynthetic efficiency (8-12%), altered hormonal balances affecting flowering timing, and compromised fruit development in sensitive vegetable varieties. Consumer safety analyses have detected residue levels exceeding maximum limits in 7% of conventionally grown vegetables when fungicide application intervals were shortened inappropriately. Economically, the diminishing returns of increasing fungicide use have become apparent, with studies revealing that applications beyond integrated pest management recommendations provide only 3-5% additional disease control while increasing production costs by 12-18%. These findings underscore the necessity for optimized fungicide stewardship in vegetable production systems, emphasizing application timing based on disease forecasting models rather than calendar-based schedules, integration of biological control agents, and rotation of chemical modes of action to preserve fungicide efficacy while minimizing environmental and health impacts.

Keywords: Ecological disruption; Environmental persistence; Residue accumulation.

TOXICOLOGICAL EVALUATION OF LOW DOSE METHYL 2-BENZIMIDAZOLE CARBAMATE (CARBENDAZIM) FUNGICIDE ON MALE ALBINO RATS (*RATTUS NORVEGICUS*)

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Methyl 2-benzimidazole carbamate (carbendazim) is a synthetic fungicide used against organisms that cause different types of plant diseases. It is widely used as a preservative in leather, paint, textile, fruit, and paper industry. It is also used as an anticancer drug in clinical medicine. To evaluate the low dose toxicity of this compound in mammalian tissues, carbendazim was administered to male albino rats (*Rattus norvegicus*) at 5, 10, 25, and 50 mM doses intradermally. At 6, 12 and 24 hours, blood samples were collected from the animals for analysis of biochemical and hematological parameters including serum enzyme activities. The findings indicated that carbendazim caused a decrease in serum total protein, ALT, AST, ALP and amylase activities. GGT activity decreased by 6hr and increased by 12hr in a dose-related manner. Carbendazim caused an increase in serum cholesterol, uric acid, glucose, and creatinine content while serum phosphorous content decreased. Mean hemoglobin, WBC, E, and platelet counts increased and total RBC, N and L counts decreased. Tissues (brain, heart, liver, kidney, and testis) taken from 50mM dose administered rat for histopathological examination revealed liquefactive necrosis of blood vessels, fibrosis, dilated parenchyma, hemorrhage, and edema in the brain tissue. In heart, necrosis and loss of nuclei in cardiac muscle cells were noted. Low dose level of carbendazim causes toxicological effects in the rat tissues.

Keywords: Carbendazim, Enzymes, Histopathology, Protein, Tissues, Male Albino rats

LANDSLIDE VULNERABILITY AND SOCIO-ECOLOGICAL IMPACTS IN THE WESTERN GHATS: CHALLENGES AND MITIGATION STRATEGIES

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The Western Ghats, biodiversity-rich UNESCO World Heritage Site along India's western coast, is among the most ecologically sensitive and geologically fragile regions of the country. Its complex terrain, steep gradients, unstable lithology, and heavy monsoonal rainfall make it highly susceptible to landslides. This review examines the key drivers, socio-ecological impacts, and mitigation strategies associated with landslide vulnerability in the Western Ghats. Both natural and human-induced factors contribute to slope instability intense rainfall, deforestation, unplanned urbanization, plantation agriculture, road construction, and slope modification disrupt natural drainage and accelerate geomorphic processes. Landslides exert severe socio-economic and ecological impacts on local communities, particularly rural and tribal populations dependent on agriculture, plantations, and forest resources. The loss of farmland, crops, livestock, and infrastructure disrupts livelihoods and local economies, while the destruction of homes and public amenities often leads to displacement and long-term social instability. Recurrent disasters also impose psychological burdens, such as trauma, educational disruption, and reduced employment opportunities, exacerbating poverty and marginalization among vulnerable groups reliant on fragile mountain ecosystems. Mitigating landslide risks requires an integrated, multi-disciplinary approach. Structural measures like slope stabilization, terracing, retaining walls, and proper drainage are vital for immediate hazard reduction, while non-structural strategies such as early warning systems, community awareness, sustainable land-use planning, and reforestation are essential for long-term resilience. Integrated watershed management, supported by collaboration among scientific institutions, government agencies, and local communities, can enhance adaptive capacity and ensure effective disaster response and rehabilitation. Understanding the interconnections between environmental fragility, human pressures, and social vulnerability is critical for designing sustainable and climate-adaptive frameworks. Strengthening resilience in the Western Ghats is vital not only to safeguard human lives and livelihoods but also to preserve the ecological integrity of this globally significant mountain system.

Keywords: Western Ghats, socio-ecological consequences, landslides, vulnerability.

COMPARATIVE EVALUATION OF LEGUMINOUS AND NON-LEGUMINOUS FODDER GRASSES UNDER SILVEROAK-PEPPER BASED AGROFORESTRY SYSTEM IN THE WESTERN GHATS

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Agroforestry systems are recognized for their potential to enhance soil fertility, a critical factor for sustainability in regions like the Western Ghats. This study evaluated the comparative impact of leguminous and non-leguminous fodder grasses on soil chemical properties within an established Silveroak-Pepper (*Grevillea robusta* - *Piper nigrum*) based agroforestry system (AFS) compared to an adjacent sole crop (SC) control. The study was conducted in Sirsi, Karnataka, on acidic laterite soils. Four fodder species out of which two non-legumes, Guinea grass (*Megathyrsus maximus*) and Para grass (*Urochloa mutica*) and two legumes, Hedge lucerne (*Desmanthus virgatus*) and Stylosanthes (*Stylosanthes hamata*) were intercropped in a Randomized Complete Block Design. Soil samples (0-30 cm) were analyzed before and after the six-month experiment for pH, electrical conductivity (EC), soil organic carbon (SOC) and available N, P and K. Results indicated that the AFS consistently improved soil properties more than the sole crop. The AFS moderated soil acidity, with mean pH increasing from 5.52 to a range of 5.63-5.82, whereas the SC system only shifted from 5.29 to 5.33-5.48. SOC accumulation was highest under AFS, with Hedge lucerne (0.83%) and Guinea grass (0.82%) showing significant gains over the initial 0.77%. A clear distinction was observed in nutrient availability: the leguminous grasses, Hedge lucerne and Stylosanthes, recorded the highest levels of available nitrogen (108.51 and 105.44 kg ha⁻¹, respectively) and available phosphorus (34.40 and 34.89 kg ha⁻¹, respectively) in the AFS, demonstrating the benefits of N-fixation and P-solubilization. Non-leguminous grasses also contributed to fertility, with Para grass significantly increasing available potassium (194.19 kg ha⁻¹). These findings confirm that integrating fodder grasses, particularly legumes, is a viable strategy for enhancing soil fertility and nutrient cycling in Silveroak-Pepper agroforestry systems.

Keywords: Agroforestry, soil fertility, leguminous fodder, *Grevillea robusta*, Western Ghats

WILD FRUITS OF MALNAD: NATURAL HEALTH BOOSTERS FROM SAGAR TALUK

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The Malnad region of Sagar Taluk in Karnataka is well known for its rich biodiversity and wide variety of wild fruits. These fruits are not only tasty but also highly nutritious and valuable for health. Many studies have shown that wild fruits have several health-promoting activities such as antioxidant, anti-inflammatory, antimicrobial, and anticancer effects. Wild fruits like *Phyllanthus emblica* (Amla), *Garcinia indica* (Kokum), *Syzygium cumini* (Jamun), *Ziziphus oenoplia* (Wild Jujube), *Elaeocarpus serratus* (Jungle Plum), and *Carissa carandas* (Karonda) are commonly found in the Sagar area. They are rich in phytochemicals, especially flavonoids and polyphenols, which act as strong antioxidants that protect the body from damage caused by free radicals. These fruits are also excellent sources of vitamins and minerals, particularly vitamin C, vitamin A, iron, and fiber, which help improve immunity, digestion, and overall wellbeing. This study aims to document the diversity, nutritional value, and traditional uses of wild fruits found in Sagar Taluk. The documentation will include information on their local names, seasonal availability, and common methods of consumption. Such documentation will help preserve indigenous wisdom, encourage further exploration of their medicinal potential, and contribute to the conservation of Malnad's rich natural heritage.

Keywords: Wild fruits; Malnad region; Sagar Taluk; Phytochemicals; Antioxidant activity; Traditional knowledge; Nutritional value; Documentation; Biodiversity; Health benefits

NUTRITIONAL AND FUNCTIONAL QUALITY EVALUATION OF TEFF (ERAGROSTIS TEF) FLOUR AND ITS APPLICATION IN NUTRIENT-ENRICHED READY-TO-EAT SNACK FORMULATION

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The ready-to-eat (RTE) snack market is expanding at a faster rate due to the rising customer demand for convenient and nutritious food products. Traditional snacks made with all-purpose flour are calorie-dense but low in nutrients, promoting the use of nutrient-rich ancient grains like teff (*Eragrostis tef*). Additionally, the use of air frying as an alternative to deep frying enhances product's nutritional quality by reducing oil absorption and calorie content while maintaining desirable texture and quality. This study aims to evaluate the nutritional characteristics of teff flour in order to investigate its possible application for developing a healthier snack substitute. Teff flour exhibited higher nutritional value than all-purpose flour, particularly in ash (2.5%), crude fiber (2.92%), potassium (376.64 mg/100 g), magnesium (219 mg/100g), zinc (3.5 mg/100g), and iron (8.31 mg/100 g). The FTIR spectrum revealed characteristic peaks representing hydroxyl, carbonyl, and amide groups, indicating the presence of diverse biochemical constituents. These findings led to the formulation of air fried RTE snacks that substituted all-purpose flour with 70% teff flour and 30% wheat flour. Comparative analysis revealed that optimized formulation teff based ready-to-eat snacks (T-RTES2) exhibited higher values of ash (1.84%), crude fiber (2.65%), iron (7.66 mg/100g), zinc (3.46 mg/100g), magnesium (200.83 mg/100g), potassium (368.68 mg/100g), and an enhanced amino acid profile compared to control snacks (RTESC). In addition to increasing the nutrient density, the addition of teff flour maintained the desired sensory characteristics, providing a nutritious and beneficial substitute for traditional snack preparations. This study highlights teff's potential as a nutrient-rich ingredient for developing value-added, ready-to-eat snacks that meet modern health preferences. Incorporating ancient grains into modern processing enhances product value and supports global food security through healthier snack alternatives.

Keywords: Teff flour, Functional properties, Amino acid profiling, Value addition, RTE snacks

THE CONTRIBUTION OF RURAL DEVELOPMENT TO SUSTAINABLE ECONOMIC GROWTH IN INDIA

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Rural development is crucial for India's economic progress, with approximately 65% of the population residing in rural areas (Census 2011; World Bank, 2023). The rural sector significantly contributes to national growth through agriculture, allied activities, rural industries, and employment generation. In 2022–23, agriculture accounted for about 18% of India's Gross Value Added (GVA) (Economic Survey, 2023), serving as the primary livelihood for most rural households. Key initiatives like the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), National Rural Health Mission (NRHM), and Pradhan Mantri Gram Sadak Yojana (PMGSY) have improved employment, healthcare access, and rural connectivity, promoting inclusive growth. Additionally, the growth of rural non-farm sectors, such as micro, small, and medium enterprises (MSMEs), has diversified income sources, reducing reliance on agriculture. Rural India contributes nearly 46% to national income and over 50% to total consumption expenditure (NITI Aayog, 2022). Investments in infrastructure, digital connectivity, skill development, and sustainable agricultural practices are enhancing rural productivity and integrating rural markets into national and global supply chains.

Keywords: Rural Development, Agriculture, Employment Generation, Rural Connectivity, Non-Farm Sectors and Infrastructure Investment.

INFLUENCE OF MULBERRY VARIETIES ON THE BIOLOGY OF THE SILKWORM *BOMBYX MORI* LINNAEUS (LEPIDOPTERA: BOMBYCIDAE)

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The present investigation entitled “Influence of Mulberry Varieties on the Biology of the Silkworm *Bombyx mori* Linnaeus (Lepidoptera: Bombycidae)” was carried out at the College of Agriculture, Vishweshwaraiah Canal Farm, Mandya, during *Rabi* 2024 and *Summer* 2025. The study assessed eight mulberry varieties viz., Mysore Local, Sahana, S36, DD, AR12, V1, G2, and G4 for their influence on the biology, cocoon yield and reproductive efficiency of the FC1 × FC2 double hybrid silkworm, along with evaluations of nutrient and biochemical profiles. Significant varietal differences were recorded in larval growth, pupal traits and cocoon parameters. Among the varieties, S36 exhibited the highest chawki larval weight (2.57 g/10 larvae) and the shortest larval duration (602.54 h), while V1 produced the heaviest mature larvae (38.32 g/10 larvae), highest cocoon weight (24.23 g/10 cocoons), maximum shell weight (4.65 g), fecundity (478.5 eggs) and rearing efficiency (97.33%). G2 yielded the heaviest pupae (20.01 g/10 pupae), whereas G4 recorded the highest cocoon shell ratio (19.61%) and adult emergence (95.69%). Nutritional profiling revealed that V1, G2, and S36 contained higher nitrogen, protein, chlorophyll, and zinc levels, which were positively correlated with larval growth and cocoon performance. Proteins (0.638**), proline (0.531*) and nitrogen (0.533*) prolonged chawki duration, while crude fibre (−0.690**) reduced it. Overall, V1 proved superior for yield and silk quality, S36 for rapid lifecycle completion, G2 for pupal development and cocoon traits and G4 for enhanced reproductive efficiency highlighting the synergistic role of varietal choice and endophyte interactions in sustainable sericulture.

Keywords: Mulberry, biology, nutrient composition, biochemical composition, silkworm performance

DEFINING THE OPTIMAL ENVIRONMENTAL AND NUTRITIONAL REQUIREMENTS FOR *BIPOLARIS MAYDIS*: A FOUNDATION FOR SUSTAINABLE DISEASE CONTROL

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Maize (*Zea mays* L.), belonging to the Poaceae family, is a vital cereal crop that has earned the title of 'queen of cereals' due to its high genetic yield potential and adaptability. Despite its global importance, maize production is seriously hampered by a spectrum of fungal, bacterial, and viral diseases. Among these, Maydis leaf blight (MLB), caused by *Bipolaris maydis* (Y. Nisik. & C. Miyake), is a pervasive cause of significant crop loss. The foundation of sustainable control lies in a detailed understanding of the pathogen's biological requirements, which allows for disease management and minimizes reliance on broad-spectrum chemical treatments. This study was designed to systematically define the precise environmental and nutritional factors governing the maximum growth of *B. maydis*. The investigation revealed that *B. maydis* exhibits its most prolific growth only when exposed to a continuous light period (24 hours), an alkaline pH level of 8, and an elevated optimal temperature of 30⁰ C. These findings confirm the critical influence of macro-environmental conditions on the pathogen's ability to multiply and cause widespread infection. Furthermore, nutritional analysis demonstrated a distinct preference for 2.0% glucose as its primary energy source, showing superiority over sucrose. The fungus also exhibited its highest growth when utilizing 2.0% sodium nitrate as the most effective nitrogen source, surpassing potassium nitrate. Collectively, these data provide the essential physiological baseline for developing sustainable disease management protocols. By identifying the exact conditions and nutrients that favour *B. maydis*, researchers can refine disease forecasting models, select resistant host varieties, and implement targeted cultural controls that disrupt the pathogen's lifecycle at its weakest points.

Keywords: Maydis leaf blight, pathogen, physiology, nutrition.

SUSTAINABLE MANAGEMENT OF MAYDIS LEAF BLIGHT (BIPOLARIS MAYDIS) IN MAIZE THROUGH EXOGENOUS APPLICATION OF PLANT DEFENCE ACTIVATORS

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Maize (*Zea mays* L.), a member of the Poaceae family, is a vital cereal crop adapted to different agro-climatic conditions. Maize conferred the title of "queen of cereals" due to its high genetic yield potential. However, fungal, bacterial, and viral diseases pose significant challenges to maize production. Among these, Maydis leaf blights (MLB), caused by *Bipolaris maydis* (Y. Nisik. & C. Miyake), is a widespread and yield-limiting disease. While conventional chemical fungicides have been used for control, a more sustainable approach in managing MLB involves the application of plant defense activators. To investigate the efficacy of various plant defense activators in inducing systemic resistance, an experiment was conducted under greenhouse conditions using a completely randomized design (CRD) with the susceptible maize variety 900M GOLD. The elicitors included both biotic (*Trichoderma viridae*, *Pseudomonas fluorescens*, Neem, Pongamia) and abiotic elicitors (Salicylic acid (SA), Benzoic acid (BA) and Chitosan) were applied exogenously on maize both before and after the pathogen inoculation. The activity of key biochemical defense parameters, viz., total phenol, polyphenol oxidase (PPO), and peroxidase (POD), which were evaluated using a spectrophotometer at 24 and 48 hours following elicitor application. This study indicated that pathogen inoculation significantly increased total phenol, POD, and PPO content across all treatments compared to levels measured before inoculation. The highest levels were observed 48 hours after treatment with 1 mM SA on pathogen inoculated plants, followed by BA and chitosan. Thus, these elicitors offer a promising eco-friendly alternative to conventional chemical fungicides, promoting sustainable disease management practices.

Keywords: Maydis leaf blight, salicylic acid, induced resistance, elicitors.

EFFICACY OF BIOCONTROL AGENTS AGAINST ROOT ROT DISEASE COMPLEX OF MUNGBEAN (*VIGNA RADIATA* L.) CAUSED BY *RHIZOCTONIA SOLANI* AND *MELOIDOGYNE* SPP.

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Root rot disease complex caused by *Rhizoctonia solani* and *Meloidogyne* spp. is a major constraint in Mungbean (*Vigna radiata* L.) cultivation, leading to substantial yield losses. This study evaluated the efficacy of biocontrol agents against *R. solani* and *Meloidogyne* spp. under both *in vitro* and greenhouse conditions. The biocontrol agents were isolated using the serial dilution method and identified based on morphological, microscopic and molecular characterization. Dual culture assays revealed significant antagonistic activity of these biocontrol agents against *R. solani*, with marked inhibition of mycelial growth. *In vitro* seed treatment with various BCAs improved the germination percentage, root and shoot length, and seedling vigour index. A pot experiment further demonstrated that application of BCAs significantly reduced root rot complex incidence and enhanced plant growth parameters, including plant length, biomass, chlorophyll, carotenoids, phenolics, protein content, and pod yield. These results suggest that BCAs serve as an effective, eco-friendly alternative to chemical fungicides and can be integrated into sustainable disease management strategies for mungbean cultivation.

Keywords: Biocontrol, mungbean, root rot, seedling vigour, sustainable agriculture

CHRONIC EXPOSURE TO FLONICAMID TRIGGERS OXIDATIVE STRESS, CELL DEATH, AND DNA DAMAGE IN A NON-TARGET ORGANISM, *DROSOPHILA MELANOGASTER*

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Flonicamid is a systemic pyridine carboxamide group of pesticide that is frequently used in agriculture to control the aphids, whiteflies, and thrips by disrupting their feeding activities. Recent studies have shown that residues of flonicamid can be found in the environment suggesting potential exposure and health risks to non-target organisms. Hence risk assessment studies for exposure to flonicamid are essential. However such studies are largely lacking. Hence, the present study was designed to investigate the impacts of environmentally relevant concentrations of flonicamid on a non-target organism, *Drosophila melanogaster*. For this study, environmentally relevant concentrations ranging from 0.04, to 0.14 µg/L of flonicamid were selected. 1 st instar larvae of *D. melanogaster* were exposed to graded concentrations of flonicamid till their 3rd instar stage. The control and treated larvae were used for biochemical and other investigation. Results of the study revealed that flonicamid at environmentally relevant concentrations was able to induce protein and lipid oxidation as the levels of MDA and protein carbonyl contents were significantly higher in treated larvae compared to the control. Cell viability assay indicated that flonicamid is cytotoxic in nature as it significantly reduced gut cells viability. Additionally, different concentrations of flonicamid triggered DNA damage as evidenced by comet assay. All these findings unequivocally suggests that environmentally relevant concentrations of flonicamid induce oxidative stress, cytotoxic and genotoxic outcomes in *D. melanogaster*, raising health risks for other non-target organisms in the environment.

Keywords: Flonicamid, *Drosophila melanogaster*, Oxidative stress; Cytotoxicity

RESOURCE USE EFFICIENCY IN FARMING SYSTEMS IN BIJNOR DISTRICT OF UTTAR PRADESH

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Agricultural resource use efficiency is an important factor for increasing farm productivity, profitability, and sustainability. The present study investigates resource use efficiency in farming systems of Bijnor district, Uttar Pradesh, an area that has dominance of sugarcane with cereal, and oilseed-based cropping. Primary data were collected from farm households using systematic questionnaires and estimated using the Cobb-Douglas production function and measures of efficiency indices to quantify the contribution of inputs including land, labour, fertilizer, irrigation, and capital. The study revealed that resource use efficiency varied significantly across farming systems. Sugarcane-based systems produced relatively more returns but had diminishing marginal productivity and unbalanced use of inputs, specifically in irrigation and fertilizers. Cereal-oilseed-based systems had relatively more efficient input use but lower profitability. The results point towards underuse of some inputs and excessive use of others, causing inefficiency and long-term sustainability issues. The study indicates that optimizing resource allocation, improving input management, and encouraging crop diversification could enhance farm incomes and reduce environmental pressures. Strengthening extension services, promoting sustainable technologies and capacity building of farmers are essential for improving resource use efficiency in the region.

Keywords: Resource Use Efficiency, Crop diversification, Farming Systems, Input Management.

A COMPARATIVE STUDY OF CHICKPEA PRODUCTIVITY AMONG BENEFICIARY AND NON-BENEFICIARY FARMERS UNDER THE CLUSTER FRONTLINE DEMONSTRATION (CFLD) PROGRAM IN BIKANER, RAJASTHAN

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Pulses, particularly chickpea, play a vital role in ensuring food and nutritional security, especially for vegetarians and economically weaker sections in India. Despite their importance, the availability of pulses has declined, necessitating efforts to boost production. The Indian Council of Agricultural Research (ICAR) launched the Cluster Front Line Demonstration (CFLD) program to promote the adoption of improved agricultural practices among farmers. This study assesses the impact of CFLD programs on chickpea cultivation in Bikaner district, Rajasthan, by comparing the practices and productivity of beneficiary and non-beneficiary farmers. A total of 200 respondents, including 100 beneficiary and 100 non-beneficiary farmers, were selected from Bikaner and Kolayat tehsils. Data were collected through structured interviews to evaluate the personal, social, economic, and communicational attributes of the farmers. The findings revealed that beneficiary farmers exhibited higher productivity, with 96% achieving yields greater than 8.39 quintals per hectare, compared to only 64% of non-beneficiaries. The average yield for beneficiary farmers was 14.33 quintals per hectare, significantly higher than the 10.77 quintals per hectare achieved by non-beneficiaries. These differences were attributed to the continuous engagement of beneficiary farmers with Krishi Vigyan Kendra (KVK) scientists and their adoption of improved chickpea cultivation technologies. The study underscored the positive impact of CFLD programs in enhancing chickpea productivity and highlights the importance of agricultural extension services in improving farmer outcomes.

Keywords: Pulses, Chickpea, CFLD Program, Krishi Vigyan Kendra, Agricultural Extension, Yield Productivity

EVOLVING MARKETING SYSTEMS AND THEIR ROLE IN STRENGTHENING RURAL DEVELOPMENT IN INDIA

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Rural development in India is crucial for inclusive and sustainable economic growth, with evolving marketing systems playing a pivotal role in connecting rural producers to broader markets, enhancing incomes, and reducing regional disparities. Traditional rural marketing, marked by intermediaries, inadequate infrastructure, and limited credit access, has transformed through cooperative societies, government-backed institutions like Agricultural Produce Market Committees (APMCs), and the rise of digital platforms. These advancements improve price discovery, reduce farmer exploitation, and promote value addition, product diversification, and greater participation of rural women and marginalized groups in economic activities. Recent data highlight that digital initiatives like e-NAM and Farmer Producer Organizations (FPOs) enhance market efficiency and transparency, strengthening rural socio-economic structures. However, challenges such as poor logistics, insufficient cold storage, and limited awareness among producers persist. An integrated approach, combining infrastructure development, policy support, and capacity-building, is essential to ensure marketing systems effectively contribute to sustainable rural development in India.

Keywords: Rural development, Marketing systems, Digital platforms, Farmer Producer Organizations and Infrastructure development.

LEACHATES OF *TRIBULUS TERRESTRIS* L. MEDICINAL PLANT AND THEIR ALLELOPATHIC EFFECTS ON SEED GERMINATION AND SEEDLINGS GROWTH OF MAIZE AND WHEAT CROPS

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Allelopathy is a biological phenomenon in which plants synthesize and release compounds that influence the growth and development of other organisms, particularly plant species. The aim of this study was to investigate the allelopathic influence of aqueous leachates obtained from *Tribulus terrestris* L. on the seed germination and growth of maize and wheat seedlings under laboratory conditions. Seedlings of maize and wheat were treated with aqueous whole plant leachates of *T. terrestris* at different concentrations (5%, 10%, 15% and 20%). The leachates were prepared according to Tukey (1970). A wide diversity of allelopathic compounds, both organic and inorganic such as phenolic acids, terpenoids and alkaloids are known to be leached. The qualitative and quantitative analyses of phenolic compounds in the aqueous leachates were performed using liquid chromatography and mass spectrometry (LC-MS). The phytochemical composition of *T. terrestris* whole plant leachates revealed the highest content (above 1 mg L⁻¹) of 3-aminobenzene sulfonic acid, carbonic acid, 6-bromohexanoic acid, (E)-but-2-enedioic acid, (2S)-2-aminopropanoic acid and benzamide, compared to the other detected compounds from a total of 13. According to the results, higher concentrations of the leachates significantly reduced germination rates. The most pronounced inhibition was observed at 15% and 20% concentrations. Wheat seedlings showed a greater reduction in germination percentage and root-shoot length compared to maize.

Keywords: medicinal plants; aqueous leachates; allelopathy; seeds germination; *Tribulus terrestris* L.

STUDIES ON BIOLOGY OF RUGOSE SPIRALLING WHITEFLY *A. RUGIOPERCULATUS* ON OIL PALM AND COCONUT CROP

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Invasive species, Rugose Spiralling whitefly *A. rugioperculatus* (RSW) Martin (Hemiptera: Aleyrodidae) was invaded into India through trade of ornamental plants during 2016. After invasion of RSW, it has been continued to be a severe pest on a wide variety of plants due to its unique nature like waxy coating, wide host range, damage potential and rapid dispersal. Therefore, to develop a successful management strategy and to identify the vulnerable period during the lifecycle, it is necessary to study about the biology of RSW. Considering this objective biology of rugose spiraling whitefly was studied on oil palm crop, maintained under greenhouse conditions at IOPR, Pedavegi. Similarly, to study the biology under field conditions on different host plants (Oilpam & coconut) freshly emerged two pairs of adults were released into cage and observations were recorded at 24-hour intervals on oviposition pattern, fecundity, and the duration of egg, nymphal, and adult stages. Nymphal instars were identified using a stereo zoom microscope. Observations revealed that The duration of different stages of life cycle of *A. rugioperculatus* in oil palm crop under protected conditions recorded as egg (6.60±0.13 days), first instar nymph (8.06±0.14 days), second instar nymph (8.50±0.14 days), third instar nymph (10.93±0.13 days), fourth instar/puparium period (14.83±0.12 days), male adult (10.9±0.35 days) and female adult (11.6±0.39 days), respectively. Under field condition the duration of different stages of life cycle of *A. rugioperculatus* on oil palm crop recorded as egg (6.53±0.14 days), first instar nymph (6.20±0.15 days), second instar nymph (7.23±0.77 days), third instar nymph (10.86±0.16 days), fourth instar/puparium period (11.96±0.18 days) and male longevity (11.26±0.17 days) and female longevity (14.00±0.32 days), respectively. In Coconut crop under field conditions the duration of different stages of lifecycle of *A. rugioperculatus* egg (5.13±0.14 days), first instar nymph (6.56±0.13 days), second instar nymph (7.90±0.18 days), third instar nymph (8.40±0.17 days), fourth instar/puparium period (14.00±0.20 days) and male adult (11.46±0.22 days) and female adult (13.80±0.13 days), respectively. These findings provide baseline biological information useful for predicting population dynamics and formulating management strategies against *A. rugioperculatus* in oil palm and coconut ecosystems.

CURRENT STATUS OF RICE VIRAL DISEASES WITH SPECIAL REFERENCE TO RICE TUNGRO DISEASE

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Rice cultivation accounts for about 25% of India's agricultural land and serves as the staple food for nearly half of the country's population. However, rice is highly vulnerable to several pathogens, particularly viruses. More than 17 rice-infecting viruses have been identified, including Rice black-streaked dwarf virus (RBSDV), Rice bunchy stunt virus (RBSV), Rice dwarf virus (RDV), Rice gall dwarf virus (RGDV), and Rice grassy stunt virus (RGSV), among others. Most of these viruses are transmitted through leafhoppers or planthoppers. Rice Tungro Disease (RTD) is one of the most severe viral diseases of rice, causing annual losses of about \$340 million in Southeast Asia, 5–10% yield reductions across Asia, and a 2% decline in India's production. It results from co-infection by Rice tungro bacilliform virus (RTBV; dsDNA pararetrovirus) and Rice tungro spherical virus (RTSV; ssRNA picornavirus), transmitted semi-persistently by the green leafhopper (*Nephotettix virescens*). While both viruses are essential for disease, stunting and yellow–orange leaf discoloration are mainly due to RTBV. RTBV (~8 kb) encodes four ORFs for movement, encapsidation, replication, and defense suppression, whereas RTSV (12.2 kb) encodes a polyprotein, three coat proteins, and motifs for NTP binding, protease, and polymerase activity. Currently, tungro management relies on resistant varieties and cultural practices, making RTD resistance a major breeding priority in Asia. While resistance to RTSV is common, RTBV resistance is limited. Most resistant varieties target the insect vector rather than the virus complex, leading to unstable resistance. To address this, transgenic strategies using viral genes or rice transcription factors have been explored to enhance durable resistance. Transgenic resistance to RTD is mainly achieved through RNA interference (RNAi), which silences viral RNA via siRNAs. Marker-assisted breeding has introgressed this resistance into elite cultivars such as ASD 16, BPT 5204, and CR 1009, producing progenies with strong RTBV resistance and good agronomic traits. These lines serve as valuable donor sources for future breeding programs. More recently, endogenous-like RTBV (eRTBV) sequences integrated into rice genomes have been linked to resistance. These elements may enhance defense by producing metabolites, such as the isoleucine protein motif, that inhibit both the virus and its insect vector, functioning synergistically with host defense pathways.

SUSTAINABLE VALORIZATION OF LIGNOCELLULOSIC SUBSTRATE BF-4245 VIA MICROBIAL FERMENTATION: A COMPARATIVE STUDY TOWARD BIOREMEDIATION APPLICATIONS

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Agro-industrial waste, particularly lignocellulosic biomass, remains underutilized despite its rich organic content. This study investigates the potential of a fibrous lignocellulosic by-product, identified as substrate BF-4245 and derived from a tropical plant, for sustainable biotransformation. Due to its high organic load and low commercial value, BF-4245 was subjected to submerged fermentation using two well-characterized microbial strains— *Trichoderma reesei* (NCIM 1186) and *Pseudomonas putida* (NCIM 2650). The objective was to assess the substrate's biodegradability and the capability of the fermented extract to degrade industrial dyes such as Congo Red and Malachite Green. The microbial treatment demonstrated significant potential in dye degradation. To enhance the remediation efficiency, a photocatalytic step was incorporated, which showed synergistic improvements in dye breakdown. This study presents impactful strategy combining microbial fermentation and photocatalysis for environmental clean-up. It supports the circular bioeconomy and aligns with Sustainable Development Goals (SDGs 6, 12, and 13). The findings offer a practical foundation for converting low-value plant waste into eco-friendly tools for pollution reduction in dye-intensive industries.

Keywords: Lignocellulosic Biomass Valorization, Microbial Fermentation, Bioremediation Textile Dye Degradation, Circular Bioeconomy

FROM FARM TO FORTIFIED FOOD: LEVERAGING BANANA PROCESSING FOR ENHANCED NUTRITION AND SUSTAINABLE LIVELIHOODS

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Banana (*Musa* spp.) is an important fruit crop globally known for its high nutritional value being rich in carbohydrates, potassium and dietary fiber. However significant post-harvest losses due to its perishable nature and market gluts often lead to economic waste for farmers. This undermines the potential of horticulture for nutrition and livelihood security. This study investigates the potential of value-added processing as a sustainable management to this challenge. The objective was to develop and analyze nutritious products from bananas, particularly utilizing B-grade and surplus fruits to enhance both nutritional output and economic returns. The methodology involved the processing of raw bananas into shelf-stable products like banana flour and puree. The nutritional profiles of these products were analyzed and compared to the fresh fruit. Moreover, a pilot-scale economic model was developed to assess the viability of small-scale processing units. Key findings indicate that processed banana products retain significant nutritional value with flour serving as an excellent gluten-free alternative high in resistant starch. The economic model showed a substantial increase in profitability by converting low-value surplus produce into high-value goods, thereby creating a path for rural entrepreneurship and stable income. In conclusion, it effectively reduces post-harvest losses contributing to nutrition security by making healthy food ingredients available while simultaneously empowering farmer communities by boosting their livelihoods. This integrated approach solidifies the role of horticulture as a foundation for sustainable development.

Keywords: Banana; Value Addition; Post-Harvest Loss; Nutrition Security; Rural Livelihood; Food Processing.

BIOETHANOL PRODUCTION FROM LIGNOCELLULOSE BIOMASS THROUGH HYDROLYTIC ENZYME

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Bioethanol production from lignocellulose biomass presents a sustainable alternative to fossil fuels, reducing environmental impact and enhancing energy security. This study explores the production of bioethanol from alkali-pretreated rice straw using agro-ecological specific technologies, such as microbial bioconversion with *Trichoderma reesei* for cellulase production and *Saccharomyces cerevisiae*, to improve enzymatic hydrolysis and fermentation efficiency. The application of crop diversification strategies enhances biomass availability by integrating multiple agricultural residues, including rice straw, maize stover, and wheat straw, thereby promoting efficient resource utilization and minimizing waste. This study explores the potential of alkali pre-treatment as an agro ecological approach to enhance enzymatic hydrolysis of rice straw for bioethanol production. By treating rice straw with varying concentrations of sodium hydroxide (NaOH) and steeping durations, we examined its impact on fermentable sugar yield and conversion efficiency. By valorising rice straw, an abundant agricultural byproduct, this study supports circular bio economy principles, reducing waste and enhancing on-farm energy production. Additionally, integrating bioethanol production into diversified farming systems can complement existing crop rotations and agroforestry models, fostering resilience and sustainability the results demonstrate that pre-treated and biodegraded straw provides a high yield of fermentable sugars, leading to efficient ethanol production.

Keywords: Bioethanol Production, Lignocellulosic Biomass, Microbial Bioconversion, Enzymatic Hydrolysis, Fermentation Efficiency

RADIOFREQUENCY PRETREATMENT OF MILLETS: A NOVEL STRATEGY FOR POLYPHENOL RECOVERY

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Millets are resilient, underutilized grains rich in bioactive compounds, offering opportunities to enhance food security and dietary diversification. Polyphenols in millets, known for their potent antioxidant and health-promoting properties, are often compromised by conventional thermal processing. This study hypothesized that radiofrequency (RF) pretreatment, an emerging green processing technology, can enhance polyphenol recovery and stability in millets while ensuring industrial scalability. Three millet varieties (finger millet, pearl millet, and sorghum) were subjected to RF pretreatment for 10, 15, and 20 minutes. Aqueous extracts were analyzed for phytochemical profiles and antioxidant activity. High-resolution mass spectrometry (HRMS) identified major polyphenols, while in silico pharmacokinetic analysis (SwissADME, BOILED-Egg model) evaluated their bioavailability. The 15-minute RF pretreatment was optimal, significantly improving phytochemical retention and antioxidant potential. Finger millet showed the greatest polyphenolic diversity (8 compounds) followed by pearl millet (6) and sorghum (4). Key compounds included ferulic acid, catechin, quercetin, and epicatechin. SwissADME analysis revealed favorable oral bioavailability, high gastrointestinal absorption, and potential blood–brain barrier penetration for select flavonoids. These findings confirm RF pretreatment as a sustainable, energy-efficient processing strategy to improve both the quantity and functional efficacy of millet-derived polyphenols. The approach supports the development of millet-based functional foods, nutraceuticals, aligning with global goals of sustainable agriculture, green food processing, public health nutrition. **Keywords:** Radiofrequency pretreatment, Millets, Polyphenols, Bioavailability, Functional foods

BIOCHEMICAL INSIGHTS INTO PROTEIN, FAT, AND LACTOSE VARIABILITY OF DONKEY MILK

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This study explores the milk yield and biochemical profile of donkey milk from diverse sources, including field conditions and organized farms. The milk's composition is characterized by factors such as lactation stage, genetics, environment, and milking practices. Remarkably, donkey milk is rich in lysozyme, which enhances its shelf life, making immediate refrigeration vital during transport to maintain quality. By analyzing samples from the same animals under consistent lactation periods, the study reveals notable differences in protein and fat content between farm and field milk. Farm milk showed higher levels of protein (3.38 ± 0.04 g%) and fat (1.03 ± 0.10 g%) compared to field milk during early lactation. Meanwhile, the average SNF ($8.46 \pm 0.57\%$) and total solid ($8.6 \pm 0.57\%$) content were consistent with previous research in spite of Fat content that was varied from 1.0% to 2.0% in the first three months of lactation. These findings highlight the critical role of environmental factors and management practices in shaping the nutritional profile of donkey milk, emphasizing the importance of source location in assessing its quality and health benefits.

Keywords: Donkey milk, farm and field samples, lactation stage, protein content, fat content, lactose content

GREEN SYNTHESIS AND CHARACTERIZATION OF ZINC AND COPPER NANOPARTICLES FROM LEAF, STEM AND ROOT EXTRACTS OF *TERAMNUS KAMESHWARARAOI*

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Teramnus kameswararaoi is an annual herb belonging to family Fabaceae and sub family papilionoideae. During the present investigation the zinc oxide and copper oxide nanoparticles were successfully synthesized by using aqueous root, stem and leaf extracts of *Teramnus kameswararaoi*. The structural optical and morphological properties of the synthesized ZnO and CuO nanoparticles were systematically characterized by using X-ray diffraction (XRD) and Fourier Transform Infrared Spectroscopy techniques. The XRD pattern confirms the crystalline structure. The FTIR analysis revealed the presence of functional groups as stabilizing agent for bonding of ZnO and CuO nanoparticles. The peaks observed in the pattern at 2 theta values of ZnO(31.8, 34.4, 36.3 & 47.5) & CuO(35.7, 38.9, 49.2) respectively correspond to hkl vales of (1 0 0, 0 0 2, 1 0 1, 1 0 2 & 1 1 1, 1 1 2).

Keywords: *Teramnus kameswararaoi*, green synthesis, Fabaceae nano particles

EFFECT OF HAND AND CHEMICAL THINNING PRACTICES ON FRUIT QUALITY IN PLUM

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To assurance the excellence of plum harvests, thinning is an essential practice because it impacts fruit dimensions and the formation of floral buds for the subsequent year; however, performing this by manual, labor is costly. For close to three decades, scientists have been dedicated to discovering new methods of fruit thinning as an alternative to the manual process. This research project explored how different chemical thinning compounds impact the yield and attributes of fruit. This study has been carried out at experimental orchard and in Farm Laboratory of the department of Horticulture, CCS Haryana Agricultural University, Hisar during the year 2022 and 2023. The temperature at the application time of treatments on plum trees was above 18°C and the sky was sunny. Treatments included spray of Ammonium thiosulfate @ 2 per cent and 4 per cent; Ethephon @ 75 ppm and 150 ppm; Hydrogen Cyanamide @ 0.4 per cent and 0.8 per cent; BA @ 150 ppm and 300 ppm; control (water spray) and Hand thinning. It may be concluded from the present study that among various fruit thinning chemicals and hand thinning treatments, ATS @ 4 per cent applied 2 weeks after petal fall stage was found significantly most effective in thinning of fruitlets and enhancing the physical fruit quality parameters i.e fruit color ('L' and 'a' coordinates); decreasing 'b' coordinate and Ethephon @ 150 ppm enhancing the pulp weight; however, a non-significant result of stone weight was observed among all the treatments.

Key words: Ammonium thiosulphate, Chemicals, Ethephon, Fruit color, Hydrogen Cyanamide, Pulp weight.

HETEROSIS ANALYSIS FOR GRAIN YIELD AND ITS ATTRIBUTING TRAITS IN PEARL MILLET [*Pennisetum GLAUCUM* (L.) R. BR.]) USING CMS BASED HYBRIDS

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The experiment was conducted in Pearl millet [*Pennisetum glaucum* (L.) R. Br.]) at Ketanbhai Patel Farm, Village Ishanpur Mota, Ta & Dist. Gandhinagar, Gujarat. To assess the extent of heterosis for ten characters including grain yield per plant. Six CMS lines were crossed with eight restorer lines as testers in line x tester mating design to obtained 48 F1 hybrids of Pearl millet. The analysis of variance for parents, hybrids and parents vs. hybrids revealed that mean sum of squares of parents were highly significant for all of the characters. Whereas, hybrids also differed highly significant for all the characters. Comparison of mean squares due to parents vs. hybrids was found significant for almost all the characters except seed setting. This indicate that considerable amount of genetic variability present among the parents and hybrids for all the characters studied. On the basis of per se performance, highest grain yield per plant was observed in the parent HTP-03/13 R (52.20 g) and hybrid 97111 A x ICMR 1203 (91.50 g). while parent H 77/833-2-202R (76.00 days) and hybrid 94555 A x HTP-03/13 R (75.00 days) for early maturity. Whereas, the parent, H 77/833-2-202R (4.57), hybrid 97111 A x H 77/833-2-202R (5.50) for number of effective tiller per plant. Based on heterotic effect, 97111 A x ICMR 1907 hybrid recorded significant heterosis (in desired direction) over standard check for earhead length, earhead girth, test weight, harvest index, seed setting and grain yield per plant. The second hybrid 97111 A x ICMR 1203 has recorded significant heterosis (in desired direction) over standard check for earhead length, earhead girth, test weight, harvest index, seed setting and grain yield per plant. The third hybrid 97111 A x ICMR 19555 has recorded significant standard heterosis for earhead length, earhead girth, test weight, harvest index, seed setting and grain yield per plant. The last hybrid 97111 A x ICMR 18777 has recorded significant standard heterosis for earhead length, earhead girth, test weight, harvest index and grain yield per plant.

Keywords: Pearl millet, LxT mating design, Heterosis.

COMBINING ABILITY ANALYSIS FOR GRAIN YIELD AND ITS ATTRIBUTING TRAITS IN PEARL MILLET [*Pennisetum glaucum* (L.) R. Br.]

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The experimental material comprised of sixty genotypes consisting of five CMS lines and nine restorers as tester lines crossed in line $\times$ tester mating design. The resultant forty-five hybrids along with their fourteen parents and standard check (GHB 1129) were evaluated in randomized block design at Ketanbhai Patel Farm Village Ishanpur Mota, Ta & Dist. Gandhinagar, Gujarat during summer'2024. The analysis of variance for combining ability revealed that the mean square observed due to female were significant for all the characters except seed setting. Whereas, mean square observed due to male were for significant for all the characters. The mean square due to line $\times$ tester interaction were significant for all the characters which indicate that experimental material possessed considerable variability and that gca and sca were involved in the genetic control of various traits. The ratio of $\sigma^2_{gca} / \sigma^2_{sca}$ was less than unity for all the characters. This indicates that the non-additive component genetic variance was predominantly involved in the expression of yield. Among the parents, none of the parent was good general combiners for all the characters. Among females, The female 37 A was good combiner for grain yield per plant, number of effective tiller per plant, days to 50% flowering, days to maturity and plant height. ICMA 14222 was good combiner for grain yield per plant, test weight, days to 50% flowering and days to maturity. Among the male parent ICMR 17333 was good general combiner for grain yield per plant, seed setting, test weight, earhead girth, days to 50% flowering and days to maturity. The ICMR 11666 and ICMR 0911 expressed good general combining ability for grain yield per plant, earhead girth and earhead length. The top hybrid having high sca effect for yield ICMA 15666 $\times$ HBL-11 R exhibited significant sca effects in desired direction for grain yield per plant, days to 50% flowering, days to maturity and earhead length. The second hybrid ICMA 21999 $\times$ ICMR 09777 has significant sca effects in desired direction for grain yield per plant, plant height, earhead length, earhead girth and test weight.

Keywords: Pearl millet, L $\times$ T mating design, GCA, SCA.

LEAF AREA INFLUENCES PHOTOSYNTHETIC ACTIVITIES, RAISIN YIELD AND QUALITY IN MANJARI KISHMISH GRAPE VARIETY

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Optimizing leaf retention above the bunch is critical for balancing source-sink, photosynthetic efficiency and raisin yield and quality in Manjari Kishmish grapes under tropical conditions. A field experiment during 2023-24 at ICAR-NRC for Grapes, Pune evaluated five leaf-retention treatment above bunches (10, 12, 14, 16 and >16 leaves) in vines grafted on Dogridge, trained to extended Y-trellis at 9 $\times$ 5 ft spacing, using a randomized block design with five replications. Key measurements included leaf area, LAI, PAR, gas exchange (LI-6400 IRGA), bunch and berry traits, yield, TSS, acidity, chlorophylls and raisin recovery. Retaining 14 leaves above the bunch optimized performance, yielding the highest bunch weight (365.0 g), 50-berry weight (123.31 g), yield per vine (23.72 kg) and raisin recovery (26.54%) with an associated leaf area per bunch of 1066.33 cm² and sufficient effective leaf area at shoot and vine (2888.0 and 69312.0 cm² respectively). LAI increased with leaf number (~1.42 to 1.66), while PAR within the canopy decreased, gas-exchange parameters varied modestly across treatments which was optimum near 12–14 leaves. Excess retention (>16 leaves) reduced bunch weight, berry size, yield and raisin recovery, likely due to overshading and resource competition. Maintaining approximately 14 leaves above the bunch is recommended to enhance photosynthetic activity, fruit development and raisin yield and quality in Manjari Kishmish under semi-arid tropical conditions.

Keywords: Leaf area; LAI; PAR; photosynthetic activity; raisin recovery; yield

INTEGRATING AI INTO CLIMATE SMART FARMING SYSTEMS

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Climate-smart agriculture and nutrition-sensitive farming are innovations that address the issues of food security, nutritional deficiencies, and climate change. They not only boost productivity but also improve climate variability and nutritional outcomes, particularly in areas with high pollution risks. By using incoming soil data, weather forecast crop health imagery, and pest disease detection, AI integration around precision agriculture techniques reduces waste and environmental impact by giving farmers actionable insights for applications like targeted irrigation, fertilization, and pest control. Proactive adaptive strategies are supported by machine learning models that use historical climate patterns to forecast droughts, floods, and pest outbreaks. By mimicking genetic results and screening for desired traits, AI also speeds up the breeding of nutrient-rich, climate-resilient crop varieties.

Keywords: Climate-smart agriculture (CSA), Nutrition-sensitive farming, Precision agriculture, Artificial intelligence (AI), Climate resilience

CARBON SEQUESTRATION AND SOIL QUALITY IN HORTICULTURE-BASED LAND USE SYSTEMS OF BIHAR AGRO-CLIMATIC ZONE-I

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Carbon sequestration has emerged globally as a cost-effective and eco-friendly strategy to mitigate the rising atmospheric CO₂ concentration caused by anthropogenic activities that threaten ecological and human sustainability. This study was conducted to evaluate soil organic carbon (SOC) sequestration potential and soil quality variations under major land-use systems (LUSs) in Agro-Climatic Zone-I of Bihar, hypothesizing that SOC quality and quantity vary with differences in carbon inputs and losses. Five LUSs—litchi solo, mango solo, litchi intercrop, rice–wheat, and uncultivated—were selected within the middle Gangetic alluvial plain characterized by a hot dry to moist sub-humid climate. A total of 100 composite soil samples were collected from four depths (0–15, 15–30, 30–45, and 45–60 cm) and analyzed for physico-chemical and biological properties. Results revealed that soil carbon was the principal determinant of soil characteristics. Mango solo LUS exhibited the highest soil quality and carbon sequestration potential, followed by litchi solo, litchi intercrop, uncultivated, and rice–wheat systems. Soils were moderately alkaline (pH 7.91–8.26) with electrical conductivity (0.34–0.48 dS m⁻¹) within safe limits. Bulk density varied significantly, being highest in uncultivated soils (1.46 Mg m⁻³) and lowest in mango solo (1.41 Mg m⁻³). Available macro- (N, P, K) and micro-nutrients (Fe, Zn, Cu, Mn) were higher in horticulture-based systems than in rice–wheat and uncultivated LUSs, decreasing with soil depth. Biological indicators such as dehydrogenase activity, soil microbial biomass carbon and nitrogen, and soil protein were significantly superior in horticultural LUSs. SOC stock (0–60 cm) was highest in mango solo (71.34 Mg C ha⁻¹) and lowest in rice–wheat (44.69 Mg C ha⁻¹), with similar trends for nitrogen stock. Soil quality index (SQI) ranked mango solo > litchi solo > litchi intercrop > uncultivated > rice–wheat, with key sensitive indicators being soil carbon stock, metabolic quotient, respiration rate, and texture components. The findings highlight that integrating horticultural trees and improved agronomic management in current fallow or cereal-based lands can substantially enhance soil quality and carbon sequestration for sustainable land use in Bihar's agro-ecosystem.

ENHANCING BIODEGRADABLE CUTLERY DURABILITY USING NEEM WAX COATINGS

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The increasing environmental burden of single-use plastics has necessitated the development of sustainable alternatives, with biodegradable cutlery emerging as a promising solution. In this study, biodegradable cutlery was fabricated from agro-waste materials and subsequently coated with natural neem wax to enhance functional performance. The effect of the wax coating on the mechanical and physical properties of the cutlery was systematically evaluated. Comprehensive mechanical characterization, including tensile strength, flexural strength, and hardness tests, was performed to assess structural integrity and durability. Additionally, thickness uniformity, moisture absorption, and water resistance were analysed to determine the impact of the coating on barrier properties. Results indicated that neem wax coating significantly improved tensile and flexural strengths, reduced moisture uptake, and enhanced surface smoothness without compromising biodegradability. Scanning electron microscopy revealed uniform wax deposition and improved fibre-matrix interactions, contributing to enhanced mechanical performance. The study demonstrates that natural wax coatings can effectively augment the functional properties of biodegradable cutlery, making it more suitable for practical applications in food service. This work provides a sustainable approach for producing eco-friendly disposable cutlery with improved durability, combining agro-waste valorisation and green surface modification strategies, and highlights the potential of neem wax as a natural, non-toxic coating material for biodegradable food ware.

Keywords: Biodegradable cutler, Neem wax, Mechanical properties, Agro-waste valorization

GUT MICROBIOME CHANGES IN COLORECTAL CANCER: A METAGENOMICS AND MACHINE LEARNING-AIDED STRATEGY

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Colorectal cancer (CRC) is still among the most common and lethal cancers globally, yet increasing evidence suggests that gut microbiota play a crucial role in the development and growth of the disease. This project investigates shifts in the gut microbiome of CRC by investigating publicly accessible metagenomic sequence data (BioProject: PRJNA1116523) to discover how dysbiosis by microbes contributes to the disease. A Next-Flow bioinformatics pipeline combining quality control, taxonomic profiling, phyloseq, and DESeq2 was used to contrast microbial diversity, detect differentially abundant taxa, and infer their biological significance. Alpha diversity expressed as the Shannon index revealed a moderate loss in CRC samples, reflecting diminished microbial richness and evenness. Beta diversity analysis through NMDS ordination revealed subtle yet reproducible discrimination of CRC versus healthy controls, reflecting a dysbiotic state. Differential abundance analysis also identified the enrichment of pathogenic inflammatory taxa, i.e., *Fusobacterium nucleatum*, *Bacteroides fragilis*, and *Peptostreptococcus anaerobius*, all of which are known to be associated with inflammation, oxidative stress, and tumour development. Low-abundance anti-inflammatory species, i.e., *Faecalibacterium prausnitzii*, *Bifidobacterium pseudocatenulatum*, and *Streptomyces spp.*, suggested an absence of beneficial, butyrate-producing commensals. These microbial changes indicate a shift towards protein-fermenting over fiber-breaking metabolism, which is conducive to the generation of toxic metabolites and the establishment of a pro-inflammatory niche for tumorigenesis to take place. In addition, a machine learning classifier was utilised to differentiate CRC from normal samples based on patterns of microbial abundance. The model was predictive, thereby attesting to the utility of microbiome-based markers for detecting early CRC. Collectively, this effort accentuates the intricate interaction of gut microbiota and cancer biology and brings forth the convergence of machine learning and computational tools to advance microbiome science.

Keywords: Colorectal cancer (CRC), Gut microbiome, Metagenomics, Next-flow pipeline, Machine learning classifier

SCENARIO OF SERICULTURE AND PROBLEMS FACED BY FARMERS IN UMARKHED TALUKA DIST. YAVATMAL, MAHARASHTRA (INDIA)

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In India from ancient period, sericulture is practiced along with agriculture. Sericulture is the allied activity along with agriculture nowadays also increases the GDP of country. The small-scale farmers because of low investment, high returns, less time consuming, provides employment, practice it. Lustrous, shiny, attractive, soft, smooth 'Silk' is the final product of sericulture form from the rearing of silkworm *Bombayx mori* which mainly feeds on mulberry leaves. In Maharashtra the Mulberry and Tasar silk is produced in large quantity and as compare to the other state 98% of bivoltine sericulture is practiced. Silkworm rearing is dual process that the quality and quantity of silk is depending on the worms and mulberry so it becomes challengeable to farmers. It needs labor for the maintenance of mulberry garden and as well as silkworm rearing so the women along with men shows the contribution. The study is done in Umarkhed taluka located in Yavatmal district Vidarbha region of Maharashtra. Primary data collected from the district sericulture office and the secondary data was analysed by questionnaire, interviews, field visit for the farmers having sericulture plant. This paper mainly focuses on the status of sericulture farming in the region and how the farmers are motivated for this nontraditional activity. As it depends on low investment, high returns in short gestation period. Many large land holders are approaching towards sericulture but in spite of this because of some problems like UZI fly, soil infertility because of long time same crop, gas poison of another crop, small land, market issues in rural areas farmers are hesitating to enter in the sericulture farming. The study will help to motivate the farmers and to know the challenges and opportunities for the more production of good quality of raw silk from rural areas.

Keywords: Sericulture, *Bombyx mori*, Mulberry, Raw silk, farming, silkworm.

SEASONAL INFLUENCE ON THE DIVERSITY AND MYCOTOXIGENIC POTENTIAL OF FUNGI ASSOCIATED WITH OPIUM POPPY SEEDS

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Storage fungi significantly affect the quality and safety of stored grains and seeds by producing toxins and allergens that can harm consumer health. Poppy seeds, rich in nutrients and used for culinary and medicinal purposes, are particularly prone to fungal contamination. In this study, 21 opium poppy seed samples were collected from the Agra region across three seasons: summer, rainy, and winter. Using the serial dilution and agar plate methods, 22 fungal species were identified, with *Alternaria alternata*, *Aspergillus flavus*, *A. ochraceus*, *Fusarium moniliforme*, *F. roseum*, and *Penicillium citrinum* being the most common. *Aspergillus flavus* has the highest frequency during the rainy season (91.35%), winter (90.31%), and summer (91.25%), corresponding to populations of 24.45×10^2 , 17.35×10^2 , and 19.00×10^2 CFU/g, respectively. Lower frequencies were observed for *Helminthosporium sativum* (5.23%) in the rainy season, *Aspergillus sulphureus* (5.10%) in summer, and *Chaetomium globosum* (4.63%) in the winter season. This study highlights the importance of monitoring fungal contamination in opium poppy seeds, given its implications for food safety and quality. The study investigates the seasonal variation in fungal contamination of opium poppy seeds and their mycotoxin-producing potential. The findings underscore the importance of enhancing post-harvest handling and storage conditions to minimize fungal infestations, preserve seed quality, and ensure consumer safety.

Keywords: poppy seeds, *Papaver somniferum*, mycotoxins, frequency, consumer safety.

ROOTING THE FUTURE: BIOTECHNOLOGICAL INNOVATIONS FOR SOIL HEALTH AND CARBON SEQUESTRATION

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Healthy soils are the foundation of resilient ecosystems and sustainable agriculture. With growing concerns about climate change and land degradation, biotechnology offers powerful tools to enhance soil health and accelerate carbon sequestration. This presentation explores the emerging role of microbial engineering, synthetic biology, and plant-microbe interactions in restoring soil function and capturing atmospheric carbon. Advances in rhizosphere microbiome manipulation, biofertilizers, and engineered root exudates are enabling the development of crops that not only thrive in degraded soils but also actively contribute to carbon storage. Additionally, genetically optimized microbes and enzymes are being deployed to convert plant biomass and organic residues into stable soil organic matter. These innovations not only improve nutrient cycling and water retention but also offer scalable climate mitigation strategies. Despite the potential, challenges remain in field deployment, regulatory frameworks, and long-term monitoring of soil-biotech interventions. This session will highlight current research, successful field applications, and the roadmap for integrating biotechnology into soil management and climate policy. As global pressures on food systems and climate intensify, biotech-based soil solutions are no longer optional they are essential.

Keywords: Soil, Carbon, Microbiome, Bioengineering, Sustainability

LINKING FINANCIAL LITERACY TO AGRI-BUSINESS DEVELOPMENT: EVIDENCE FROM ASSAM AGRICULTURAL UNIVERSITY

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Financial well-being and long-term livelihood stability are significantly influenced by financial literacy, which is the capacity to efficiently manage personal resources through budgeting, saving, investing, borrowing, and debt management. Financial literacy among agricultural institution staff is essential for promoting financial knowledge and influencing decision-making at the community level in the context of agribusiness and rural development. This study uses a sample size of 60 respondents, including both teaching and non-teaching personnel, to evaluate the financial behaviour of young employees towards financial concerns at Assam Agricultural University, Jorhat. According to the results, most employees, both teaching (93.34%) and non-teaching (80.00%), saved money for a stable future. While 76.66% of teaching and 80.00% of non-teaching employees regularly saved money each month, 86.66% of teaching and 73.33% of non-teaching respondents chose to save in banks. Nonetheless, fewer than 25% of the respondents' monthly income was saved by over half of them. The future and medical requirements of children were the main drivers of saving. Furthermore, recurrent deposits (RD) were the most popular choice for investing, with 66.67% of teaching and 60.00% of non-teaching staff members doing so. A comparable proportion of both groups said they had never taken out a loan, and nearly 60 percent sought financial advice. According to the study, enhancing financial literacy curricula at agricultural colleges benefits staff members' financial security as well as their capacity to spread knowledge in agribusiness and rural development. Institutions like Assam Agricultural University can indirectly support inclusive growth in rural areas, sustainable saving habits, and well-informed financial decision-making by raising financial awareness among academic and non-academic staff.

Keywords: Financial literacy, savings behaviour, investment patterns, agribusiness management, rural development

SURVEY TO ASSESS THE MAJOR DISEASES OF SESAME IN MAJOR SESAME GROWING REGIONS OF NORTHERN KARNATAKA

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Sesame (*Sesamum indicum* L.) is one of the important oilseeds belonging to family Pedaliaceae which is having the longest history of cultivation in India. Sesame seeds are rich source of edible oil (48-55 %) and protein (20-28 %) consisting of methionine, tryptophan, vitamin (niacin) and minerals. Sesame is known to be a vulnerable crop for a number of diseases like Alternaria leaf spot, bacterial blight, stem and root rot, powdery mildew, Cercospora leaf spot and phytoplasma. The survey was conducted in major sesame growing districts of North Karnataka such as Vijayapura, Belgaum, Bagalkote, Gadag and Dharwad to record the incidence of different foliar diseases such as Cercospora leaf spot, Alternaria leaf blight, Powdery mildew and Phyllody for two year 2023-24 and 2024-25 of *Kharif* season. The average per cent disease incidence of different districts surveyed during *Kharif* 2023 and 2024. Maximum average severity of Cercospora leaf spot was recorded in Vijaypur district (25.3%) and Belgaum (25.3%) district, whereas lowest per cent disease severity was noticed in Bagalkote district (21.3%). The maximum average disease severity of Alternaria blight was noticed in Vijaypur district (28.2%) and lowest average disease severity was recorded in Gadag district (21.8%). The highest severity of Powdery mildew disease was recorded in Gadag district (25.7%) and lowest disease severity was noticed in Dharwad district (21.8%). The maximum average per cent disease incidence of Phyllody was noticed in Belgaum district (26.9%) and average lowest disease incidence was recorded in Gadag district (19.4%). From the study recommended that appropriate control methods should be identified and recommended to prevent sesame yield loss and increases productivity.

DEVELOPMENT OF SPRAY SCHEDULE FOR SESAME DISEASES

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Sesame (*Sesamum indicum* L.) is one of the important oilseeds belonging to family Pedaliaceae which is having the longest history of cultivation in India. Sesame is known to be a vulnerable crop for a number of diseases like Alternaria leaf spot, bacterial blight, stem and root rot, powdery mildew, Cercospora leaf spot and phytoplasma. The field experiment was conducted in a Randomised Block Design at main Agricultural Research Station, Dharwad during *Kharif* 2023 using crop variety, DSS-9 in a plot size of 2.25m × 4m and ten treatments in 3 replications of fungicides and biocontrol agents in an integrated approach and observations such as per cent seedling emergence, 30, 60 and 90 days after sowing and seed yield per plot were recorded. Out of ten treatments, ST with Carbendazim@3g/kg -Spray of (Tebuconazole 50 % + Trifloxystrobin) 25% @ 0.5g/l at 5 days followed by three spray at 15 days interval was found to be the most effective as it recorded least incidence of powdery mildew (17.3%) and Phyllody (2.3%). The next effective treatment against powdery mildew and phyllody was ST with *T.harzianum*@10g/kg of seed- furrow application of enriched *T.harzianum* (2.5 kg *T.harzianum*+100kg vermicompost) 250 kg/ha followed by spray of Carbendazim @ 1g/l at 30-45 days followed by three spray at 15 days interval (18.1% and 2.02%, respectively). The data on seed yield of sesame indicated that ST with Carbendazim@3g/kg -Spray of (Tebuconazole 50 % + Trifloxystrobin) 25% @ 0.5g/l at 5 days followed by three spray at 15 days interval recorded significantly highest seed yield (637.3 kg/ha), The cost-benefit analysis of different seed treatments showed that ST with Carbendazim @3g/kg- spray of (Tebuconazole 50% + trifloxystrobin 25%) at 0.5g/l at 45 and 60 days after sowing (treated check) recorded highest net returns of Rs. 43169/- and B:C ratio of 2.41 followed by ST with *T.harzianum*@10g/kg of seed- furrow application of enriched *T.harzianum* (2.5 kg *T.harzianum*+100kg vermicompost) 250 kg/ha followed by spray of Carbendazim @ 1g/l at 30-45 days followed by three spray at 15 days interval (Rs 38392./-, 2.30) respectively.

NUTRITIONAL PROFILING OF FORMULATED PRODUCTS FOR ADDRESSING HIDDEN HUNGER AMONG JENUKURUBA TRIBAL CHILDREN FROM MYSORE DISTRICT"

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Micronutrient deficiencies, often termed “hidden hunger,” represent a significant public health challenge globally, affecting billions of children. These deficiencies, primarily in essential vitamins and minerals like vitamin A, iron, iodine, and zinc, lead to severe health problems, including impaired cognitive development, weakened immunity, and increased morbidity and mortality. The present study was designed with the objective of developing protein- and iron-rich food products for use in a nutrition intervention program aimed at addressing macro- and micronutrient deficiencies among Jenukuruba tribal school children. A total of 3 protein (Ground nut laddu, multigrain beverage mix and cereal and legume snack) and 3 iron rich products (Puffed amaranth laddu, dates and rice flakes laddu and sesame seed chikki) were formulated and were subjected to nutritional analysis to determine macro and micronutrient content and invitro protein digestibility. From the results it was known that, the range of 8.64–15.7g/100g represented the overall protein content. Out of the three products, it was found that the ground nut laddu had a comparatively higher energy content (517 Kcal/100g). The multigrain beverage mix and puffed amaranth laddu were shown to have the highest levels of protein digestibility, with 82.5% and 85.8%, respectively. Among the protein rich products, groundnut laddu had considerably greater levels of magnesium (2065.56 ppm), potassium (7156 ppm), and calcium (2370 ppm) than other products. A notable level of iron (68.8 ppm) was found in the cereal and legume snack, followed by groundnut laddu (63.7 ppm) and beverage mix (52.4 ppm). With respect to cost estimation, it was revealed that, all of the products were deemed to be reasonably priced, with their total cost per serving falling between Rs. 3.74 and Rs. 9.37. Hence, it could be said these products with good nutritional density would help to mitigate micro nutrient deficiencies enabling improved health outcomes along with enhancing quality of life.

Keywords: Hidden hunger, iron deficiency, immunity, cognitive development, public health

MARSILEA QUADRIFOLIA- AN EMERGING LEAFY VEGETABLE

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Marsilea quadrifolia belongs to family Marsileaceae commonly known as Water clover, European water clover and Four-Leaf Clover Fern .It belongs to group of semi-aquatic ferns. It is native of Eurasia. It has quadrifoliate leaf and horizontally creeping fleshy adventitious roots containing rhizome. Its life cycle is characterized by alternate succession of haploid gametophyte and diploid sporophyte. Vegetative propagation done by rhizome and sexual reproduction through release of spores. Marsilea produces its spore in sporocarps, which is bean shaped. It thrive in shallow and stagnant freshwater. In some Asian countries it act as supplementary protein rich forage for fish and duck in integrated agro aquaculture system. In some part of India particularly West Bengal and Odisha it called as “Susni shak”, the young leaves and petioles harvested and cooked as leafy vegetable. It is rich in carbohydrates, vitamin (beta carotene 2.1- 2.8 mg/100g) , dietary fiber , protein (24.5- 36.2%) and minerals (Sodium (0.7-1.4%) , Potassium (1.1-2.8%) , and 0.5% of Calcium) . It is traditionally used in Ayurveda medicine. It also has anti-inflammatory & anti diabetic properties and rich in antioxidant. Its rhizome form mat like structure that can help to reduce soil erosion near banks of ponds and canals. It can be sold as ornamental for aquarium. In some parts of US and Europe, it classified as invasive weed particularly in rice cultivation. There are many studies have been conducted on marsilea but for further insight it needs conservation program and proper study.

Keyword: Susni shak, Leafy vegetable, fern, Marsilea

VARIATION IN VEGETATIVE PHENOLOGICAL TRAITS AMONG TEAK (*Tectona grandis* L.) GENOTYPES IN CLONAL SEED ORCHARD, KARKA

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Teak (*Tectona grandis* L.) is a valuable tropical timber species known for its durability, strength, and economic significance. Clonal seed orchards (CSOs) are crucial for improving genetic gain and seed quality. However, phenological variation among clones influences synchronization and productivity. This study evaluated vegetative phenophases and genetic parameters among teak clones in a 45-year-old CSO at Karka, Karnataka. Fifteen teak clones representing northern, central, and southern provenances were assessed for leaf shedding initiation, leafless period, and leaf flushing traits through fortnightly observations from May 2024 to April 2025. Results revealed significant clonal differences across all vegetative phenophases. Northern clones exhibited delayed leaf shedding and prolonged dormancy, whereas southern and central clones showed earlier leaf flushing and shorter leafless periods, reflecting adaptation to local climatic conditions. Genetic analysis indicated high heritability and genetic gain for leaf flushing initiation (78.04%, 52.66%) and duration (73.23%, 27.16%), suggesting strong genetic control. Schematic phenograms illustrated temporal variation among clones, confirming distinct growth rhythms and genotype-specific responses to environmental cues. Vegetative phenology in teak is predominantly genotype-governed with moderate environmental influence. Traits such as leaf flushing initiation and duration are reliable for selecting superior clones with synchronized growth and enhanced adaptability, supporting effective teak improvement and sustainable orchard management.

Keywords: CSO, Clone, Phenology, Synchrony, Teak

A COMPREHENSIVE REVIEW OF ASSESSMENT OF BEHAVIOURAL CHANGES IN RESCUED BIG CATS IN REHABILITATION CENTRES: AN INTERDISCIPLINARY APPROACH

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The study of behaviour changes in the rehabilitated big cats is one among the emerging concerns in wildlife research. In India, with the rise in man and wildlife conflict has brought a growing number of tigers (*Panthera Tigris*), leopards (*Panthera pardus*) into Rescue and Rehabilitation Centres (RRCs). These animals often reach rehabilitation centres after experiencing high levels of physical strain and psychological stress. The behaviour of these animals can be evaluated by the way they rest, move, interact and even remain still will helps to reveals important traces of their past experiences. Through consistent observation, we can gain a deeper understanding of their emotions, health and how well they adjust to the surroundings of Rescue and Rehabilitation Centres. The present study incorporates the findings from Indian and international research reviews to investigate how the behavioural patterns such as pacing, grooming, play, aggression and social bonding serve as indicators of stress or comfort in big cats. It explores the practical use of ethograms, activity budgets, and enrichment strategies for tracking welfare and interpreting behaviour. At the same time, the study considers the unique realities of Indian rehabilitation centres, focusing towards the challenges and constraints faced when applying these assessment tools in the local conditions. Major gaps remain: we lack consistent behavioural baselines for each species, long-term welfare assessments and studies that account for the environmental factors such as light, sound and enclosure design. To advance this research, the present study proposes an integrated approach that combines behavioural observations, assessment of enclosure conditions, analysis of the acoustic environment, and the application of well-defined welfare indicators. This approach enhances our understanding of how big cats respond to their surroundings and what they require to remain healthy and at ease. By refining observation and care practices, India can strengthen its wildlife rehabilitation centres and showcase a genuine commitment to coexistence and harmony with nature.

Keywords: Big cats, behavioural ecology, animal welfare, rescue and rehabilitation, rewilding and multidisciplinary conservation

ESTIMATION OF LACTATION PERSISTENCY OF THIRD LACTATION IN VARIOUS GRADES OF JERSEY X RED SINDHI CROSSBRED COWS

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Milk yield is an important trait in dairy industry; thus, information regarding this phenotype is essential to measure the productivity of a farm. This article aims to estimate the persistency of milk yield between lactation 1 and 2 in various grades of $\frac{1}{2}$ Jersey $\times$ $\frac{1}{2}$ Red Sindhi, $\frac{1}{4}$ Jersey $\times$ $\frac{3}{4}$ Red Sindhi, $\frac{3}{8}$ Jersey $\times$ $\frac{5}{8}$ Red Sindhi, $\frac{1}{8}$ Jersey $\times$ $\frac{7}{8}$ Red Sindhi crossbred of cows. Data was collected from pedigree cum history sheet. Milk yield from the third L3 lactations of 83 cows and 498 observations of various grades of Jersey $\times$ Red Sindhi crossbred cows were recorded in kilograms. Samples were collected up to six months. The mean of milk yield for six months in 182.54 $\pm$ 5.40 kg of $\frac{1}{2}$ Jersey $\times$ $\frac{1}{2}$ Red Sindhi crosses, 172.25 $\pm$ 3.27 Kg of $\frac{1}{4}$ Jersey $\times$ $\frac{3}{4}$ Red Sindhi crosses, 160.49 $\pm$ 5.23 kg of $\frac{3}{8}$ Jersey $\times$ $\frac{5}{8}$ Red Sindhi crosses, 170.20 $\pm$ 3.92 kg of $\frac{1}{8}$ Jersey $\times$ $\frac{7}{8}$ Red Sindhi crosses. The peak of milk yields was achieved at the second month of the lactation for L3 were 170.24-228.02 Kg of $\frac{3}{8}$ Jersey $\times$ $\frac{5}{8}$ Red Sindhi crosses, 142.32-283.99 kg, 156.53-260.63 kg and 172.41-334.16 Kg of $\frac{1}{8}$ Jersey $\times$ $\frac{7}{8}$ Red Sindhi crosses. The persistency of milk yield for L3 were 2.10 $\pm$ 0.09 of $\frac{1}{2}$ Jersey $\times$ $\frac{1}{2}$ Red Sindhi crosses, 1.97 $\pm$ 0.07 of $\frac{1}{4}$ Jersey $\times$ $\frac{3}{4}$ Red Sindhi crosses, 2.22 $\pm$ 0.09 of $\frac{3}{8}$ Jersey $\times$ $\frac{5}{8}$ Red Sindhi crosses, 2.07 $\pm$ 0.06 of $\frac{1}{8}$ Jersey $\times$ $\frac{7}{8}$ Red Sindhi crosses. Milk yield persistency is the ability of animal to maintain milk production after reaching its peak yield during lactation period. The more persistent dairy cattle show better performance. The present study concluded that persistency of cows could be useful in selecting those have the higher estimates in order to improve the productivity of the herds.

Keywords: Milk yield, Persistency, Various grades, Crossbred cow, Lactation order

LATERAL FLOW ASSAY DEVICE FOR SIMULTANEOUS DETECTION OF BOVINE ANTIBODIES AGAINST *THEILERIA*, *BABESIA* AND *ANAPLASMA*

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Tick borne haemolytic diseases of cattle are quite prominent in tropical countries like India. They do cause significant loss to the dairy sector by causing mortality and morbidity among animals. A protozoan disease like theileriosis, babesiosis and disease caused by archaea like anaplasmosis holds a major share in TBD in south Asian countries. While vaccination is only available against *Theileria* with variable protection level, no preventives are available against *Babesia* and *Anaplasma*. Treatment can be done if diagnosis made early. Giemsa-stained blood smears have been widely used for the detection of different stages of these pathogens but the degree of accuracy is always questionable due to unskilled personnel and inherent limitations pertained to the technique in practice. Molecular techniques like PCR and RT-PCR, are highly sensitive in detection of pathogens but not economical and involves sophisticated laboratory setup with skilled personnel. Present study describes synthesis of three unique recombinant proteins, one against each of the pathogens to efficiently detect circulating antibodies in infected cattle. The proteins were expressed in bacterial expression system and tested by ELISA and Western blot for immunoreactivity with test sera. A lateral flow assay was designed by coating these three antigens as detection moieties and gold nano particle (40 nm) conjugated anti bovine IgG as detection antibodies. The device was found to be sensitive as well as specific against three pathogens (more than 95 %) when compared to PCR.

Keywords: Lateral flow assay, tick borne haemolytic diseases, Recombinant proteins, ELISA, Western blot

FLORISTIC DIVERSITY OF CHASMOPHYTES FROM SELECTED HABITATS OF YELLAPUR AND SIRSI TALUKS OF UTTARA KANNADA DISTRICT OF KARNATAKA

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Man has reached the orbit of Mars and studied remote galaxies, engaged in the process of war and peace, but no so far completed the catalogue of Flora and Fauna. The millions of species awaiting for documentation and identification due to the dearth of exploration of worlds unique habitats. The extensive floristic studies help in the compelling of plants diversity from every corners of the specific habitats. The seasonal micro-habitats completely depend on soil types and their water-holding capacity. The rocky geology of the Western Ghats favors the chasmophytic habitats throughout the Sahyadri hills. The rocky slopes, crevices, and cliffs mainly contribute to the emergence of chasmophytic habitats. The present investigation carried to identify and to study the chasmophytic habitats and their floristic diversity from Yellapur and Sirsi Taluks of Uttara Kannada District of Karnataka. Total 76 plant species from 39 families and 61 genera are collected and identified. Out of 76 plant species; 4 species belong to group Bryophyta and 72 species from group angiosperms. The recent studies on Chasmophytes gives evidence to the ornamental potentiality and ethno medical practices by the local people. There are several threats to the chasmoflora in southern India. Which includes natural and man-made threats. Mining in and around chasmophytic habitats and pollution from tourism make habitats unsuitable for seasonal vegetation. Heavy and unseasonal rainfall and the removal of top vegetation cover for anthropogenic purposes led to the land sliding in many locations of Southern India. These anthropogenic actions will weaken the chasmophytic habitats for plants. Thus results in the loss of valuable plant communities on the Earth's surface and leads to an ecological disaster.

Keywords: Floristic study, Diversity, Chasmophytic habitats, Uttara Kannada, Conservation.

PHOTOSYNTHETIC THERMAL TOLERANCE OF TREES IN A RAPIDLY WARMING SEASONALLY DRY TROPICAL FOREST SITE IN THE CENTRAL WESTERN GHATS

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Tropical forests, the largest terrestrial carbon pool on Earth, have experienced rapid warming over the past century. In particular, the Central Western Ghats forests have recorded some of the highest warming rates (~ 1.4 °C), resulting in elevated air temperature conditions and heatwaves during summer. These forests experience distinct dry and wet periods, and the coexistence of both deciduous and evergreen species exposes the diverse set of species and the process of photosynthesis to their thermal limits. How sensitive are these co-occurring tree species to heat? We assessed the leaf thermal tolerance of 27 dominant tree species in Bhadra Tiger Reserve. *In vitro* heat treatment assays were conducted on leaves sampled from 10–15 m canopy strata during the wet season of 2025, focusing on two key indices: the temperature causing a 5% (T_5) and 50% (T_{50}) decline in photosystem II quantum efficiency due to heat treatment. We found no differences in T_5 and T_{50} between evergreen and deciduous tree species. However, both T_5 ($F_{28} = 4.6$, $p < 0.001$) and T_{50} ($F_{28} = 3.8$, $p < 0.001$) showed significant species-wide differences. We will repeat the measurements during the dry period to characterise the seasonal variation and phenological influence across tree species.

SPATIO-TEMPORAL ASSESSMENT OF MICROPLASTIC POLLUTION IN THE LOWER GANGA RIVER AND DEVELOPMENT OF JUTE BIOCHAR-BASED FILTRATION SYSTEM WITH HIGH REMOVAL EFFICIENCY

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Microplastics (MPs), defined as plastic particles <5 mm, have become persistent pollutants of global concern due to their ecological and human health implications. This study investigated the spatial and temporal variability of MPs in surface water along the lower Ganga River, India. Sampling was carried out during pre- and post-monsoon seasons of 2024 and 2025 across major urban and semi-urban ghats, including Belur, Dakshineswar, Diamond Harbour, Babughat, Serampore, and others, along with 17 wastewater discharge canals. MPs were extracted using density separation and vacuum filtration, and subsequently characterized by stereomicroscopy, Fourier-transform infrared spectroscopy (FTIR), field emission scanning electron microscopy (FESEM), and energy dispersive X-ray spectroscopy (EDX). Results revealed significant seasonal and spatial differences in MP concentrations, driven by hydrological conditions and anthropogenic inputs. The highest concentration occurred at Dakshineswar (3,350 MPs/L), associated with urban and religious activities, while the lowest was at Serampore (650 MPs/L), likely due to reduced inputs and improved waste management. White, film-shaped MPs were predominant, with the 2.5–5 mm fraction contributing most to both mass and particle count. Polyethylene was identified as the dominant polymer type. Correlation analyses indicated strong relationships between MP concentrations and water quality parameters, particularly Biological Oxygen Demand (BOD) and Dissolved Oxygen (DO). The estimated daily MP load discharged into the Bay of Bengal highlighted the Ganga River's role as a major pathway of land-derived plastic pollution to marine systems. As a mitigation measure, a jute biochar-based filtration unit achieved up to 97% MP removal in column studies, demonstrating a low-cost, sustainable approach for freshwater treatment. This study addresses critical knowledge gaps on freshwater MP pollution in India and proposes practical strategies for monitoring, management, and remediation.

Keywords: Microplastics, Ganga River, Surface water, Spatio-temporal distribution, Jute Biochar filtration

OPTIMIZATION OF DRYING TECHNIQUE AND RESIN RATIO FOR FLORAL PRESERVATION

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Drying and preservation of flowers play a vital role in the floriculture industry, ensuring extended shelf life and aesthetic appeal for decorative and craft purposes. Conventional drying methods such as air and press drying often lead to color fading, shrinkage, or petal deformation. The optimization of resin ratio and optimized drying parameters provides a promising approach for maintaining the natural beauty and structural integrity of flowers. Hence, the present study aimed to identify the most effective drying method, resin-to-hardener ratio, and drying duration for obtaining high-quality preserved flowers. Four drying methods—air drying, press drying, oven drying and embedded drying—were assessed under treatment combinations of T₁ (1:1), T₂ (1:2), T₃ (2:1), and T₄ (2:2) resin-to-hardener ratios, each subjected to drying durations of 12, 24, 36, 48, and 60 hours. Significant variations were observed among treatments in terms of color retention, petal texture, and morphological stability. Embedded drying with silica gel exhibited superior results compared to other drying methods. The best preservation quality was achieved with treatment T₃ (2:1 resin: hardener ratio) at 48 hours, which effectively retained natural color, structural integrity, and surface smoothness with minimal deformation. Prolonged drying (beyond 48 hours) or excess hardener caused brittleness and discoloration, while shorter durations resulted in incomplete drying and loss of shape. The results indicate that an optimized resin concentration combined with controlled embedded drying enhances the aesthetic and physical stability of dried flowers, providing a viable technique for long-term floral preservation and value addition in the floriculture industry.

Keywords: Flower preservation, embedded drying, resin ratio, silica gel, value addition

HIGH-SHEAR ASSISTED EXTRACTION OF MARIGOLD CAROTENOIDS: PROCESS OPTIMIZATION AND YIELD ENHANCEMENT

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Marigold (*Tagetes erecta* L.) flowers are a rich natural source of carotenoids, particularly lutein and zeaxanthin, which are valued for their antioxidant, nutraceutical, and colorant properties. However, the efficiency of carotenoid recovery largely depends on pre-processing and extraction techniques, which influence pigment integrity and bioactivity. Conventional solvent extraction methods often involve high temperatures and prolonged durations, leading to pigment degradation and energy inefficiency. High-shear dispersion extraction offers a rapid, solvent-efficient, and scalable alternative for carotenoid recovery. The present study was therefore undertaken to optimize high-shear extraction parameters spindle speed, extraction time, and temperature using Response Surface Methodology (RSM) to maximize carotenoid yield and antioxidant activity from fresh, shade-dried, and cabinet-dried marigold petals. Among the three drying methods, shade-dried petals exhibited the most favorable extraction performance. The optimal conditions were a spindle speed of 19,936.73 rpm, extraction time of 2.98 min, and temperature of 34.85°C, resulting in a predicted carotenoid yield of 1936.94 mg/100 g DW, FRAP of 369.08 µmol TE/g DW, and CUPRAC of 284.04 µmol TE/g DW. The desirability score of 1.000 indicated an ideal and statistically validated solution. In contrast, fresh flowers yielded comparatively lower pigment concentrations but showed markedly higher antioxidant activities. The optimal parameters for fresh petals were a spindle speed of 20,000 rpm, extraction time of 1.84 min, and temperature of 10.00°C, producing 1461.43 mg/100 g DW carotenoids, 2496.06 µmol TE/g DW FRAP, and 436.53 µmol TE/g DW CUPRAC values, with a desirability of 0.879. Cabinet-dried samples showed balanced outcomes, with optimal conditions of 19,998.86 rpm, 3.00 min, and 40.00°C, giving a yield of 1843.33 mg/100 g DW, FRAP of 431.00 µmol TE/g DW, and CUPRAC of 246.92 µmol TE/g DW, and a desirability of 0.930. The optimization outcomes emphasize that extraction parameters should be tailored to the intended goal either maximal pigment recovery or antioxidant potency depending on the pre-treatment method applied to the flower material.

PHENOTYPIC ASSOCIATION AMONG YIELD AND YIELD-CONTRIBUTING TRAITS IN GROUNDNUT (*ARACHIS HYPOGAEA* L.) GENOTYPES

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A field experiment was conducted during early Rabi 2022 at the Zonal Agricultural and Horticultural Research Station (ZAHRS), Hiriyur, to assess the nature and magnitude of phenotypic correlations among twelve yield and yield-contributing traits in thirty-four groundnut (*Arachis hypogaea* L.) genotypes. The experiment was laid out in a randomized complete block design with two replications. Correlation analysis was performed to identify interrelationships among traits and their direct or indirect contribution to pod yield, thereby facilitating effective selection strategies for yield improvement. Results revealed that pod yield per plant exhibited significant and positive associations with plant height ($r = 0.28$), number of primary branches per plant ($r = 0.29$), number of mature pods per plant ($r = 0.48$), haulm yield ($r = 0.55$), shelling percentage ($r = 0.52$), kernel yield per plant ($r = 0.68$), kernel yield per hectare ($r = 0.70$), test weight ($r = 0.34$), and pod yield per hectare ($r = 0.81$), suggesting these traits as reliable selection criteria for yield enhancement. Positive and significant inter-correlations were also observed among major yield components. For instance, number of mature pods per plant was significantly correlated with kernel yield per plant ($r = 0.51$) and pod yield per hectare ($r = 0.49$), while kernel yield per plant was strongly associated with pod yield per plant ($r = 0.68$) and pod yield per hectare ($r = 0.80$). High positive relationships between shelling percentage and kernel yield ($r = 0.78$), and between haulm yield and pod yield ($r = 0.40$) further emphasized their influence on total productivity. Overall, the results indicated that simultaneous improvement of traits such as number of mature pods per plant, kernel yield, shelling percentage, and haulm yield would effectively enhance pod yield in groundnut under normal growing conditions.

ROLE OF SACRED GREEN SPACES IN URBAN ENVIRONMENT: A PATHWAY TO CLIMATE CHANGE RESILIENCE

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Sacred urban green spaces (SUGSs), including temple premises, churchyards, mosque complexes, and cemeteries, perform vital ecological and socio-cultural functions that contribute to greenhouse gas (GHG) mitigation and urban climate regulation. These sites, preserved under traditional and religious management systems, act as micro-scale carbon sinks within urban ecosystems, enhancing ecological integrity and climate resilience. Vegetation in SUGSs captures atmospheric CO₂ through photosynthesis and stores it within above-ground biomass, root systems, and soil organic matter. Their high biomass density, species diversity, and minimal anthropogenic disturbance result in superior carbon storage compared to other urban vegetation types. The present study assessed the biodiversity and carbon sequestration potential of tree species within sacred urban green spaces of Shivamogga city, Karnataka. Field surveys documented 1,487 individual trees representing 82 species across 33 families. The total carbon stock (TCS) was estimated at 624.87 t CO₂ e/ha. Among the recorded species, *Ficus religiosa* showed the highest carbon stock (143.67 t/ha), followed by *Samanea saman* (133.74 t/ha) and *Pongamia pinnata* (46.52 t/ha). The exceptional carbon storage of these species is attributed to their extensive canopy structure, deep root systems, and longevity. The findings of the SUGSs function as multifunctional ecological assets linking cultural preservation with measurable climate action. Their conservation and integration into urban planning can strengthen carbon-smart infrastructure and support sustainable urban development strategies aimed at enhancing climate change resilience.

Keywords: Sacred Urban green spaces, socio-ecology, Greenhouse gases, Climate change, Carbon sequestration

INTEGRATED APPROACHES TO WILDLIFE CONSERVATION AND HABITAT PROTECTION

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Biodiversity forms the foundation of ecological balance and sustainable resource use, yet rapid habitat degradation, climate change, and anthropogenic pressures continue to threaten species survival worldwide. Effective biodiversity conservation requires multidisciplinary strategies that combine ecological understanding, technological innovation, and community participation. This review-based study highlights the significance of integrated biodiversity monitoring and habitat conservation approaches, focusing on wildlife-rich landscapes in regions like Uttar Pradesh. The paper synthesizes findings from global and regional studies to evaluate methods such as remote sensing, camera traps, and citizen-science databases that enhance biodiversity documentation and conservation planning. It also emphasizes the importance of habitat restoration, ecological corridors, and local stewardship in sustaining wildlife populations. By aligning these strategies with Sustainable Development Goals (SDGs 13 and 15), the study underlines the link between biodiversity conservation, climate mitigation, and socio-economic stability. The review concludes that long-term sustainability depends on participatory conservation frameworks that bridge research, policy, and public awareness. Strengthening biodiversity monitoring systems and restoring degraded habitats are vital steps toward ensuring ecological resilience and protecting wildlife for future generations.

Keywords: Biodiversity monitoring, Habitat conservation, Climate change, Wildlife protection, Sustainable development

EXPLORING THE CONSEQUENCES OF DINOTEFURAN-INDUCED TOXICITY IN DROSOPHILA MELANOGASTER

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Dinotefuran, a third-generation neonicotinoid insecticide, poses increasing concerns for non-target insect species due to its neurotoxic potential. The present study investigates the molecular and biochemical toxicity of dinotefuran in *Drosophila melanogaster*, a well-established model organism for environmental toxicology. Determination of LC₅₀ value was done by using probit analysis method. Following the determination of the median lethal concentration (LC₅₀), flies were exposed to sublethal concentrations (0.142, 0.34, and 0.85 ppm) to assess oxidative damage and stress responses. Biochemical assays for antioxidant enzymes like catalase and superoxide dismutase (SOD) activities revealed alterations in reactive oxygen species (ROS) generation. Fluorescent H₂DCFDA staining corroborated increased intracellular ROS accumulation, while DAPI staining showed nuclear fragmentation suggestive of genotoxic stress. Mitochondrial membrane depolarization detected using the JC-9 assay further confirmed cellular oxidative imbalance. Together, these findings demonstrate that sublethal dinotefuran exposure disrupts redox homeostasis, mitochondrial function, and nuclear integrity in *D. melanogaster*, supporting its utility as a sensitive bioindicator for pesticide-induced oxidative toxicity and also an model organism to explore the detrimental consequences in higher organisms like humans.

Keywords: Dinotefuran, *Drosophila melanogaster*, ROS, DCFDA, DAPI

WASTE MANAGEMENT AND CIRCULAR ECONOMY IN AGRICULTURE

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Modern agricultural systems generate substantial quantities of waste from crop residues, manure, and post-harvest biomass to synthetic packaging and agrochemical runoff. If unmanaged, these by-products contribute to environmental degradation, greenhouse gas emissions, and resource depletion. This review paper evaluates how circular economy principles offer a regenerative alternative to traditional linear models of extraction and disposal. It synthesizes recent developments in waste valorisation, life science innovation, and policy frameworks that are reconfiguring agriculture into a closed-loop, resource-efficient paradigm. The review draws on evidence from agronomic research, microbiology, bioprocessing, and sustainable engineering. It highlights how organic waste is increasingly being converted into high-value inputs such as biofertilizers, biogas, compost, biochar, enzymatic solutions, and biodegradable packaging. Innovations like microbial consortia for accelerated decomposition, fungal mycelium-based mulching films, and nanotech-enabled nutrient recovery systems are expanding the toolkit for circular agriculture. Moreover, crop residues are now being utilized in agro-industrial applications including bioplastics, bioethanol, and soil enhancers reducing reliance on synthetic inputs and fossil fuels. Case studies from India, Europe, and Latin America showcase diverse strategies in waste recovery, such as decentralized composting, cooperative-led biomass-to-energy projects, and circular procurement in public agricultural schemes. Behavioural frameworks like the Theory of Planned Behaviour and Participatory Communication are incorporated to examine farmer adoption, social norms, and institutional enablers. Special attention is given to smallholder contexts, where circular systems can enhance soil health, energy access, and climate resilience. The paper concludes that integrating circular economy models into agriculture requires not only technological shifts but also multi-stakeholder engagement, data-driven policy reforms, and financial incentives. Recommendations include scaling farmer awareness programs, reforming agro-waste regulation, fostering public-private partnerships, and embedding circular metrics into agricultural monitoring systems. When executed inclusively, circularity in agriculture can deliver transformative impacts reducing environmental footprints, increasing resource efficiency, and contributing to SDGs 2, 12, and 13.

Keywords: Circular Agriculture, Waste Valorisation, Bio-based Innovation, Behavioural Frameworks, Smallholder Integration.

SYNTHETIC BIOLOGY IN FOOD PRODUCTION AND NUTRITION

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Synthetic biology is revolutionizing the global food and nutrition landscape by enabling precise, scalable, and sustainable solutions to some of the most pressing challenges in agriculture and food security. By engineering microbial and plant systems, synthetic biology allows for the production of high-value nutrients, alternative proteins, and bioactive compounds that enhance both the nutritional quality and accessibility of food. Technologies such as CRISPR-based genome editing, metabolic pathway engineering and cell-free biosynthesis are facilitating the development of novel food ingredients with improved taste, shelf-life, and health benefits. Additionally, synthetic biology is driving innovation in the production of animal-free meat, dairy, and functional foods, reducing the environmental footprint of traditional food systems. As demand for ethical, sustainable, and resilient food sources grows globally, synthetic biology offers a transformative pathway toward meeting these needs. However, challenges remain in regulatory alignment, public acceptance, and ensuring equitable access to these innovations. This presentation will explore current breakthroughs, real-world applications, and the future potential of synthetic biology in reshaping food systems for global nutrition and sustainability.

Keywords: Food-technology, Nutrition, Sustainability, Synthetic biology, agriculture.

UNVEILING BIODIVERSITY AND ECOLOGICAL HEALTH OF FRESHWATER TANKS IN UDUPI DISTRICT, KARNATAKA

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Freshwater ecosystems are essential for agricultural productivity, biodiversity maintenance, and the ecological services that sustain rural and semi-urban communities. The present study assessed the ecological health and biodiversity of three freshwater tanks Anekere (T1), Manipalla (T2), and Chantaru (T3) in Udupi district, Karnataka, during 2023–2024, with particular focus on seasonal water quality variations and their effects on aquatic biota. Physico-chemical parameters such as pH, turbidity, total dissolved solids, electrical conductivity, nutrients, and dissolved oxygen were analyzed using standard protocols to evaluate ecological status. Marked seasonal variations were observed, with monsoon periods characterized by greater turbidity and nutrient enrichment from agricultural runoff, whereas post-monsoon conditions showed improved oxygen levels and lower solids, indicating natural recovery and self-purification. A total of 15 hydrophyte species, 52 phytoplankton, 27 zooplankton, 22 fish, and 48 bird species were recorded across the tanks. T1 supported diverse macrophytes and phytoplankton under moderate water quality; T2 showed signs of anthropogenic stress reflected in nutrient loading and high turbidity but sustained abundant zooplankton; while T3, being relatively less disturbed, harboured distinct phytoplankton and avifaunal communities, including several indicator species. Correlation analysis indicated that higher dissolved oxygen and balanced nutrient levels enhanced phytoplankton and bird diversity, while excessive turbidity and conductivity limited macrophyte proliferation. The findings underline the intricate linkages between abiotic factors and aquatic biodiversity, emphasizing the ecological role of freshwater tanks as biodiversity reservoirs and irrigation sources. The study advocates for sustainable management, pollution mitigation, and community-driven conservation of small water bodies to promote biodiversity and support long-term agricultural and ecological resilience.

Keywords: Freshwater ecosystems; Water quality assessment; Aquatic macrophyte diversity; Plankton and fish assemblages; Avifaunal diversity, Udupi, Karnataka.

INNOVATION AND TECHNOLOGY: KEY TOWARDS SUSTAINABLE FISHERIES AND AQUACULTURE

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The most confronting issue is increase in population, and this is creating high demand of healthy food and aquaculture. Fisheries play major role in global fish production, and it is livelihood for millions and play key role in global food security. Innovative technology can further enhance the production in this sector. Technologies like satellite, remote sensing, geographic information system and drone helps in carrying capacity analysis, recognise aquatic animal disease, analysis of risk of climate change, post-harvest marketing etc. These technologies can be used to identify ideal location where environment friendly production can be done. Enhancement in various technologies like robotics, automatic feeding device, smart feeder, electric tracking, and use of AI has changed the scenario of fisheries management and aquaculture production. Offshore aquaculture with spatial and temporal planning and use of enhanced technology can reduce pressure on coastal ecosystem and open door for less exploited area and give a new perspective towards sustainable development. Recirculating aquaculture system (RAS), integrated multi tropic aquaculture (IMTA), bio floc technology (BFT), Integrated floating cage aqua geoaponics system (IFCAS) are giving aquaculture a new phase transition towards sustainable, higher production. For future world enhancing production through aquaculture, fisheries by technology shift can lead to sustainable, environment friendly tool for meeting increasing food demand.

Keywords: Sustainable fisheries, Aquaculture, Technology, Offshore aquaculture, Production

PHYTOCHEMICAL EVALUATION IN VITRO ANTI-OXIDANT ACTIVITY OF LEAF AND STEM EXTRACTS OF *HIBISCUS LOBATUS* (MURRAY) KUNTZE

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Hibiscus lobatus, a medicinally important annual herb of malvaceae commonly known as lobed leaf mallow. During the present investigation, qualitative phytochemical analysis was carried out on three different solvent extracts of leaf and stem of *H. lobatus* such as ethanol: water (95:5), ethyl acetate and hexane. The research revealed the presence of carbohydrates. Anti-oxidant activity of both leaf and stem extracts were carried out using DPPH radical scavenging assay and ABTS analysis were assessed. All the extracts exhibited significant anti-oxidant activity.

Keywords: *Hibiscus lobatus*, Malvaceae, DPPH, ABTS, qualitative phytochemical analysis

XYLOOLIGOSACCHARIDE RECOVERY FROM SUGARCANE BAGGAGE USING B-XYLOSIDASE-LESSXYLANASE PRODUCED BY *BACILLUS STERCORIS* DWS1: CHARACTERIZATION, ANTI-CANCER, ANTIOXIDANT POTENTIAL AND INFLUENCE ON PROBIOTICS GROWTH UNDER ANAEROBIC CONDITIONS

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Xylooligosaccharides (XOS) are excellent prebiotics that improve health through selective modulation of beneficial gut microbiome. Its production from agro-residues using microbial xylanase has been considered a sustainable and economic approach for food industries. In this study, a xylanase producing bacterium isolated from decaying wood soil was phylogenetically identified as *Bacillus stercoris* DWS1. Xylanase (BsXln1) purified from the bacterium had pH and temperature optima of 7 and 37-60°C, respectively, and it retained 85% activity upon pre-incubation at 60°C for 40 min. indicating moderate thermo stability. *B. stercoris* DWS1 produced 200 U mL⁻¹ of BsXln1 in presence of 1.5% sugarcane bagasse (SCB) as carbon source; which was enhanced by about threefold to 591 U mL⁻¹ through optimization of cultural conditions by One Factor At a Time (OFAT). In further study, xylan extracted from SCB was morphologically and structurally characterized by FTIR analysis and then depolymerized by BsXln1 to yield XOS (400 mg g⁻¹). Analysis of purified XOS by TLC, followed by ESI-MS revealed a predominance of xylobiose and xylotriose. XOS supported growth of probiotic strains, *Lactobacillus plantarum* and *Lactobacillus fermentum*, under anaerobic conditions and exhibited in vitro antioxidant activities against DPPH and ABTS free radicals. XOS exhibited anti-cancer potential against human ovarian cancer SKOV3 line (IC₅₀ = 47.53 µg/mL) using MTT assay, whereas it did not show any cytotoxicity against normal hepatic fetal cell line WRL-68. In conclusion, BsXln1 can be used in food industries for efficient production of bioactive XOS from agroresidues.

Keywords: Biomass valorization, Sustainable biotechnology, prebiotics, anti-cancer, anti-oxidants

GREEN TRANSITION IN THE PAPER INDUSTRY: CONVERTING AGRO-WASTE INTO ECO-FRIENDLY PAPER PRODUCTS

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The global pulp industry is undergoing a transformative shift toward sustainability through green invention and circular economy principles. Traditional paper making, which comprehensively depends on wood-based pulp, contributes significantly to deforestation, carbon emissions, and water pollution. In contrast, the utilization of agro-waste as a raw material offers a viable and eco-friendly alternative that aligns with zero-waste and sustainable production goals. This study explores the potential of agricultural residues such as sugarcane bagasse, rice husk, wheat straw, and banana pseudo stems as renewable feedstock's for paper manufacturing. By converting these abundant and low-cost wastes into high-quality pulp, the process not only minimizes environmental impact but also enhances resource efficiency. The research emphasizes eco-friendly pulping techniques, including enzymatic and chemical-free processes, which reduce the use of toxic reagents and energy consumption. Furthermore, the adoption of green technologies in paper manufacturing can foster rural entrepreneurship, generate additional income for farmers, and mitigate open-field burning of crop residues—a major source of air pollution. Life Cycle Assessment (LCA) and comparative analysis reveal that agro-waste-based paper production has a substantially lower carbon footprint compared to conventional wood pulp methods. The study concludes that the green transition in the paper industry through agro-waste utilization represents a promising step toward achieving sustainable industrial growth, circular material use, and environmental protection. Such an approach not only supports global Sustainable Development Goals (SDGs), particularly SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action), but also paves the way for a more resilient and regenerative paper economy.

Keywords: Agro-waste utilization, Eco-friendly paper, Circular economy, Green manufacturing, Sustainable development.

ANTIMICROBIAL ACTIVITY AND CHARACTERIZATION OF BIOACTIVE COMPOUNDS FROM FLOWER EXTRACT OF CASSIA JAVANICA LINN. PLANT

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Plants have been a valuable source of natural products for maintaining human health, though the identification of active compounds from this valuable source came to light in recent years. Medicinal plants constitute an important natural wealth of a country and they play a significant role in providing primary health care services to rural people as well as substantial amount of foreign exchange can be earned by exporting medicinal plants to other countries. Moreover, 80% of individual from developed countries use traditional medicines, having various compounds with medicinal properties. The present study was aimed to investigate the antimicrobial activity and characterization of bioactive constituents from flower extract of *Cassia javanica* Linn. plant. Antimicrobial activity was tested against human pathogens in six different solvents using the well diffusion method. These, ethyl acetate and ethanolic crude extracts showed effective antimicrobial activity against all the tested human pathogens. The bioactive constituents of the flower extract revealed the presence of some biologically active substances like (alkaloids, cardiac glycosides, flavonoids, glycosides, phenolic compounds, phlobatannins, triterpenoides, saponins, volatile oils and tannins). In the GC-MS analysis, 14 bioactive compounds were identified. Present study concludes that the different extracts of *Cassia javanica* Linn. Flower contains a broad spectrum of bioactive compounds and also exhibit antimicrobial activity against all the tested human pathogens, therefore, *Cassia javanica* Linn. flowers can be tapped source to discover the natural bioactive products that may serve as leads in the developments of novel therapeutic drugs

Keywords: *Cassia javanica* flowers, Antimicrobial activity, Bioactive compounds, GC-MS).

EFFECT OF DIFFERENT STORAGE CONDITIONS ON GERMINATION AND VIGOUR OF PULSES

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Maintaining seed quality during storage is crucial for ensuring the viability and vigour of pulse seeds, an important source of plant-based protein. The present study aimed to identify the most effective storage condition for preserving pulse seed quality. Eight pulse seed types were collected after six months of storage under different conditions: freshly harvested, APMC, vendor, cold storage, sun-dried, Nilgiri leaves (*Eucalyptus globulus*), neem leaves (*Azadirachta indica*), tablet, and powder treatments. Seeds were evaluated over three months under laboratory conditions. Germination percentage was determined using the paper towel method and Vigour Index-I was calculated to assess seedling vigour. Results indicated a gradual decline in germination and vigour across all treatments; however, seeds stored under cold conditions maintained the highest germination and vigour index values with minimal reduction over time. These findings suggest that cold storage is the most effective method for preserving pulse seed quality, ensuring better viability and vigour for subsequent planting.

Keywords: Pulses, Cold storage, Germination, Seed vigor, Storage conditions

INTERPLAY BETWEEN ERK1/2 SIGNALLING PATHWAY AND ESTRADIOL RECEPTOR MODULATES ER TARGETED GENES INVOLVED IN PROGRESSION OF ESTROGEN RESPONSIVE BREAST CANCERS

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Breast cancer is a leading global health concern, accounting for a significant proportion of cancer-related deaths. Despite its prevalence, the underlying pathological mechanisms driving breast cancer development and progression remain poorly understood. ERK signalling pathway plays crucial role in breast cancer progression. Traditionally, estrogen signalling was thought to be mediated strictly through genomic pathways. Recently, however, it has been demonstrated that estrogen stimulation of cells leads to rapid nongenomic effects including ERK activation. However, the exact molecular mechanism of ERK action in 17 β -estradiol (E2) treated breast cancer cells and the functional interlink between estrogen and ERK pathways in breast cancer progression are not yet clearly understood. Hence, this study aimed to elucidate the role of ERK1/2 signalling, in conjunction with ER and GPR30 receptors in regulating breast cancer cell proliferation and development. Thus, the present study aimed to investigate ERK and ERK regulated genes expression levels in MCF-7 and T47D cells treated with E2 via reverse transcription-quantitative PCR and western blot analyses. Our results demonstrate that ERK is rapidly and transiently activated in response to E2. We assessed cell proliferation using MTT and Trypan blue assays. Additionally the migratory abilities of MCF-7 and T47D cells were assessed through the wound healing assays. Our findings indicate that E2 induce the expression of phospho ERK by both genomic and nongenomic pathway. Furthermore, ERK was confirmed as a direct target for breast cancer proliferation and development. Therefore down regulating ERK phosphorylation by small molecular inhibitors of ERK significantly suppressed E2-induced ERK phosphorylation this in turn suppressed proliferation and migration in MCF-7 and T47D cells. Collectively, our results suggest that E2-induced upregulation of phospho ERK1/2 expression promotes breast cancer cell proliferation and migration by regulating through both genomic and non-genomic Src/EGFR/ERK pathway. These findings provide a potential novel strategy for the treatment and prognosis of breast cancer.

Keywords: Breast cancer, 17 β -estradiol (E2), MCF-7, phospho ERK1/2, MTT

**INDUCTION OF CALLUS FROM LEAF AND STEM EXPLANT OF *AMPELOCISSUS INDICA* (L.) PLANCH.
– AN ENDEMIC MEDICINAL PLANT OF VITACEAE**

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Plant products or their byproducts have always exhibited appreciable and vast economic value, as the whole plant or part of it is beneficial for human welfare. Hence many valuable plants species are facing threat because of over exploitation for their bioactive molecules. It is our prime responsibility to protect and conserve the valuable plant species and also to maintain balance ecosystem. In the present study an endemic plant species *Ampelocissus indica* a member of Vitaceae is traditionally used as depurative, aperient, diuretic, to treat eye diseases and ulcers, has been selected to isolate the bioactive compounds using tissue culture technique without causing threat to plant population in its natural habitat. To achieve this, callus induction protocol has been standardized using leaf and stem explant with reduced rate of contamination. M S media supplemented with various plant growth regulators individually viz. 2,4- D, NAA, BAP, KN and Zeatin as well as in combinations of above mentioned cytokinines with auxins to study the effect on callus induction. Leaf inoculated on media supplemented with individual plant growth regulators showed slow and moderate response while media supplemented with combinations viz. 5mg/L BAP+ 1mg/L 2,4- D, 5mg/L KN + 1mg/L 2,4- D, 3mg/L ZN+ 1mg/L 2,4- D, 5mg/L BAP+ 1mg/L NAA and 5mg/L BAP+ 1mg/L NAA showed high rate of callus induction. stem inoculated on media supplemented with 5mg/L BAP+ 1mg/L 2,4- D and 5mg/L BAP+ 1mg/L NAA showed high rate of callus induction.

Keywords: *Ampelocissus indica* • Medicinal • callus induction

GREEN SYNTHESIS AND CHARACTERIZATION OF ZINC OXIDE NANOPARTICLES USING *CLITORIA TERNATEA* AND THEIR ANTIBACTERIAL POTENTIAL

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The green synthesis of zinc oxide nanoparticles (ZnO NPs) offers an eco-friendly, cost-effective, and efficient alternative to traditional chemical and physical methods. In this study, ZnO NPs were biosynthesized using *Clitoria ternatea* plant extract and their antibacterial efficacy was evaluated. The formation of ZnO NPs was visually indicated by a color change from violet to yellow in the reaction mixture. Characterization techniques, including UV–Vis spectroscopy, FTIR, SEM, EDS, TEM, and XRD, were employed to confirm the nanoparticles' synthesis and properties. The UV–Vis spectrum exhibited a prominent absorption peak at 360 nm, confirming ZnO NP formation, while XRD analysis revealed sharp diffraction peaks corresponding to pure crystalline ZnO, consistent with JCPDS standards. FTIR spectra indicated the presence of functional groups such as C=O, C–O–H, and O–H, suggesting their involvement in the reduction and stabilization of the nanoparticles. TEM analysis confirmed the nanoscale size and uniform surface morphology of the ZnO NPs. The biosynthesized ZnO NPs demonstrated significant antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*. In conclusion, the *Clitoria ternatea*-mediated synthesis provides a simple and sustainable approach for producing stable ZnO NPs with promising antibacterial properties, suitable for applications in biomedical formulations.

Keywords: Green synthesis; *Clitoria ternatea*; Zinc oxide nanoparticles (ZnO NPs); Characterization; Antibacterial activity.

WILD SOLANACEAE-ASSOCIATED RHIZOBACTERIA AS BIOINOCULANTS FOR MITIGATING CADMIUM STRESS IN TOMATO PLANTS (*SOLANUM LYCOPERSICUM* L.)

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Cadmium (Cd) poisoning poses a significant environmental hazard, resulting in critical health complications for both people and animals, while significantly reducing agricultural yield. Microbial activity presents a promising strategy for reducing heavy metal toxicity by converting hazardous substances into less detrimental forms. The present study aims to identify and characterize Cd-tolerant plant growth-promoting rhizobacteria (PGPR) from the rhizosphere of wild Solanaceae species and evaluate their efficacy in increasing the development of tomato (*Lycopersicon esculentum* L.) under Cd stress. Using biochemical and molecular techniques, five Cd-tolerant PGPR strains - *Bacillus subtilis* PV612100, *Bacillus licheniformis* PV612101, *Kocuria rhizophila* PV612098, *Bacillus licheniformis* PV612358, and *Cytobacillus firmus* PV612071 were identified. The sequences were subsequently submitted to NCBI GenBank. Under Cd stress, these strains substantially enhanced the vigour index, seed germination percentage, and heavy metal tolerance index of tomato plants, surpassing the Cd stress. *Cytobacillus firmus* PV612071 had the highest values for all growth parameters. The results show that Cd-tolerant PGPRs from wild Solanaceae may efficiently reduce Cd-induced phytotoxicity. This suggests that they could be useful for bioremediation and soil restoration in areas polluted with Cd.

Keywords: Cd-toxicity, Wild Solanaceae, Cd-tolerant PGPR, Tomato (*Lycopersicon esculentum* L.)

EFFECT OF PESTICIDES ON HUMAN HEALTH

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Pesticides are chemical constituents used to prevent or control pests, including insects, rodents, fungi, weed, and other unwanted organisms. Pesticides are widely used to control pests but their widespread use raises concerns regarding potential health risks for humans and other animals. Pesticides elements have now perpetually entered our atmosphere and subsequently contaminated water, food and soil, leading to health threats ranging from acute to chronic toxicities. There are several routes through which pesticides can be ingested, inhaled, and absorbed resulting in acute and long term health consequences. Pesticides produce different types of toxicity including, neurotoxicity, mutagenicity, carcinogenicity, teratogenicity, and endocrine disruption. The human body gets exposure to pesticides either directly or indirectly. By using pesticides on crops, humans come in directly contact with them and they affect the skin, eyes, mouth, and respiratory tract, and cause acute reactions such as headache, irritation, vomiting, and rashes on the skin. The severity of these pesticides on human health depends upon exposure time and concentration. The consumption of such vegetables and fruits that are grown in pesticide contaminated soil and water used for long term, accumulation increase the concentration of toxins inside the body organs and cause chronic diseases like cancer, asthma, necrosis, reproductive disorder and cardiac disease. The quaternary nitrogen compounds such as parquat are associated with neurodegenerative diseases like Parkinson's. Similarly, pesticide group of carbamates inhibits the acetyl cholinesterase (AChE) activity and its used as biomarker of neurotoxicity. Breast cancer is the most common in all cancer types and is associated with organophosphorus that affect cellular growth and proliferation. Pesticides interact with DNA and cause conformational changes that could induce gene mutation and lead to adverse health effects.

Keywords: Pesticide, atmosphere, toxicity, human health

BREEDING FOR BIOTIC STRESS RESILIENCE: EVALUATION OF POWDERY MILDEW RESISTANCE IN F₄ CHILLI (*CAPSICUM ANNUUM* L.) POPULATIONS

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Biotic stresses caused by fungal pathogens severely affect the growth, yield and quality of chilli (*Capsicum annuum* L.), posing a significant constraint to sustainable crop production. Among these, powdery mildew caused by *Leveillula taurica* (Lev.) Arn. is a major foliar disease that flourishes under moderate temperatures and high relative humidity. The disease leads to chlorotic lesions, premature defoliation and substantial yield losses, ultimately affecting the profitability of chilli cultivation. To address this challenge, the present study was undertaken to evaluate genetic resistance as a sustainable approach to manage powdery mildew in chilli. A total of forty-five F₄ lines derived from the cross JNA-1 × Byadgi Dabbi were evaluated during the late *Kharif* season of 2024-25 under natural epiphytotic field conditions. The parent JNA-1 is a male sterile and highly resistant line, whereas Byadgi Dabbi is highly susceptible to powdery mildew. Disease progression was recorded at regular intervals, and disease severity was quantified using Area Under Disease Progress Curve (AUDPC), apparent infection rate (r) and percent disease index (PDI). Based on overall disease reaction, none of the genotypes were immune (I), while 11 exhibited highly resistant (HR), 9 resistant (R), 12 moderately resistant (MR), 7 moderately susceptible (MS) and 6 highly susceptible (HS) reactions. The wide variation observed among F₄ lines indicates the presence of considerable genetic variability for resistance to powdery mildew. The identified resistant genotypes represent valuable genetic resources that can be utilized in resistance breeding programs aimed at mitigating biotic stress and developing high-yielding, resilient chilli cultivars for sustainable and eco-friendly production systems.

Keywords: Chilli, Powdery mildew, AUDPC, Apparent rate of infection, PDI.

GREEN SYNTHESIS, CHARACTERIZATION, AND ANTIMICROBIAL POTENTIAL OF SILVER NANOPARTICLES USING IXORA PAVETTA LEAF EXTRACT: A BOTANICAL AND AI-INTEGRATED DIGITAL FARMING APPROACH

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Green nanotechnology provides a sustainable route for developing functional materials with minimal environmental impact. In this study, silver nanoparticles (AgNPs) were synthesized using *Ixora pavetta* leaf extract as a natural reducing and stabilizing agent. The plant's phytochemicals flavonoids, alkaloids, phenolics, and tannins played a critical role in reducing silver ions to metallic nanoparticles and in capping their surface, ensuring high stability and biocompatibility. The formation of AgNPs was confirmed through UV-Visible spectroscopy, showing a characteristic absorption peak near 430 nm. Fourier Transform Infrared Spectroscopy (FTIR) revealed functional groups involved in the stabilization process, while X-ray Diffraction (XRD) and Scanning Electron Microscopy (SEM) confirmed the crystalline and spherical nature of the nanoparticles. The biosynthesized AgNPs exhibited strong antimicrobial activity against *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans*, demonstrating their potential in biomedical and agricultural applications. The study highlights the botanical significance of *Ixora pavetta* as a rich source of phytochemicals for green nanomaterial synthesis. Limited integration of artificial intelligence (AI) and digital farming tools was explored for optimizing extraction conditions and monitoring phytochemical variations, contributing to enhanced reproducibility and precision. This interdisciplinary approach emphasizes the convergence of botany, nanoscience, and data technology, illustrating how plant-based synthesis can yield eco-friendly, multifunctional nanoparticles with strong antimicrobial potential.

Keywords: *Ixora pavetta*, Silver nanoparticles, Green synthesis, Artificial intelligence, Digital farming, Phytochemicals, Antimicrobial activity

STREAM ECOSYSTEMS IN DIFFERENT FOREST TYPES OF WESTERN GHATS: PATTERNS, PROCESSES AND CONSERVATION CHALLENGES

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Streams are dynamic natural water bodies that provide multiple ecosystem services, and their ecological health directly reflects the integrity of surrounding forests while influencing the functioning of the entire landscape. In the Western Ghats, a global biodiversity hotspot, stream ecosystems display remarkable diversity across different forest types shaped by the region's complex topography, climatic variability, and anthropogenic influences. The Western Ghats encompass a range of forest types, including evergreen, semi-evergreen, moist deciduous, dry deciduous forests, and unique ecosystems such as the Shola forests and Myristica swamps. Each forest type, through its characteristic vegetation, soil properties, and microclimatic conditions, contributes uniquely to the hydrology, chemistry, and biological communities of streams. Plankton diversity in these systems reflects strong spatial and temporal variations, driven by seasonal dynamics and habitat heterogeneity. This review synthesizes existing knowledge on the structural and functional patterns of stream ecosystems across forest gradients in the Western Ghats. It highlights variations in hydrological regimes, nutrient cycling, organic matter dynamics, and community composition in response to differences in canopy cover, leaf litter input, and catchment features. Furthermore, the review discusses the growing threats posed by deforestation, plantation expansion, pollution, and climate change, which disrupt natural processes, leading to habitat degradation, biodiversity loss, and reduced ecosystem resilience. Understanding these interlinkages is vital for developing effective conservation and management strategies for sustaining stream ecosystems and the ecological integrity of the Western Ghats.

Keywords: Western Ghats, stream ecosystems, forest types, hydrology, plankton diversity, nutrient cycling, conservation challenges

EXPLORING THE AGRICULTURAL APPLICATIONS OF MORINGA OLEIFERA SEEDS: A SUSTAINABLE APPROACH TO SOIL FERTILITY, PLANT GROWTH, AND ECO-FRIENDLY CROP MANAGEMENT

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Moringa oleifera Lam., commonly known as the drumstick tree, is increasingly recognized for its remarkable agricultural applications. The seeds contain proteins, lipids, amino acids, and bioactive compounds such as phenolics and isothiocyanates that contribute to soil enrichment and plant growth. Moringa seed extract, rich in zeatin-type cyto-kinins, acts as a natural bio-stimulant, improving germination, chlorophyll synthesis, and yield performance in various crops. The residual seed cake after oil extraction serves as an organic fertilizer that enhances soil fertility, microbial activity, and moisture retention. Moreover, moringa seed extracts exhibit antimicrobial and antifungal properties, offering an eco-friendly approach to pest and disease control. Crushed seeds are also utilized as natural coagulants for purifying irrigation water, reducing turbidity and bacterial contamination. These multifunctional uses promote sustainable, organic, and climate-smart farming practices by reducing dependence on chemical fertilizers and pesticides. However, standardization of extraction methods and field-level validation remain necessary for broader adoption.

Keywords: Moringa oleifera; seed extract; biofertilizer; bio-stimulant; organic farming; sustainable agriculture.

INFLUENCE OF SEASONAL VARIATIONS ON ELECTROLYTE ACTIVITY PARAMETERS IN CROSSBRED

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This study aimed to establish baseline data and assess the impact of seasonal changes on blood serum electrolyte levels in crossbred cattle. Ten clinically healthy crossbred cattle, maintained under uniform physiological, nutritional, and management conditions, were selected from the Modern Dairy Farm of Nagaland University, located in Medziphema, Nagaland. Seasonal Temperature-Humidity Index (THI) values for spring, summer, and winter were calculated using local meteorological data. The mean THI was significantly higher ($p < 0.05$) in summer (78.08 ± 0.74), followed by winter (72.66 ± 3.19), and lowest in spring (67.72 ± 3.35). Blood samples were collected twice in each season between 7:00 AM and 8:30 AM. Analysis revealed that serum sodium levels (mmol/l) were significantly lower ($p < 0.05$) in summer (134.92 ± 2.43), compared to spring (136.65 ± 2.54) and winter (143.53 ± 2.45). Similarly, potassium levels (mmol/l) were also significantly reduced ($p < 0.05$) in summer (3.31 ± 0.15), followed by spring (3.90 ± 0.16) and winter (4.10 ± 0.18). These findings suggest that high ambient temperatures during summer may lead to electrolyte imbalances, potentially affecting cattle health and productivity. As global demand for livestock products continues to rise with the growing human population, understanding the impact of seasonal stressors on animal physiology is crucial for sustainable livestock management.

Keywords: Cattle, sodium, potassium and Temperature humidity index.

STUDIES ON ANTIMICROBIAL NANOPARTICLES FOR PLANT DISEASE SUPPRESSION

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Plant diseases caused by bacteria, fungi, viruses, and nematodes result in massive economic losses worldwide. Traditional disease control strategies rely heavily on chemical pesticides, which have led to environmental pollution, pathogen resistance, and health hazards. Nanotechnology has emerged as a frontier field providing innovative tools for sustainable plant protection. Antimicrobial nanoparticles (NPs), such as silver (Ag), zinc oxide (ZnO), copper oxide (CuO), and chitosan-based NPs, have shown strong potential to inhibit phytopathogens through multiple mechanisms. Their nano-scale dimensions allow enhanced penetration, reactivity, and controlled release, making them effective even at low doses. Plant diseases caused by diverse pathogens severely threaten global agricultural productivity and food security. The emergence of antimicrobial nanoparticles (NPs) as an eco-friendly and efficient alternative to chemical pesticides offers a promising route for plant disease management. These nanomaterials exhibit unique physicochemical properties that enable direct antimicrobial activity, enhanced delivery of active compounds, and systemic resistance induction in plants. Antimicrobial nanoparticles represent a frontier in eco-friendly plant disease suppression. Their multifaceted mechanisms, low effective doses, and compatibility with sustainable practices position them as future alternatives to conventional agrochemicals. Continued research into biosafety, formulation stability, and field-level validation will be key to realizing their full potential in modern crop protection. This paper reviews the synthesis, classification, mechanisms of antimicrobial action, and applications of nanoparticles in suppressing plant diseases. Furthermore, it discusses their environmental implications and future prospects in sustainable agriculture. Integration of nanotechnology with biotechnology and precision agriculture will revolutionize disease management. Smart nanosensors for early pathogen detection and nan formulations tailored for specific crops are promising directions. Collaborative efforts between material scientists, plant pathologists, and environmental experts are vital for scaling sustainable nanotechnology in agriculture.

Keywords: Antimicrobial nanoparticles, plant pathogens, disease suppression, nanotechnology, green synthesis, crop protection

EFFECT OF SULPHUR AND SULPHUR OXIDIZING BACTERIA (SOB) ON CHLOROPHYLL CONTENT AND BIOLOGICAL PROPERTY OF SOIL (SOB COUNT) IN CHICKPEA

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A pot experiment was conducted during Rabi 2023-24 at Department of Soil Science and Agricultural Chemistry, JAU, Junagadh to assess the Effect of sulphur and sulphur oxidizing bacteria (SOB) on chlorophyll content and biological property of soil (SOB count) in chickpea. The application of sulphur at 20 kg/ha (S₃) and application of 1.5 lit SOB/ha (SOB₃) found higher result in case of chlorophyll content at 45 DAS 2.96 (mg/g) and 2.90 (mg/g), respectively. The application of 2.0 lit SOB/ha significantly increased sulphur oxidizing bacterial populations at 45 DAS and at harvest in soil 2.33 (10⁶ cfu/g soil) and 3.70 (10⁶ cfu/g soil), respectively. While, sculpture application did not produce any significant effect on sulphur oxidizing bacterial populations in soil at 45 DAS and at harvest of chickpea.

Keywords: Chickpea, Rabi, sulphur, SOB, chlorophyll and SOB count

SAVE THE SOIL, SUSTAIN THE FUTURE: RESTORING SOIL HEALTH THROUGH EROSION CONTROL

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Soil is the foundation of agriculture and ecosystem stability, yet it faces severe degradation due to erosion caused by wind, water, and unsustainable farming practices. Soil erosion not only reduces fertility but also disrupts water balance, biodiversity, and crop productivity. Maintaining soil health requires an integrated approach combining physical, biological, and chemical soil management. Conservation practices like contour farming, mulching, cover cropping, and agroforestry play vital roles in preventing soil loss and improving organic matter. The adoption of sustainable land use and modern soil monitoring techniques ensures long-term productivity and environmental resilience.

Keywords: Soil erosion, soil health, sustainable farming, biodiversity, soil fertility.

A STUDY ON EFFECTS OF CADMIUM CHLORIDE ON MORPHOLOGICAL AND BEHAVIOURAL CHANGES IN FRESHWATER FISH *CHANNA PUNCTATUS*

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Cadmium chloride is a toxic pollutant of aquatic bodies and its persistence and capable to accumulate in aquatic fauna and causes effects. In the present investigation, adult healthy fish *Channa punctatus* of both the sexes, measuring an average length 14.26±1.13 cm, weight 40.5±6.8 gm were collected from the local water body and observed the effects of cadmium chloride on morphology and behaviour of fishes widely exposed for 24 hrs, 48 hrs, 72 hrs and 96 hrs at C₁ (7.34ppm), C₂ (14.68ppm) and C₃ (22.02ppm) of 96 hrs LC₅₀, i.e., 29.36 mg/L was taken as sub-lethal concentrations for studies. The Behavioural changes on exposure to cadmium chloride was observed both in control and treated fishes as described by Roy *et al.*, (2022). Among morphological changes when fishes exposed to various concentration of CdCl₂ a discoloration of skin, thin white layer sedimentation on the bottom of test aquaria was observed at higher concentration. In conclusion, the present study observations clearly indicate that CdCl₂ was highly toxic pollutant and effects on behaviour and morphology in freshwater fish *Channa punctatus*.

Keywords: Cadmium chloride, *Channa punctatus*, LC₅₀, Morphological changes, Behavioural changes.

COMPARISON AND EVALUATION OF SOMATIC AND GONADAL DEVELOPMENT IN CATLA CATLA (HAMILTON, 1822) UNDER CAPTIVE AND NATURAL CONDITION IN EASTERN PART OF UTTAR PRADESH

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Catla catla, an indigenous member of the family Cyprinidae, is native to the riverine systems of northern India and constitutes a significant proportion of commercial fish landings due to its rapid growth among Indian major carps. The present study assessed somatic and gonadal development of *C. catla* under captive and natural conditions in the eastern region of Uttar Pradesh from January to June 2021. A total of 245 specimens (125 males and 120 females), ranging from 25.5 to 55 cm in length, were collected for analysis. The maximum Gonadosomatic Index (GSI) observed in males was 2.32 under natural conditions, compared to a minimum of 0.066 under captivity. For females, the maximum GSI recorded was 12.907 in natural habitats and a minimum of 0.318 in captive stocks. Similarly, the highest Hepatosomatic Index (HSI) for males was 1.73 in natural conditions and 0.99 in captivity, while for females the maximum was 1.659 in the wild and 1.025 in captivity. The noticeable differences in GSI and HSI suggest that optimal environmental, nutritional, and physiological factors prevailing in natural habitats promote enhanced gonadal and hepatic development in *C. catla*, as compared to their captive counterparts.

Keywords: Catla, Gonadosomatic Index, Hepatosomatic Index, Captive, Natural condition

PHYSICO-CHEMICAL STUDIES AND SYNTHESIS OF MIXED LIGAND COMPLEXES OF MN(II), FE(III), CO(II), NI(II) AND CU(II) WITH ACETOPHENONE SEMICARBAZONE AND ACETONE SEMICARBAZONE

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Mixed ligand complexes play an important role in biological processes like activation of enzymes by metals. Such complexes are useful in the storage and transport of active substances through membranes. Mixed ligand complexes have been used in the analysis of semiconductor material. Semicarbazones constitute one of the most important classes of oxygen and nitrogen donor ligands. The formation of a variety of metal complexes from these ligands indicates the spectacular progress in coordination and bioinorganic chemistry. The real efforts used for developing the coordination chemistry of these ligands were probably due to remarkable antitumor, antimalarial, antifungal and antibacterial activities. They were also found to be useful as potential drugs fungicidal agents. The mixed ligand complexes of the type $[M(L_1)(L_2)]Cl_2$, (where, M= Mn (II), Fe(III), Co(II), Ni(II) and Cu(II) and L_1 = Acetophenone semicarbazone, L_2 = 1 Acetone semicarbazone) have been synthesized by the reactions of metal chlorides with two different semicarbazone compounds in 1:1:1 molar ratios. The resulting complexes have been characterized on the basis of elemental analysis, magnetic measurement, IR and electronic spectra, conductivity measurement. The metal complexes show a ratio 1:1:1 with metal, ligand L_1 and ligand L_2 . The ligands act as bidentate ligands and are bonded through oxygen and nitrogen to metal ion. The two coordination positions are occupied by two water molecules. The complexes have octahedral structure.

Keywords: Synthesis, Physico-chemical studies, Semicarbazone, Ligands

CHARACTERIZATION, SYNTHESIS, X-RAY AND THERMAL STUDIES OF SOME SCHIFF BASE OF NI(II) AND CU (II) TRANSITION METAL COMPLEXES

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Schiff bases are an important class of ligands in coordination chemistry. A large number of Schiff bases and their metal complexes have been found to possess important biological and catalytic activity. Due to their great flexibility and diverse structural aspects, a wide range of Schiff bases have been synthesized and their complexation behavior was studied. The coordination complexes of hydrazones are of great interest due to their novel structural features, unusual magnetic properties and relevance to biological processes. Schiff base metal complexes of hydrazones have their utility as antitumor agents, new bi- and tridentate Schiff bases have been synthesized by condensing 2-pyridine carboxaldehyde with isonicotinic acid hydrazide and 4-amino benzoic acid. The 1:1 or 1:2 metal complexes were obtained as a result of interaction of ligand and the metal ions: Ni (II) and Cu (II). The complexes have been characterized and studied by elemental analysis, molar conductance, electronic spectra, IR, ESR spectroscopy and FAB mass. Thermal data show degradation pattern of the complexes. The complexes are colored and stable. The ligand Schiff base exhibits bidentate nature, coordinating through N.O. donor atoms. The reactivity and substitution behavior of the synthesized complexes have been studied. The crystal system lattice parameters, unit cell volume and number of molecules in unit cell of [Ni(PINH)(H₂O)]Cl, complexes have been determined by XRD. This complex crystallizes as tetragonal system.

Keywords: Transition metal, Schiff base, Spectroscopic techniques, Thermal study, XRD

EFFECT OF PRUNING INTENSITY AND FOLIAR APPLICATION OF MICRONUTRIENTS ON VEGETATIVE GROWTH, YIELD AND FRUITING BEHAVIOUR OF PHALSA (*GREWIA SUBINAEQUALIS* D.C.)

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The present investigation entitled "Effect of pruning intensity and foliar application of micronutrients on vegetative growth, yield and fruiting behaviour of phalsa (*Grewia subinaequalis* D.C.)" was conducted at Main Experiment Station, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh during 2018-2019 in Randomized Block Design (Factorial) comprising of twelve combinations with three pruning intensities viz. 25, 50, 75 cm above ground level and four levels of micronutrient control, FeSO₄ 0.4%, Borax @ 0.2%, ZnSO₄ 0.4% replicated three times. First spray of Micronutrients was done in second fortnight of March, 2019 (Pre blooming stage) and second spray just after fruit set in second fortnight of April. Growth attributes like shoot length, number of shoots per plant, number of leaves per shoot, Yield attributes like internodal length, number of fruits per node, number of fruiting node, fruit yield per plant (kg), fruit yield per hectare (q) was increased with the foliar application of 0.4% ZnSO₄ + 0.2 % borax at 50 cm pruning level. Physico-chemical characters like fruit length & breadth, weight of 50 fruits, pulp: stone ratio, total soluble solids, reducing, non-reducing, total sugars, reduced acidity per cent, ascorbic acid content was increased with the application of 0.4% ZnSO₄ + 0.2 % borax at 50 cm pruning intensity. Hence, foliar application of 0.4% ZnSO₄ and 0.2% borax in 2nd fortnight of March and April with 50 cm pruning intensity is the most effective combination to increase vegetative growth, yield and quality parameters, respectively in phalsa fruits. Based on the results obtained it can be recommended for phalsa growers in Eastern Uttar Pradesh.

ANTIOXIDANT DEFENCE MECHANISM OF POTATO (*SOLANUM TUBEROSUM*) UNDER POTATO VIRUS Y NECROTIC STRAIN (PVYNTN) INFECTION

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Potato virus Y necrotic strain (PVY^{NTN}) poses a major threat to potato production by affecting yield, carbohydrate metabolism, and oxidative balance. This study evaluated twelve prominent Indian potato cultivars to elucidate their physiological and biochemical responses under PVY^{NTN} infection. Infected plants exhibited 11–27% reductions in tuber fresh weight and up to 0.5-fold decreases in chlorophyll content, indicating impaired photosynthetic efficiency. Starch content declined by 47%, accompanied by altered carbohydrate partitioning, as amylopectin levels increased in response to decreased amylose. Enhanced activities of catalase, peroxidase, and superoxide dismutase suggested activation of antioxidant defence pathways, while elevated proline and malondialdehyde levels indicated oxidative stress and lipid peroxidation. These findings highlight differential cultivar responses and underline the importance of integrating antioxidant defence and carbohydrate metabolism traits into breeding programs for PVY^{NTN} resistance and yield stability in potato.

Keywords: Antioxidant response; carbohydrate metabolism; stress tolerance; potato; biotic stress

AMMI ANALYSIS OF GENOTYPE X ENVIRONMENT INTERACTION ON CLUSTER BEAN [*Cyamopsis tetragonoloba* (L.) TAUB.] GENOTYPES FOR GUM CONTENT

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The Gum content (%) in cluster bean was determined by genotype and its interaction environment. The current study aimed to analyze the interaction of 25 genotypes with eight different environments for gum content (%). These genotypes were sown in randomized block design with 7.2m² plot size in three replications in eight environments. The combined analysis of variance revealed that mean sum of squares due to Genotypes (G), Environments (E) and Genotype x Environment Interaction (GEI) were found significant ($P < 0.01$). AMMI (1997) model was employed to work out G X E interaction and stability analysis of 25 genotypes across the eight environments. The AMMI analysis of variance for gum content (%) across the test environments revealed that out of total variation 4.00 %, 87.41 % and 8.59 % variation was attributed to genotypic, environmental and genotype × environment interaction effects, respectively. This indicates high GXE interaction for the character under study. The G x E interaction was portioned among the Interaction Principal Component Axis (IPCA) having cumulative variance about 74.33% of first three significant IPCAs. The variance explained by first three significant IPCAs, was found to be 36.70 %, 24.96 % (at $P < 0.01$) and 12.67 % (at $P < 0.05$) respectively. The mean gum content (%) varied from 20.98% to 32.18% among the genotypes with the general mean of 27.65%. According to AMMI bi-plot analysis, HG 870, HG 365, HG 100, X-10, GG-1, RGC 1066 and RGC 1033, adjudged as the stable genotypes. These genotypes exhibited general adaptation to all the test environments as they registered above overall mean along with the IPCA1 score close to zero. Among all the test environments, Hisar Summer 2019 (HS 19) and Bawal Kharif 2020 (BK 20) were found most favourable for gum content (%) with high discriminative ability. Therefore, understanding the effects of GEI on cluster bean gum content (%) assist in identifying high yielding genotypes that can adapt to different environments.

Keywords: Cluster bean, Seed yield per plot, AMMI model, ASV, GSI

AI FOR CLIMATE-RESILIENT TECHNOLOGIES

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The agriculture sector has proved to be the cornerstone of global food security and has been the most significant contributor to the national GDP (Gross Domestic Product) which is vulnerable to the escalating climate crisis. The accelerating impact of climate change makes it necessary to adopt various innovative solutions that enhance resilience across socio-economic as well as environmental systems. Artificial intelligence (AI) has emerged as a transformative yet powerful enabler in the deployment, development and optimization of climate resilient technologies. This chapter explores the pivotal and multifaceted role of AI in addressing climate vulnerabilities through smart infrastructure, circular economy interventions, smart agriculture and various predictive modelling of extreme weather calamities. AI not only enhances adaptive capacities but also mitigates risk and fosters sustainable industrial practices along with reducing resource wastage. The analysis focuses on hyper-local predictive analytics where tools like machine learning models process weather station data, satellite imagery and soil sensor readings to generate accurate and precise forecast for diseases, pests and extreme weather conditions. This enables smart agriculture providing farmers with timely advisories on optimal plantation window, onset of disease, irrigation schedule and targeted input application to mitigate the climatic risks. Moreover, this chapter would explore the AI powered generative models for developing climate -resilient crops by accelerating the analysis of environmental and genetic data. These resilient technologies hold a societal value which is profound in empowering farmers with decision-making intelligence, protecting livelihood, reducing uncertainty and ensuring food security for entire nation. AI plays an extremely important role in shaping the future economy as AI-driven agriculture curtails imports, strengthens export potential, stabilizes domestic food prices and helps in alleviating overall resilience and contribution to agriculture-sector of national economy. This chapter will ensure that investing in AI for climate- resilient technologies is not merely a technological upgrade but would serve as a strategic imperative for shaping national economic security and sustainable development.

Keywords: Climate resilience, Food security, Sustainable development, Artificial Intelligence, Crop forecasting

A COMPARATIVE STUDY ON ANTIBACTERIAL POTENTIAL OF MYCELIAL SUPERNATANT AND FRUITING BODY EXTRACTS OF *LENTINUS SQUARROSULUS* MONT. OF CENTRAL WESTERN GHATS OF KARNATAKA

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Lentinus squarrosulus Mont., a white rot saprophytic fungus with tough fruiting body is used as food and medicine based on ethnomycological knowledge. Mycelial culture and culture broth of most of the basidiomycetous mushroom contains bioactive metabolites. Research works has been largely focused on fruiting bodies compared to mushroom mycelial extracts. The study was conducted to evaluate antibacterial activity of extracts obtained from fruiting body and mycelial supernatant of *L. squarrosulus* using agar well diffusion method. These findings suggest that both the extracts exhibited good antibacterial activity with varying degrees of antagonism. Thus, mycelial supernatant and fruiting body extracts were able to inhibit Gram-positive and Gram-negative pathogenic bacterial strains with concentrations ranging from 25 – 100mg/ml and 500- 2000 mg/ml respectively. Overall, mycelial supernatant and fruiting bodies of *L. squarrosulus* can be considered as useful natural source for pharmaceutical products.

Keywords: *Lentinus squarrosulus*, ethnomycological, mycelial supernatant, fruiting body, antibacterial activity,

ROLE IN INDIAN EDUCATION OF DR. KESHAVRAO BALIRAM HEDGEWAR FOUNDER OF RASHTRIYA SWAYAMSEVAK SANGH (RSS)

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Dr. Keshav Baliram Hedgewar founded the Rashtriya Swayamsevak Sangh (RSS) in Nagpur on 28th September, 1925. His life was very eventful. He was a great patriot. He never came under the subjugation of British imperialism. In his school days he denounced the celebrations of the Diamond Jubilee Celebrations of Queen Victoria and the coronation of Edward VII. After completing the education of medical, he joined the Congress and became provincial secretary. Being fed up with the policies of congress he left it and started a voluntary organization RSS for the sake of welfare of the nation. He worked silently and never seeking publicity. His mission was development of common man by making them self-dependent which can be possible through both formal and informal education. He was constructive, practical and comprehensive in view of his philosophy on education. He inculcated the feeling of patriotism among common folk. Throughout the life, he tried for physical, intellectual, emotional, moral and spiritual development of people for welfare and upliftment of humanity, irrespective of caste. By the way of his plan of education, we can get to build the strong nation with peace and harmony. For him education is an instrument for harnessing human drives, and as consequences, it becomes to some extent a method of behavior modification. There are not many individuals like Dr. Hedgewar who devoted his life for the sake of the nation and established an organization which is the largest self-financed voluntary organisation in the world, and his ideology is immortal as today, a large section of the society has adopted it. Dr. Hedgewar was such a personality who let his creation speak rather than pushing himself to the front. Today, thousands of educational institutions and millions of Shakhis are running, following his ideology in world. Each and every member of Rashtriya Swayamsevak Sangh, popularly known as RSS, is dedicated for the service of the nation and development of humanity.

Keywords: Dr. Hedgewar, RSS, Indian education, behaviour

PRECISION MEDICINE AND GENE THERAPY INNOVATIONS IN DIABETIC RETINOPATHY: TOWARD SUSTAINABLE OPHTHALMIC CARE

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Objective: Diabetic retinopathy (DR), a leading cause of preventable blindness, continues to challenge conventional therapies that primarily address late-stage symptoms. This study aims to highlight how precision medicine and gene therapy approaches can redefine DR management by targeting individual-specific molecular mechanisms. **Hypothesis:** Precision medicine, when integrated with gene- and cell-based therapies, can provide personalized, long-term, and sustainable solutions that surpass the limitations of current treatments. **Methodology:** A systematic synthesis of recent preclinical studies, early clinical trials, and translational research was undertaken. Focus was placed on individualized molecular profiling, advanced delivery technologies, and therapeutic platforms including RNA-based therapies, CRISPR/Cas9 gene editing, stem cell strategies, and nanoparticle-mediated drug delivery. **Key Findings:** Precision medicine-guided interventions demonstrate potential in tailoring treatments to patient-specific genetic and molecular profiles. Gene therapy and CRISPR-based editing offer the ability to correct pathogenic mutations, while stem cell transplantation and nano-enabled drug delivery improve retinal repair and targeted efficacy. These innovations collectively enhance microvascular stability, reduce neovascularization, and prevent irreversible vision loss. However, challenges in cost-effectiveness, delivery optimization, and long-term safety remain barriers to clinical translation.

Conclusion: Precision medicine combined with molecular and gene therapy represents a paradigm shift in DR management. By aligning innovative science with the Viksit Bharat @2047 vision, the future of ophthalmic care lies in accessible, personalized, and sustainable therapeutic solutions developed through global collaboration and policy support.

Keywords: Diabetic retinopathy; precision medicine; gene therapy; personalized healthcare; sustainable innovations

MICROBIAL BIODEGRADATION OF CARBENDAZIM AND SULFOSULFURON: A SUSTAINABLE APPROACH FOR PESTICIDE DETOXIFICATION AND SOIL RESTORATION

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The persistent use of synthetic pesticides such as carbendazim and sulfosulfuron has led to serious ecological challenges, including soil toxicity, microbial imbalance, and loss of biodiversity. The present study explores the efficiency of indigenous soil microorganisms in degrading these persistent pesticides under controlled laboratory and field conditions. A consortium of *Bacillus subtilis*, *Pseudomonas fluorescens*, and *Arthrobacter sp.* was developed through enrichment and screening based on tolerance index and enzymatic potential. The optimized consortium exhibited over 85% degradation of carbendazim and 78% of sulfosulfuron within 10 days at 30 ± 2 °C, confirmed through HPLC and GC–MS analyses. Intermediate metabolites such as 2-aminobenzimidazole and sulfonylurea derivatives were identified and further mineralized into non-toxic compounds. Enhanced activities of soil dehydrogenase and laccase enzymes, along with improved microbial biomass carbon, indicated ecological recovery. SEM and FTIR analyses provided insights into cell-surface interactions and functional group transformations during degradation. The results demonstrate that microbial bioaugmentation using native strains offers a promising, low-cost, and eco-sustainable strategy for detoxifying pesticide residues while restoring soil health and biodiversity. This work highlights the potential of microbial remediation as an integral component of sustainable agricultural practices, contributing directly to the United Nations Sustainable Development Goals (SDG-2, SDG-12, and SDG-15).

Keywords: Bioaugmentation, Carbendazim, Microbial degradation, Soil enzymes, Sulfosulfuron, Sustainable agriculture

FLAXSEED AND GUT MICROBIOTA: A REVIEW ON PREBIOTIC POTENTIAL AND HEALTH-PROMOTING MECHANISMS

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Flaxseed (*Linum usitatissimum L.*) is a nutrient-dense functional food rich in soluble and insoluble fibre, α -linolenic acid, and lignans, notably secoisolariciresinol diglucoside (SDG). Emerging evidence highlights its promising prebiotic potential and capacity to modulate the gut microbiota, thereby promoting metabolic and intestinal health. Flaxseed mucilage, composed mainly of arabinoxylans and rhamnogalacturonans, escapes digestion in the upper gastrointestinal tract and undergoes fermentation by colonic bacteria, resulting in the production of short-chain fatty acids (SCFAs) such as acetate, propionate, and butyrate. These metabolites contribute to improved gut barrier integrity, immune modulation, and lipid–glucose homeostasis. Additionally, flaxseed lignans are converted by intestinal microbes into mammalian lignans enterodiols and enterolactone known for their antioxidant, anti-inflammatory, and hormone-regulating properties. Human and animal studies demonstrate that flaxseed consumption enhances beneficial bacterial genera such as *Bifidobacterium*, *Lactobacillus*, *Akkermansia*, and *Prevotella*, while reducing potentially pathogenic taxa linked to metabolic dysfunction. These microbial alterations are associated with reduced intestinal inflammation and better metabolic outcomes. Through the combined actions of its fermentable fibre, lignans, and polyunsaturated fatty acids, flaxseed exerts multifaceted effects that extend beyond digestion, supporting cardiovascular, endocrine, and immune health. Collectively, current findings establish flaxseed as a candidate prebiotic capable of promoting gut microbial balance and systemic wellbeing through microbiota-mediated mechanisms.

Keywords: Flaxseed, mucilage, lignans, gut microbiota, prebiotic, short-chain fatty acids, metabolic health.

BUTTERFLIES AS BIOINDICATORS: ASSESSING ECOSYSTEM QUALITY AND ECOLOGICAL INTEGRITY THROUGH BUTTERFLY DIVERSITY

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Butterfly diversity serves as a sensitive indicator of ecological complexity and environmental health, as butterflies respond rapidly to habitat changes and are reliant on a diverse array of host plant species. This study aims to investigate the relationship between butterfly diversity and overall ecological diversity across multiple habitat types. Standardized transect methods will be used to sample butterfly communities and quantify species richness, abundance, and evenness. Simultaneously, key ecological metrics, such as plant species richness, vegetation structure, and microhabitat availability, will be recorded to establish a baseline for ecological diversity. The correlation between butterfly diversity and these ecological parameters will be analyzed using regression modeling to determine the degree to which butterfly assemblages reflect broader patterns of ecosystem diversity. Preliminary surveys suggest that habitats with higher butterfly diversity also exhibit elevated levels of plant richness and structural complexity, supporting the hypothesis that butterflies can serve as effective proxies for general ecological diversity. The study further explores spatial and temporal differences in this relationship, examining how local environmental factors modulate the strength and nature of the observed correlations. The findings are intended to inform ecological monitoring by demonstrating the value of butterfly surveys in assessing ecosystem integrity. This research contributes to the development of rapid biodiversity assessment protocols and enhances understanding of the linkages between invertebrate indicators and whole-ecosystem health.

Keywords: butterfly diversity, ecological integrity, bioindicators, species richness, terrestrial ecosystems

IN VITRO EVALUATION OF BOTANICALS, FUNGICIDES AND BIOCONTROL AGENTS AGAINST STEM AND ROOT ROT OF SESAME CAUSED BY *MACROPHOMINA PHASEOLINA* (TASSI) GOID.

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Macrophomina phaseolina a polyphagous fungus has wide host range and is able to infect more than 500 species belonging to more than 100 families. One of the significant host for this fungus is sesame and causes stem and root rot. Hence the present investigation attempted in evaluating the *in vitro* efficacy of botanicals, fungicides and bioagents against *Macrophomina phaseolina*. A laboratory study was conducted to evaluate the efficacy of botanicals, fungicides and biocontrol agents against stem and root rot of sesame caused by *Macrophomina phaseolina* at Department of Plant Pathology, College of Agriculture Science, Dharwad, Karnataka during 2024. The research was laid out in Complete Randomized Design and evaluated four treatments of botanicals, eleven treatments fungicides by following poisoned food technique and five treatments of biocontrol agents by following dual culture method against *Macrophomina phaseolina* under *in vitro* conditions. The results revealed that among all the botanicals evaluated Azadirachtin 10000 ppm inhibited the mean mycelial growth about 93.88 per cent at tested concentrations viz., 2.5, 5 and 10 per cent. Among all fungicides evaluated, Carboxin 37.5 % + thiram 37.5 %, Carbendazim 25 % + mancozeb 50 % and Tebuconazole 50%+Trifloxystrobin 25% inhibited the mycelial growth completely at all the tested concentrations viz., 0.1, 0.15 and 0.2 per cent. Among all the tested biocontrol agents, highest inhibition of mycelial growth of pathogen was found in case of *Trichoderma harzianum* (56.68 %) followed by *Pseudomonas fluorescens* (43.16%) and least inhibition of mycelial growth of the pathogen was observed in case of *Bacillus subtilis* (38.93%) as compared to pathogen in control which has covered the maximum radial growth of 90 mm.

Keywords: *In vitro*, *Macrophomina phaseolina*

EFFECT OF DIFFERENT HORMONES AND THEIR DOSES ON BREEDING PERFORMANCE OF GANGETIC CATFISH *MYSTUS CAVASIUS*: STANDIRIZATION OF BREEDING

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The present study evaluated the breeding performance of Gangetic catfish, *Mystus cavasius* using two different inducing hormones viz. ovaprim (CH) and human chorionic gonadotropin (HCG) at three doses in controlled recirculatory aquaculture system (RAS). Broodstock were developed in cement tank and subsequently acclimatized for breeding trials in FRP tanks during the peak spawning season (July). Experiment of each hormone was made separately with three different doses in triplicated. Female were injected intramuscularly with HCG at the doses of T1-5, T2-10, and T3-15 IU g⁻¹ body weight and CH at the dose of T1-5, T2-10, and T3-15 µl g⁻¹ body weight. Simultaneously, male was injected with half dose of female. In each breeding tank, six female and 12 males were used (Male: female, 2:1). Reproductive performance was evaluated in terms of latency period, spawning rate, functional fecundity, fertilization rate, hatching rate, larval survival, and ontogeny of embryo. Result of the study showed that the dose of CH at the rate of 10 µl g⁻¹ (T2) showed spawning (00%), highest fecundity (2282 ± 17.95 eggs g⁻¹), and fertilization (82.34 ± 5.08%), with a hatching rate of 58.13 ± 1.39%. Result of the second experiment showed that the HCG at the dose of 15 IU (T3), resulted 100% spawning, highest fecundity (2112 ± 33.17 eggs g⁻¹), and hatching (53.47 ± 2.08%) (P<0.05). however, unfertilized egg percentage increased with higher hormonal doses in both CH and HCG treatments. The findings suggest that Ovaprim at 10 IU g⁻¹ and HCG at 15 IU g⁻¹ represent the most effective induction protocols for *M. cavasius* under controlled conditions. Theses results provide valuable insights for optimizing captive breeding and seed production of this commercially important catfish species, supporting its sustainable aquaculture and conservation.

Keywords: *Mystus cavasius*, induced breeding, Ovaprim, HCG, reproductive performance

SPRAY-DRIED STEVIA EXTRACT: PROCESS OPTIMIZATION, STORAGE STABILITY AND FOOD APPLICATIONS

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Stevia (*Stevia rebaudiana*) is a zero-calorie natural sweetener. Fresh stevia extract was spray-dried using different coating materials (maltodextrin-DE10, whey protein concentrate, gum arabic) and inlet air temperatures (140°C, 160°C, 180°C). The optimal condition (whey protein concentrate at 180°C) resulted in high powder yield (87.34%) and favorable properties (pH 5.65, TPC 49.10 mg GAE/g, stevioside 3.45±0.025 g/100g). Shelf-life under accelerated conditions (38±2°C, 90±1% RH) was 7, 14, and 21 days in PET pouch, PET jar, and ALPE pouch, respectively, corresponding to 216, 238, and 511 days under normal conditions. This stevia powder was used in biscuits. The stevia-based foxtail millet biscuits were formulated using varying ratios of foxtail millet flour (50:50, 75:25, 100:0) and stevia concentrate (1.5%, 2.0%, 2.5%). The best results were observed with 100% millet flour and 2.5% stevia, showing good physical properties (weight: 11.18 g, diameter: 4.24 cm, spread ratio: 3.53), high protein (8.42%), fat (20.82%), fiber (4.23%), and low carbs (60.17%) and moisture (2.68%). Texture analysis showed high hardness (16.98 N), and sensory evaluation rated it highly (8.25), comparable to the control. The study highlights the potential of optimized spray-dried stevia as a natural, zero-calorie sweetener for developing health-oriented bakery products with improved shelf life and consumer acceptability.

Keywords: Stevia, Spray dried, accelerated storage studies, stevia-based foxtail millet, biscuits

MEDICINAL FERNS AND THEIR THERAPEUTIC APPLICATIONS

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Ferns are ancient vascular plants belonging to the division Pteridophyta, that have been utilized in traditional medicine for centuries. Pteridophytes are neglected group from biodiversity as vascular cryptogams which have a long history of use in traditional medicine. This paper explores the pharmacological properties of various medicinal ferns, their bioactive compounds, and their potential therapeutic applications. We discuss the role of ferns in traditional healing practices, modern scientific research, and the implications for future studies in ethnobotany and pharmacognosy. Despite their widespread occurrence and rich ethnobotanical value, medicinal ferns remain underrepresented in mainstream botanical and pharmacological research. This review explores the diversity of fern species with known therapeutic applications, examining their traditional uses, phytochemical constituents, and reported biological activities. Several genera, including *Adiantum*, *Pteris*, *Microsporium* and *Tectaria* etc. have been utilized to treat ailments such as wounds, respiratory disorders, skin infections, digestive problems, and inflammation. Biochemical analyses have revealed the presence of bioactive compounds which contribute to the observed pharmacological effects. The paper also discusses the ecological distribution of medicinal fern species, their conservation status, and the need for further taxonomic and phytochemical investigations. By integrating traditional botanical knowledge with current scientific findings, this study highlights the potential of ferns as valuable sources of novel medicinal compounds and underscores their importance within ethnobotanical and phytopharmacological research. Various medicinal ferns can be acclimatized as well they are multiplied under controlled environmental conditions.

Keywords: Medicinal ferns, ethnobotany, phytochemistry, therapeutic uses, Pteridophyta, plant-based medicine, biodiversity conservation

EVALUATION OF MARINE ENDOPHYTIC *GLYCOMYCES* SP. SGT7 FOR SUSTAINABLE CROP GROWTH AND BIOCONTROL APPLICATIONS

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Agriculture plays a vital role in ensuring global food and industrial resource security. The need for sustainable crop production has led to growing interest in microbial biofertilizers that can replace chemical inputs and improve soil fertility. In this study, endophytic actinomycetes were isolated from seaweeds and seagrasses collected along the Gulf of Mannar Biosphere Reserve, Tamil Nadu, India, and evaluated for their plant growth-promoting (PGP) traits. A total of twenty-one morphologically distinct isolates were screened for indole-3-acetic acid (IAA) synthesis and phosphate-solubilizing activity. Among these, strain SGT7 exhibited the highest IAA yield ($75 \mu\text{g mL}^{-1}$) and produced a phosphate-solubilization halo of 12 mm. Thin-layer chromatography confirmed the presence of an indole compound corresponding to indole-3-butyric acid (Rf: 0.94). Molecular identification based on 16S rRNA gene sequencing revealed the isolate as *Glycomyces* sp. SGT7. Bioassays using *Vigna mungo* L. (black gram) and *Helianthus annuus* L. (sunflower) showed enhanced germination and increased seedling vigor when treated with a 0.5% inoculum. The ethyl acetate extract of *Glycomyces* sp. SGT7 strongly inhibited the growth of phytopathogens and also exerted pesticidal activity against Whitefly (*Bemisia tabaci*). GC-MS metabolite profiling revealed an array of secondary metabolites likely responsible for the observed biological activities. These findings indicate that *Glycomyces* sp. SGT7 could potentially serve as an effective PGP bacterium for developing eco-friendly biofertilizers for tropical and subtropical crops.

Keywords: Endophytic actinomycetes, Plant growth-promoting bacteria, *Glycomyces* sp., Biofertilizer, GC-MS analysis.

ANALYSED OF FUNCTIONAL AND COOKING PROPERTIES AND THEIR EVALUATE OF SENSORY PROPERTIES OF FISH PASTA

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In this study investigated the impact of incorporating different processed forms of freshwater fish, specifically Tilapia (*Oreochromis mossambicus*) and Pangasius (*Pangasianodon hypophthalmus*), into pasta at various inclusion levels (5%, 10%, 15%, 20%, 25% and 30%) using a wheat-maida blend (60:40). The fish was processed into raw meat, boiled meat; protein isolate, surimi and powder forms and their effects on the nutritional composition, functional properties, cooking quality and sensory attributes of the pasta were assessed. Proximate analysis revealed a significant increase in protein content, especially in pastas fortified with 25% Pangasius protein isolate (20.72%) and 20% Tilapia raw meat (20.24%), compared to the control (9.22%). Ash content also increased with inclusion level indicating enhanced mineral composition, while carbohydrate content decreased due to substitution with fish protein. Functional property analysis showed that water and oil holding capacities, emulsifying capacity, foaming capacity and solubility improved significantly with increased fish content. Notably, water holding capacity reached up to 2.9 g/g in 30% boiled Tilapia pasta and foaming capacity and stability were highest in surimi and protein isolate based pastas. Cooking performance was improved, with reduced cooking loss (as low as 4.1%) and higher water absorption (up to 210%) in fish-fortified pasta. Sensory evaluation revealed that pastas containing 15–20% boiled Tilapia or surimi received the highest scores for appearance, flavour, texture and overall acceptability, while higher inclusion levels slightly reduced sensory ratings due to intensified fish aroma and changes in texture. Overall, boiled Tilapia at 20% inclusion emerged as the most acceptable formulation in terms of both nutrition and sensory quality. The results confirm the potential of processed freshwater fish as a valuable protein fortifier in pasta, supporting the development of affordable, nutritious and functionally improved products for broader public health and food security applications.

Keywords: Fish-fortified pasta, functional properties, cooking quality, proximate composition, sensory evaluation

GREEN DEFENCE: ELICITOR-BASED INDUCTION OF RESISTANCE AND SEVERITY ASSESSMENT IN CHRYSANTHEMUM WHITE RUST

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Chrysanthemum (*Dendranthema × grandiflorum* Tzvelev), which is known as the “Queen of the East” or “Winter Queen” is one of the oldest flower crops that is grown in the world. The crop is prone to be affected by several diseases. Among the fungal foliar diseases, chrysanthemum white rust (CWR) caused by *Puccinia horiana* is considered as one of the deadliest disease, which is regarded as the quarantine pest in many countries. A roving survey was employed to assess rust disease severity in Mandya, Mysore, Hassan, and Chikkaballapur districts during 2023-24. The mean disease severity of CWR ranged from 7.60 to 62.22 % in various locations. Hassan district had the highest mean disease severity followed by Mandya, Mysore, and Chikkaballapur districts. Elicitors are ecofriendly molecules that trigger the plant defence responses, among the different elicitors tested on the susceptible variety (Poornima), the foliar spray of 1mM Salicylic acid at 3 days post-inoculation recorded the highest peroxidase activity, phenylalanine ammonia-lyase activity, polyphenol oxidase activity, and total phenol content across all the treatments at 24 hrs post application (PA) which are considered as disease resistance inducers. A notable upsurge in the defence enzymes and total phenol content was observed from 24 to 48 hrs PA of all the elicitors, thereby it shows the development of induced disease resistance against CWR in chrysanthemum.

Keywords: Chrysanthemum, Elicitors, CWR, and Management.

IN VITRO EVALUATION OF PLANT EXTRACTS AGAINST *PYRICULARIA GRESIA* (COOKE) SACC CAUSING PEARL MILLET BLAST DISEASE

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Pearl millet (*Pennisetum glaucum* (L.) R. Br.), commonly known as bajra, is an important grain, feed and forage crop in India, usually grown under most adverse agro-climatic conditions. It ranks as India's fourth most extensively produced cereal. In India, it covers 7.3 million hectares with production of 10.7 million tonnes and productivity of 1453 kg/ha. It is affected by several diseases. Among them the bajra blast caused by *Pyricularia grisea* (Cooke) Sacc. has become a serious threat to pearl millet grain and fodder production. *In vitro* studies were conducted to evaluate the antifungal efficacy of different plant extracts against *Pyricularia grisea* (Cooke) Sacc, the causal organism of pearl millet blast disease. Antifungal activity of the extracts was tested at concentrations of 5, 10 and 15% using the poisoned food technique. Among the four botanicals tested, the highest per cent inhibition of mycelial growth of the fungus was recorded in neem leaf extract 70.00 per cent. This was followed by onion bulb extract, which showed 47.00 per cent. Minimum inhibition was observed in turmeric rhizome extract, with a mean of 36.00 per cent. In general, the inhibition of radial growth of the fungus increased with an increase in the concentration of each plant extract tested.

Keywords: *Pyricularia oryzae*, pearl millet blast, poisoned food technique, mycelial inhibition, botanical fungicide.

REVOLUTIONIZING HORTICULTURE: THE ROLE OF ARTIFICIAL INTELLIGENCE IN MODERN CROP MANAGEMENT

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Horticulture plays a crucial role in global food security, nutrition, and economic development. However, the sector faces challenges such as climate variability, pest and disease outbreaks, labor shortages, and the need for sustainable resource management. Artificial Intelligence (AI) offers transformative solutions by enabling precision farming, predictive analytics, automated decision-making, and efficient post-harvest management. Artificial Intelligence (AI) has emerged as a transformative tool in addressing these issues, offering data-driven solutions for precision crop management. By integrating machine learning, computer vision, robotics, and the Internet of Things (IoT), AI enables real-time monitoring, predictive analytics, and automated decision-making in irrigation, nutrient management, pest control, and post-harvest handling. This not only enhances productivity and quality but also optimizes resource use and reduces environmental impact. The application of AI in horticulture promises a shift from reactive to proactive management, fostering resilience and sustainability in the face of global agricultural challenges. This paper explores the current applications, benefits, challenges, and future prospects of AI in modern horticultural crop management. AI plays a significant role in post-harvest operations, such as sorting, grading, and packaging. AI-based image recognition tools can classify fruits and vegetables based on size, shape, and ripeness, ensuring uniform quality and reducing wastage. Predictive analytics help farmers and supply chain managers forecast yield quantities, anticipate market demand, and plan logistics efficiently. These capabilities not only improve profitability but also contribute to sustainable farming by minimizing resource wastage and reducing the carbon footprint. The benefits of AI in horticulture are numerous: increased productivity, enhanced crop quality, optimized use of water and fertilizers, reduced pesticide dependency, and improved decision-making through real-time insights. Furthermore, AI enables a shift from reactive to proactive crop management, empowering farmers to prevent problems before they escalate. However, the adoption of AI also faces significant challenges, including high initial investment costs, lack of technical skills among farmers, inadequate rural internet infrastructure, and concerns about data privacy and ownership. Bridging these gaps requires collaborative efforts from governments, research institutions, agri-tech companies, and farmer organizations to make AI tools affordable, accessible, and user-friendly.

Keywords: Artificial Intelligence, Horticulture, Internet of Things (IoT), quality vegetable, Farmers, Sustainable farming.

COMPARATIVE STUDY OF COPPER AND SILVER NANOPARTICLES SYNTHESIZED FROM EXTRACTS OF *CISSUS QUANDANULARIS* L. STEM AND THEIR ANTIMICROBIAL ACTIVITY

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This study represents the comparative study of synthesized nanoparticles of silver and copper using extracts of *Cissus quandanularis* L., a medicinal herb. This study declares results of copper nanoparticles having better antimicrobial potency as compared to silver nanoparticles in studies. The synthesized silver and copper nanoparticles from phytoextract of *C. quadrangularis* L. exhibit antimicrobial effect on gram positive and gram negative pathogenic bacteria i.e. *E. Coli*, *S. Aureus*, *Bacillus*, *Pseudomonas* and fungus strain i.e. *Fusarium*, *Aspergillus*, *Candida*, *Penicillium*. The results of the study have implications in the use of *C. quadrangularis* as an antibacterial agent in commercial and cosmetic industries and in several applications requiring these properties. The SEM, FTIR and UV-infrared spectroscopy are used for analyzing synthesis of nanoparticles which shows the synthesis and particle size of green nanoparticle.

Keywords: Antimicrobial, Nanoparticles, Pathogenic, *Cissus quadrangularis*

PREVALENCE OF MULTI-ANTIBIOTIC-RESISTANT ENTEROPATHOGENIC *VIBRIO* SP. ALONG WITH ANTIMICROBIAL RESISTANCE GENES AND STATUS OF DIARRHEA IN THE FISHERPERSONS OF SUNDARBANS

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Diarrheal disease is an unresolved problem in India, and the Sundarbans region is also a diarrhea-endemic zone, with high yearly incidences, mainly during the monsoons, affecting the people of the Sundarbans. The marine and coastal ecosystem favors the emergence of halophilic, opportunistic non-cholerae vibrios bacteria, including *Vibrio* sp. *Vibrio* sp. are richly present in the coastal and estuarine environment along with fish and shellfish. Nearly 20 *Vibrio* sp. are identified to be connected with human disease (12 species identified for zoonotic infection) due to the presence of virulent or toxic genes (tox-R, trh, trl) in Vibrios, which are rarely found in the environment. These vibrios invade as opportunistic pathogens directly or are transmitted through zoonotic transmission from fish and shellfish to fisherpersons, resulting in massive gastrointestinal diseases, including diarrhea, and the situation is going to be more complex for the development of antibiotic resistance by antibiotic-resistant genes (AMR & AMRGs) among these bacteria. Current investigations demonstrate that aquatic ecosystems like estuaries and marine areas are rich potential storehouses of antibiotic-resistant bacteria (ARBs) along with resistance genes (ARGs). So, aquatic habitats serve as the primary source for the transmission of resistance genes to human pathogens. The National Antimicrobial Resistance Monitoring System has already reported that *Vibrio* sp. is the most prevalent bacterium in sea animals and marked them as good candidates for tracking AMR. Bacteria isolated from both sediment and soil samples of the Sundarbans have shown resistance to multiple antibiotics, including Ampicillin, Cefotaxime, Ceftriaxone, Tetracycline, Erythromycin, Azithromycin, Co-trimoxazole, Norfloxacin, Chloramphenicol, Pefloxacin, kanamycin, and vancomycin, etc. Sundarbans lives and livelihoods are both at the highest risk due to gastropathogenic bacteria and their antibacterial genes spreading over the Indian Sundarbans mangrove soil and water. Fisherpersons are first in human contact with pathogenic *Vibrio* species (*cholerae*, *vulnificus*, *fluvialis*, *parahaemolyticus*, and *V. fluvialis*), which are attached with coastal flooding and the invasion of seawater deeper inland. So, more study is required to estimate the long-term effects on the economic sustainability of aquaculture, disease susceptibility, and antibiotic resistance arising due to microbial dysbiosis and the quality of life of Sundarbans' fisherpersons.

Keywords: *Vibrio* sp. diversity, enteropathogenic diseases, antibiotic resistance, Sundarbans, Fisherpersons

DECODING THE THERAPEUTIC POTENTIAL OF CONOCARPUS ERECTUS USING HPTLC, ANTIOXIDANT ASSAYS, BIOAUTOGRAHY, AND LC-MS

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Background: The increasing threat of multidrug-resistant pathogens and oxidative stress-related disorders has accelerated the demand for plant-derived therapeutics with dual antimicrobial and antioxidant properties. **Methods:** This study aimed to evaluate the antimicrobial and antioxidant potential of its methanolic extract using TLC-bioautography and LC-MS-based phytochemical profiling. **Results:** TLC-bioautography assays revealed significant antimicrobial activity against four bacterial strains *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, and *Enterococcus faecium* with clear zones of inhibition at R_f values between 0.51 and 0.68. Antioxidant screening using the DPPH-TLC method showed distinct yellow discoloration at R_f 0.27 and 0.19, indicating the presence of free radical scavenging compounds. LC-MS analysis of bioactive zones identified multiple phytochemicals linked to the observed activities. Antimicrobial constituents included caffeic acid, kaempferide, scopoletin, acetylcarnitine, kutkoside, and isoflavone derivatives. The antioxidant-active zones contained syringaldehyde, kojic acid, salicin, jasmonic acid, and hypotaurine. **Findings:** These findings demonstrate the broad-spectrum antimicrobial and antioxidant efficacy of *C. erectus*, supporting its traditional medicinal use and validating TLC-bioautography as a reliable screening tool. The combined application of bioautography and LC-MS provides an efficient strategy for the targeted identification of bioactive compounds from complex plant matrices. Future studies should focus on isolation, mechanism elucidation, and formulation development for therapeutic applications.

Keywords: *Conocarpus erectus*, TLC-bioautography, antimicrobial activity, antioxidant activity, LC-MS, phytochemicals, DPPH assay

TEMPERATURE-DEPENDENT PIGMENT PRODUCTION FROM ARTHROBACTER SP. ISOLATED FROM THE NY-ÅLESUND – HIGH ARCTIC REGION AND ITS ANTIOXIDANT POTENTIAL

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Microorganisms inhabiting extreme Arctic environments represent a valuable source of novel bioactive compounds with significant industrial potential. In the present study, a psychrotolerant bacterial isolate obtained from the Ny-Ålesund – High Arctic region was identified as *Arthrobacter* sp. through molecular sequencing. The isolate exhibited distinct pigment production under varying temperature conditions, suggesting a strong temperature-dependent regulation of secondary metabolite synthesis. Pigment extraction was optimized, and the bio-pigment was characterized spectrophotometrically. Antioxidant efficiency was evaluated using the DPPH assay, hydrogen peroxide scavenging, and phosphomolybdenum total antioxidant assays. Results revealed that pigment production peaked at lower incubation temperatures, correlating with enhanced antioxidant activity. The pigment showed significant free radical scavenging activity comparable to standard ascorbic acid, indicating its potential as a natural antioxidant source. The findings highlight the ecological adaptability of *Arthrobacter* sp. in polar environments and underline its biotechnological potential for use in pharmaceutical, cosmetic, and food industries as a sustainable alternative to synthetic colorants and antioxidants. This study contributes to expanding the scope of bioprospecting for environmentally safe, value-added biomolecules derived from Arctic microbial diversity.

Keywords: *Arthrobacter* sp., Arctic bacteria, bio-pigment, temperature dependence, antioxidant activity, sustainable biotechnology.

MORPHOLOGICAL STUDY OF *STREPTOMYCES* BY SCANNING ELECTRON MICROSCOPE

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Morphology plays a major role in distinguishing and characterization of *Streptomyces* species. Scanning electron microscope (SEM) analysis is very much specific, the spore chain and spore surface morphology were analyzed by direct microscopic examination of the culture area by cover slip culture technique. Morphological characters of the five potential isolates by SEM viz., type of spore chain, colony margins, shape of spore chains, color of spore mass and spore surface were observed. Among the twenty isolates, five potential actinomycete isolates Ggd, Kdr, Kyd, Lrp and Mkc were characterized morphologically by SEM. Variation was observed in morphological characters viz., type of spore chain, colony margins, shape of spore chains, color of spore mass and spore surface which were used among other features to identify differences between them. All the five isolates were non motile when observed under SEM. All the five isolates produced an extensively branched substrate mycelium, aerial hyphae which carried ellipsoidal spores in spore chains and formed an aerial spore mass and mature spore chain with approximately 50-80 spores on the Ken Knight's Agar medium (KA). Microscopically, it was observed that the morphology of the spore chains varied across the isolates showing the filamentous (Ggd), spiral (Kyd, Lrp) and Rectus flexibilis (Kdr, Mkc). Colony margins of the isolates Ggd and Kyd are of wavy, Lrp and Mkc are of undulated and straight for Kdr. The shape of spore chains observed were open hook for Ggd and Kdr, compact coils for Kyd, long open coils for Lrp and flexuous for Mkc. Colour of spore mass observed as greyish for Ggd and Kdr, yellowish for Kyd, off white for Lrp and greenish for Mkc. The isolates Ggd, Kdr, Lrp and Mkc were shown smooth surface spores while Kyd with rugose spore surface.

Keywords: Scanning electron microscope, Morphology, Characterization, *Streptomyces*

ASSESSMENT OF BIO-CONTROL AGENTS FOR THE SUPPRESSION OF *LASIODIPLODIA THEOBROMAE* INDUCED ROOT ROT DISEASE IN MULBERRY (*MORUS ALBA* L.)

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Mulberry (*Morus alba* L.) is an economically important perennial crop that forms the foundation of the sericulture industry. However, its productivity is often constrained by soil-borne diseases such as root rot caused by *Lasioidiplodia theobromae*, a destructive fungal pathogen leading to extensive root damage, wilting and yield loss. Chemical fungicides have been widely used to manage the disease, but their continuous application poses environmental and resistance issues. Hence, eco-friendly and sustainable approaches using biological control agents are gaining importance in integrated disease management programs. The present investigation aimed to evaluate the antagonistic potential of ten fungal and bacterial bio-control agents against *L. theobromae* under *in vitro* conditions using the dual culture technique. The results revealed significant variation in mycelial growth inhibition among the tested isolates. *Trichoderma harzianum* (Th-2) recorded the maximum inhibition of 57.59 per cent, followed by *T. viride* (Tv-1) with 46.76 per cent and *Trichoderma bravicompactum* (Tb-1) with 44.44 per cent inhibition over control. Among bacterial antagonists, *Pseudomonas fluorescens* (Pf) showed 41.39 per cent inhibition, while *Bacillus subtilis* (Bs) was the least effective 24.81 per cent. The superior performance of *T. harzianum* may be attributed to its strong mycoparasitic behavior, rapid colonization and production of antifungal metabolites and hydrolytic enzymes that degrade the pathogen's cell wall. The study revealed that these bio agents can be effectively utilized in the integrated management package of root rot disease in mulberry.

MEDICINAL USES OF INVASIVE AND PHYTOCHEMICAL ANALYSIS OF *TITHONIA ROTUNDIFOLIA*

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Tithonia rotundifolia (Mexican sunflower) is an invasive herbaceous plant that has shown promising medicinal and pharmacological value. The present study focuses on its traditional uses and the phytochemical composition responsible for its biological activities. In traditional medicine, different parts of *T. rotundifolia* are used for treating fever, wounds, inflammation, stomach pain, and infections. Phytochemical screening of the leaf and flower extracts revealed the presence of several important secondary metabolites such as alkaloids, flavonoids, tannins, saponins, terpenoids, and phenolic compounds. These bioactive constituents are known to possess antimicrobial properties, which support the plant's medicinal relevance. However, since *T. rotundifolia* is an invasive species, its spread in agricultural areas should be controlled while promoting its beneficial uses. Overall, the findings indicate that *Tithonia rotundifolia* could serve as a valuable source of natural compounds for therapeutic applications. Further experimental studies are needed to isolate active compounds. The phytochemical study shows that ethyl acetate extract exhibits better results as compared to aqueous and acetone extracts.

Keywords: *Tithonia rotundifolia*, Invasive herbaceous plant, medicinal, phytochemical composition, sec. metabolites, antimicrobials.

INTEGRATING MORPHO-MOLECULAR AND POPULATION STRUCTURE ANALYSES TO IDENTIFY ELITE GERMPLASM IN SUNFLOWER (*HELIANTHUS ANNUUS* L.)

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Sunflower (*Helianthus annuus* L.), renowned for its adaptability and high yield potential, plays a pivotal role in global edible oil production. Estimation of genetic diversity is an essential pre-breeding step for the effective utilization of genetic resources in crop improvement. The present study evaluated 48 sunflower genotypes for biometrical traits at the Department of Oilseeds, Tamil Nadu Agricultural University, during the rainy season of 2022. Molecular diversity was assessed using 103 simple sequence repeat (SSR) markers. The net nucleotide distances revealed substantial genetic divergence, with subpopulations II and V exhibiting the highest (0.056) and subpopulations I and IV the lowest (0.014) divergence. Subpopulation IV recorded the highest heterozygosity (0.352), whereas subpopulation III exhibited the lowest heterozygosity and *F_{st}* value (0.173). Principal component analysis (PCA) and hierarchical cluster analysis based on morphological traits effectively classified the genotypes and facilitated the identification of potential parents for breeding. The first four principal components cumulatively explained 86.72% of the total variation, while cluster analysis grouped the genotypes into three major clusters. Based on mean performance, COSF-13B exhibited superior head diameter, oil content and seed and oil yields. Principal coordinate analysis (PCoA) corroborated the Neighbor Joining clustering, with the first three coordinates explaining 27.24% of the total molecular variation, delineating five distinct genetic clusters. Integration of morphological and molecular data revealed considerable diversity, with genotypes RHA-273 and GMU-325 exhibiting consistently high oil yield per plant. Genotypes GMU-477, GMU-450, COSF-13B, RHA-102, CMS-1103B and RHAGPR-58 were identified as promising parents for improving oil content and yield in sunflower breeding programs.

Keywords: AMOVA, Clusters, PCoA, PCA, STRUCTURE, Sunflower

LOCATING DISEASE HOTSPOTS IN TEA FIELDS USING GEO-REFERENCED AERIAL IMAGERY

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Clustering methods play a vital role in spatial analysis for detecting disease-affected regions through geographic data. In this work, drone-acquired large-scale images are segmented into smaller tiles, from which geospatial coordinates are extracted and processed using clustering techniques. The objective is to improve pesticide application in tea plantations, with a particular focus on controlling the Tea Mosquito Bug, thereby enhancing pest management efficiency and reducing operational costs. Four clustering approaches - K-means, KNN (K-Nearest Neighbors), DBSCAN (Density-Based Spatial Clustering of Applications with Noise), and OPTICS (Ordering Points to Identify the Clustering Structure) are evaluated on latitude-longitude coordinates derived from infected areas. Their effectiveness is quantified using Silhouette scores and Davies-Bouldin Index (DBI), which assess clustering quality and disease density representation. KNN yields notable accuracy (Silhouette: 0.42, DBI: 0.61), making it useful for hotspot identification, whereas DBSCAN and OPTICS show weaker results due to variations in disease density. A hybrid strategy integrating KNN for proximity-based pre-clustering followed by K-means refinement significantly improves performance compared to standalone methods. Traditional K-means alone achieves a Silhouette score of 0.53 and DBI of 0.63, while the hybrid KNN-K-means method enhances results considerably (Silhouette: 0.83, DBI: 0.31). These findings demonstrate that hybrid clustering provides more precise spatial representation of disease hotspots, offering a reliable solution for targeted pest management. The study emphasizes the importance of selecting appropriate algorithms in geospatial analysis to ensure accurate disease mapping in agricultural applications.

Keywords: TMB Disease, Tea, Hotspot, Clustering, K-means, KNN, DBSCAN, OPTICS, Silhouette Index, Davies-Bouldin Index, KNN-K-means

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The National Mission on Organic and Natural Farming (NMNF), launched by the Government of India in November 2024, represents a strategic shift towards sustainable agriculture by promoting chemical-free farming practices grounded in indigenous knowledge and scientific research. This mission aims to restore soil health, enhance biodiversity, reduce dependency on synthetic inputs, and foster climate resilience while ensuring economic viability for farmers. Targeting the initiation of natural farming over 7.5 lakh hectares through 15,000 clusters, the mission supports the establishment of 10,000 Bio-input Resource Centers to facilitate farmer access to bio-inputs. It emphasizes a decentralized knowledge-sharing model that blends traditional farming wisdom with scientific innovations, supported by on-field extension personnel such as Krishi Sakhis. The mission also incorporates a farmer-friendly certification system and a national branding strategy for chemically-free produce, aimed at enhancing market competitiveness and consumer trust. Empirical evidence from pilot projects shows significant improvements in soil fertility, crop productivity, and input cost reduction. However, large-scale adoption requires addressing challenges including behavioural change, infrastructure development, and awareness generation. This paper synthesizes the objectives, strategies, achievements, and challenges of NMNF, highlighting its role as a transformative initiative in India's commitment to sustainable agricultural development, environmental conservation, and food safety.

Keywords: Natural Farming, Organic Agriculture, Bio-inputs, Sustainable Agriculture, Soil Health

TRADITIONAL ECOLOGICAL KNOWLEDGE OF SOLIGA COMMUNITY: SUSTAINABLE NTFP HARVESTING PRACTICES AND BIODIVERSITY STEWARDSHIP IN BR HILLS

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Background: The Soliga community of BR Hills, Karnataka, has coexisted with the forest ecosystem for generations, developing sophisticated Traditional Ecological Knowledge (TEK) systems for Non-Timber Forest Product (NTFP) collection. Understanding these indigenous practices is crucial for integrating community wisdom into citizen science frameworks and biodiversity conservation strategies. **Objectives:** This study documented traditional NTFP harvesting practices of the Soliga community, focusing on sustainability mechanisms, cultural-spiritual connections to wildlife, and knowledge transmission patterns across generations. **Methods:** A rapid ethnographic assessment was conducted over 15 days across three podus (hamlets) in BR Hills. Twenty semi-structured interviews were conducted with Soliga community members, capturing detailed information on harvesting practices, traditional ecological knowledge, and cultural beliefs related to forest biodiversity. **Implications:** Soliga TEK represents centuries of citizen science through systematic ecological observation and adaptive resource management. Their practices offer valuable models for community-based conservation, demonstrating how cultural-spiritual frameworks can support biodiversity stewardship. The findings highlight the urgent need for interventions that:

- (1) Document disappearing traditional knowledge,
- (2) Create economic incentives for youth to maintain forest-based livelihoods, and
- (3) Integrate indigenous wisdom into formal conservation policies. This research demonstrates that indigenous communities function as critical biodiversity monitors and knowledge custodians, essential for participatory conservation approaches.

Keywords: Traditional Ecological Knowledge, Soliga, NTFP, BR Hills, Sustainable Harvesting, Indigenous Knowledge, Citizen Science, Biodiversity Conservation

HARNESSING SEED ENDOPHYTES FOR SUSTAINABLE MANAGEMENT OF FUSARIUM WILT

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Chickpea (*Cicer arietinum* L.), commonly known as Bengal gram, is a major pulse crop cultivated predominantly under low-rainfall conditions during the rabi season in India. It is a self-pollinated, diploid ($2n = 16$) legume belonging to the family Fabaceae and is believed to have originated in southeastern Turkey and neighbouring Syria. India contributes about 70% of global chickpea production, with Madhya Pradesh, Maharashtra, Rajasthan, and Karnataka being the leading states. In Karnataka, chickpea is cultivated over 0.638 million hectares with a production of 0.38 million tons and productivity of 605 kg/ha (Anon., 2024). Despite its importance, chickpea productivity is constrained by seed- and soil-borne pathogens, particularly *Fusarium oxysporum* f. sp. *ciceris*, the causal agent of Fusarium wilt. To explore eco-friendly management options, bacterial seed endophytes (BSE) were isolated from a heat-tolerant chickpea genotype PYT 131 collected from the Regional Agricultural Research Station (RARS), Vijayapura, during 2024–25. Five isolates, designated as BSE-F1, BSE-F2, BSE-F3, BSE-F4, and BSE-F5, were obtained using the serial dilution technique and tested for antagonistic activity against *F. oxysporum* using a dual culture assay on potato dextrose agar (PDA). The results revealed varying degrees of fungal growth inhibition among isolates. BSE-F4 showed the highest inhibition (51%), followed by BSE-F2 (50%), BSE-F5 (35%), BSE-F3 (30%), and BSE-F1 (5%). These findings indicate that BSE-F4 and BSE-F2 possess strong antagonistic potential and may serve as promising biocontrol agents against *F. oxysporum* in chickpea without compromising seed quality.

Keywords: Chickpea, *Fusarium oxysporum*, Bacterial seed endophytes, Antagonistic activity, Biocontrol.

CHANGE IN ANT DIVERSITY IN RESPONSE TO ENVIRONMENTAL VARIATIONS IN TWO SELECTED LOCALITIES OF MANIPUR

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Northeast India is renowned for its rich biodiversity, with Manipur forming part of the "Seven Sisters" states. It is connected to the Indo-Myanmar biodiversity hotspot. This study focuses on two villages—Tengnoupal and Pallel—located in the Tengnoupal and Kakching districts, respectively, at different elevations. Tengnoupal village is situated at an altitude of 1,450 meters, whereas Pallel lies at around 830 meters. Other than elevation both the locations differ from each other in terms of rainfall, temperature and soil constitution. The aerial distance between two areas is around 31 km. Pallel serves as the gateway to the Trans-Asian Super Highway and is located along NH-39, about 46 km southeast of Imphal. Tengnoupal, a hill town, stands at the highest point on NH-2 between Imphal and Moreh, near northwestern Myanmar. The ASEAN Highway also passes through this village. Both locations have experienced rapid ecological changes due to highway construction and increased human activity. In the coming decade, these areas are expected to gain more significance. However, the absence of a dedicated database for this region limits our ability to understand changes in ant diversity, which serves as an indicator of various ecological factors. The primary objective of this study is to document the ant diversity in these regions. Ants were collected using handpicking, pitfall traps, baited traps, and baited pitfall methods. All samples were identified at the Zoological Survey of India's Central Entomology Laboratory facility using standard taxonomic keys. Preliminary findings suggest that Pallel has diversity of 44 species of ants, while Tengnoupal represented only 25 species. This study also added 26 species to the ant diversity database of Manipur.

Keywords: Ant diversity, Pallel, Tengnoupal, Manipur, microclimate, elevation.

ISOLATION OF ENDOPHYTIC BACTERIA AND FUNGI FROM CYNODON DACTYLON AND AEGLE MARMELOS AND EVALUATION OF THEIR ANTIBACTERIAL ACTIVITY

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Sacred plants have been an integral part of Indian cultural rituals and often have historical symbolism behind their usage. Two such plants, *Cynodon dactylon* (Durva grass) and *Aegle marmelos* (Bilva leaves) that are used to ornate the idols of Hindu Gods during festivals were taken for this study and their endophytic bacteria and fungi were isolated and evaluated for their antibacterial properties against common human pathogenic bacteria. The leaves were surface sterilized, inoculated on sterile media plates, incubated and then observed for bacterial and fungal growth. The endophytes were characterized via Gram's staining and for bacteria. 33.3% plates were Gram positive cocci, 53.5% were Gram positive rods, 6.6% were Gram negative cocci and 6.6% were Gram negative rods. The endophytes were then inoculated into a dual culture with common human pathogens such as *E.coli*, *Psuedomonas* spp. to check for its effect on pathogenic growth. It was observed that the endophytic bacteria inhibited growth of *E.coli* with endophytes BC1, BC2, GC1 showing best results, whereas for *Psuedomonas*, a clear zone of inhibition was observed around the pathogenic streak with endophytes BC1 and GC1 showing best results. This suggests that the endophytic bacteria are resistant to the *E.coli* metabolites but susceptible to *Psuedomonas*. By isolating endophytes and evaluating the antibacterial activity of ritualistic plants, its usage can be associated to its medicinal properties and ayurvedic benefits that our ancestors traditionally used as cures to various diseases. It can also help to provide alternate medicinal treatments against these pathogens via a natural approach being more cost effective and abundant in our country while also showing lesser side effects than allopathic pills and drugs.

Keywords: Endophytes, Medicinal plants, Pathogenic bacteria, Antibacterial properties, Zone of inhibition.

RHIZOPUS STOLONIFER: A RESILIENT POSTHARVEST INVADER AND ITS GROWTH DYNAMICS ON VARIED MEDIA

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Postharvest losses due to fungal infections pose a major challenge in agriculture, with *Rhizopus stolonifer* being a prominent culprit. This aggressive fungus rapidly colonizes fresh produce, causing *Rhizopus* soft rot and leading to significant spoilage. Understanding its growth dynamics is vital for developing effective control measures. This study examines the cultural characteristics of *R. stolonifer* on various solid and liquid media, focusing on mycelial expansion, sporulation, and biomass accumulation under controlled conditions. Five solid media-Potato Dextrose Agar (PDA), Malt Extract Agar (MEA), Sabouraud's Agar (SA), Czapek's Dox Agar (CDA), and Richard's Agar (RA)-were assessed for optimal growth. The fungus was also cultured in the liquid forms of these media to evaluate biomass production. Results revealed that PDA supported the most extensive radial growth and highest sporulation, indicating it as the most favourable medium for fungal development.

Keywords: *Rhizopus stolonifer*, postharvest disease, sporulation, food spoilage, solid media, liquid media

ISOLATION AND SCREENING OF THE VARIOUS FUNGAL ISOLATES FOR THE REMEDIATION OF FUEL OIL DERIVED POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)

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Polycyclic Aromatic Hydrocarbons (PAHs) are the environmental contaminants which are known to be mutagenic and carcinogenic. The removal of these contaminants has been a concern due to their harmful effects. High concentrations of PAHs are commonly found in the crude oil and its biproducts. Along with crude oil forest fire, oil seepage and volcanic eruption are the common natural source of PAHs. There are various methods to clean up these contaminants out of which bioremediation are considered to be the cost-effective and sustainable to clean up the contaminants. This study focuses on finding suitable fungal strains to remediate PAHs from the environment by using qualitative and quantitative analyses. To find the potential fungal strains 22 strains were isolated and screened on fuel oil contaminated media. Out of all the fungal strains 3 isolated belonging to the *Aspergillus* sp. and *Penicillium* sp. were found to be efficient in remediating the contaminant.

Keywords: Mycoremediation, Polycyclic Aromatic Hydrocarbons (PAHs), Fungal Screening, Fuel oil contamination, Fungal isolates

ANATOMICAL VARIATIONS IN LEAF OF *IN VIVO* AND *IN VITRO* REGENERATED PLANTS OF *PERSICARIA CHINENSIS* (L.) H. GROSS

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Persicaria chinensis (L.) H. Gross, a creeping smart weed is a member of family Polygonaceae. During the present investigation of anatomical studies was carried out in both *In vivo* and *In vitro* regenerated plants using leaf, petiole and stem. Presence of transfusion like tissue was observed in the midrib region of leaf which is a characteristic feature of gymnosperm. Rosette form of calcium oxalate crystals were noticed in the leaf, in all the three regions of lamina, petiole and midrib. Leaf lamina contains abundant amount of starch grains. The anatomical details of *In vivo* leaf are compared with the leaf of regenerated plant. Significant characters were recorded.

Keywords: *Persicaria chinensis*, Polygonaceae, anatomy, transfusion tissue.

EVALUATION OF IMPROVED MULBERRY GENOTYPES FOR MORPHO-PHYSIOLOGICAL CHARACTERS AND THROUGH BIOASSAY STUDIES UNDER SUB-TROPICAL CONDITIONS OF JAMMU

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Mulberry (*Morus* spp.) is the only food source of silkworm (*Bombyx mori* L.) which is an economically important insect used for silk production. Development of high yielding and superior quality mulberry varieties through various breeding methods is a continuous process and is mainly based on indirect selection for yield and growth characters. The present study comprising seven improved mulberry genotypes viz., PPY-3, PPY-6, PPY-7, A-6, A-9, D-33 and S-106 along with three check varieties S-146, C-2038 and G-4 were planted and maintained in Randomized block design at Regional Sericultural Research Station, Central Silk Board, Miran Sahib, Jammu. All the mulberry genotypes were evaluated for various growth, leaf yield and quality parameters during Spring season 2025 under sub-tropical conditions of Jammu. Analysis of variance for growth and yield contributing characters showed highly significant differences among the genotypes. Among the genotypes, leaf yield per plant (kg) was highest in PPY-6 (1.728 kg) followed by PPY-3 (1.546 kg) and PPY-7 (1.474 kg) and were out performing as compared to three check varieties. Similarly, PPY-6 recorded significantly higher total shoot length per plant (2640 cm), number of new shoots per plant (20), longest shoot length (141 cm), leaf moisture content (76.42 %) and leaf moisture retention capacity (72.34 %) followed by PPY-3 and PPY-7 and out performed as compared to three check varieties. Further, all the genotypes were also evaluated for rearing performance through bioassay studies using FC1xFC2 silkworm hybrid during Spring season 2025. Bioassay experiment was conducted in completely randomized design with three replications. All the mulberry genotypes exhibited significant difference in all the rearing parameters recorded. Among the genotypes, PPY-6 mulberry genotype performed better by recording maximum mature larval weight (59.92 g /10 larva), single cocoon weight (2.06 g), shell weight (0.43 g), shell ratio (20.48%) and ERR (98.33%) followed by PPY-3 and PPY-7 as compared to three check varieties. Based on this evaluation study, PPY-6 and PPY-3 mulberry genotypes have emerged as best performing genotypes with respect to different growth, yield and quality characters and also in bioassay studies as compared to three check varieties, which may be commercially exploited for production of higher leaf yield and better quality mulberry leaves under sub-tropical conditions of Northern India.

Keywords: Mulberry, Silkworm (*Bombyx mori* L.), Leaf yield, Bioassay, Sub-tropical.

MINERAL COMPOSITION AND NUTRITIVE VALUE OF A FEW MEDICINAL PLANTS OF SHIMOGA DISTRICT, KARNATAKA INDIA

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An attempt has been made to determine proximates, nutritive value and elemental composition of a few fruits of *Cordia dichotoma* G Forst, *Garcinia xanthochymus* Hook f. *Calophyllum inophyllum* Linn and *Gmelina arborea* Roxb. were collected from different places of Shimoga district. The macronutrients studies reveal that the highest percentage value (1.55) of potassium was recorded in the fruits of *G.arborea* and lowest percentage value (0.33) of magnesium was recorded in the fruits sample of *G.xanthochymys* respectively. Among the micronutrients iron was the dominant element which was followed by zinc, copper and manganese in *C.inophyllum*, *G arborea*, *C dichotoma* and *G.xanthochymus* respectively. Among the proximates, the carbohydrate was dominant proximates which was followed by fiber, moisture, fat and ash in *G.dichotoma*, *C.inophyllum* and *C.dichotoma* respectively. The highest value of nutritive value (431.66 Cal/100gm) was recorded in the fruits of *G.arborea* and lowest value (223.54 cal/100gm) was recorded in the fruits of *C.dichotoma* respectively. The average value of proximate, nutritive value and elements composition of these fruits are compared with Recommended Dietary Allowance (RDA) values are discussed. Further, this study is helps to establish cottage industries to improve economic and social condition of local people are appended.

Keywords: Edible fruits, Macronutrients, Nutritive value, Western Ghats.

BIOINSPIRED NANOBIOTECHNOLOGY FROM *CYPERUS SCARIOSUS* : HARNESSING VOLATILE PHYTOCHEMICALS FOR SMART NANO-FORMULATIONS IN HERBAL THERAPEUTICS

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The combination of natural product chemistry with nanoscience has led to the emergence of bioinspired nanobiotechnology, which can provide environmentally friendly and biocompatible drug delivery systems. The present study envisages the use of the aromatic medicinal sedge *Cyperus scariosus* (Nagarmotha), which contains essential oil rich in volatile phytochemicals, namely cyperol, α -cyperone, patchoulone, and mustakone, as a biogenic source to fabricate smart nanomaterials. Using the green synthesis method, the phytochemicals of *C. scariosus* species acted as reducing, capping, and stabilising agents at the same time, which caused the eco-friendly biosynthesis of metal and polymeric nanoparticles without the use of external toxic agents. Using techniques such as UV-Vis spectroscopy, FTIR, XRD, and TEM, the characterisation results confirmed the existence of uniform nanoscale architectures functionalized with the bioactive agent, which displayed significant stability and biocompatibility. The nano formulations could show better antioxidant, anti-inflammatory and antimicrobial properties; therefore, they could be an excellent choice for herbal therapeutics and targeted drug delivery. Tests in test tubes showed that cells can take in our product easily. Also, it releases with time and it does not cause any harm like other products. Disease Model Studies Suggest Synergistic Action of *Cyperus scariosus*. The modulation of ROS and cell repair mechanisms is promoted by *scariosus* volatiles. In conclusion, the phytochemical volatile quality of *C. scariosus* can have a major impact on bioinspired nanobiotechnological applications and its use as a multi-functional nano-formulation smart sustainable high-performance agent.

Keywords: Bioinspired nanobiotechnology, *Cyperus scariosus*, Green synthesis, Smart nano-formulations and Herbal therapeutics.

ASSESSMENT OF SUGARCANE GENOTYPES FOR YELLOW LEAF DISEASE RESISTANCE AND ASSOCIATED PHYSIOLOGICAL TRAITS

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A field investigation was carried out to evaluate the reaction of sugarcane genotypes to the yellow leaf disease (YLD) under natural conditions to characterize their associated biophysical and biochemical responses, as well as to assess the correlations among the disease expression, the vector (aphid) incidence and weather factors. Pooled data of three years (2022-23 to 2024-25) revealed that out of thirty one genotypes studied, six genotypes—2015A311, 2017A553, CoA20321, CoA20323, CoA20325, and CoV19359 recorded disease severity between 0.0 and 1.0, conferring resistant (R) reactions. Nine genotypes exhibited moderately resistant (MR) reactions with disease severity >1.0–2.0, while others such as CoA19322 and 2001A63 were moderately susceptible (MS). The susceptible check variety, 2003V46, was highly susceptible (S) with disease severity >3.0. Biophysical traits revealed that resistant types maintained semi-erect leaves (inclination angles 22.0°–28.0°), medium to medium-wide leaf width, and light green leaves having SPAD values between 28 and 31. Phenol content (33.67–40.34%) and silica levels (1.64–2.41%) were also notably higher in resistant genotypes. Whereas the susceptible 2003V46 exhibited higher leaf droopiness (42.0°), higher sucrose (17.62 %), reduced phenols (28.32%) and silica (1.30%). DAS-ELISA assays confirmed viral presence in infected leaves of both resistant and susceptible lines, with absorbance values ranging 3.693–3.957 in positive samples. Aphid samples tested positive in susceptible genotypes only, indicating vector-mediated transmission. Correlation analysis demonstrated positive associations between aphid population and YLD incidence with maximum temperature ($r = 0.62$ and 0.48) and relative humidity ($r = 0.65$ and 0.67), while rainfall showed a negative correlation ($r = -0.66$ and -0.63), suggesting dry warm conditions favoured aphid activity and disease spread. Consequently, the genotypes 2015A311, 2017A553, and CoA20323 were identified as stable YLD-tolerant sources suitable for resistant breeding programmes in sugarcane.

Keywords: Sugarcane, Yellow leaf disease (YLD), Biophysical and Biochemical parameters, aphid vector, weather parameters

ROLE OF ENDOPHYTIC BACTERIA FROM INDIGENOUS AROMATIC RICE CULTIVAR (O. SATIVA CV. TULAIPANJI) OF WEST BENGAL AS POTENT DIAZOTROPHIC BIOCONTROL AGENT FOR SUSTAINABLE AGRICULTURAL ENHANCEMENT

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Global production of rice (*Oryza sativa* L.) is hampered by the scarcity of plant-available nitrogen (N), and by the attack of various phytopathogens. This study aimed to isolate and select potent diazotrophic endophytic bacteria with biocontrol ability. Endophytic bacteria were isolated from “Tulaipanji”, an aromatic rice variety of West Bengal. Among the endophytes, 65.85% exhibited the ability to grow on nitrogen-free agar medium. Ten isolates were further selected based on their diazotrophic attributes (ammonia production, acetylene reduction assay, and *nifH* gene amplification). These isolates were further screened for PGP traits, like auxin and siderophore production, zinc solubilization, antagonism to rice bacterial and fungal pathogens, abiotic stress, and heavy metal tolerance. Two isolates exhibited >75% antifungal activity in dual culture assay against the brown-spot disease-causing fungus *Bipolaris oryzae*. Isolate FTFR4, later identified as *Bacillus tequilensis*, and its secondary metabolites were highly antagonistic towards *B. oryzae*. Further study revealed that the volatile compounds present in the secondary metabolites of *Bacillus tequilensis* exhibited significant antifungal activity, as confirmed by agar well diffusion assay, detached leaf assays, and scanning electron microscopy. The endophytic nature of the isolate was verified in phase contrast and fluorescent microscope using DAB-aniline blue staining. Rice plants grown from bioprimed seeds (FTFR4 treated), exhibited significantly higher biomass and chlorophyll, carbohydrate and protein content under low N input. In conclusion, the isolate FTFR4 came across as a potential biocontrol agent for sustainable and ecofriendly rice cultivation that may reduce reliance on chemical fertilizers and pesticides.

Keywords: Rice, Endophytic Bacteria, Diazotroph, Biocontrol agent, Bioinoculant

ISOLATION AND CHARACTERIZATION OF CELLULOSE DEGRADING BACTERIA AND THEIR APPLICATIONS IN SUGARCANE BAGASSE DEGRADATION

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The current research focused on isolating, identifying, and characterizing of cellulose degrading bacteria. These bacteria were isolated from farm soil samples collected from various locations in Pune district Maharashtra, India. Soil samples were used for screening of bacterial isolates that are capable of producing cellulose degrading enzymes. Total 8 bacterial isolates were screened for cellulolytic activity on CMC agar plate and CMC medium without cellulose containing sugarcane bagasse. Among these two isolates were selected for further degradation studies. These two isolates designated PFS2 and PFS3. These isolates were identified as *Achromobacter xylosoxidans* & *Pseudomonas aeruginosa* based on morphological, biochemical characteristics according to Bergey's manual of determinative bacteriology followed by 16S rRNA gene sequencing. Degradation study was carried out using sugarcane bagasse as a substrate in vitro. The experiments were carried out containing bagasse with each isolates. The cultures were incubated at room temperature on a rotary shaker at 120 rpm for 15 days. Broth samples were collected periodically to measure glucose concentration and dry weight of sugarcane bagasse. Results showed a significant increase in glucose concentration and a reduction in dry weight of sugarcane bagasse across treated samples compared to the control. The results confirmed degradation of cellulose polymer by the isolates and its possible application in management of sugarcane bagasse waste.

Keywords: Cellulose, Cellulolytic activity, Cellulase, Sugarcane Bagasse, *Achromobacter xylosoxidans*, *Pseudomonas aeruginosa*.

POPULAR TRADITIONAL CRAFTS TURNED INTO BEAUTIFUL DIGITAL APPLIQUE WORK

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Applique work is one of the most famous art form around the world (Anonymous, 2018). The term appliqué is derived from French and Latin word appliquer, which both mean to join or attach (Upadhyay, 2017). Like embroidery, it has a humble beginning. The technique was used as a way to strengthen worn areas of items or to patch holes that had formed. An early applique was used to prolong the life of clothing and transferred to artistic techniques that can be seen in blankets and quilts from many cultures around the world (Mohapatra 2005). The applique work designs were documented for the study from secondary sources and the most preferred designs were selected for digitization as per preferences of experts. Digitization was done using embroidery softwares and products were developed. Developed products with digital technology were evaluated on various parameters. The study was found that applique works such a fabulous craft, developed products with digital technology were highly liked by consumers in terms of Motif (2.96), Design (2.94), placement of Design (2.78), colour ways (2.32) and overall appearance (2.68) Weighted Mean Score.

Keywords: Digital software's, Applique work, Consumer Opinion, Marketability, Textile Heritage.

PHYTOCHEMICAL EVALUATION IN VITRO ANTI-OXIDANT ACTIVITY OF LEAF AND STEM EXTRACTS OF *DENDROPTHOE GAMBLEI* L

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Dendrophthoe gamblei a member of the family Loranthaceae, a stem parasite recorded for the first time from Southern parts of Karnataka. The present investigation evaluates the phytochemical and antioxidant activity of different solvent extracts the leaf and bark of *D. gamblei*. Antioxidant activity was assessed by using multiple in vitro assays including DPPH radical, ABTS and Hydrogen peroxide scavenging activities using leaf and bark extracts. All the six extracts exhibited good antioxidant activity. Further phytochemical investigation and biological activity guided fractionation are warranted to isolate and characterize the specific bioactive compounds responsible for the observed effects of *D. gamblei* shows promise in the formulation and evaluation of novel drugs. Hence the present study.

Keywords: *Dendrophthoe gamblei*, DPPH, ABTS, anti-oxidant, Loranthaceae

IN VITRO PROPAGATION OF ANDROGRAPHIS MACROBOTRYS

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In vitro propagation method was developed for an endangered medicinal plant *Andrographis macrobotrys* for large-scale multiplication. Nodal explants were cultured on Murashige and Skoog (MS) medium containing cytokinins including 6-benzyl amino purine (BAP), kinetin (KN), 2-isopentyl adenine (2-iP) and thidiazuron (TDZ) at 2.5, 5, 7.5 or 10 $\mu\text{M L}^{-1}$. Multiple axillary shoots (32 shoots per explants) were regenerated from nodal explants on MS medium supplemented with 7.5 $\mu\text{M L}^{-1}$ BAP. Rooting of micro shoots was tested on full, half and quarter strength MS medium supplemented with various auxins including Indole-3 acetic acid (IAA), Indole-3 butyric acid (IBA), and Naphthalene acetic acid (NAA) at 1, 2, 5 or 10 $\mu\text{M L}^{-1}$. Quarter strength MS medium supplemented with 5 $\mu\text{M L}^{-1}$ indole-3-butyric acid (IBA) was effective for induction of roots from the regenerated shoots and on this medium optimal of 49 roots were regenerated from shoots. Micropropagated plants were transplanted to pots containing soil and coco-peat (1:1) mix and maintained in growth chamber at $25 \pm 2^\circ\text{C}$, relative humidity 80%, irradiance of $100 \mu\text{mol m}^{-2} \text{s}^{-1}$ for 16-h photoperiod. After eight weeks, plants were transferred to field where soil was mixed with farmyard manure and sand.

Keywords: Micropropagation; *Andrographis macrobotrys*; Medicinal plant; Axillary shoots

RESPONSE OF NANO DAP, NANO UREA, AND SAGARIKA ON GROWTH, YIELD AND QUALITY OF SUGARCANE

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The use of nano urea and nano DAP in sugarcane crop is a modern nutrient management method that can enhance cane productivity and fertilizer use efficiency, reduce losses due to leaching and vitalization and soil environment when used correctly. An experiment was conducted in randomized block design with three replications to find out the effect of Nano DAP, Nano urea, and Sagarika on growth, yield and quality of sugarcane in spring season. It was consisted in eight treatments i.e. T₁- 100 per cent recommended dose of NPK through inorganic (Conventional), T₂- 100 per cent recommended dose of P₂O₅ and K₂O through inorganic+spraying nano urea@5ml/litre of water at 60 DAP and 90 DAP, T₃-50 per cent recommended dose of P₂O₅ and K₂O through inorganic +sett treatment with nano DAP @ 5ml/litre water+spraying nano DAP and nano urea@ 5ml/litre water at 60 DAP+spraying of nano urea@5 ml/liter water and Sakariga@5 ml/liter of water at 90 DAP (Days after planting), T₄- Sett treatment with nano DAP @ 5ml/litre water +spraying Nano DAP and Nano urea @5 ml/liter of water at 60 DAP + spraying of Nano DAP and Nano urea @ 5ml/liter and Sagarika@5 ml/liter of water at 90DAP , T₅- Sett treatment with nano DAP @ 5ml/litre water +spraying Nano DAP and Nano urea @5 ml/liter of water at 60 DAP + spraying of Nano DAP and Nano urea @ 5ml/liter and Sagarika@5 ml/liter of water at 90DAP and 120 DAP, T₆- Sett treatmnt with nano DAP@5 ml/liter of water +spraying of water soluble fertilizer (19:19:19 N:P:K) @ 1.0kg in 100 liter water and nano urea @ 5 ml/liter of water at 60 and 90 DAP, T₇- Sett treatmnt with nano DAP@5 ml/liter of water +spraying of water soluble fertilizer (19:19:19 N:P:K) @ 1.0kg in 100 liter water and nano urea @ 5 ml/liter of water at 60, 90 and 120DAP and T₈- Conventional + Sagarika@ 25 kg ha⁻¹. The soil of the experimental plot was medium in organic carbon, low in available phosphorus and potash with pH 7.86. On the basis of mean data of two years showed that germination and commercial cane sugar per cent were not affected significantly by various sources of plant nutrients. Conventional 100 percent RDF+ sagarika@ 25 kg ha⁻¹ practice produced significantly higher shoot population (156.75 thousand ha⁻¹) and NMC (122.32 thousand ha⁻¹) over remaining treatments except conventional 100 percent RDF (T₁). Conventional + sagarika@ 25 kg ha⁻¹ treatment produced significantly higher cane yield (86.13 t ha⁻¹) but statically at par with T₁ (conventional 100 percent RDF treatment). The effect of sett treatment with nano-DAP and spraying of nano urea on sugarcane productivity was not resulted upto the level of significance if totally applied through nano urea and nano DAP fertilizer in comparison with conventional 100 percent RDF (81.66 t/ha). Use nano version fertilizer as a supplement not a 100 percent replacement basal dose. 100 per cent recommended dose of P₂O₅ and K₂O through inorganic+spraying nano urea@5ml/litre of water at 60 DAP and 90 DAP treatment produced yield (75.44 t/ha) which was at par with 100 percent RDF conventional practice.

PERFORMANCE OF SINGLE-CUT FODDER OAT GENOTYPES FOR QUALITY, YIELD AND ITS ATTRIBUTING TRAITS

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Ten genotype of fodder Oats were evaluated along with two checks during Rabi 2022-23 in Randomized Block Design with three replications. The data was recorded for the fodder yield, its ancillary characters and crude protein (%). Among ten genotypes, two genotypes, HFO 718-1 (768.81 q/ha) and OL 1964 (752.15 q/ha) were found superior than the best check OS 6 (742.52 q/ha) for green fodder yield. For dry matter yield, the genotype OL 1976-1 (187.61 q/ha) was found superior than the best check OL 1896 (172.62 q/ha). The highest dry matter percentage out of green fodder was found in OL 1976-1 (27.32%), followed by check OS 6 (24.25%). Highest crude protein (%) was exhibited by genotypes, UPO 22-2 (10.23%) and check OS 6 (9.99%). The check OS 6 also exhibited highest per productivity of green fodder (7.30) & dry matter yield (1.77) and crude protein yield (17.99 q/ha) among all the genotypes.

Keywords: Fodder Oats, Single-cut, Crude protein (%)

CHRONIC SUB-LETHAL EXPOSURE TO CLOTHIANIDIN IMPACTS REPRODUCTIVE FITNESS IN FEMALE *DROSOPHILA MELANOGASTER*

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Clothianidin is a neonicotinoid insecticide commonly employed in agricultural fields to kill or repel pests. Nonetheless, unintentional chronic exposure to this chemical may adversely affect reproductive fitness in non-target organisms. Hence, to understand the reproductive risks of clothianidin exposure, the present study was conducted to explore the chronic sub-lethal effects of clothianidin on the reproductive health of female *Drosophila melanogaster*. Briefly, the 1st instar larvae of *D. melanogaster* were exposed to six sub-lethal concentrations (0.05-0.1 µg/mL) of clothianidin till their adult stage. Notably, clothianidin exposure (0.07 µg/mL) reduced fecundity and egg hatchability by 42.57 % and 10.93 %, respectively, in treated females. The test chemical also escalated sub-cellular ROS production, which is evident by H₂ - DCFDA assay in female gonads. Moreover, nuclear damage was also apparent in gonads of the adult female flies. The investigation was extended to the subcellular level, where chronic exposure to clothianidin reduced vitellogenin activity in adult females by 35.24 % and 36.06 % at 0.07 and 0.1 µg/mL concentrations, respectively. Hence, the findings of this study equivocally suggest that exposure to clothianidin at sub-lethal concentrations fuels oxidative stress and modulates reproductive mediator in *D. melanogaster*. Moreover, nuclear damage in gonads can synergistically contribute to less fecundity and fertility in *Drosophila*.

Keywords: Pesticide, Neonicotinoid, Clothianidin, Reproductive toxicity, Oxidative stress

OPTIMIZATION OF A GREEN ETHANOL–WATER EXTRACTION SYSTEM FOR *PIMENTA DIOICA* LEAVES: EFFECTS ON PHYTOCHEMICAL CONTENT AND ANTIOXIDANT POTENTIAL

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The present study investigated the effect of extraction parameters on the phytochemical composition, total phenolic content, and antioxidant activity of *Pimenta dioica* (L.) Merrill leaf extracts, emphasizing a green and sustainable approach for the efficient utilization of plant biodiversity. Extraction was performed using an ethanol–water solvent system at varying solvent ratios (70:30, 80:20, and 90:10), temperatures (60°C, 70°C, and 80°C), and incubation times (60 and 120 min). Preliminary phytochemical screening revealed the presence of major bioactive constituents such as flavonoids, phenols, tannins, saponins, and glycosides in most extracts, while alkaloids appeared only at specific combinations 80:20 at 80°C and 90:10 at 60°C after 60 min, but were detected in nearly all solvent systems after 120 min. The total phenolic content was highest in extracts obtained at 80:20 solvent ratio, 60°C, and 120 min incubation, indicating the influence of solvent polarity and extraction duration on phenolic recovery. Antioxidant potential evaluated through reducing power and DPPH radical scavenging assays demonstrated that extracts at 60°C exhibited the highest reducing power, whereas the 70:30 solvent ratio showed superior DPPH radical scavenging activity. Overall, ethanol–water extraction proved effective and environmentally benign for recovering phenolic-rich bioactives from *P. dioica* leaves. The findings highlight optimized extraction as a green strategy to enhance the recovery of natural antioxidants, supporting the sustainable exploitation of plant biodiversity for pharmaceutical and nutraceutical applications. The ethanol–water solvent system represents an environmentally benign alternative to conventional organic solvents, being biodegradable, renewable, and safe. Hence, the extraction approach adopted in this study aligns with green chemistry principles and contributes to sustainable biodiversity utilization.

Keywords: Green extraction, Ethanol: water solvent system, Total Phenol Content, Reducing power assay, DPPH Radical scavenging assay

INFLUENCE OF INORGANIC NUTRIENTS AND BIO-FERTILIZERS IN COMBINATION WITH BIO-CONTROL AGENTS AND BOTANICAL EXTRACTS ON QUALITATIVE PARAMETERS AND ECONOMICS OF GARLIC (*ALLIUM SATIVUM* L)

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Garlic (*Allium sativum* L.,) is used as a spice and condiment. It is one of the important cultivated *allium* species after onion having tremendous medicinal properties. In current investigation the attempt was made to test the inorganic nutrients and bio-fertilizers in combination with bio-control agents and botanical extracts on qualitative properties and economics of garlic under southern Telangana region. The results revealed that, significant difference in Total Soluble Solids, sulphur content of bulb and essential oil content of bulb was observed with combined application of soil nutrients and bioformulations. The highest TSS (39.29 °Brix) was reported in treatment N₃B₁ (50%N +50%P+ 100%K+ *Azotobacter* at 5 kg/ha+ PSB 5 kg/ha+ *Trichoderma viride* at 10ml/l + Neem oil at 0.5%) and highest dry matter content (34.52%), sulphur content (1.25%) was recorded in N₂B₃ (50%N +100%P+50%K+ *Azotobacter* at 5kg/ha+ KSB at 6 kg/ha+ *Bacillus subtilis* at 10ml/l + Sesame oil at 1%). The highest ascorbic acid content (8.66 mg/100g) was recorded in N₃B₃ (50%N +50%P+ 100%K+ *Azotobacter* at 5 kg/ha+ PSB 5 kg/ha+ *Bacillus subtilis* at 10ml/l + Sesame oil at 1%). Further, the highest total biomass 7.80 t/ha harvest index (82.97 %), Grass returns Rs. 782333.3, net returns Rs.579319.35 and highest benefit cost ratio (2.86) was obtained under N₂B₁ (50%N +100%P+50%K+ *Azotobacter* at 5kg/ha+ KSB at 6 kg/ha+ *Trichoderma viride* at 10ml/l + Neem oil at 0.5%) among all the tested treatments.

Keywords: Quality, Bio-fertilizers *Trichoderma viride*, *Bacillus subtilis*, Neem oil

MAGNETIC AND STRUCTURAL ASPECTS OF TETRANUCLEAR COMPLEXES OF BIS-DIACETYL MONOOXIME-P-PHENYLENEDIAMINE WITH BIVALENT CO(II) NI(II), CU(II), ZN(II) AND CD(II) METALS COMPLEXES.

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It has been well established that transition and post transition metal chelate, complexes with bidentate and polydentate Schiff bases or ligands containing coordinated phenolic group or oxygen atoms further coordinated with metal atom to bonded oxygen atom, forming, polynuclear complexes, Polynuclear complexes formed by chelate complexes have been studied extensively by Sinn Harris and others Recently polynuclear chelates of transition metals have been studied due to their interesting structural variation. In present paper we report the tetranuclear complexes of Co (II), Ni (II), Cu (II), Zn (II) and Cd (II) with bis-diacetylmonooxime-p-phenylenediamine (BDMPDH₂). The tetranuclear complexes of Co (II), Ni (II), Cu (II), Zn (II) and Cd (II) with bis-diacetylmonooxime-p-phenylenediamine (BDMPDH₂) of composition [M₂(BDMPD)₂ (H₂ O), (CuCl₂)] (M =Co²⁺ Ni²⁺ or Cu²⁺. and [M₂ (BDMPD)₂(CuCl₂)₂] (M – Zn²⁺ and Cd²⁺ has been prepared and characterized. The dinuclear chelate of bivalent metal has been found to coordinate with oxime group free oxygen (N-O) atom. The electrical conductance value suggested coordinated nature of chloride in complexes. The magnetic and electronic spectra of Co (II) and Ni (II) metal complexes are consistent with octahedral structure, while those of Zn (II) and Cd (II) possess tetrahedral structure.

Keywords: p-phenylenediamine, diacetylmonooxime and (BDMPDH, Metal Complexes

CLIMATE SMART AGRICULTURE AND NUTRITION SENSITIVE FARMING

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Climate-smart agriculture (CSA) and nutrition-sensitive farming are increasingly recognized as complementary strategies to address the interconnected challenges of food security, climate change, and malnutrition. With agriculture being both a major contributor to greenhouse gas emissions and highly vulnerable to climate impacts, there is an urgent need for farming systems that not only adapt to and mitigate climate change but also enhance the nutritional outcomes of rural and urban populations. This study explores the integration of CSA practices with nutrition-sensitive approaches to promote resilient, sustainable, and healthy food systems. CSA aims to increase productivity, enhance resilience to climate shocks, and reduce emissions. Nutrition-sensitive farming, on the other hand, focuses on producing diverse, nutrient-rich foods while addressing the underlying causes of malnutrition such as limited dietary diversity, poor soil health, and inadequate agricultural practices. Drawing on case studies from Sub-Saharan Africa and South Asia, this research highlights practical examples of how integrated strategies—such as agroecology, intercropping, biofortification, water conservation, and soil fertility management—can simultaneously improve climate resilience and dietary quality. Furthermore, the study emphasizes the role of women farmers, local knowledge systems, and participatory decision-making in enhancing both the effectiveness and sustainability of these approaches. The findings reveal that climate-smart, nutrition-sensitive interventions not only improve yields and environmental outcomes but also contribute to reducing hidden hunger, particularly in vulnerable populations. However, challenges persist, including limited access to finance, extension services, and climate information, which hinder the scaling of such interventions. Policy alignment, capacity building, and investment in integrated agricultural research are crucial for overcoming these barriers. In conclusion, the convergence of CSA and nutrition-sensitive farming represents a viable pathway toward achieving sustainable development goals related to zero hunger, climate action, and improved health. The study calls for multi-sectoral collaboration, inclusive policy frameworks, and innovative financing to mainstream these practices into national and regional agricultural development plans.

Keywords: Climate-smart agriculture (CSA), Nutrition-sensitive farming, Food security, Dietary diversity, Sustainable agriculture.

FROM MOUND TO MEDICINE: UNVEILING THE ANTI-BREAST CANCER POTENTIAL OF TERMITE MOUND SOIL

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Termite mound soil is a unique ecological niche enriched with bioactive minerals and microorganisms that may possess therapeutic potential. This study investigates the in vitro anti-breast cancer activity of termite mound soil filtrate, its precipitate (ppt), and the nanoparticles synthesized from these fractions. The samples were characterized using physicochemical and spectroscopic analyses to confirm nanoparticle formation. Cytotoxic effects were evaluated against MCF-7 breast cancer cell lines using the MTT assay. Results revealed significant dose-dependent inhibition of cancer cell proliferation, with nanoparticle formulations showing enhanced activity compared to crude filtrates and precipitates. These findings suggest that termite mound soil, a natural and underexplored resource, holds promise as a novel source for anticancer agents and nanoparticle-based therapeutics.

Keywords: Termite mound soil, MCF-7 breast cancer cell lines, MTT assay, anticancer agent, nanoparticle-based therapeutics

CHLOROPHYLL-BASED ASSESSMENT OF MUNGBEAN YELLOW MOSAIC DISEASE SEVERITY USING SPAD METER

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Objective: Mungbean (*Vigna radiata* L. Wilczek) is an important legume widely cultivated in tropical and subtropical regions, valued for its high protein content and ability to improve soil fertility through nitrogen fixation. Despite its significance, mungbean production is often constrained by diseases, among which Mungbean Yellow Mosaic Disease (YMD), caused by begomoviruses and transmitted by the whitefly *Bemisia tabaci*, is highly destructive. This study aimed to evaluate the effectiveness of a SPAD chlorophyll meter as a rapid, non-invasive tool for estimating YMD severity and to explore its potential for monitoring disease progression and identifying resistant genotypes. **Methodology:** The experiment was conducted during the summer of 2025 at the Main Agriculture Research Station, University of Agricultural Sciences, Dharwad, using six mungbean genotypes with differing levels of resistance. SPAD readings were recorded at 20, 40 and 60 days after sowing (DAS) to monitor changes in leaf chlorophyll content and visual assessments of per cent disease severity (% DS) were performed for comparison. Correlation and regression analyses were conducted to determine the relationship between SPAD readings and disease severity. **Key Findings:** Results showed a strong negative correlation between SPAD values and YMD severity ($r = -0.85$ to -0.96), indicating that genotypes with higher chlorophyll content experienced lower disease incidence. Resistant genotypes maintained consistently higher chlorophyll levels, whereas susceptible genotypes showed marked declines by 60 DAS. Regression analysis confirmed the reliability of SPAD readings in predicting disease severity, though factors such as leaf maturity, leaf shape and the point-based nature of measurements may influence accuracy. **Conclusion:** Overall, the SPAD chlorophyll meter is a reliable, rapid and non-destructive tool for assessing YMD severity in mungbean. Integration with image-based and AI-driven approaches is recommended to enhance large-scale disease monitoring, improve resistance screening, and facilitate timely management interventions, thereby supporting sustainable mungbean production.

Keywords: AI-driven, Disease severity, Mungbean, SPAD chlorophyll meter, Yellow Mosaic Disease

ISOLATION AND CHARACTERIZATION OF RHIZOSPHERE MYCOFLORA OF ARECANUT GROWING AREA IN SHIVAMOGGA DISTRICT, KARNATAKA, INDIA

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The present investigation was carried out with the rhizosphere and rhizoplane mycoflora of the Arecanut growing area in Shivamogga district. Physico-chemical parameters were analyzed using standard procedures. Rhizosphere and rhizoplane mycoflora were isolated on different culture media, viz., Potato Dextrose Agar and Martins Rose Bengal Agar media supplemented with 1% Streptomycin, from the collected soil samples using the dilution plate technique. A total of 165 colonies were isolated, about 25 Rhizosphere and Rhizoplane fungal species belong to 3 Divisions, 9 Families, of 11 Genera were isolated and identified morphologically and microscopically characterized during the study period. These Rhizosphere and Rhizoplane fungi represented different fungal groups: Ascomycota (78%), Mucoromycota (9%), Oomycota (13%). Ascomycota was the dominant phylum being represented by 19 species, followed by Oomycota represented by 4 species, and the least occurring phylum was Mucoromycota, with 2 species. On the other hand, in our present study, it was observed that *Trichoderma*, *Aspergillus*, and *Penicillium* species were dominant fungi in both the Rhizosphere and Rhizoplane soil. Physicochemical analysis revealed that the soil is rich in mycoflora due to acidic pH, rich organic matter, and optimum moisture content. This study was conducted as an effort to understand the soil microbial diversity in the Arecanut growing area in Shivamogga district. Soil mycoflora not only plays an important role in decomposition and contributes to biogeochemical cycling, but also is responsible for the prevalence of diseases in the crop fields and the availability of some minerals and nutrients.

Keywords: Ascomycota, Physicochemical, Rhizosphere, Rhizoplane

FUNCTIONALITY IMPROVEMENT OF BUFFALO MILK PROTEIN CONCENTRATE 80 (BMPC80) VIA SODIUM BICARBONATE ADDITION AND SHEARING TREATMENT

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Poor solubility is the major problem in high-protein milk protein concentrates (MPC). Therefore, present investigation aimed at improving solubility and characterizing buffalo milk-based milk protein concentrate 80 powders manufactured from (a) UF retentate (UFR) with desired protein / TS ratio treated with NaHCO₃ and high-shear treatment. The control (MPC) was produced from UF retentate (UFR) directly without any treatment. The spray drying was carried out at 190°C ± 5°C inlet and 90°C ± 5°C outlet temperatures, respectively. Addition of NaHCO₃ to the UFR significantly (p<0.05) increased ash content, pH, zeta potential, interstitial air content (IAC), occluded air content (OAC), porosity, and particle size (d₁₀, d₅₀ and d₉₀), wettability, dispersibility, solubility, viscosity, water binding capacity (WBC), oil binding capacity (OBC), foaming and emulsification properties while decreased the loose bulk density (LBD), packed bulk density (PBD) and particle density (PD) as compared to control. This investigation clearly demonstrated marked improvement in solubility of treated powder over control sample. The price of control and treated BMPC80 powders were Rs. 627.15/-, and Rs. 644.49/-, respectively.

Keywords: Buffalo milk, Milk protein concentrate 80, Functional properties, Sodium bicarbonate, High-shear

IMPACT OF DIRECT SOWN RICE (DSR) METHOD OF CULTIVATION ON PADDY YIELD AND FARMERS' INCOME IN MYSORE DISTRICT

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Direct Sown Rice (DSR) method, using drum seeder, emerges as an excellent opportunity for enhancing yield and income of paddy farmers in Mysuru district. A detailed study was conducted on Impact of Direct Sown Rice (DSR) method of cultivation on paddy yield and farmer's income. Paddy growing farmers have been facing problems of labour scarcity, especially transplanting labours, which eventually delays paddy transplanting and results in higher cost of production in paddy cultivation, higher paddy nursery preparation, higher labor and inputs costs like seed and fertilizers. The ICAR JSS KVK Mysuru has found an intervention to address above mentioned problems faced by paddy farmers in command area of the district. The KVK has started conducting FLD programs on Direct Sown Rice (DSR) method using drum seeder in low lying irrigated paddy areas of Mysuru district with dual objectives – to help farmers avoid dependence on expensive, skilled labours and to take up planting in time as also to reduce the cost of cultivation. The KVK borrowed the technology from UAS, Bengaluru. The demonstration was planned and implemented on 6 ha area with 15 farmers in G.Marahalli, Suttur, Kalkunda, Hosakote, Bilugali, and Nagarle villages of Mysuru district. The study of economics of DSR method revealed that the cost of paddy cultivation reduced drastically, on average to 27% (from Rs. 60,000 to Rs. 43,800/ha), apart from contribution to yield improvement to the extent of 8% (from 52.1 q/ha to 56.6 q/ha). Drastic reduction of paddy seed rate from 65 kg/ha in conventional transplanting method to 20 kg/ha in DSR method, nearly 70% seed rate is reduced in DSR method and also irrigation water is saved up to 15-20% due to alternate wetting and drying practice. The KVK, further in collaboration with Department of Agriculture, has spread the Direct Sown Rice (DSR) technology on an area of 3,250 ha in the district during *kharif* 2018-19 through trainings and field demonstrations. Area under DSR method is gradually increasing in Mysuru district from 2019-20 to 2024-25; nearly 17 % of total paddy area in the district has adopted DSR method till 2024-25.

Keywords: Direct Sown Rice (DSR) method, Paddy yield, Farmers income and Impact, Mysuru district

EVALUATION OF BLACK GRAM VARIETY LBG-791 UNDER IRRIGATED PADDY FALLOW CROPPING SYSTEM

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ICAR JSS Krishi Vigyan Kendra Suttur (Mysuru) has conducted Cluster Frontline Demonstration (CFLD), a large-scale demonstration on Integrated Crop Management in black gram variety LBG-791. CFLD demonstrations were planned to be conducted in a 100-ha area of 200 farmers in Muguru and Hyakanuru cluster villages of T. Narasipura taluk, Mysuru district. To demonstrate the performance of Yellow Vein Mosaic-tolerant black gram variety LBG-791, line sowing of seeds in paddy fallows, seed treatment with *Rhizobium* and *Trichoderma*, and use of bio pesticides like neem oil to improve black gram yield in traditional black gram growing areas of T Narasipura taluk. Black gram variety LBG-791 has recorded 29% higher yield (14.3 q/ha) when compared to check black gram variety T-9 (10.2 q/ha) and found tolerant to Yellow Vein Mosaic disease (<3% incidence) in demo plots. Demo plot has recorded 35% higher net returns (Rs. 46369/ha) compared to Check plot (Rs. 30196/ha) and found a higher Benefit Cost ratio (B: C ratio) 2.97 in demo plot compared to check plot (2.33).

Keywords: Performance, black gram variety LBG-791, irrigated, paddy fallows, cropping system

POLICY AND GOVERNANCE FOR BIODIVERSITY AND ENVIRONMENTAL PROTECTION

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Biodiversity and environmental protection are increasingly central to policy and governance frameworks worldwide, particularly in developing countries like India where ecological resources are under immense pressure from rapid urbanization, industrialization, and population growth. Effective governance of biodiversity requires more than conservation measures it involves integrating ecological considerations into economic planning, social development, and institutional decision-making. Policies and governance mechanisms serve as tools to regulate, manage, and safeguard natural resources while balancing the competing demands of development and sustainability. At the global level, agreements such as the Convention on Biological Diversity (CBD), the Paris Agreement, and the Sustainable Development Goals (SDGs) have provided overarching frameworks to align national efforts with international commitments. At the national and regional levels, environmental policies, forest and wildlife protection acts, pollution control laws, and biodiversity conservation strategies aim to protect critical ecosystems and species. Governance mechanisms ranging from centralized ministries to decentralized institutions like local self-governments and community-based organizations play a vital role in ensuring that these policies translate into action. Biodiversity governance is primarily determined by transparency, inclusiveness, and accountability. Community participation, particularly through indigenous knowledge and local stewardship, enhances the effectiveness of conservation measures. Judicial interventions and public interest litigations have also been significant in shaping environmental governance, ensuring enforcement of existing laws, and holding authorities accountable. However, challenges persist, including weak enforcement, overlapping institutional responsibilities, lack of reliable ecological data, and conflicts between economic growth and ecological sustainability. In the face of climate change, habitat loss, and increasing ecological degradation, stronger policy frameworks and governance innovations are essential. This includes promoting ecosystem-based management, strengthening monitoring systems, mainstreaming biodiversity into developmental policies, and fostering public-private partnerships. By embedding biodiversity and environmental protection into broader governance structures, nations can ensure ecological resilience, human well-being, and sustainable development for future generations.

Keywords: Biodiversity, Policy, Governance, Environmental Protection, Sustainable Development, Conservation

PERFORMANCE OF BLAST-TOLERANT FINGER MILLET VARIETY KMR-316 UNDER RAINFED CONDITIONS

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ICAR JSS Krishi Vigyan Kendra Suttur (Mysuru) has conducted a frontline demonstration (FLD) on blast-tolerant finger millet variety KMR-316 mainly to address a suitable variety for late sowing of finger millet and blast tolerance under rainfed conditions. Frontline demonstration was planned and implemented in 4-hectare area at 10 farmers' fields in Hulyalu cluster village of Hunsuru taluk Mysuru district and demonstrated the performance of finger millet variety KMR-316. Line sowing of seeds, seed treatment with carbendazim was carried out to increase the yield and income of ragi farmers. Finger millet variety KMR-316 has recorded 23% higher yield in the demo plot (33.25 q/ha) compared to the check variety GPU-28 (25.53 q/ha) and also recorded less incidence (<2% incidence) of blast in demo plots. Finger Millet variety KMR-316 is suitable for delayed sowing, and blast-tolerant feedback collected from farmers.

Keywords: Performance, finger millet variety KMR-316, rainfed condition

BIOEFFICACY OF PLANT-DERIVED ESSENTIAL OILS AGAINST THE RICE ROOT-KNOT NEMATODE, *MELOIDOGYNE GRAMINICOLA*

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The nematocidal potential of ten commercially available plant-derived essential oils (EOs) was evaluated against the rice root-knot nematode, *Meloidogyne graminicola*, through in vitro bioassays. Among the oils tested, peppermint and lemongrass essential oils exhibited significant activity, causing over 80% mortality of second-stage juveniles (J2) at a 1% concentration after 24 hours of exposure. Complete (100%) mortality was observed after 48 hours. These two oils demonstrated high toxicity, with LC₅₀ values of 345.5 ppm (peppermint oil) and 738.2 ppm (lemongrass oil) after 48 hours of incubation. Additionally, lemongrass oil proved highly effective in suppressing egg hatching, showing 0% hatchability at a concentration of 2200 ppm, in contrast to 98% hatchability in the untreated control after 16 days of incubation. The findings suggest that peppermint and lemongrass essential oils possess strong nematocidal properties and hold promise as botanical alternatives for the management of *M. graminicola* in rice cultivation.

Keywords: Essential oils, *Meloidogyne graminicola*, Rice root-knot nematode, Plant-derived nematicides

EFFECT OF MACHINE TRANSPLANTING ON YIELD AND INCOME OF PADDY FARMERS

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ICAR JSS Krishi Vigyan Kendra Suttur (Mysuru), in collaboration with SKDRDP Mysuru, has conducted a frontline demonstration (FLD) on machine transplanting in paddy to ensure timely row planting, optimum plant density for better growth of paddy crop and to reduce dependency on transplanting labour. Frontline demonstration (FLD) is planned and conducted 25 demonstrations in 10 hectares at Hebbalakuppe cluster village of H D Kote taluk, Mysuru district. Training and method demonstrations are given to paddy farmers on seed treatment with fungicide carbendazim, preparation of the dapog method of paddy nursery, paddy planting machine use and operations. Demonstration plot (Machine transplanting) has recorded 10% higher grain yield (54.68 q/ha) of paddy compared to check plot (49.73 q/ha) (Manual transplanting) and also recorded 16% higher net returns (Rs.65888/ha) in demo plot compared to check plot (Rs. 55599/ha) and also found higher Benefit Cost ratio (B: C ratio) 2.61 in demo plot compared to check plot (2.34). Drudgery reduction was found to be 75% in machine transplanting (3 man days/ha) compared to manual transplanting (12 man days/ha). Machine transplanting ensured optimum plant density and facilitated better aeration, thereby reducing the incidence of pests and diseases.

Keywords: machine transplanting, paddy, yield and income, paddy farmers

MORPHOLOGY AND HISTOLOGY OF THE MALE REPRODUCTIVE SYSTEM IN THE FRESHWATER CRAB, OZIOTELPHUSA PARAKKAI

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The studies on the morphology of the male reproductive system and the formation of spermatozoa in decapods are essential for understanding the sexual maturation as well as conservation, management, and cultivation of a species. Crustaceans exhibit considerable morphological diversity and significant variations in the reproductive structures across taxa, particularly in reproductive anatomy, yet freshwater taxa remain underrepresented in comparative studies. The present study provides the first comprehensive histological characterization of the male reproductive system in the freshwater crab, *Oziotelphusa parakkai*, from Lake Parakkai, Nagercoil, Tamil Nadu, and southern India. The male reproductive system of *O. parakkai* is H-shaped and bilaterally symmetrical, comprising paired testes and vas deferens. The vas deferens is subdivided into anterior (AVD), middle (MVD), and posterior (PVD) regions. Testes consisted of multiple lobules displaying a sequential arrangement of germ cells at various stages of spermatogenesis, supported by accessory cells. Based on cytological features, six spermatogenic stages were identified which include, primary gonidia, secondary gonidia, primary spermatocytes, secondary spermatocytes, spermatids and spermatozoa. We recognised squamous type epithelium for anterior, middle and posterior vas deferens regions. Spermatophore formation initiates in the AVD, followed by enrichment and storage in the MVD, and temporary retention in the PVD before copulation. Morphometric and histological analyses revealed species-specific features and developmental patterns of sperm and spermatophores. These findings contribute to baseline information about the reproductive biology of freshwater brachyurans.

Keywords: Freshwater crab, Histology, Morphology, Male reproductive system.

HALOTOLERANT PLANT GROWTH-PROMOTING RHIZOBACTERIA FROM KAIPAD FIELDS OF KERALA: CHARACTERIZATION AND FIELD APPLICATION OF POTENT ONISHIA SP. STRAIN ST2 FOR SALINITY STRESS MITIGATION

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Beneficial halotolerant plant growth-promoting rhizobacteria have been increasingly adopted as a sustainable strategy for mitigating the challenges posed by salinity in agricultural soils. The present study investigates the *in vitro* characterization of indole-3-acetic acid (IAA)-producing halotolerant bacterial strains, previously isolated from saline Kaipad rice fields in Kerala, and identified through 16S rRNA gene sequencing, with their respective accession numbers documented in GenBank (NCBI). The isolates, taxonomically classified as *Onishia sp.* (ST2), *Onishia sp.* (ST16), *Halobacillus sp.* (ST21), and *Lentibacillus sp.* (ST22), were systematically evaluated for multifaceted plant growth-promoting (PGP) activities. Among them, *Onishia sp.* strain ST2 (ID: PQ459745.1) exhibited superior PGP attributes, including maximum IAA production ($227.59 \pm 2.39 \mu\text{g mL}^{-1}$), the highest phosphate solubilization ($7.9 \pm 0.065 \mu\text{g L}^{-1}$), and notable siderophore production ($64.7 \pm 0.26\%$). Additional biochemical assessments revealed significant antioxidant activity, along with ammonia, hydrogen cyanide (HCN), and exopolysaccharide synthesis. All isolates demonstrated robust tolerance to salinity stress up to 20% (w/v) NaCl under controlled *in vitro* conditions. Seed bacterization experiments using *Onishia sp.* strain ST2 resulted in a marked increase in okra seed germination compared to untreated controls and effectively alleviated salinity-induced stress symptoms. Plants inoculated with ST2 showed pronounced improvements in root and shoot length, biomass accumulation (fresh and dry weight), alongside enhanced biochemical parameters such as total soluble sugar, reducing sugar, protein concentration, chlorophyll content, and activities of key antioxidant enzymes including superoxide dismutase (SOD, $0.0838 \pm 0.0013 \text{ mg}^{-1}$), catalase ($1.937 \pm 0.055 \text{ U mg}^{-1}$), ascorbate peroxidase ($0.1858 \pm 0.0042 \text{ U mg}^{-1}$), and lipid peroxidase ($3.137 \pm 0.019 \text{ U mg}^{-1}$). Collectively, these findings underscore the profound halotolerance and versatile PGP potential of *Onishia sp.* strain ST2, supporting its application as a promising biofertilizer for sustainable crop productivity in saline agroecosystems.

Keywords: Indole-3-acetic acid, Halotolerant bacteria, 16S rRNA sequencing, Plant growth-promoting rhizobacteria, Salinity stress.

COMPUTATIONAL EXPLORATION OF PHYTOCONSTITUENTS FROM *ARISTOLOCHIA INDICA* AND *PTEROCARPUS MARSUPIUM* AS MULTI-TARGETED INHIBITORS AGAINST COLORECTAL CANCER

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Colorectal cancer (CRC) remains a critical global health concern, as current treatments are often associated with toxicity, limited efficacy, and recurrence. This study aimed to identify multi-targeted anticancer phytoconstituents from *Aristolochia indica* and *Pterocarpus marsupium* through an in-silico approach. A total of 41 phytochemicals were screened using Schrödinger Maestro 14.2 against 15 CRC-associated oncogenic and immune-regulatory proteins, including EGFR, VEGFR, HGF, IGF-1R, TGF- β , Notch-3, PD-1, CTLA-4, and LAG-3. Docking scores, Glide energies, and interaction profiles were analysed to identify potent lead molecules. Among *A. indica* compounds, hinokinin, cubebin, savinin, magnoflorine and allotin showed strong binding affinity, particularly toward EGFR (–9.85 kcal/mol), VEGFR (–8.058 kcal/mol), and HGF (–11.301 kcal/mol), indicating the potential to inhibit angiogenesis and proliferation. From *P. marsupium*, pterosupin, pteroisauriside, and pteroside demonstrated superior binding, with pterosupin exhibiting the highest affinity toward EGFR (–13.39 kcal/mol) and VEGFR (–13.36 kcal/mol). Several compounds also showed favourable interaction with immune checkpoint receptors, suggesting possible immunomodulatory activity. These findings highlight promising plant-derived molecules with multi-target inhibitory potential against CRC. Future studies will include molecular dynamics simulations, ADMET profiling, in vitro cytotoxicity assays, followed by gene expression studies to validate molecular mechanisms.

Keywords: Colorectal cancer, Molecular docking, *Aristolochia indica*, *Pterocarpus marsupium*, Phytochemicals

MICROBIAL CONSORTIUMS AS BIOREMEDIATORS FOR CONTAMINANTS OF EMERGING CONCERNS

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Contaminants of emerging concerns are those harmful compounds which travel from their source of origin to environment, get accumulated over time and become harmful as they are consumed in one or other way. These contaminants have very negative impact on social welfare as they may cause serious illness, endocrine disruptions, nervous breakdowns, paralytic attacks or even deaths. It is meant that these contaminants are still not fully regulated under current environmental laws. These Contaminants of emerging concerns (CECs) are discharged as waste into water bodies through industries like food and dairy, pharmaceuticals and personal care products (PPCP'S), agricultural, metal, plastic, textile, electronics, mineries, domestic waste, urban runoff, thermal plants and waste water treatment plants etc. These CEC's have the ability to enter water cycle as they enter public water system through waste water treatment plants. Lifestyle of humans has changed to such an extent that for healthy survival consumption of pharmaceuticals is enhanced manifold times and this is one of the major reasons for increase of CECs. Due to continual increase these pharmaceuticals are left unregulated. Industrial effluents like DBT (Dibutyl Phthalate), DEHP (Diethyl hexyl Phthalate), BP's (Bisphenols) from plastic, textiles, food industries etc contribute maximum contaminants which accumulate into environment. Cyanotoxins, released from cyanobacterial blooms also contribute for CEC's. Due to increased nutrient levels in water bodies, cyanobacterial blooms growth is flourished which releases toxins in water when they grow beyond limit and create risk to human and animal life. Thus the current situation demands immediate action and remediation of CEC's. There are various means of remediation of which bioremediation is the best. Bioremediation is natural and safest method because the microbes or plants present in nature itself helps in cleaning of environment by degrading the complex and toxic contaminants. Microbial remediation can be applied ex situ or in situ conditions. However, in situ bioremediation is a slow process that is difficult to optimize and control. To resolve these issues, bioreactors are developed. Microbes like Bacteria, Fungi and Algae are known for bioremediation. Fungi are very environmental friendly due to their ecological adaptations, nutrient cycling efficiency, faster metabolism and publicly acceptable as they do not leave traces of harmful byproducts behind the utilization of fungi for phthalate bioremediation (mycoremediation) is advantageous due to their highly effective enzyme secretory system. These transformations are effected by various factors like temperature, oxygen, soil quality, moisture content and their efficiency of transformations. Consortia of different microbes enhance the bioremediation efficiency manifold times. In many cases of degradation efficiency, microbial consortia have been found superior when compared to single strains. CEC's can also be degraded at faster rate because consortia have high biological proficiencies, high biocatalytic potential, improved biomass, stability and division of labour. Further, the utilization of microbial consortia offers considerable advantages over the use of pure cultures in the degradation of recalcitrant compounds considering its multifunctional ability and can be more robust to environmental fluctuations.

ANTIOXIDANT POTENTIAL OF ANANAS COMOSUS PEEL POWDER: INFLUENCE OF DRYING TECHNIQUE

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One of the most popular fruits in the *Bromeliaceae* family is *Ananas comosus*. This tropical fruit is well-known for its taste. Following use, a significant amount of by-product is produced, of which 34–38% is peel alone. The total flavonoid content (TFC) and total phenolic content (TPC) of four different methods of drying *A. comosus* (pineapple) peel powder (PPP) hot air oven, microwave, sun, and freeze drying as well as the in-vitro antioxidant activity using the DPPH assay were qualitatively and quantitatively determined in order to turn this waste into valuable aqueous, methanolic, and acetone solvent extracts. The study's findings revealed that the aqueous extract of microwave oven-dried PPP had the greatest TPC value (79.39772 mg GAE/g), while the acetone extract of hot air oven-dried PPP had the lowest TPC value (14.04545 mg GAE/g). The methanolic extract of freeze-dried PPP had the highest TFC value (48.3636 mg QE/g), whereas the methanolic extract of hot air-oven-dried PPP had the lowest value (3.60606 mg QE/g). It was discovered that the methanolic extract of microwave-dried PPP had the highest antioxidant potential (97.6%). Additionally, out of all the extracts, the methanolic extract had the highest antioxidative capability across all drying methods. Therefore, the primary goal of this study was to determine the optimal drying method for extracting the most antioxidant potential from the peel of *Ananas comosus* and to measure the phytochemicals that are responsible for this activity.

Keywords: *Ananas comosus*, peel, antioxidant, extracts, by-product.

IMPACT OF SUSTAINABLE TILLAGE PRACTICES ON SOIL NEMATODE COMMUNITY STRUCTURE IN SELECTED CROPPING SYSTEMS

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In this study, we evaluated the effects of conventional tillage (CT), minimum tillage (MT), and occasional tillage within a no-tillage (NT) framework on nematode communities in corn–wheat cropping systems in Aligarh (Uttar Pradesh, India). Soil samples were collected from two depths (0–5 cm and 5–20 cm) during planting and pre-harvest stages of both crops. The results revealed that tillage practices significantly influenced the structure and vertical distribution of nematode communities. Free-living nematodes, particularly beneficial groups, were more abundant in the 0–5 cm layer (exceeding 70%), whereas herbivorous nematodes predominated at the 5–20 cm depth. MT and NT systems supported a higher relative abundance of bacterivores especially the genus *Acrobeles* across both depths. At crop maturity, bacterivore populations were 1.5 times higher in MT compared to CT. In contrast, CT plots showed a marked increase in herbivorous nematodes, particularly *Pratylenchus*, with populations 46% higher at 0–5 cm and 75% higher at 5–20 cm than those under MT and NT. Although CT initially exhibited higher Maturity Index (MI) and Structure Index (SI) values likely due to legacy effects both indices declined over time. Conversely, these values progressively increased under NT systems. The Plant Parasitic Index (PPI) was elevated under both CT and NT, although the dominant functional guilds differed between systems. A higher Nematode Channel Ratio (NCR) in CT and MT indicated dominance of bacterial decomposition pathways, while NT showed a gradual shift toward a fungal-dominated channel. These findings suggest that MT and NT systems enhance soil health and contribute to long-term resilience against herbivorous nematodes in corn–wheat-based agroecosystems.

Keywords: Tillage practices, Nematode community structure, Corn–wheat cropping system, Soil health indicators, Maturity index

ECOLOGICAL ASSESSMENT OF PLANKTON COMMUNITIES IN A FISH POND ECOSYSTEM AT HISAR

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Present study was conducted to evaluate the composition and diversity of plankton communities in relation to physico-chemical parameters of pond water at CCS Haryana Agricultural University (HAU), Hisar. Water samples were collected fortnightly from October 2024 to February 2025 from the pond located near the university library. Physico-chemical parameters, including pH, temperature, electrical conductivity (EC), dissolved oxygen (DO), turbidity, total alkalinity, and total dissolved solids (TDS), were analysed. The mean values recorded were: pH 7.30 ± 0.02 , temperature $21.02 \pm 0.10^{\circ}\text{C}$, EC $208.24 \pm 2.14 \mu\text{S/cm}$, DO $6.12 \pm 0.88 \text{ mg/L}$, turbidity $45.20 \pm 1.21 \text{ NTU}$, total alkalinity $167.30 \pm 1.30 \text{ mg/L}$, and TDS $225.11 \pm 2.45 \text{ mg/L}$. The diversity indices revealed a high level of biodiversity: Shannon's Index (H') was 3.65 ± 0.04 for phytoplankton and 3.06 ± 0.04 for zooplankton; Simpson's Index ($1-D$) was 0.03 ± 0.00 and 0.05 ± 0.00 , respectively; Margalef's Species Richness was 5.68 ± 0.45 for phytoplankton and 3.73 ± 0.33 for zooplankton; species evenness remained consistently high (0.98 ± 0.01) for both groups. Among phytoplankton, Chlorophyceae dominated (31%), followed by Cyanophyceae (20%), Trebouxiophyceae (15%), Zygnematomyceae (13%), Bacillariophyceae (8%), Diatoma and Conjugatophyceae (5% each), and Dinophyceae (3%). Zooplankton communities were composed of Cladocera (26%), Rotifera (22%), Copepoda (17%), Protozoa and Insecta (13% each), and Ostracoda (9%). The results indicate that biodiversity patterns in the pond are strongly influenced by underlying physico-chemical factors, and the pond supports a diverse and balanced aquatic ecosystem.

Keywords: Plankton diversity, Fish pond ecosystem, Phytoplankton, Zooplankton

BIO-NANOTECHNOLOGY AND GREEN TECHNOLOGY: A SUSTAINABLE APPROACH FOR A BETTER FUTURE

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Bio-nanotechnology and green technology are emerging as powerful interdisciplinary fields that combine the principles of biology, nanoscience, and environmental sustainability to address some of the most pressing challenges faced by modern society. Bio-nanotechnology utilises biological systems, such as microorganisms, enzymes, and plant extracts, to design and synthesize nanomaterials in an eco-friendly manner. This approach reduces the dependence on harmful chemicals and promotes safer, biocompatible alternatives for applications in medicine, agriculture, and environmental management. Similarly, green technology focuses on the development and use of processes and products that minimize environmental impact, conserve natural resources, and reduce pollution. The integration of bio-nanotechnology with green technology has led to advancements such as green synthesis of nanoparticles, biodegradable materials, targeted drug delivery systems, and eco-friendly energy solutions. These innovations not only enhance efficiency but also promote circular economy practices by reducing waste generation and encouraging recycling and renewable resource use. Moreover, biosynthesized nanoparticles are proving effective in environmental remediation, including water purification, soil restoration, and pollutant degradation. Together, bio-nanotechnology and green technology represent a promising path toward sustainable development by harmonizing technological progress with environmental preservation. Their combined potential is paving the way for a cleaner, healthier, and more sustainable future, highlighting the importance of interdisciplinary collaboration and responsible innovation in science and technology.

Keywords: Bio-nanotechnology, Green technology, Sustainable development, Environmental remediation

DECIPHERING EVOLUTIONARY TRAJECTORIES IN ALLOTETRAPLOID *BRASSICA JUNCEA* ACROSS GENERATIONS AND PARENTAL BACKGROUNDS

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One significant evolutionary factor that has influenced plant diversity is polyploidy but the multifold processes leading to the development of polyploids is not very well understood. A great model to learn more about polyploid evolution is Brassica species because the allopolyploid Brassica species can be resynthesized by crossing diploid progenitor species followed by chromosome doubling. Resynthesized Brassica polyploids are ideal for studying polyploid evolution in action because the exact diploid progenitors are known and completely homozygous polyploids can be created by chromosome doubling of amphihaploids. This study used resynthesized *Brassica juncea* (RBJ) lines across generations (F1, S1, S2, S3, S4, S5, S6, S7 and S8), their parents (*B. rapa* P1 and *B. nigra* P2), and the natural *B. juncea* variety Varuna. Morphological traits related to yield and diversity were assessed. RNA-Seq was performed on P1, P2, F1, S1, S4, S8, and Varuna, mapping against the *B. juncea* (Varuna) reference genome to identify DEGs ($p \leq 0.05$) across six comparisons: Varuna vs. P1, P2, F1, S1, S4, and S8. Seeds per silique showed the highest heritability, indicating strong genetic control. Number of silique per plant had the highest genetic advance, suggesting high selection potential. Economic heterosis for silique per plant peaked in the S₆ generation, demonstrating significant hybrid vigor. Venn diagram analysis from transcriptomic data revealed that there were 474 DEGs (either up- or down-regulated) common in all combinations. These DEGs fall into key categories like methylation, disease resistance, and stress. They offer crucial insights into polyploid evolution, revealing how gene expression differences between diploids and allopolyploids influence growth, development, and stress responses. This understanding helps explain morphological and physiological variations, shedding light on *B. juncea*'s evolutionary mechanisms.

Keywords: Polyploidy, Resynthesized *Brassica juncea* (RBJ), RNA-sequencing, Morphological traits, Heterosis

PRESENT SCENARIO OF AGRI. BUSINESS MANAGEMENT AND MARKETING IN INDIA

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The Indian agricultural sector, a pivotal pillar of the economy, significantly contributes to the nation's GDP while providing livelihoods to nearly half of its workforce. Agri-business management and marketing in India have experienced a profound transformation, propelled by cutting-edge technological innovations, progressive policy reforms, and shifting consumer preferences. Digital platforms like e-NAM (National Agriculture Market) have redefined market access, empowering farmers to engage directly with buyers and secure better price realization. Advancements such as precision agriculture, IoT-driven solutions, and digitized supply chains have markedly improved productivity and operational efficiency. Nevertheless, persistent challenges fragmented land holdings, inadequate cold storage infrastructure, and limited access to credit and modern marketing tools continue to impede smallholder farmers. Government initiatives, including PM-KISAN, Farmer Producer Organizations (FPOs), and the rise of agri-tech startups, are catalyzing entrepreneurial growth and strengthening market linkages. Yet, obstacles such as price volatility, substantial post-harvest losses, and regulatory complexities pose significant barriers to scalability. This abstract delves into the evolving dynamics of agri-business management and marketing in India, underscoring the opportunities, challenges, and the pivotal roles of technology and policy in forging a resilient and sustainable future for the sector.

Keywords: Agri-business, Marketing, Digital platforms, Precision agriculture, Policy reforms, Farmer Producer Organizations

MULTI-METAL RESISTANT PLANT GROWTH PROMOTING RHIZOBACTERIA IN SUSTAINABLE AGRICULTURE

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Heavy metal pollution is a severe environmental problem. Due to a variety of natural and anthropogenic processes, heavy metal toxicity of soil constitutes a substantial hazard to all living beings in the environment. The heavy metals alter the soil properties, which directly or indirectly influence the agriculture systems. To address the problems associated with heavy metal contamination and agriculture practices, various solutions are applied like microbial bioremediation, phytoremediation which remove or lowers the concentration of heavy metals by using biological systems. The plant growth promoting rhizobacteria (PGPR) that are resistant to multiple heavy metals have emerged as a promising biological alternative. This study emphasizes on exploring rhizobacteria from heavy metal contaminated sites for their ability to promote growth of economically important crops in metal contaminated soil. This study seeks to isolate, characterize, and evaluate the efficacy of multi-metal resistant PGPR strains in promoting plant growth and remediating metal-contaminated soils, contributing to the development of eco-friendly and cost-effective agricultural practices. Exploring and harnessing these microbes could offer a dual benefit: improving plant health and reducing metal toxicity in the soil. This aligns with the principles of sustainable agriculture by reducing reliance on chemical inputs and promoting ecological balance.

Keywords: PGPR, Heavy metal, sustainable, multi-metal, agriculture

BOUNDARY-BASED AGROFORESTRY: A CLIMATE-SMART AND ECONOMICALLY VIABLE LAND-USE MODEL FOR SUSTAINABLE RICE-BASED FARMING SYSTEMS IN DHAMTARI DISTRICT, CHHATTISGARH

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Boundary-based agroforestry represents a sustainable and integrated land-use system that harmonizes agricultural and forestry components along the peripheries of farmlands. The present study emphasizes its potential in the Dhamtari District of Chhattisgarh, where *Oryza sativa* (rice) is the predominant staple crop. This model promotes simultaneous cultivation of rice in the central field area while planting multipurpose tree species such as *Tectona grandis*, *Gmelina arborea*, *Mangifera indica*, *Terminalia arjuna*, and *Eucalyptus* spp. on the field boundaries. The selected tree species were chosen for their high economic value, ecological adaptability, and compatibility with paddy cultivation. *Tectona grandis* and *Gmelina arborea* yield valuable timber within 15–20 years, *Mangifera indica* provides annual fruit returns after 4–5 years, *Terminalia arjuna* improves bund stability and soil-water conservation, while *Eucalyptus* ensures a steady supply of fuelwood and pulpwood. This integration enhances income diversification, land productivity, and ecological balance without reducing cultivable area. Furthermore, boundary agroforestry contributes significantly to climate resilience through carbon sequestration, soil fertility improvement, and microclimate regulation. Empirical studies reveal that similar agroforestry models can store 25–60 tonnes of carbon per hectare over 15–20 years, depending on species composition and management practices. Economic evaluations indicate a strong financial feasibility, with benefit–cost ratios ranging from 1.5 to 2.0 and substantial long-term returns. The system ensures continuous cash flow through intermediate products like fruits, leaves, and small timber while securing major returns from mature trees. Overall, boundary-based agroforestry emerges as a climate-smart, economically profitable, and ecologically sustainable land-use model capable of strengthening livelihoods, conserving resources, and contributing to India's carbon reduction and sustainable development commitments.

Keywords: Boundary agroforestry, *Oryza sativa*, carbon sequestration, sustainable land use

IMPACTS OF DIFFERENT STRATEGIC NUTRIENT METHODS ON ARECANUT YIELD IN UTTARA KANNADA DISTRICT OF KARNATAKA

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Nutrient management practices play a crucial role on yield and quality of horticultural crops. In Uttara Kannada, Arecanut is one of the most profitable commercial cropping systems. we see areca cultivation with pure organics (Organic); combination of fertilizers and organic manures (INM); and natural farming (NF). A study was carried out to compare the three nutrient management strategies on available nutrient status and corresponding areca yields. Twenty representative areca gardens, with minimum 5 years of nutrient management practices, were chosen from each category. The questionnaires were used to quantify amount of nutrients added and the soils were analysed individually for nutrient status. The study indicated that the NPK nutrients applied by INM famers were substantially higher while, least amounts of nutrients were supplied in NF areca gardens. The total NPK nutrients applied by three groups were in the order - INM > organic >NF. In terms of nutrient availability in soils, higher nutrient contents were recorded in INM areca gardens while; lower nutrient contents were noticed in NF areca gardens. The soil nutrient status was just similar to nutrient applications. Finally, the arecanut yields among three different categories varied significantly and recorded in the order of INM > Organic >NF areca gardens with respective arecanut yields of 3245 kg ha⁻¹, 1920 kg ha⁻¹ and 1137 kg ha⁻¹. Thus, the INM practices in areca garden were found better and important to achieve higher yields and maintain good soil fertility.

Keywords: INM, Organic farming, Natural farming, soil fertility Arecanut yield

PHYTOCHEMICAL COMPOSITION AND IN VITRO BIOACTIVITIES OF SKIMMIA LAUREOLA: A THREATENED MEDICINAL PLANT OF WESTERN HIMALAYAS

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Skimmia laureola (DC.) Zucc., a small evergreen shrub of the Rutaceae family, is an important yet threatened medicinal plant native to the Western Himalayas. Traditionally employed in the treatment of respiratory, inflammatory, and microbial disorders, this study investigates its phytochemical composition and evaluates its in vitro bioactivities to validate its ethnomedicinal significance. Phytochemical screening of *S. laureola* revealed the presence of major secondary metabolites such as alkaloids, flavonoids, phenolics, terpenoids, and saponins, which are known for their diverse pharmacological properties. The extracts demonstrated strong antioxidant potential in DPPH assay, along with notable antibacterial and antifungal activities against selected pathogenic strains. Furthermore, anti-inflammatory evaluations supported the plant's therapeutic potential, providing scientific evidence for its traditional medicinal uses. However, the natural populations of *S. laureola* are rapidly declining due to overexploitation, habitat degradation, and changing climatic conditions. The study emphasizes the urgent need for effective conservation strategies to protect this species and its native ecosystems. Promoting sustainable harvesting, community awareness, and cultivation through in situ and ex situ conservation measures can aid in preserving its genetic diversity and ecological role. Integrating phytochemical and biological insights with habitat conservation initiatives highlights the dual importance of *S. laureola* as a valuable medicinal resource and a component of Himalayan biodiversity. This research advocates for the inclusion of this threatened species in regional biodiversity protection and wildlife habitat conservation programs. The conservation of *Skimmia laureola* is vital not only for its medicinal importance but also for maintaining the ecological balance of Himalayan Forest ecosystems. The study reinforces the link between plant-based traditional medicine, wildlife protection, and long-term biodiversity conservation in mountain landscapes. Protecting this species contributes to the preservation of associated flora and fauna that depend on similar environmental conditions for survival.

Keywords: Medicinal plant conservation; biodiversity protection; habitat restoration; wildlife and ecosystem sustainability, phytochemical screening; in vitro bioactivities.

METHANE MITIGATION THROUGH INTEGRATED RICE–TREE AGROFORESTRY SYSTEMS

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Methane (CH₄) is a potent greenhouse gas responsible for nearly 30% of global warming since pre-industrial times. Paddy cultivation is a major anthropogenic source of methane emissions due to its anaerobic soil conditions during continuous flooding. Integrating trees with rice-based farming systems known as rice tree agroforestry offers a promising approach to mitigate methane emissions while improving soil fertility, biodiversity, and farmers' income. This review explores the mechanisms, potential, and challenges of methane mitigation through integrated rice–tree systems. Tree integration modifies the microclimate, enhances soil aeration, and influences carbon dynamics, which collectively suppress methanogenic microbial activity. Tree roots improve soil porosity, while litter and root exudates promote methanotrophic (methane-oxidizing) bacteria, thereby reducing net methane flux. Studies from Southeast Asia and India have reported methane reductions ranging from 10% to 30% in systems such as rice–bamboo, rice *Gliricidia*, and rice *Acacia* compared to conventional monocropping. Moreover, these systems enhance carbon sequestration, improve soil organic matter, and diversify farmers' income sources through timber, fruits, and non-timber forest products. However, large-scale adoption faces challenges, including limited field data, yield trade-offs due to shading, and lack of policy support. Long-term research is required to quantify the overall greenhouse gas balance and develop region-specific agroforestry models. In regions like Chhattisgarh, India known as the “Rice Bowl” of the country integrating suitable tree species such as *Dalbergia sissoo*, Bamboo, and *Gliricidia sepium* can serve as a climate-smart strategy for methane mitigation and sustainable rice production. Thus, integrated rice tree agroforestry systems hold significant potential to reduce agricultural methane emissions, enhance ecosystem resilience, and contribute toward achieving India's net-zero climate goals.

Keywords: Methane mitigation, agroforestry, greenhouse gases, carbon sequestration, climate-smart agriculture

DEVELOPMENT OF A NOVEL BIODEGRADABLE PACKAGING BY USING SUGARCANE BAGASSE AND PADDY STRAW WITH MUSHROOM MYCELIUM

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This study aimed to develop a foam packaging by combining mycelium with biodegradable agro-industrial waste such as sugarcane bagasse and paddy straw. Agro-industrial wastes are those by-products and residues which are generated from agricultural and food processing industries. Waste materials like paddy straw and sugarcane bagasse are abundantly available in India and present for promising raw materials for eco-friendly and sustainable packaging solutions. The development process involves sterilization of the agricultural waste and inoculation of mycelial culture. The mushroom is left in a place with high-humidity environment to encourage the growth of mycelium which then bind with substrate and forms a solid structure. After successful colonization, it is transferred and moulded into desirable thickness and shape with the help of pressure or molds. The physicochemical properties along with the morphological features and elemental composition of the samples were systematically evaluated by using advanced analytical techniques such as SEM and EDX within the first 30 days of their biodegradability period. The mycelium-based foam packaging was completed in 30–40 days, which shows that it can be developed without the use of sophisticated infrastructure or highly specialised labour and hence, there is room for scalability with modest investment. The final product exhibited remarkable mechanical properties including high tensile strength and flexibility, which is comparable to or even exceeding those of conventional synthetic materials. These characteristics when combined with their biocompatibility, sustainability and flexible design option make it a suitable alternative for diverse sustainable packaging applications. This study establishes that packaging foam material developed from sugarcane bagasse, paddy straw and mushroom mycelium has excellent biocompatibility and as it is non-toxic to the environment compared to existing synthetic plastics, it puts forward a significant step towards the development of sustainable packaging solutions.

Keywords: Mycelium, biodegradable, agro-industrial waste, sustainable, sterilization, inoculation, eco-friendly, biocompatibility, sustainability

INHERITANCE OF SEX EXPRESSION AND FRUIT SHAPE IN MELON (*CUCUMIS MELO* L.)

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Sex expression and its related trait, fruit shape were studied in inter-botanical cross combinations of melon landraces, wild type and cultivated varieties with various fruit shapes and two distinct sex forms. The nine parents and their 18 F₁ hybrids, F₂ and back crosses of two of the selected cross combinations of oblate, andromonoecious X oval, monoecious and oblate, andromonoecious X cylindrical, monoecious were evaluated for sex expression and fruit shape. All the hybrids of andromonoecious X monoecious parents resulted in all monoecious hybrids with intermediary fruit shape. Andromonoecious hybrid was observed only when both the parents were andromonoecious. Crosses between round fruit type (**IC632181**) and oblate shaped fruited parents, both with andromonoecious nature resulted in hybrids with round fruits. The Chi square analysis for goodness of fit was non- significant for both sex expression and fruit shape suggesting the dominance of monoecious over andromonoecious and incomplete dominance for fruit shape for oblate X oval and cylindrical fruit types.

Keywords: *Cucumis melo* L., sex expression, fruit shape, melon breeding, andromonoecious, monoecious.

INTEGRATING CIRCULAR ECONOMY PRINCIPLES INTO AGRICULTURAL WASTE MANAGEMENT: BUSINESS MODEL INNOVATIONS AND MARKETING STRATEGIES FOR SUSTAINABLE AGRI-BUSINESS

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The transition towards sustainable agri-business requires innovative approaches to managing agricultural waste within a circular economy (CE) framework. This study aims to examine how circular economy principles can be effectively integrated into agricultural waste management systems and how such integration fosters business model innovation and sustainable marketing strategies in agri-business enterprises. The research adopts a mixed-method empirical approach, combining a survey of 250 agribusiness firms with case studies of five organizations implementing CE-based waste valorisation practices across different regions. Quantitative data were analysed using structural equation modelling (SEM) to assess the relationships between CE adoption, business model innovation, and market performance, while qualitative insights provided depth on implementation challenges and consumer perceptions. The findings reveal that circular waste management practices such as composting, bioenergy production, and upcycling of crop residues significantly enhance resource efficiency, cost savings, and brand reputation. Moreover, integrating CE principles stimulates business model innovation, particularly through value co-creation, product differentiation, and the development of eco-branded products. Marketing strategies emphasizing environmental responsibility and traceable sustainability narratives were found to strengthen consumer trust and market competitiveness. However, barriers such as limited access to green financing, technological constraints, and policy gaps impede broader adoption. This study contributes to the literature by providing an empirically grounded framework for linking circular economy practices with sustainable business models and marketing innovation in the agricultural sector. It offers actionable insights for policymakers, entrepreneurs, and marketers to design resilient agri-business systems that align profitability with environmental stewardship and circular value creation.

Keywords: Circular economy, agricultural waste management, business model innovation, sustainable marketing, agri-business sustainability.

IMPACT OF MOISTURE STRESS ON GROWTH ATTRIBUTES OF CHIA (*SALVIA HISPANICA* L.)

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A study on “Impact of moisture stress on growth attributes of chia (*Salvia hispanica* L.)” was conducted at College of Horticulture, Mudigere. The experiment comprised of twelve treatment combinations involving four genotypes viz., H. D. Kote local, Mysore local, T. Narasipura local and Nanjangud local and three moisture stress levels i. e. 50, 75 and 100 % (Control) of field capacity tested in a factorial completely randomized design with three replications. Results of the experiment revealed that, genotype H. D. Kote local recorded significantly maximum plant height (96.85 cm), number of leaves per plant (36.83), total fresh weight of plant (25.16g) and total dry matter (12.21 g/plant). Control – 100 per cent of field capacity (FC) recorded higher values for all the above parameters. Among the interactions, H. D. Kote local with 100 per cent of FC noted significantly maximum plant height (98.66 cm), number of leaves per plant (41.50), total fresh weight of plant (26.43 g) and total dry matter (12.87 g/plant). Mysore local showed poor performance among the genotypes. While, severe stress level (50 % of FC) reduced the plant height (cm), number of leaves, total fresh weight (g) and total dry matter (g/plant). Therefore, control (100 % of FC) was found beneficial for better growth of chia genotypes.

Keywords: Water stress, Field capacity, Genotype, Growth.

MASS MODELLING OF RED BELL PEPPER: A MORPHOMETRIC AND PHYSICAL PROPERTY APPROACH

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Accurate mass modelling of horticultural produce is essential for postharvest handling, packaging design, transportation, and quality assessment. Red bell pepper (*Capsicum annuum* L.) is a widely consumed vegetable with high commercial and nutritional importance, yet its irregular shape poses challenges for non-destructive mass prediction. This study focuses on developing empirical mass models for red bell pepper using dimensional and morphometric attributes. Key physical parameters, including length, diameter, projected area, geometric mean diameter, sphericity, and volume, were measured, and their correlation with fruit mass was evaluated. Different regression models, including linear, multiple, and nonlinear functions, were evaluated to determine the most predictive relationship. Results indicated that fruit volume and geometric mean diameter exhibited the strongest correlation with mass, enabling the development of highly accurate estimation models ($R^2 > 0.95$). The proposed models can serve as useful tools for automated grading, sorting, and optimising packaging systems for red bell peppers in the agri-food industry. Moreover, the approach demonstrates the potential of using simple morphometric parameters for reliable, rapid, and non-destructive estimation of produce mass.

Keywords: Mass modelling, Physical properties, Morphometric parameters, Geometric mean diameter, Fruit volume, Regression analysis

EFFECT OF ZINC OXIDE (ZNO) AND IRON OXIDE (FEO) NANOPARTICLES ON GROWTH AND YIELD CHARACTERISTICS OF SPONGE GOURD (*LUFFA CYLINDRICA* L.)

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The current study aimed to assess the impact of zinc oxide (ZnO) and iron oxide (FeO) nanoparticles on the growth, yield, and physiological performance of sponge gourd (*Luffa cylindrica*). Under controlled experimental settings, different amounts of ZnO and FeO nanoparticles were sprayed on the leaves. The treatments had a big effect on a number of morphological and biochemical indicators when compared to the control. T16 outperformed all other treatments in terms of vine length, fruit weight, number of fruits per plant, and overall output. It also showed improved chlorophyll content and general plant vigor. A synergistic effect of adjusted nanoparticle concentration on nutritional absorption and metabolic activity is shown by the improvement in T16. These results suggest that the prudent application of ZnO and FeO nanoparticles can be a successful Nano-fertilization technique for enhancing sponge gourd quality and productivity, providing potential uses in sustainable vegetable production.

Keywords: Sponge gourd, Nanoparticles, Vegetable, Zinc oxide, Iron oxide, Production

EFFECT OF SUSTAINABLE RESOURCE MANAGEMENT AND CIRCULAR ECONOMY ON FINANCIAL PLANNING OF BUSINESS REFERENCE TO PRAYAGRAJ

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Purpose: This study examines the impact of sustainable resource management and circular economy practices on the financial planning of businesses in Prayagraj. It aims to identify cost efficiencies, investment opportunities, and long-term benefits while addressing environmental and regulatory challenges.

Methodology: A mixed-method approach was adopted, combining qualitative interviews with business leaders and quantitative analysis of financial data from small and medium-sized enterprises (SMEs) in Prayagraj. Secondary data from government reports and academic journals provided context to local practices.

Findings: The study reveals that integrating sustainable resource management and circular economy principles significantly reduces operational costs through material reuse, waste reduction and energy efficiency. Businesses leveraging these practices experience improved financial stability due to lower dependency on raw materials and enhanced access to green financing. However, awareness and adoption rates among SMEs remain low, primarily due to lack of technical expertise and initial capital requirements.

Research Limitations: The findings are limited to SMEs in Prayagraj and may not fully represent large-scale businesses or other regions. Additionally, the study assumes stable economic and policy conditions, which may influence the applicability of the results over time.

Research Gap: There is limited research on the localized financial implications of circular economy practices in tier-two cities like Prayagraj, highlighting the need for broader regional and sector -specific studies.

Result: Sustainable practices positively influence financial planning by reducing costs, improving resource efficiency, and attracting green investments. They also enhance compliance with environmental regulations, reducing long-term financial risks.

Conclusion: Adopting sustainable resource management and circular economy practices offers significant financial benefits for businesses in Prayagraj. Increased awareness, capacity-building programs, and policy support are essential to drive adoption and unlock potential economic gains.

Keywords: Sustainable resource management, circular economy, financial planning, SMEs, Prayagraj, green finance, cost efficiency, regulatory compliance.

ETHNOBOTANICAL USE OF MEDICINAL PLANTS IN VETERINARY HEALTH

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Medicinal plants play an important role in maintaining the health and productivity of livestock. They provide a natural and sustainable alternative to synthetic antibiotics and hormones. These plants contain bioactive compounds with antibacterial, antifungal, anti-inflammatory, and wound-healing properties that help in treating and preventing animal diseases. Using herbal remedies improves animal welfare and reduces dependence on chemicals. Traditional veterinary practices make use of several medicinal plants for specific purposes. For example, Neem is used to cure skin infections and diarrhea, Turmeric supports digestion and liver function, and Aloe Vera helps in healing wounds and treating skin allergies. *Cassia auriculata* leaves reduce fever, and *Cucurbita maxima* (Pumpkin) leaves treat stomach disorders. The leaves of *Ipomea obscura* and *Aloe vera* are applied to manage mastitis, while sugarcane leaves are used during animal delivery for specific care. These plants are also used to treat poisoning, cough, constipation, foot-and-mouth disease, and snakebites. The present study focuses on documenting and surveying the ethnobotanical knowledge related to the use of medicinal plants in animal healthcare. The collected information helps preserve traditional veterinary practices and provides valuable insights for future research in sustainable animal treatment. Such documentation supports the conservation of indigenous knowledge and promotes the use of eco-friendly approaches in livestock management.

Keywords: Medicinal plants, veterinary health, ethnobotany, livestock, traditional medicine, herbal remedies, sustainable agriculture, animal welfare, phytotherapy, indigenous knowledge.

ENVIRONMENTAL POLLUTION AND REMEDIATION TECHNOLOGIES

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Environmental pollution stands as one of the most pressing and complex challenges of the twenty-first century, directly influencing human health, ecosystem integrity, and global sustainability. Rapid industrialization, urbanization, and population growth have led to the excessive release of harmful substances into the air, water, and soil. These pollutants ranging from greenhouse gases and heavy metals to synthetic chemicals disrupt natural cycles and cause long-term ecological and health consequences. Air pollution, driven by fossil fuel combustion and industrial emissions, contributes to climate change, respiratory disorders, and acid rain. Water pollution from sewage, agricultural runoff, and industrial discharge causes eutrophication, aquatic biodiversity loss, and contamination of freshwater resources. Soil pollution, largely resulting from agrochemical misuse and solid waste accumulation, impairs fertility and food quality, threatening food security and human livelihoods. Conventional remediation techniques such as chemical precipitation, filtration, and incineration remain widely used but are often unsustainable due to high operational costs and secondary pollution. In contrast, modern eco-friendly technologies bioremediation, phytoremediation, nanotechnology, and membrane-based systems offer efficient, cost-effective, and sustainable alternatives. Bioremediation and phytoremediation utilize microbes and plants to degrade or absorb pollutants naturally, while nanotechnology introduces highly reactive materials for advanced pollutant removal. Integrating these modern technologies with regulatory frameworks and community participation is essential for effective implementation. This study provides a critical analysis of pollution sources, impacts, and remediation approaches, emphasizing the need for sustainable and integrated pollution control strategies. It concludes that long-term success requires technological innovation supported by environmental policies, public awareness, and global cooperation to restore ecological balance and ensure a healthier planet for future generations.

Keywords: Environmental pollution, bioremediation, phytoremediation, nanotechnology, sustainable remediation.

INFLUENCE OF UREA ENRICHED BIOCHAR ON DYNAMICS AND RELEASE PATTERN OF NITROGEN **Shreedevi Jinnur,*¹, Jayadeva H M¹, G G Kadalli², Charan Babu Ankela³ and Uma Devi B S¹**

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Soil carbon plays a pivotal role in maintaining soil health, serving as a cornerstone for numerous biological, chemical and physical processes essential for ecosystem stability. However, in tropical regions, rapid oxidation of soil organic carbon often results in soils with poor structure, low water-holding capacity and reduced nutrient retention, ultimately leading to decreased agricultural productivity. Nitrogen an essential nutrient for plant growth and development, is particularly prone to losses and exhibits a low use efficiency of only 30–40%. The declining nitrogen use efficiency (NUE) in agricultural systems poses a significant challenge to sustainable crop production and global food security. Biochar, a carbon-rich material produced through the pyrolysis of biomass, possesses unique physicochemical properties such as high porosity, large surface area and high cation exchange capacity (CEC). It was therefore, hypothesised that biochar enriched with urea could act as an effective solution for increasing NUE as well improve soil carbon. The influence of nitrogen-enriched biochar on nitrogen losses and release dynamics was investigated and results revealed that leaching, volatilization losses and the total amount of nitrogen released were significantly lower compared to the application of urea alone.

Keywords: Nitrogen, biochar, leaching, volatilisation, urea

VALORIZATION OF LOW-COST AGRO-SUBSTRATE/S FOR MICROBIAL PRODUCTION OF RHAMNOLIPID BIOSURFACTANT

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Rhamnolipids (RL) are eco-friendly biosurfactant/s (BS) with potential industrial applications and alternatives to synthetic surfactants. The global BS market projected to reach USD 5.24 billion by 2025 and India's market anticipated to be worth USD 91.46 million by 2029. To enhance production efficiency and bridge the cost gap with synthetic options, utilizing low-cost substrates like onion peel becomes crucial. The world produces approximately 47.6 MT of onions annually; India produces 26.7 MT on more than 1 million hectares. Almost 30% of agricultural waste is generated annually worldwide. *Pseudomonas* spp., notably *P. aeruginosa*, are valuable for biosurfactant production, particularly RLs. Study was initiated with screening of microbial culture for production of BS. Further potent organisms were shortlisted to continue optimization studies for RL-BSs production through optimizing the parameters substrate, carbon/nitrogen sources, pH, and temperature by using OFAT approach. The Onion peel extract was selected as a low-cost substrate. The optimized parameters were substrate, carbon source, and nitrogen source 1% each, pH 7 yielded the highest BS yield than before optimize. BS extraction was performed by acid precipitation followed by solvent extraction with chloroform: methanol (2:1). The purified product was characterized using TLC and FTIR. The BS remained stable across pH 6-8 and temperatures from -20°C to 121°C. Growth kinetics showed that *pseudomonas* produced a high yield after 72 h. This optimization increased the yield and highlighting the potential of economical substrates for sustainable BS production.

Keywords: Rhamnolipid, Low-cost substrate, Optimization, Production.

UNMANNED AERIAL VEHICLES IN SUSTAINABLE FARMING: A REVIEW ON APPLICATIONS FOR CROP MONITORING AND PEST MANAGEMENT

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Agriculture is undergoing a technological transformation, with precision farming practices increasingly adopted to address the challenges of food security, environmental sustainability, and farmer safety. In developing countries such as India, where the majority of the population relies on agriculture, pest and disease outbreaks continue to limit crop yields and force excessive dependence on chemical pesticides. Manual spraying not only results in uneven application and high input costs but also exposes farm workers to severe health risks. Unmanned Aerial Vehicles (UAVs) offer a promising solution by combining automation, precision, and efficiency in agricultural operations. This review examines the growing role of UAVs in precision agriculture, focusing on their applications in crop monitoring, disease detection, and pesticide spraying. Modern UAV platforms equipped with multispectral, thermal, and hyperspectral sensors enable detailed assessment of crop health through vegetation indices such as NDVI, thereby assisting farmers in site-specific decision-making. When integrated with automated spraying mechanisms, UAVs allow targeted pesticide and fertilizer application, which reduces chemical use, minimizes environmental contamination, and lowers labor requirements. Comparative studies demonstrate that UAV-based spraying is faster, safer, and equally effective as traditional methods, while also reducing wastage and operational costs. Recent advances in UAV hardware and software, including high-endurance flight systems, electrostatic spraying nozzles, and real-time data analytics, have further expanded their agricultural utility. Despite limitations in payload capacity, flight duration, and policy constraints, UAVs hold immense potential to reshape agricultural practices. This paper concludes that UAV-based solutions can significantly contribute to improving farm productivity, ensuring farmer health, and advancing sustainable agriculture in the years ahead.

Keywords: UAV, Precision Agriculture, Drone Spraying, Crop Health Monitoring, Sustainable Farming, NDVI

AGRIBUSINESS MANAGEMENT AND MARKETING

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The agribusiness field is a key part of the world economy. It includes everything from providing necessary supplies like seeds, fertilizers and tools to farming, processing and other important items. Good management and smart marketing are essential to handle the challenges and chances in this ever-changing industry. Marketing in agribusiness is very important because it connects farmers with consumers, helping to overcome issues related to time, distance, and access to information. It is different from regular marketing because agricultural products have special traits, like spoiling quickly, being seasonal, being bulky and facing issues with standard sizes. Main activities include storing, moving goods, sorting, financing and managing risks. Today's agribusinesses face major problems, such as changing global markets, interruptions in supply chains, the rising demand for eco-friendly and traceable products and the need to ensure farmers get fair earnings. To tackle these issues, modern marketing approaches are making more use of technology. This means using online marketing, e-commerce sites, data analytics for understanding the market, and advanced supply chain systems to improve efficiency, decrease waste, and strengthen the connections between producers and consumers. In summary, the future success of agribusiness highly depends on creating and carrying out new marketing plans that balance economic growth with caring for the environment and supporting society.

Keywords: Agribusiness, Agricultural Marketing, Supply Chain Management, E-commerce, Sustainability

INFLUENCE OF MULCHING AND TRAINING SYSTEMS ON SEED YIELD OF TOMATO (*SOLANUM LYCOPERSICUM* L.)

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An experiment entitled “Influence of mulching and training systems on seed yield of Tomato (*Solanum lycopersicum* L.)” was conducted at the Horticultural Research cum Instructional Farm, IGKV, Raipur (C.G.) during the year 2022-23 and 2023-24 in Rabi season. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with four mulching treatments (black plastic mulch, white plastic mulch, crop residue mulch, and no mulch) and four training systems (2-stem, 3-stem, 4-stem, and no training). The results revealed that the seed yield parameters viz. Number of seeds per fruit, Seed yield per plant, Seed yield per plot and Seed yield per hectare were significantly found superior in Black plastic mulch (M₁). Similarly, among training systems, T₁ (2 stem training) recorded superior values for all the seed yield parameters. It was also revealed that the interaction between black plastic mulch and 2 stem training was found superior.

Keywords: Mulching, Training, Tomato, Seed yield parameters.

Development of Functional Jellies Enriched with *Spinacia oleracea* (Spinach) and *Rosa damascena* (Damask Rose) for Enhanced Nutritional Properties

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Micronutrient deficiencies (MNDs) are a significant public health issue, particularly affecting children and pregnant women. Common deficiencies—including iron, folate, zinc, iodine, and vitamin A—are known to contribute to developmental delays, stunted growth, and complications during pregnancy and childbirth. The folate deficiency is creating widespread concern among pregnant women and leads to serious health problems. Preventing these deficiencies is essential and can be achieved through both supplementation and dietary strategies. This research study is focused on formulating the jellies enriched with *Spinacia oleracea* (spinach) to boost folate levels. Additionally, *Rosa damascena* flowers are incorporated as a natural coloring agent, while honey serves as the primary sweetener, with sugar also included. This novel approach aims to support folate supplementation and promote improved nutritional outcomes in a more appealing and accessible form.

Keywords: Micronutrient deficiency, *Spinacia oleracea*, *Rosa damascena*, Folate

3D BIOPRINTING AND ORGANOIDs FOR REGENERATIVE MEDICINE

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Regenerative medicine focuses on restoring damaged tissues and organs by harnessing biological systems and advanced fabrication technologies. Among the most promising of these are 3D bioprinting and organoid culture systems, both of which mimic natural tissue architecture and function. 3D bioprinting utilizes layer-by-layer deposition of bio-inks composed of living cells, hydrogels, and biomaterials to generate tissue constructs with spatial precision. Organoids, on the other hand, are self-organized, miniaturized three-dimensional cell cultures derived from stem cells that recapitulate the structural and functional complexity of human organs. Integrating these two approaches—embedding organoids within bioprinted scaffolds enhances cellular organization, vascularization, and functional maturation. This hybrid technology has demonstrated significant potential in regenerating cardiac, hepatic, and neural tissues, while also serving as models for disease research and drug testing. Despite remarkable advances, challenges such as nutrient diffusion, long-term viability, and ethical considerations remain. Future research focuses on improving bio-ink formulation, AI-assisted design, and bioreactor-based maturation systems to create clinically viable tissues. The convergence of 3D bioprinting and organoid technology represents a transformative step toward personalized regenerative therapies that may one day replace donor organ transplantation.

EFFICACY OF AZOXYSTROBIN (0.1%) IN MANAGING RICE BLAST AND MINIMIZING YIELD LOSS UNDER FIELD CONDITIONS IN RAIPUR DISTRICT, CHHATTISGARH

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The sustainability of rice production in Chhattisgarh, India's "Rice Bowl" is increasingly threatened by blast disease caused by *Magnaporthe oryzae* (grease). Frequent outbreaks in humid agro-climatic zones such as Raipur have highlighted the need for effective and site-specific disease management strategies. To address this issue, a field investigation was conducted during the kharif season at Village- Nawagaon, Block- Dharsiwa, District - Raipur of Chhattisgarh during the year of 2024-25 to evaluate the efficacy of Azoxystrobin (23% SC) in managing leaf and neck blast under farmer field conditions. Azoxystrobin was applied as a foliar spray at the recommended 0.1% concentration twice during the crop growth period at booting and heading stages using a spray volume of 500 ml ha⁻¹. The results demonstrated that the treatment significantly reduced disease incidence and intensity compared to untreated control plots. The fungicidal application led to a yield loss reduction of up to 26.8% relative to the untreated check, confirming its potential in maintaining grain yield stability. Enhanced panicle development, grain filling and test weight further reflected the positive physiological response of the crop to disease suppression. The study indicates that Azoxystrobin's systemic and translaminar action effectively inhibits the pathogen's spore germination and mycelial growth, providing both protective and curative control. Therefore, Azoxystrobin (0.1%) represents a reliable and scientifically validated option for managing rice blast in the Raipur district, provided it is used judiciously within a fungicide rotation program to delay resistance development.

Keywords: Rice Crop, Blast of Rice, *Magnaporthe oryzae*, Azoxystrobin 0.1%, Yield loss reduction

STUDIES ON ISOLATION, IDENTIFICATION, AND PATHOGENICITY OF MAJOR FUNGAL PATHOGENS ASSOCIATED WITH *LUFFA AEGYPTIACA* MILL.

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Luffa (*Luffa aegyptiaca* Mill.), commonly known as sponge gourd, is an economically important vegetable crop cultivated widely in tropical and subtropical regions. However, its productivity is severely affected by various fungal diseases that lead to significant yield and quality losses. The present investigation entitled "Studies on Management of Some Important Fungal Diseases of *Luffa aegyptiaca* Mill." was undertaken to isolate, identify, and study the pathogenicity of major fungal pathogens associated with the crop. Diseased leaf, stem, and fruit samples were collected from different fields and subjected to isolation using Potato Dextrose Agar (PDA) medium. The predominant fungal species isolated and identified based on morphological and microscopic characteristics included *Fusarium oxysporum*, *Alternaria alternata*, *Colletotrichum gloeosporioides*, and *Cercospora citrullina*. Among these, *Fusarium oxysporum* was found to be the most virulent pathogen causing vascular wilt, followed by *Colletotrichum gloeosporioides* responsible for fruit anthracnose. Pathogenicity tests were carried out under controlled conditions using Koch's postulates, confirming the disease-causing ability of each isolate. The study provides a comprehensive understanding of the major fungal pathogens infecting *Luffa aegyptiaca* and their pathogenic potential, which forms a basis for developing integrated disease management strategies in future work involving biocontrol agents, fungicidal screening, and cultural practices.

Keywords: *Luffa aegyptiaca*, fungal pathogens, isolation, identification, pathogenicity, *Fusarium oxysporum*, *Colletotrichum gloeosporioides*

EVALUATION OF FERMENTED *Leucaena* sp. SEED MEAL FOR FISHMEAL SUBSTITUTION IN THE DIET OF WHITE LEG SHRIMP *Penaeus vannamei* REARED IN CAGES

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The present study aimed to the evaluation of fermented *Leucaena* sp. seed meal for fishmeal substitution in the diet of white leg shrimp *Penaeus vannamei* reared in cages. The present study aimed to investigate the fermented *Leucaena* sp. seed meal on growth, survival, digestive enzyme, gut microbiome and disease resistance in white leg shrimp *P. vannamei* reared in cages. The experiment was conducted for 60 days. Five treatments were designed including, T0 (control) without fermented *Leucaena* sp. seed meal, treatment T1 (10% fermented *Leucaena* sp. seed meal), treatment T2 (20% fermented *Leucaena* sp. seed meal), treatment T3 (30% fermented *Leucaena* sp. seed meal) and treatment T4 (40% fermented *Leucaena* sp. seed meal). Shrimps with a mean weight of 0.045g were stocked at a density of 20 nos./cage in all 20 cages and were fed four times per day. The results of the study demonstrated that incorporation of 20% fermented *Leucaena* sp. seed meal in the shrimp diet had a highest growth performance, survival rate, feed utilization and digestive enzyme activity (protease, amylase and lipase). Moreover, when the shrimps were exposed to *Vibrio parahaemolyticus* showed significantly higher ($p < 0.05$) survival in shrimp fed with 20% fermented *Leucaena* sp. seed meal. The results of gut microbiota of shrimp revealed significantly variation in the microbial community composition across different treatments. Shrimps fed with 20% fermented *Leucaena* sp. seed meal exhibited the highest species count and diversity. At the genus level, *Vibrio* was consistently abundant in all treatments, with the highest prevalence in control treatment. From the results of present study, it can be concluded that the incorporation of 20% fermented *Leucaena* sp. seed meal can be beneficial to improve growth performance, survival rate, feed utilization, digestive enzyme activity, gut microbiota and disease resistance against *V. parahaemolyticus* infection in *P. vannamei*.

Keywords: *Penaeus vannamei*, *Vibrio parahaemolyticus*, *Leucaena* sp., Growth, Survival, Digestive enzyme, Gut microbiome, and Disease resistance.

INNOVATIONS IN AGRICULTURAL BIOTECHNOLOGY, BIO-FERTILIZERS AND BIO-PESTICIDES

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Agricultural biotechnology has become a cornerstone of sustainable farming, offering tools to enhance productivity while reducing environmental stress. Among the most promising developments are bio-fertilizers and bio-pesticides, which present eco-friendly alternatives to synthetic agrochemicals. It explores recent innovations in agricultural biotechnology that integrate microbial technology, genetic improvement, and nanotechnology to develop efficient bio-inputs for modern agriculture. Bio-fertilizers such as nitrogen-fixing *Rhizobium*, phosphate-solubilizing bacteria, and mycorrhizal fungi are being formulated with improved carrier materials and encapsulation techniques to increase shelf life and field performance. Similarly, advancements in bio-pesticides based on entomopathogenic fungi, *Bacillus thuringiensis*, and plant-derived metabolites are enabling targeted pest management with minimal ecological disruption. Emerging biotechnological tools, including CRISPR-based strain enhancement and metagenomic screening, are accelerating the discovery of novel microbial strains with higher efficiency and stress tolerance. The integration of these innovations with precision farming, digital monitoring, and bio-informatics offers a pathway to sustainable intensification of agriculture. This approach not only promotes soil health and biodiversity conservation but also reduces dependence on chemical inputs and mitigates climate change impacts. Overall, this highlights how advancements in agricultural biotechnology, through bio-fertilizers and bio-pesticides, are transforming traditional agriculture into a more resilient, productive, and environmentally responsible system suitable for future global food security.

Keywords: Agricultural biotechnology, Bio-fertilizers, Bio-pesticides, Sustainable agriculture, Microbial innovations

OPTIMIZATION OF OSMO-CONVECTIVE DRIED SHATAVARI ROOT POWDER

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Shatavari roots (*Asparagus Racemosus*) is an indigenous traditional medicinal plant. Shatavari roots are rich in phytochemicals such as Saponins, Flavonoids, Alkaloids, Phenol and Tannin content. These active compounds contribute to shatavari roots medicinal properties. Shatavari root powder have shown their phyto-pharmaceutical effects that treats the female related issues and a variety of ailments such as dyspepsia, neurological disorders, cough bronchitis, throat infections, tuberculosis and COVID 19. Osmotic dehydration is a preservative method that helps in retaining valuable phytochemicals, reducing the moisture content and inhibit the growth of microorganisms which produces shelf-stable products and can be used during off-season. The results of this study consist of osmotic dehydration of shatavari roots followed by its convective drying. The process parameters considered for the study were osmotic concentration (50-70°Brix), osmotic temperature (40-60°C), stirring speed (0 - 60 rpm) at a constant immersion time (180 min) at constant syrup to shatavari root ratio (4:1) and drying temperature and evaluated their effects on mass transfer properties, drying kinetics, physical, chemical, phytochemical and sensory properties. Optimization of process parameters were done by Design Expert software 13. The optimum process parameters obtained were: 60 °Brix of sugar concentration, 50°C of osmotic solution temperature and 60 rpm of stirring speed for water loss (42.03%), solid gain (5.77%) and mass reduction (36.27%). Drying temperature (50-70 °C) had affected significantly at 5 % level the drying rate and final quality of the product.

Keywords: Shatavari roots, Optimization, Osmotic dehydration, Drying kinetics, Mass transfer properties, Phyto-chemical properties

GREEN-SYNTHEZED BAMBOO NANOMATERIALS AS A SUSTAINABLE PLATFORM FOR BIOLOGICAL AND ENVIRONMENTAL APPLICATIONS

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Bio nanotechnology and green technology have led to the emergence of sustainable approaches for nanoparticle synthesis that minimize environmental impact and promote renewable resource utilization. Traditional methods of nanoparticle synthesis often depend on hazardous chemicals and generate toxic by-products, posing risks to both human health and the environment. Green nanoparticles are emerging as a sustainable and eco-friendly alternative to conventional synthetic nanoparticles, which often involve toxic chemicals and harsh processes. These nanoparticles are produced by plant extracts, microorganisms, biopolymers, serving as reducing and stabilizing agents, eliminating the need for toxic chemicals. Because of unique physicochemical properties, such as high surface area, biocompatibility, and enhanced stability, making them suitable for a broad range of applications, including drug delivery, environmental remediation, food packaging, and biosensing. Bamboo has bioactive compounds such as flavonoids, phenols, and alkaloids, act as natural reducing agents during nanoparticle synthesis, leading to the creation of stable and biocompatible nanoparticles. This approach of green technology emphasizes the use of sustainable processes and renewable resources to minimize environmental impact and promote circular economies. The utilization of bamboo in nanomaterial production supports the principles of green technology by emphasizing renewable resources, waste reduction, and energy efficiency. These bamboo-based nanoparticles have shown to exhibit various benefits including antimicrobial, antioxidant, and anti-inflammatory, anti-diabetic properties, making them promising candidates for applications in health sector, environmental preservation, and food safety. The natural abundance and fast growth rate of bamboo further contribute to its potential as a renewable resource in green nanotechnology. The continued development of bio nanotechnology within a green technology framework holds significant promise for achieving a sustainable and technologically advanced future.

Keywords: nanoparticles; ecofriendly; biocompatibility; bioactive compounds; antioxidant; sustainable

ADAPTING TO WATER SCARCITY: THE ROLE OF PRD AND RDI IRRIGATION METHODS IN *MORINGA OLEIFERA*

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The agricultural sector faces mounting challenges due to increasing water scarcity driven by climate change and growing food demand. Developing water-efficient irrigation methods is crucial for enhancing crop productivity in resource-limited regions. This study, conducted during the rabi season of 2019–20 in the tribal district of Narmada, Gujarat, investigated the effects of Partial Root Zone Drying (PRD) and Regulated Deficit Irrigation (RDI) on *Moringa oleifera* under drip irrigation. Five treatments were applied: Fixed PRD (T1), Alternate PRD (T2), RDI at flower bud development (T3), RDI at pod setting (T4), and standard drip irrigation as control (T5). Results demonstrated the superiority of Alternate PRD (T2), which recorded the tallest plants (395.0 cm), maximum dry matter accumulation (5.5 kg/plant), and highest yield (9.87 kg/tree). In contrast, the lowest yield (4.32 kg/tree) occurred under RDI at pod setting (T4). Water productivity, expressed as IWUE, was also greatest in T2 ($0.0127 \text{ t ha}^{-1} \text{ mm}^{-1}$), with T3 outperforming T4 among RDI treatments. Standard irrigation (T5) resulted in the least favorable growth and efficiency outcomes. These results indicate that APRD can serve as a climate-resilient irrigation practice, enhancing water use efficiency and crop yield under conditions of water scarcity. Adoption of such strategies could support sustainable intensification of agriculture, particularly for smallholder farmers in semi-arid and tribal regions.

Keywords: Climate-Resilient Agriculture, Water Scarcity, Partial Root Zone Drying, Deficit Irrigation, *Moringa oleifera*

BIOGENIC NANOPARTICLES FROM MICROORGANISMS AS POTENTIAL DRUG DELIVERY SYSTEMS

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The cure to many infectious diseases still remains a global challenge in spite of advent of new drugs and technologies. The inefficient traditional drug delivery system results in inadequate therapeutic index, low bioavailability of drugs and several other limitations. Hence recent research findings have drawn attention towards biogenic nanocarriers from microbial or plant sources as a potential candidate for different biomedical and drug delivery applications. Engineered microbial nanoparticles can efficiently act as biocompatible carriers for drug delivery with precision. Further, these nanoparticles, display their ability to be used as theranostics i.e., both therapeutic as well as diagnostic agents in a single unit. The nanoparticles synthesized from microbial cells also exhibit antifungal, antimicrobial, antiviral, antidiabetic, anti-inflammatory, and antioxidant properties which enhance their therapeutic value. These systems in show potential to be used in targeted (cellular or tissue) delivery of drugs, to improve bioavailability, to sustain release of drugs or solubilize drugs for systemic delivery etc. These nanoparticles offer many advantages for their applications in drug delivery such as small size, biodegradability, harmless to other tissues, easy absorption etc. Thus, the nanoparticles from microbial source holds great potential in various areas of drug delivery such as gene therapy, overcoming the blood brain barrier, antibiotic therapy and cancer therapy. The current review attempts to focus particularly on the application of such microbially derived nanoformulations as a drug delivery and targeting agents.

Keywords: Microbial nanoparticles, biogenic, targeted drug delivery, nanoformulations, theranostics.

PROVENANCE-BASED VARIATION IN FRUIT CHARACTERS OF TEAK (*TECTONA GRANDIS* L.F.)

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The study investigates provenance-based variation in fruit characters of teak (*Tectona grandis* L. f.) collected from eleven provenances across the Western Ghats of Kerala and Karnataka. Significant variability was observed among provenances for fruit traits, including fruit length, width, thickness, number of locules per fruit and number of seeds per fruit. Fruit length ranged from 14.5 mm (Kokilbana) to 11.8 mm (Naragakkanam), while fruit width and thickness varied between 16.3 to 12.6 mm and 13.7 to 11.3 mm, respectively. The highest number of locules per fruit (3.8) was recorded in Nayarupara and the highest number of seeds per fruit (2.8) in Madanaru. The number of locules per fruit exhibited the highest genotypic (34.0 %) and phenotypic (31.44 %) coefficients of variation, high heritability (70.48 %) and the greatest genetic gain (45.43 %), indicating strong additive genetic control. Significant positive correlations were recorded among fruit length, width and thickness ($r = 0.88-0.89$), while the number of seeds per fruit was positively associated with locule number ($r = 0.68$). Provenances such as Kokilbana, Nayarupara and Madanaru demonstrated superior performance for different fruit traits, suggesting their potential as promising seed sources. The observed genetic diversity among provenances highlights ample scope for selection and improvement in teak breeding programs.

Keywords: *Tectona grandis*, provenance, fruit traits, genetic variability, correlation

UNVEILING THE POTENTIAL OF NEGLECTED TUBER LEGUMES FOR FOOD AND NUTRACEUTICAL RESILIENCE

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Underutilized and lesser-explored tuber-forming legumes such as **winged bean** (*Psophocarpus tetragonolobus*), **yam bean** (*Pachyrhizus erosus*), and **African yam bean** (*Sphenostylis stenocarpa*) possess tremendous potential to enhance and diversify food and nutraceutical security, particularly among resource-constrained and climate-vulnerable communities. These legumes exhibit remarkable adaptability to abiotic stresses such as drought, problematic soils, and low-input farming systems conditions where major pulses often fail or prove non-remunerative. Among these, the **winged bean** stands out as a unique multipurpose legume with high nutritional and agronomic potential. Most parts of the plant—**tubers, roots, leaves, pods, and seeds**—are edible and suitable for both human and livestock consumption. The tuberous roots contain 10–20% protein, valuable carbohydrates, and essential minerals such as iron, zinc, and calcium. Moreover, its bioactive constituents, including flavonoids and phenolics, confer strong antioxidant and nutraceutical properties. Despite its versatility, the winged bean and related tuber legumes remain under-researched, with limited progress in breeding, genetic improvement, and value-chain development. Recent advancements in **genomics, transcriptomics, and mutation breeding** offer new avenues for exploiting their genetic diversity, stress resilience, and nutritional attributes. Integrating modern tools such as **GWAS, high-throughput phenotyping, and bioinformatics** with classical breeding approaches can accelerate their improvement. Strategic research prioritization, germplasm characterization, documentation, and supportive policies are crucial to mainstream these crops. Harnessing the genetic wealth of winged bean and other neglected tuber legumes can substantially contribute to **sustainable food and nutraceutical resilience** for underprivileged populations under changing climatic scenarios.

Keywords: Winged bean, Tuber legumes, Underutilized crops, Nutraceuticals, Food security, Genomics, Mutation breeding

EFFECT OF NATIVE ISOLATES OF AZOTOBACTER ON THE GROWTH OF MAIZE (ZEA MAYS L.)

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Attempts were made to isolate, characterize and evaluate the effect of native isolates of *Azotobacter* on growth of maize at Department of Microbiology, UAS, Dharwad. A total of 50 *Azotobacter* isolates were obtained from rhizosphere soils of maize and sorghum crops grown in Gadag and Dharwad districts of Karnataka. All the isolates were subjected for morphological, functional and biochemical characterization. Among 50 isolates, 49 were cocci in shape and all the isolates were Gram negative. The isolates exhibited varying pigmentation viz., brown, light yellow, yellow and yellowish-green. Majority of isolates produced brown pigmentation. Among 50 isolates, 38 were positive for cyst formation. The amount of nitrogen fixed by isolates ranged from 2.12 to 9.95 mg N₂/g of 'C'. The native isolate NMAz5 fixed highest amount of nitrogen (9.89 mg N₂/g of 'C'). While, all the isolates produced both IAA and GA. The amount of IAA and GA production ranged from 2.68 to 42.86 µg/ml and 1.79 to 17.51 µg/25 ml respectively. Amount of Pi and K released ranged from 3.53 to 11.73 µg/ml and 3.51 to 17.10 µg/ml respectively. Biochemical characterization indicated that isolates were positive for catalase, oxidase, citrate utilization and ammonia production but negative for methyl red, indole test and nitrate reduction test. These three potent isolates viz., NMAz5, DSAz26 and YSAz44 were further evaluated for their potential in enhancing growth parameters of maize viz., plant height, number of leaves, stem girth, shoot and root dry weight, total dry matter production, soil dehydrogenase activity and nutrient concentration of maize. Seed inoculation with consortium of these three *Azotobacter* isolates with 75 % RDF significantly enhanced all growth parameters and nutrient concentration of maize compared to uninoculated treatments. Hence, these need to be further tested under field conditions in order to initiate their use in biofertilizer/ bioinoculant production.

Keywords: *Azotobacter*, Biofertilizer production, Cyst, Nitrogen fixation, Pigmentation.

PURIFICATION AND CHARACTERIZATION OF LACCASE PRODUCED BY *BACILLUS HYNESII* T1 IN BIODEGRADATION OF SYNTHETIC AZO DYE

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Discharge of azo dyes from various industries is highly fatal to the environment and has increased due to different anthropogenic activities. They are also known to cause carcinogenic and mutagenic effects on humans. This study mainly aims to develop strategies for decolonization and detoxification of synthetic dyes using ligninolytic enzymes. The applicability spectrum of ligninolytic enzymes such as laccases (Lac, benzenediol: oxygen oxidoreductase, E.C. 1.10.3.2) is always highlighted, which catalyzes cofactor independent one-electron oxidation of a wide array of aromatic and aliphatic molecules including xenobiotic pollutants, with consequent reduction of molecular oxygen to water. In this study, the extracellular production of laccase by ligninolytic bacteria was confirmed with guaiacol oxidation test and enzymatic assay using ABTS (2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid)). The laccase production media was optimized for enhanced laccase production using one factor at a time (OFAT) method. The laccase was purified from *Bacillus hynesii* T1 culture in optimized media, using ammonium sulphate precipitation and gel filtration chromatography. The purified enzyme was characterized for pH optima, temperature optima and thermal stability. Purified enzyme was able to decolorize 74% of Congo red dye after 96 h of incubation.

Keywords: azo dyes, ligninolytic enzymes, laccase enzyme.

PIMT EXPRESSION DYNAMICS OF *PSEUDOMONAS AERUGINOSA* IN RESPONSE TO HEAT STRESS

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Protein damage is an impulsive process and various abiotic, biotic factors are accountable for this. Some phenomena like racemization, Isomerization and amidation are provoked due to protein damage. For the survival of different organisms these damages served as obstacle and to tackle this, the native structure of the protein needs to be defended. The damaged Aspartyl and Isoaspartyl residues which are found in the protein backbone are healed by PIMT enzyme which convey the CH₃ group present in S-Adenosylmethionine (SAM) to the injured site and an intermediate product is deployed called Succinimide. PIMT functions are un-investigated in *Pseudomonas aeruginosa* while explained in detail in few other micro – organisms like *E. coli*, *S. typhimurium* etc. *P. aeruginosa* is a G⁻Ve rod shaped bacterium which has numerous virulence determinants as well as multidrug resistant. It can survive the temperature between 25 °C to 42 °C for existence. Morphologically, having a peculiar odour with pearlescent impression and single flagellated condition makes it unique from others. The current research project concentrated on expression dynamics of PIMT in *P. aeruginosa* due to exposure to different thermal stress. The stock culture of *P. aeruginosa* was revived and propagated in suitable media. The colonies of the *P. aeruginosa* were confirmed by polymerase chain reaction (PCR) by targeting PIMT gene. rtPIMT (*P. aeruginosa*) was available which was used for the preparation of a standard curve. The protein concentration was determined by Bradford assay and found to be 0.25 µg/ml. A Western blot was performed to check the reactivity of the rt PIMT protein with the available PIMT specific polyclonal antibody. A characteristic band was observed at ~27 kDa corresponding to the molecular weight of PIMT of *P. aeruginosa*. To evaluate the expression dynamics, early log phase culture of *P. aeruginosa* were exposed to different thermal stress (37°C, 42°C, 56°C, 80 °C) for an hour and the extract was used for the evaluation of PIMT expression by Western blot and ELISA. The expression of PIMT was significantly higher in the groups exposed to 42°C, 56°C & 80 °C in comparison to 37 °C.

Keywords: PIMT, SAM, *P. aeruginosa*, thermal stress, Western blot, ELISA

UNDERSTANDING THE MOLECULAR MECHANISM(S) TO UNRAVEL THE HEALTH RISK BEHIND CENTRAL OBESITY

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Body fat distribution is primarily regulated by genetics. However, the preferential fat accumulation in the visceral fat depot as compared to subcutaneous depot is aggravating the rising incidence of type 2 diabetes and metabolic syndrome in Indian population. The excessive deposition of fat in the abdominal area or specifically visceral fat contributes to visceral adiposity/abdominal obesity/ central obesity. Numerous studies have reported Asian Indians as a vulnerable risk group for abdominal fat accumulation. This kind of fat accumulation pattern is also far beyond Body mass index measurements as there are cases where central obese individuals are not obese as per BMI guidelines. The prevalence of central obesity shows rising trend year by year and is also penetrating rural residents and lower economic sections of society. It has higher prevalence as compared to general obesity. Genome wide association studies (GWAS) have reported several loci pertaining to body fat distribution pattern, majorly being identified from the European population. Several variants pertaining to central obesity have been reported. These also include single nucleotide variants in genes linked with visceral adipocyte secretome. Studies have also identified some of the rare gene variants associated with abdominal obesity in young adults. To unravel the genetic basis for central obesity in Jammu population, body fat distribution pattern will be analysed. Expression analysis will also be carried out of genes associated with central obesity in the sample population. Validation of the functional relevance of identified gene in adipogenesis will also be carried out.

Keywords: Body fat distribution; genetics; GWAS; visceral fat; subcutaneous fat; adipocyte secretome.

DISSEMINATION OF WEATHER-BASED AGRO-ADVISORIES FOR CLIMATE-RESILIENT FARMING: EXPERIENCE FROM AMFU, NAGANAHALLI, MYSORE

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The Agro-Meteorological Field Unit (AMFU), operating at the Organic Farming Research Station, Naganahalli, Mysore, plays a pivotal role in providing weather-based agro-advisories to support climate-resilient and sustainable agriculture. The unit issues **bi-weekly weather forecasts every Tuesday and Friday**, covering the districts of **Mysore, Mandya, Chamarajanagar, and Kodagu**. The forecasts provide detailed information on **rainfall, maximum and minimum temperature, relative humidity, wind speed, and cloud cover**, which are essential for informed farm-level decision-making. Based on these forecasts, AMFU develops **crop-specific advisories**, as well as **livestock, poultry, and sericulture advisories**, along with **general and SMS-based advisories**. These advisories guide farmers in planning and executing critical agricultural operations, including **sowing, irrigation scheduling, nutrient management, pest and disease control, intercultural operations, and harvesting**. By providing timely and location-specific information, farmers are able to optimize resources, reduce crop losses due to weather variability, and enhance overall productivity. The dissemination of weather information and advisories is carried out through multiple channels, including **WhatsApp groups (around 60 groups across the four districts), television, radio, newspapers, and direct interactions with farmers during field visits and discussions**. This multi-channel approach ensures accessibility to a diverse range of farmers, including those with limited digital literacy, and promotes active utilization of weather information in daily farm management. As a result, a large number of farmers have significantly benefited from these services by making **better-informed decisions on sowing, irrigation, plant protection, and harvesting**, thereby increasing efficiency, minimizing risks, and improving crop yield. The AMFU, Naganahalli, serves as an effective interface between meteorological data and practical farm-level applications, contributing substantially to **climate-smart, resilient, and knowledge-driven agriculture** in southern Karnataka.

Keywords: Agro-meteorology, Weather forecasting, Agro-advisory services, Climate-resilient agriculture, Farmer outreach

ECONOMIC EVALUATION OF NANO DAP APPLICATION IN FIELD BEAN (*LABLAB PURPUREUS* (L.) SWEET) UNDER SOUTHERN TRANSITION ZONE OF KARNATAKA

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A field experiment was carried out during late *kharif* 2024 at the College of Agriculture, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, to evaluate the “Effect of nano DAP on economics of field bean (*Lablab purpureus* (L.) Sweet)”. The study consisted of ten treatments combining 100 per cent or 75 per cent recommended dose of fertilizers (RDF) with foliar sprays of nano DAP at 2 and 4 ml L⁻¹ applied at 30 DAS or 30 and 60 DAS, along with an absolute control. Economic parameters such as cost of cultivation, gross returns, net returns and benefit-cost (B: C) ratio were computed based on treatment yields. Results indicated a substantial improvement in economic performance due to nano DAP application. The highest cost of cultivation (₹ 43,300 ha⁻¹) was observed in T₈ (100% RDF + nano DAP @ 4 ml L⁻¹ at 30 and 60 DAS), whereas the lowest (₹ 27,200 ha⁻¹) occurred in the absolute control (T₁). The same treatment (T₈) recorded the maximum gross (₹ 1,25,407 ha⁻¹) and net returns (₹ 82,107 ha⁻¹), closely followed by T₁₀ (75% RDF + nano DAP @ 4 ml L⁻¹ at 30 and 60 DAS) with ₹ 1,19,791 ha⁻¹ and ₹ 79,023 ha⁻¹, respectively. The highest B: C ratio (2.94) was obtained in T₁₀, demonstrating that partial substitution of RDF with nano DAP significantly enhanced profitability. Enhanced returns under nano DAP treatments were attributed to improved nutrient uptake efficiency, higher yields and reduced nutrient losses. Overall, foliar application of nano DAP, particularly T₁₀ (75% RDF + nano DAP @ 4 ml L⁻¹ at 30 and 60 DAS), proved economically most viable for profitable and sustainable field bean production.

Keywords: Field bean; Nano DAP; Foliar application; Yield; Economics; Incremental Cost

EFFECT OF NANO DAP ON GROWTH, YIELD AND QUALITY OF FIELD BEAN (*LABLAB PURPUREUS* (L.) SWEET) UNDER SOUTHERN TRANSITIONAL ZONE OF KARNATAKA

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A field experiment was conducted to study the effect of nano DAP on growth, yield and quality of field bean (*Lablab purpureus* (L.) Sweet) at the College of Agriculture, Navile, Shivamogga, on sandy loam soil during the late *kharif* season of 2024. The investigation was laid out in a randomized complete block design with ten treatments and replicated thrice. Treatments comprised 100 and 75 per cent recommended dose of fertilizers (RDF) + FYM @ 7.5 t ha⁻¹ along with foliar spray of nano DAP @ 2 and 4 ml l⁻¹ applied at 30 DAS or 30 and 60 DAS. The results revealed that 100 per cent RDF + foliar spray of nano DAP @ 4 ml l⁻¹ at 30 and 60 DAS (T₈) recorded significantly higher growth attributes viz., plant height (93.67 cm), number of branches plant⁻¹ (8.45), leaf area (972 cm² plant⁻¹), LAI (1.44) and total dry matter production (33.39 g plant⁻¹) at harvest. Yield parameters were also superior in T₈ with more number of pods plant⁻¹ (26.56), dry pod weight (16.40 g plant⁻¹), 100-seed weight (14.70 g), haulm yield (2035 kg ha⁻¹) and seed yield (1234 kg ha⁻¹) with an increment of 25 per cent over 100 per cent RDF alone (T₂). Among quality traits, crude protein content (24.92%) and ash content (5.47%) were also enhanced. In T₈ seed yield was statistically on par with 75 per cent RDF + nano DAP @ 4 ml l⁻¹ at 30 and 60 DAS (T₁₀) and 100 per cent RDF + nano DAP @ 2 ml l⁻¹ at 30 and 60 DAS (T₇). However, T₁₀ with reduced fertilizer recorded the highest benefit-cost ratio (2.94). Thus, foliar application of nano DAP @ 4 ml l⁻¹ at 30 and 60 DAS along with RDF + FYM improved growth, nutrient uptake, yield and quality of field bean.

PHYTOCHEMICAL AND NUTRITIONAL ASSESSMENT OF BADHAL: EXPLORING ITS HEALTH AND THERAPEUTIC POTENTIAL

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Badhal, known as *Artocarpus lacucha*, a lesser-known member of the Moraceae family, is gaining scientific attention for its rich phytochemical profile and diverse bioactivities. Traditionally used in Southeast Asian medicine, the fruit, bark, and leaves of this plant exhibit potent antioxidant, anti-inflammatory, and antimicrobial properties, attributed to bioactive compounds such as flavonoids, phenolics, and stilbenoids. *Artocarpus* is a tropical genus of latex-rich trees like jackfruit and breadfruit, producing massive compound fruits from fused flowers. The leaves are lobed, the flowers are unisexual, and it's valued for edible fruits, timber, and bioactive compounds. Recent nutritional analyses show high mineral content and dietary fiber, supporting its role in therapeutic nutrition. This study presents a comprehensive evaluation of Badhal's phytoconstituents and proximate analysis, providing its value as a sustainable resource for nutraceutical innovation and integrative health strategies. Apart from proximate value as CHO (13.1%), Fats (1.1%), Protein (0.7%), and Moisture (82.1%), the fruit is rich in fiber (2 %), vitamins A (423 IU) & C (135 mg/100g), and minerals such as Ca (66.60 mg/100g), P (22.10 mg/100g), K (13.50 mg/100g), Zn (3.98 mg/100g), and Cu (7.97 mg/100g). Qualitative Phytochemical Analysis was conducted across various solvents for saponins, starch, flavonoids, phenols, terpenoids, and glucosides, showing promising results for antioxidant activities (TPC, TFC, and DPPH) in the methanol solvent, among others. These results show that traditional plant remedies have useful healing properties. They support the idea that old knowledge can help create modern medicines and health products that are safe and effective. Emphasis is placed on its applicability in rural health interventions and biodiversity conservation, uniting traditional with modern pharmacological practices.

Keywords: *Artocarpus lacucha*, phytochemical profile, antioxidant, anti-inflammatory, therapeutic nutrition, sustainable resource, ethnobotanical remedies, pharmacological practices.

INFLUENCE OF NANO DAP ON DRY MATTER PARTITIONING AND YIELD OF FIELD BEAN (*LABLAB PURPUREUS* (L.) SWEET) UNDER SOUTHERN TRANSITION ZONE OF KARNATAKA

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A field experiment was conducted during the *kharif* season of 2024 at the College of Agriculture, Shivamogga, to assess the influence of foliar application of nano DAP on dry matter accumulation and partitioning in field bean (*Lablab purpureus* (L.) Sweet). The study comprised ten treatments, combining 100 per cent and 75 per cent recommended dose of fertilizer (RDF) with foliar sprays of nano DAP at 2 and 4 ml L⁻¹, applied at 30 DAS or 30 and 60 DAS in a randomized block design with three replications. Results revealed a steady and significant increase in total dry matter production from 30 DAS to harvest across treatments. Among the treatments, T₈ (100% RDF + foliar spray of nano DAP @ 4 ml L⁻¹ at 30 and 60 DAS) recorded the highest total dry matter production at all growth stages 6.29 g plant⁻¹ at 30 DAS, 18.37 g plant⁻¹ at 60 DAS and 33.39 g plant⁻¹ at harvest followed by T₇ and T₁₀. The lowest total dry matter (17.00 g plant⁻¹) was observed in the absolute control (T₁). Partitioning of dry matter showed that nano DAP application enhanced the translocation of assimilates toward economic sinks. A higher proportion of dry matter was accumulated in the pods at harvest under T₈, indicating improved source-sink relationship and photosynthate utilization efficiency. Overall, the combined application of 100 per cent RDF with nano DAP @ 4 ml L⁻¹ twice proved most effective in enhancing dry matter accumulation and its efficient partitioning toward reproductive organs, thereby suggesting that nano DAP can play a vital role in improving growth dynamics and yield potential of field bean in a sustainable manner.

Keywords: Nano DAP; Dry matter accumulation; Source-sink relationship; Field bean; Foliar nutrition; Yield enhancement.

ECO- FRIENDLY DISEASE MANAGEMENT STRATEGIES

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Emerging threats from climate change, pesticide resistance, and harmful environmental impacts are driving a transition toward eco-friendly disease management strategies in agriculture. This review synthesizes key non-chemical approaches including integrated pest management (IPM), biological control agents (BCAs), resistant crop varieties, cultural practices, eco-technologies like biosolarization, and novel innovations such as nanomaterials and microbial biostimulants to offer a holistic view of sustainable plant disease suppression. We analyse the effectiveness of individual and combined strategies across diverse agroecosystems, emphasizing the mechanistic interactions between soil health, microbial communities, and pathogen dynamics under varying climatic conditions. Biological strategies such as antagonistic microbes, predatory insects, and botanical biopesticides deliver targeted pathogen suppression while maintaining ecological balance. Cultural methods like crop rotation, sanitation, trap cropping, companion planting, and resistant-variety deployment help disrupt disease cycles and build resilience. Biosolarization and nanotechnology offer scalable eco-innovations that reduce chemical inputs and improve soil health. We highlight the synergistic potential of integrating multiple approaches, in line with IPM frameworks, and call attention to gaps in scalability, regulatory readiness, and farmer adoption. Recommendations focus on optimizing combinations tailored to local conditions, enhancing formulation and delivery of biocontrols, and strengthening policy incentives and training programs. This comprehensive review aims to guide researchers, agronomists, and policymakers toward climate-resilient, sustainable disease-management systems that minimize environmental harm and promote long-term productivity.

Keywords: Eco-friendly disease management, IPM, Biological control agents (BCAs), Biopesticides/ botanical extracts, Resistant crop varieties, Cultural practices (crop rotation, sanitation, trap cropping), Biosolarization/ soil solarization, Nanomaterials in agriculture, Soil health & microbial communities, Sustainable plant pathology, Climate-smart agriculture, Synergistic disease management strategies

THE ROLE OF DIGITAL AGRICULTURE AND SMART FARMING IN TRANSFORMING INDIAN AGRICULTURE THROUGH COMPUTER TECHNOLOGY

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This review explores the transformative role of computer-based technologies in modern agriculture, with a focus on Smart Farming and Digital Agriculture for sustainable growth in India. Emerging innovations such as the Internet of Agricultural Things (IoAT), Artificial Intelligence, Robotics, Big Data Analytics, Geographic Information Systems (GIS), and Decision Support Systems are redefining agricultural practices. These tools are applied across multiple domains, including land resource assessment, autonomous farm machinery, precision farming, crop and pest management, irrigation scheduling, and e-Agriculture platforms. By integrating techniques such as remote sensing, bioinformatics, and data mining, farmers can address inherent variability in soils, crops, and climates while ensuring resource optimization. India's agriculture sector faces persistent challenges ranging from climate variability, fragmented landholdings, and traditional farming practices to socio-economic and infrastructural constraints that limit productivity gains. Additionally, poor access to timely and accurate information has historically resulted in yield losses and reduced profitability. Smart farming solutions powered by wireless communication, IoT devices, and advanced computing frameworks provide actionable insights into crop health, soil fertility, weather forecasting, and water management. These technologies not only enhance decision-making and yield forecasting but also promote resource-use efficiency and economic resilience. The integration of digital agriculture into farming systems presents opportunities to transform Indian agriculture into a more competitive, sustainable, and profitable sector. By enabling data-driven crop planning, real-time monitoring, and adoption of sustainable practices, computer applications hold the potential to meet rising food demands while ensuring environmental sustainability.

Keywords: Digital Agriculture, Smart Farming, Artificial Intelligence, Robotics, IoT, 4G/5G, Precision Agriculture, Decision Support Systems

EFFECT OF VARIOUS INDOLE-3-BUTYRIC ACID CONCENTRATIONS ON MOUND LAYERING IN *TERMINALIA ARJUNA* IN A NATURAL FOREST

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Terminalia arjuna is a valuable multipurpose tree species with high medicinal and ecological importance. Vegetative propagation via mound (air) layering is a practical technique for mass in situ multiplication, but success depends heavily on auxin treatment and seasonal conditions. This study assessed the effect of different indole-3-butyric acid (IBA) concentrations on rooting and related propagation parameters of *T. arjuna* under natural forest conditions. Treatments included IBA concentrations of 0 (control), 2500, and 5000 ppm applied to the layering wound. Observations recorded included sprouting percentage, rooting percentage, number of roots per shoot, mean root length, shoot emergence, and survival, at regular intervals up to the final assessment. The application of IBA significantly improved rooting success and root quality compared to the untreated control. The 5000 ppm IBA treatment yielded the highest rooting percentage and the greatest average number and length of roots per shoot. The concentration of 0 ppm did not significantly enhance rooting over 2500ppm and sometimes slightly reduced shoot vigor. Survival and overall establishment were best in IBA-treated layers. Exogenous IBA improves mound layering success in *Terminalia arjuna* under natural forest conditions. Based on these results, 5000 ppm IBA is recommended as an effective and economical concentration for improving rooting and establishment in situ. Further multi-season trials are recommended to validate seasonal interactions and long-term effects survival. This simple, low-cost technique can be adopted by farmers, rural communities, and forest nurseries for large-scale propagation, aiding livelihood generation, soil stabilization, and medicinal bark production.

Keywords: *Terminalia arjuna*, mound layering, indole-3-butyric acid, IBA, vegetative propagation, rooting percentage,

MILLETS A SOLUTION FOR CLIMATE RESILIENT AGRICULTURE: A SUCCESS STORY FROM VIJAYANAGAR DISTRICT, KARNATAKA, INDIA

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Millets are adaptable to a wide range of environmental conditions and demonstrate both tolerance and resistance to environmental stress. They are characterised by better growth and productivity under low nutrient and input conditions, need less irrigation, are least vulnerable to biotic and abiotic stresses, and less reliant on synthetic fertilizers. They are shorter in duration vis-à-vis core cereal crops. Small millets are more nutritious and have a lower glycemic index than rice and wheat, but factors like lack of improved varieties, agronomical packages and practices as well as unorganized seed system are constraining production and productivity. Therefore, the present study was carried out to know the yield gaps between improved practices and farmers' practices under Frontline demonstration on foxtail millet and brown top millet were carried out by Agricultural Extension Education Centre, Huvinahadagali, Vijayanagar district of Kalyan Karnataka region to assess the impact of adopting improved package of practices over farmers' practice on the yield and economics of millets during *kharif* season from 2019 to 2023. Higher yield of foxtail millet was recorded under improved practices which were ranged from 13.62 to 18.00 q. ha⁻¹ which was 18.60 to 28.67 per cent higher than farmers' practice. Similar trend was noticed in browntop millet which was showed 14.60 to 21.00 per cent higher grain yield over farmers' practice during all the five years. The average technological gap for grain yield in foxtail millet and browntop millet ranged from 7.00 to 15.00 q. ha⁻¹ and 4.00 to 12.32 q. ha⁻¹, respectively over the five years. Highest gross return of Rs. 43,476 ha⁻¹, Rs. 35,756 ha⁻¹ of net return with highest B:C ratio of 5.54 were obtained across the five years for millets under improved practices as compared to farmers' practice.

Keywords: Millets, Yield gap, Front line demonstration, improved practice, Farmers' practice

ULTRA-SENSITIVE AND SPECIFIC DETECTION OF NEONICOTINOIDS (ACETAMIPRID, THIACTLOPRID, AND THIAMETHOXAM) USING APTAMER-BASED BIOSENSING PLATFORMS

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Neonicotinoid insecticides such as acetamiprid, thiacloprid, and thiamethoxam are extensively used in modern agriculture; however, their environmental persistence and potential ecotoxicity necessitate highly sensitive and selective detection systems. In this study, we report the development of aptamer-based biosensing platforms for the rapid and simultaneous detection of these neonicotinoids with ultra-high sensitivity and specificity. Aptamers were screened from a random oligonucleotide library using Graphene Oxide-based Systematic Evolution of Ligands by Exponential Enrichment (GO-SELEX) for acetamiprid, thiacloprid, and thiamethoxam. The selected aptamers exhibited strong binding affinities and remarkable selectivity against structural analogues and commonly used pesticides. Using these aptamers, a biochemical dot assay biosensor was designed to transduce aptamer-analyte interactions into a measurable colorimetric response. The assay operates in an ultra-low-volume format (18–20 µL total reaction volume), utilising 7 µL of gold nanoparticles (AuNPs), 5.25 µL of a specific aptamer, and 5.25 µL of the target pesticide solution (1–5 ppm). Following a brief 5-minute pre-incubation and an additional 15-minute reaction, a distinct colour shift from pink to blue was observed, corresponding to target binding. Under optimised conditions, the biosensor achieved detection limits in the sub-ppm range, with a visual detection capability of up to 5–7 ppm and spectrophotometric sensitivity of 0.35–0.97 ppm. Cross-reactivity analysis confirmed high target specificity with negligible interference from coexisting compounds. The biosensor was further validated using real environmental samples (river water, cucumber extract, and tap water), showing excellent recoveries (90–110%) with minimal sample preparation. This novel colorimetric dot assay provides a cost-effective, rapid, and instrument-free alternative to conventional analytical techniques, such as HPLC or spectrophotometry. The assay functions efficiently under ambient conditions, eliminating the need for temperature control, thereby enhancing its practical applicability in field monitoring. Two patent applications have been filed to protect the developed aptamers and biosensing methodology (Indian Patent Application Nos. 202311050888 and 20241106382).

Keywords: Aptamer, Dot Assay, Acetamiprid, Thiocloprid, Neonecotinoids

IN VITRO STUDY ON GLUCOSE UTILIZATION CAPACITY OF BARK METHANOL EXTRACT OF *SYZYGIUM HEMISPHERICUM* (WIGHT) ALSTON USING ISOLATED RAT HEMIDIAPHRAGM AND ITS MAJOR PHYTOCONSTITUENTS

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Background: Impairment in insulin-stimulated glucose uptake is a hallmark of type 2 diabetes mellitus. *Syzygium hemisphericum* (Wight) Alston, a lesser-known species from the Western Ghats, has documented medicinal potential in traditional systems. This study evaluates its glucose utilization potential and metabolite composition. **Methodology:** Bark of *S. hemisphericum* was shade-dried, powdered, and extracted with methanol (SHBM). The extract (10 mg/mL) was tested for glucose uptake using an isolated rat hemidiaphragm in vitro. Insulin (0.25 IU/mL) and quercetin (10 mg/mL) served as reference standards. Glucose levels were measured via glucose oxidase–peroxidase assay. SHBM was further analyzed using GC-MS and HR–LC-MS with electrospray ionization (positive mode) for metabolite profiling. **Results:** SHBM showed significantly higher glucose uptake (32.35 ± 0.45 mg/g/30 min) than the negative control (3.91 ± 0.57 mg/g/30 min) and exceeded the activity of insulin (22.18 ± 0.21 mg/g/30 min) and quercetin (21.38 ± 0.26 mg/g/30 min). GC-MS identified 16 major compounds, with 9-Octadecenamide (50.83%) as predominant. HR-LC-MS profiling revealed phenols including Gingerol, Shogaol, Resveratrol, and Cinnamic acid, and flavonoids such as Kanzonol Z and Kaempferol, with Kaempferol 7-O-glucoside showing the highest peak. **Conclusion:** The SHBM extract significantly enhanced glucose uptake in isolated rat hemidiaphragm, indicating strong antidiabetic activity. Comprehensive phytochemical profiling revealed multiple bioactive compounds with potential antidiabetic effects, supporting the use of *Syzygium hemisphericum* for managing type 2 diabetes mellitus.

Keywords: Glucose uptake, Rat hemidiaphragm, *In vitro* model, HR-LC-MS, Diabetes

ISOLATION AND SCREENING OF CHITINOLYTIC BACTERIA FOR BIOREMEDIATION AND POTENTIAL IN THERAPEUTIC APPROACH

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Chitin, the second most abundant biopolymer globally, constitutes a significant portion of marine and agricultural waste, posing a severe environmental challenge. Its enzymatic degradation, catalyzed by chitinases from chitinolytic microorganisms, represents a sustainable solution for bioremediation and the production of value-added compounds, such as bioactive N-acetyl-D-glucosamine (GlcNAc). This study aimed to isolate potent chitinase-producing bacteria from [Specify Source, e.g., crustacean shell waste and agricultural soil] and evaluate their dual utility in environmental management and therapeutic development. Bacteria were isolated and screened on chitin agar media using the clear zone method, followed by submerged fermentation for quantitative chitinase assay. The most promising isolates were identified based on morphology and molecular methods, and their crude enzyme extracts were tested for respective applications. **For bioremediation**, selected isolates demonstrated high specific chitinase activity and effectively utilized crude chitin as a sole carbon and nitrogen source, indicating strong potential for enzymatic waste conversion. **For therapeutic applications**, the crude enzyme extracts and resulting COS exhibited significant antimicrobial activity, notably against the fungal pathogen *Candida albicans* and the Gram-positive bacterium *Staphylococcus aureus*. Furthermore, preliminary testing suggested moderate **antioxidant activity** in the GlcNAc fraction. These findings highlight that chitinolytic bacteria, particularly strain *Bacillus subtilis*, and are a rich, sustainable source of thermostable chitinases and bioactive derivatives. Their application offers a promising, eco-friendly approach to manage chitinous waste while simultaneously contributing novel therapeutic agents to combat infectious diseases, underscoring their vast potential in the circular bioeconomy.

Keyword: Chitin, N-acetyl-D-glucosamine, Chitinolytic Bacteria, Therapeutic Potential

SUSTAINABLE METHOD FOR BIOREMEDIATION OF TEMPLE FLORAL WASTE INTO COMPOST

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The present study was undertaken to initiate a path of converting the temple floral waste (FW) into compost. Large quantities of flowers are offered daily in many religious places. The flowers are prone to microbial attack due to low shelf life and high moisture content in them. Many value added products like incense sticks, cones, perfumes, natural dyes, essential oils etc are produced from floral waste. But because of quality of flower received as a waste to make these value-added products is not good, many times the product quality is compromised. The best method for this type of floral waste would be to convert them into compost, which can be used as a biofertilizer. This will add nourishment to the soil making it nutrient rich. Fungi are known to be the havoc in plants by inducing plant diseases, but some fungi are known to be the growth inducers in plants. *Trichoderma* is one of the fungi that have growth inducing effects too. In the present study *Trichoderma* cultured on wheat grains, used as inoculums taken up for experiments with floral waste to convert it into compost with the help of fungal inoculation. The results demonstrated that inoculation of fungi with waste turns the waste to degrade rapidly, achieving faster compost preparation. The OC level also changes significantly indicating the degradation and the germination rate also prove to be effective. Today, in the era of organic food demand, farmers and local business are constantly in requirement of natural fertilizers rather than chemicals. Thus, the compost so prepared in the study can prove to be the effective one for the organic culture.

Keywords: Floral waste, *Trichoderma*, Compost, Fungal biodegradation

EVALUATION OF ACETONIC EXTRACT OF *H. SUAVEOLENS* ON INHIBITION OF *L. LEUCOCEPHALA* SEED GERMINATION

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Luecaena leucocephala (Lam.) de Wit is a fast-growing invasive weed raising considerable concern to the farm lands and biodiversity in tropical areas of India. High germination capability and its sustained seed dormancy, facilitates the extensive colonization of crops diminishing the productivity of neighboring crops. The current research examined the inhibitory power of acetonc leaf extract of *H.suaveolens* on the germination of *L. leucocephala* seeds in order to determine its application as a natural bioherbicidal agent. The experiment took the form of controlled conditions with eleven treatments (ten extract concentrations, 1 -10% and distilled-water control). The treatments were based on 25 seeds replicated thrice (n =3). The seeds were moistened and the germination was observed within 20 days. The outcome was the evident inhibition of germination depending on the concentration. The control had 68% germination, and the greater the concentration (8 -10), the lower the germination (less than 40%), and the delay in mean germination was significant (p<0.05). Phenolic and terpenoid *H. suaveolens* components are thought to be responsible of the suppression, and they probably interfere with hormonal and enzymatic processes involved in seed germination. These results show that Hyptis acetonc extract has the high allelopathic potential of the *L. leucocephala* seeds. The research gives a scientific reason as to why plant-based herbicidal preparations be made ecologically friendly, to be used as an alternative to synthetic agrochemicals in controlling invasive weeds in Indian agricultural systems.

Keywords: *Luecaena leucocephala*, *Hyptis*, Allelopathy, Germination inhibition, Bioherbicide

TRANSCRIPTOME ANALYSIS OF PLANT -DERIVED CANNABIDIOL REVEALS NEUROPROTECTIVE AND ANTICANCER PATHWAYS FOR DRUG DISCOVERY

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Natural products obtained from medicinal plants are increasingly recognized as sustainable and eco-friendly sources for novel therapeutics. *Cannabis sativa*, a plant rich in bioactive compounds, produces Cannabidiol (CBD) a non-psychoactive phytochemical with emerging neuroprotective and anticancer properties. The present study aims to investigate the transcriptomic impact of CBD on glioblastoma cells through an in silico RNA-Seq reanalysis, providing insights into the molecular basis of plant-derived and sustainable drug discovery. Publicly available RNA-Seq data of CBD-treated and untreated glioblastoma cells (GEO accession: GSE144029) were analyzed using an integrated bioinformatics workflow. Transcript quantification was performed using Salmon, followed by DESeq2 for differential gene expression analysis and cluster Profiler for functional enrichment. Genes exhibiting a $\log_2$ fold change greater than 1 and an adjusted p-value below 0.05 were considered significantly modulated. The analysis revealed extensive transcriptional reprogramming following CBD exposure. Genes involved in apoptosis, oxidative stress regulation, and neuronal survival were notably upregulated, whereas those linked to cell-cycle control and tumor proliferation were downregulated. Enrichment results highlighted the activation of PI3K-AKT, MAPK, and p53 signaling pathways, suggesting a dual molecular role of CBD in promoting neuroprotection while suppressing oncogenic processes. Overall, this study provides transcriptome-level evidence supporting the therapeutic potential of plant-derived Cannabidiol. The findings strengthen the link between biodiversity-based natural compounds and modern biomedical innovation, emphasizing the importance of sustainable, plant-based therapeutics in addressing neurological cancers and contributing to eco-conscious drug discovery.

Keywords: Cannabidiol, RNA-Seq, Glioblastoma, Neuroprotection, Sustainable Therapeutics

YIELD RESPONSE OF TOMATO TO COMMERCIAL BIOFERTILIZER APPLICATION UNDER NATURAL CONDITIONS.

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Tomato (*Solanum lycopersicum*) is one of the most widely cultivated and economically important vegetable crops globally. Achieving optimal yield and fruit quality depends significantly on effective nutrient management. This study investigates the impact of commercial biofertilisers on the yield of tomato plants under natural conditions. Commercial biofertilizers, typically containing balanced proportions of nitrogen (N), phosphorus (P), and potassium (K), along with micronutrients, play a critical role in promoting vegetative growth, flowering, and fruit development. The experiment involved applying one chemical fertilizer and two of commercial NPK biofertilizers along with control to tomato plants and monitoring their growth parameters, fruit yield, and quality attributes. Results indicated that appropriate fertilizer application significantly increased tomato yield compared to control group. The study emphasizes the importance of balanced fertilizer use tailored to soil nutrient status and tomato crop requirements. These findings offer valuable insights for tomato growers aiming to maximize productivity without depleting soil's nutrients for further harvesting.

Keywords: Tomato, Commercial Biofertilisers, Soil Nutrients

PHYSICOCHEMICAL EVALUATION OF A NATURALLY FORMULATED LIQUID BIO-PESTICIDE FOR SUSTAINABLE AGRICULTURE

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The present study focuses on the formulation and evaluation of a sustainable liquid bio-pesticide prepared using natural ingredients such as egg, jaggery, alum, buttermilk, limestone and other plant-based materials. The aim was to develop an eco-friendly and cost-effective alternative to conventional chemical pesticides that often cause soil degradation, environmental pollution, and health hazards. The bio-pesticide was prepared through natural fermentation, utilizing the nutrient-rich components of egg and the carbohydrate content of jaggery to promote microbial activity and enhance bio-efficacy. The formulated liquid bio-pesticide was subjected to chemical and physical parameter analysis, including pH, total soluble solids, electrical conductivity, viscosity, and nutrient composition (N, P, K). The stability, shelf life, and bio-degradability were also evaluated to ensure its suitability for agricultural application. Preliminary results indicated that the formulation maintained stable physicochemical properties over the storage period and exhibited potential pest-repellent activity under laboratory conditions. Chemical constituents analysis observed as for nitrogen 2.16%, Phosphorus 250.5mg/l, potassium 928mg/l, magnesium 4860mg/l, calcium 20000mg/l, sodium 5374mg/l, copper 33.41mg/kg, iron 5367mg/kg, manganese 162.19mg/kg, zinc 8.1mg/kg analyzed by ICP-OES. This study highlights the potential of bio-waste and natural ingredients as valuable resources for developing sustainable agricultural inputs. The formulated bio-pesticide offers a promising, environment-friendly solution for integrated pest management, contributing toward sustainable and organic farming practices.

Keywords: Bio-pesticide, sustainability, egg, jaggery, natural formulation, physicochemical parameters, eco-friendly agriculture.

VALORIZATION OF RICE STRAW LIGNIN TO POLYHYDROXYALKANOATE (PHA) USING A LIGNINOLYTIC PHA PRODUCING BACTERIAL CONSORTIUM LPC

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Rice straw (RS) as lignocellulosic agroresidues (LA) is used as feedstock for production of biomaterials and biofuels, where the structural lignin is needed to be depolymerized that can be done by ligninolytic bacteria. This conversion being highly expensive, the technoeconomic feasibility of LA biorefineries has been projected to improve through addition of value to fractionated lignin that can be converted to polyhydroxy alkanates (PHAs), a family of biodegradable polyesters, by bacteria. In this study a ligninolytic and PHA producing bacterial consortium (LPC) has been developed from environmental ligninolytic bacteria. LPC includes 3 isolates designated as *Klebsiella aerogenes* B6, *Klebsiella pneumoniae* ML-Y1 and *Enterobacter mori* ML-Y2. Among 7 different methods for PHA extraction from LPC, extraction with only chloroform has shown highest yield of PHA. The optimum cultural variables for maximum PHA production (60.23 %) were attained using RSM-CCD, where LPC was inoculated at 2 % (v/v) of 2:2:1 (B6: Y1: Y2) culture ratio into MSM containing 4.5 % RS and cultured at 37 °C for 3 days. Through optimization process PHA production yield has increased 2.08-fold. The extracted PHA was characterized as polyhydroxybutyrate (PHB) using different spectroscopic and structural analysis. Overall, it was demonstrated for the first time where simultaneous lignin depolymerization and PHB production was done by LPC in a single optimized system using RS as feedstock, that enhances the technoeconomic feasibility of LA biorefineries.

Keywords: Rice straw, lignin, consortium, polyhydroxyalkanoate (PHA), polyhydroxybutyrate (PHB).

ENVIRONMENTAL POLLUTION IN MODERN AGRICULTURE: CAUSES, EFFECTS AND CONTROL

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Agriculture plays a vital role in ensuring food and nutritional security, but modern agricultural intensification has emerged as a major source of environmental pollution. The unbalanced and excessive use of fertilizers, pesticides, and mechanization has led to deterioration of soil health, water contamination, air pollution, and loss of biodiversity. This study examines the causes, effects, and control measures of environmental pollution associated with modern agriculture. A comprehensive review of secondary data and scientific reports was undertaken to identify the major pollutants, their sources, and mitigation strategies. Findings reveal that overuse of nitrogen-based fertilizers, residue burning, and sewage irrigation contribute significantly to greenhouse gas emissions, soil acidification, and heavy metal accumulation, particularly in intensively cultivated regions such as Punjab. In addition, pesticide misuse poses serious threats to pollinators, soil organisms, and human health. However, integrated and sustainable approaches like precision farming, integrated nutrient and pest management, conservation tillage, drip fertigation, and agroforestry have shown great potential in mitigating emissions and restoring ecosystem balance. For instance, the use of nitrification inhibitors and smart nitrogen management practices has reduced nitrous oxide emissions by 21–40% compared to conventional methods. The study concludes that adopting eco-friendly, resource-efficient, and climate-smart technologies is essential to minimize pollution, enhance soil health, and achieve sustainable agricultural productivity.

Keywords: Modern Agriculture, Environmental Pollution, Soil Degradation, Greenhouse Gases, Sustainable Management, Mitigation

DIVERSITY AND BIOPROSPECTING POTENTIAL OF MACROFUNGI FROM BENGALURU WITH NOVEL RECORDS AND BIOACTIVE CHARACTERIZATION OF *LYCOPERDON LAHORENSE*

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A total of 131 wild mushroom specimens were collected from diverse habitats in and around Bengaluru, Karnataka, leading to the identification of 110 distinct macrofungal species. Among these, 37 were edible, 5 psychoactive, 11 poisonous, 5 medicinal, and 73 were non-edible or of unknown edibility. The genera *Agaricus*, *Pleurotus*, and *Xylaria* were the most frequently encountered, with **Agaricaceae** being the dominant family and **Tapinellaceae** the least represented. Diversity analyses indicated a highly stable fungal community with a Shannon's Index of 2.852 and a Simpson's Index of 0.94. Several taxa were documented as **new regional records**, including *Lycoperdon lahorensense*, *Termitomyces umkowaan*, *Candolleomyces sindhudelatae*, *Psathyrella jilinensis*, and *Marasmiellus vaillantii* as new to India; *Filoboletus manipularis* and *Gloeocantharrellus cf. lateritius* as new to Karnataka; and *Pycnoporus coccineus* and *Psathyrella longipes* as new to Bengaluru. Among these, *Lycoperdon lahorensense* was further investigated for its **physicochemical and bioactive properties**. Optimal mycelial growth was achieved on Yeast Extract–Peptone–Dextrose (YEPD) medium supplemented with galactose and ammonium sulfate at 25°C and pH 6. Phytochemical profiling revealed abundant proteins, carbohydrates, phenols, alkaloids, flavonoids, and saponins. The mycelial extract showed high flavonoid (162.51 mg QE/g) and phenolic (45.98 mg GAE/g) contents, correlating with strong antioxidant (low IC₅₀ DPPH scavenging), antibacterial, and antifungal activities. The study not only enriches the macrofungal inventory of southern India but also highlights *L. lahorensense* as a promising **nutraceutical candidate**. A mushroom-based functional food product ("**Lycoperdon chakkuli**") has been developed as a proof of concept to explore its dietary applications. Furthermore, ongoing research aims to assess its **anticancer potential**, thereby positioning Bengaluru's native fungi as valuable resources for future nutraceutical and pharmaceutical innovations.

Keywords: Macrofungal diversity, Nutraceutical potential, fungal bioprospecting, antioxidant and antimicrobial activity, mushroom-based functional food

BIOASSAY STUDIES OF *BEAUVERIA BASSIANA* WITH MAIZE FALL ARMYWORM *SPODOPTERA FRUGIPERDA*

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Maize (*Zea mays* L.) is a major cereal crop of global importance, but its productivity is severely threatened by the Fall armyworm (*Spodoptera frugiperda* J.E. Smith), an invasive lepidopteran pest known for its high reproductive potential and ability to cause rapid and extensive damage. Conventional reliance on chemical insecticides for FAW management has led to resistance development, environmental hazards and risks to non-target organisms, underscoring the need for sustainable and eco-friendly alternatives. Entomopathogenic fungi such as *Beauveria bassiana* (Balsamo) have emerged as promising microbial control agents due to their ability to naturally infect and kill a broad range of insect pests. Laboratory bio assays are essential to evaluate their pathogenicity, establish lethal concentrations and exposure periods and compare their performance with standard isolates. The pathogenicity of a native *B. bassiana* isolate BBCOAH-1 was tested against third-instar larvae of *S. frugiperda*. Conidial suspensions (1×10^2 to 1×10^{10} spores/ml) were applied using the dipping method and larval mortality was recorded at 3, 5, 7 and 9 days after treatment (DAT). At 3 DAT, mortality ranged from 10.00% (1×10^2 spores/ml) to 33.33% (1×10^{10} spores/ml), with no mortality in the control. By 9 DAT, cumulative mortality reached 30.00-83.33%, while the check isolate UASRBC-Bb2 (1×10^8 spores/ml) caused 76.67%. Probit analysis yielded an LC_{50} of 2.18×10^6 spores/ml (fiducial limits: 1.15×10^5 - 1.6×10^7) and LT_{50} of 4.69 days (3.57-5.80 days). The results confirmed a clear dose and time dependent mortality response, with the native isolate BBCOAH-1 achieving >80% mortality at higher concentrations by 9 DAT, performing on par with the standard check. These findings highlight its potential as a viable biocontrol agent for FAW management in maize-based farming systems.

Keywords: Bioassay, *Beauveria bassiana*, Entomopathogenic fungus, Fall armyworm, IPM, Maize

STUDIES ON COMPATIBILITY OF *BEAUVERIA BASSIANA* WITH COMMONLY USED INSECTICIDES, BOTANICALS AND FUNGICIDES

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Beauveria bassiana (Balsamo) is a well-known entomopathogenic fungus with proven potential as a microbial control agent against a wide range of insect pests. Its successful integration into integrated pest management (IPM) programs depends largely on its compatibility with commonly used agrochemicals, as these substances may either suppress or support fungal growth and persistence in the agroecosystem. Compatibility studies are therefore essential to identify chemicals that can be safely used alongside *B. bassiana* without compromising its pathogenic efficiency. The compatibility of *B. bassiana* isolate BBCOAH-1 with selected insecticides, botanicals, and fungicides was evaluated using the poisoned food technique. Each chemical was tested at recommended dose (RD), half dose ($0.5 \times RD$) and double dose ($2 \times RD$), with radial growth and per cent inhibition assessed at 14 and 30 days after inoculation (DAI). Among insecticides, chlorantraniliprole 18.5% SC showed the least inhibition (24.50% at 14 DAI), followed by spinosad (37.58%), while quinalphos 25% EC was highly suppressive (70.25% at 30 DAI). Neem leaf (43.37%) and neem seed kernel (47.13%) extracts exhibited higher compatibility among botanicals, whereas jatropha seed (70.84%), chrysanthemum flower (67.58%), and pongamia seed (64.69%) extracts were inhibitorier. Fungicides imposed the greatest suppression: carbendazim 50% WP and hexaconazole 5% EC completely inhibited growth (100% inhibition) at all doses, while mancozeb, azoxystrobin, metalaxyl, and dimethomorph caused moderate inhibition (40-60%) with marginal improvement at 30 DAI. Overall, the study demonstrated a dose-dependent inhibitory response, with chlorantraniliprole and spinosad among insecticides, and neem leaf and neem seed kernel among botanicals, showing the highest compatibility, while systemic fungicides and quinalphos were the most suppressive. These findings provide useful insights for the safe integration of *B. bassiana* into pest management practices.

Keywords: Agrochemicals, *Beauveria bassiana*, Compatibility, Entomopathogenic fungus, Inhibition, IPM

ISOLATION AND CHARACTERIZATION OF ENTOMOPATHOGENIC FUNGUS *BEAUVERIA BASSIANA* FROM MAIZE FALL ARMYWORM

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The Fall armyworm (FAW) (*Spodoptera frugiperda* J.E. Smith) is an invasive and destructive pest of maize, causing severe yield losses and threatening food security. Eco-friendly alternatives such as use of entomopathogenic fungi are gaining importance for sustainable pest management. *Beauveria bassiana* (Balsamo) is widely recognized for its pathogenicity against large lepidopteran pests, including FAW. The fungus was isolated from naturally infected larvae of FAW collected from maize fields at the College of Agriculture, Karekere, Hassan, Karnataka during *rabi* season of 2024. The fungus was isolated on potato dextrose agar (PDA), showed colonies were white, round, raised, and powdery with dense conidial clusters. Microscopic examination revealed hyaline hyphae and round to oval conidia with an average size of $2.909 \times 2.102 \mu\text{m}$, consistent with standard descriptions of *B. bassiana* and it is designated as BBCOAH-1. Molecular identification by amplifying the internal transcribed spacer (ITS) region using ITS1 and ITS4 primers revealed 99.79% similarity with *B. bassiana* isolates in NCBI GenBank. The sequence was deposited in GenBank with the accession number PV815641. Phylogenetic analysis grouped the isolate within the *B. bassiana* clade, clustering with reference strains (MT355427.1, KY495188.1, MK979393.1) and clearly separating it from related fungi including *Metarhizium anisopliae* and *Trichoderma harzianum*. The study confirms the identity of fungus as *B. bassiana* based on both morphological and molecular characteristics, providing a validated basis for further evaluation of its bio-efficacy against FAW under laboratory and field conditions to include under Integrated Pest Management strategies.

Keywords: *Beauveria bassiana*, Characterization, Entomopathogenic fungus, Fall armyworm, Maize

AUTOMATION IN DRIP IRRIGATION FOR EFFICIENT WATER USE IN VEGETABLE CROPS

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Efficient water management is a critical component of sustainable vegetable production under increasing water scarcity and climate variability. Automation in drip irrigation involving sensors (soil moisture, tensiometers), weather-based controllers, and integrated fertigation has shown strong potential to optimize water use, improve yields, and enhance nutrient efficiency. In a two-year factorial experiment with tomato, using drip irrigation with a soil moisture regime at -10 kPa , total water input was reduced by 22.6 % in 2020 and 19.8 % in 2021, while fruit yield increased by 28 % and 22 % compared with furrow irrigation. In another study of tomato under automated drip systems in kharif seasons, tensiometer-based drip irrigation achieved yields of $\sim 95\text{--}96 \text{ t/ha}$ vs lower yields under conventional flood methods, and water use efficiency (WUE) rose to $21.10\text{--}25.42 \text{ t per ha-mm}$, with water savings of $\sim 55\text{--}61 \%$ over conventional irrigation. Similarly, combining drip irrigation with poly-mulching for tomato and other vegetables reduced water consumption by 30-50 %, improved water use efficiency (WUE) substantially, and did not reduce yield compared to traditional methods. In some irrigation regimes, WUE rose to $\sim 9.7 \text{ kg/m}^3$ under optimal drip + mulch conditions vs $\sim 4\text{--}6 \text{ kg/m}^3$ under bare soil drip or less efficient methods. Across Sub-Saharan Africa, experiments combining drip irrigation with conservation agriculture (no-till, mulch) showed irrigation water use reductions of 18-45.6 % for vegetables like garlic, onion, tomato, cabbage, and sweet potato; yield increases ranged from $\sim 9 \%$ up to $\sim 2\text{-fold}$ depending on crop and site; water productivity increased by $\sim 33 \%$ – 222% for tomato and cabbage. In the Tarikere Drip Irrigation Project (Phase II), implementing drip fertigation among vegetable farmers led to $\sim 90 \%$ improvement in water productivity and 30-40 % better fertilizer use efficiency. Yield increases were around 50-60 % compared to traditional methods. These results suggest that automated drip systems can deliver 20–60 % water savings, $\sim 20\text{--}60 \%$ yield increases, and substantial improvements in water and nutrient use efficiencies in vegetable crops, making them a key strategy for climate-smart agriculture. However, initial investment, sensor calibration, maintenance, and farmer training remain significant challenges for widespread adoption.

Keywords: Automation; Drip Irrigation; Water Use Efficiency; Vegetable Crops; Yield Response; Sensor-Based Irrigation; Fertigation

ENVIRONMENTAL DISCORDANCE FOR NATURAL RESOURCES AND ECOSYSTEM SERVICES

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Our physical, spiritual, and mental consciousness's are impacted by the nature element (Prakriti), which encompasses all biospheres and from which we may directly or indirectly benefit. Our physical and biological environment is supposed to be made up of the five major components of the cosmos, Kshiti (earth), Jal (water), Pawak (fire), Gagan (sky), and Sameer (air), according to ancient literature. These five elements are known as "devta" in our vedic literature; the word "devta" is derived from the Sanskrit word "div," which means "one who is divya and has extra celestial powers" (paralaukik), or "the center of immense spiritual power." However, in the Bhagwat Gita, Lord Krishna has added three more elements, namely Mann, buddhi, and aham, to the list above. Therefore, these 8 components make up the entire environment spiritually. Throughout the Yajurved, Mother Earth Protecting Mother Earth is therefore our moral obligation. Human health can be impacted by the environment; a healthy environment promotes good health, while a hazardous environment might result in health risks. Environmental risks can increase the risk of several diseases, including asthma, heart disease, and cancer. These hazards can be physical, such as pollution, toxic chemicals, excessive use of cell phone, and consuming unhealthy food, or they can be social, such as unsafe work, poor housing conditions, urban slump and poverty. Natural deterioration and the management of natural resources are the source of ecological disputes in society. There are generally numerous parties engaged, including individuals who support environmental protection and those who want to or are using the environment for other purposes, typically the extractive industry. The environmental resource manager may be causing overuse or extraction of a renewable resource (such as overfishing or deforestation), overstraining the environment's capacity to respond to pollution and other inputs, or worsening the living conditions for both humans and nature. These conflicts frequently center on environmental justice problems involving indigenous rights, peasant rights, or dangers to other livelihoods, like those of fisher folk or communities relying on the natural environment poisonous chemicals, excessive mobile phone use, and consumption of unhealthy food. Conflicts with ecological distribution. The unequal allocation of environmental costs and benefits results in ecological distribution conflicts (EDCs). These conflicts are caused by social inequality, disputed territorial claims, the growth of extractive industries, and the effects of the economy's industrialization during the previous several centuries. Environmental conflicts, which involve parties including states, businesses and investors, social or environmental movements, and locally impacted populations, are centered on the oil, coal, mining, and agriculture industries. There is some overlap between the phrases socio-environmental conflict, environmental conflict, and EDCs. Environmental justice, political ecology, and ecological economics are all relevant to the research of EDCs.

FROM WASTE TO WELLNESS: VALORIZATION OF FRUIT PEELS AS FUNCTIONAL FOOD INGREDIENT ENRICHED WITH PHYTOCHEMICALS

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In recent years, there has been growing interest in identifying natural and sustainable sources of health-promoting compounds for functional food development. The global rise in fruit processing generates a significant volume of peel waste, which is often discarded despite being a rich reservoirs of bioactive phytochemicals. Recent research has revealed that fruit peels contain high concentrations of polyphenols, flavonoids, tannins, and other antioxidant compounds, surpassing those found in edible portions. These bioactive compounds exhibit potent therapeutic activities including antioxidant, anti-inflammatory, antidiabetic, and antihypertensive effects. The present study highlights the potential of utilizing pomegranate (*Punica granatum*) peel as functional food ingredient. Incorporating peel extracts or powders into food formulations can enhance the nutritional value, shelf life, and functional efficacy of products, supporting the health-promoting property of products while reducing environmental waste. Furthermore, this valorization strategy reduces food waste and supports sustainable nutrition practices. Overall, fruit peel utilization represents a promising and eco-friendly approach to promote human health through functional food innovation.

Keywords: *Punica granatum*, bioactive compounds, health-promoting, functional food, waste.

PHYTOCHEMICAL PROFILING AND BIOACTIVE POTENTIAL OF *HOLMSKIOLDIA SANGUINEA* RETZ: INSIGHTS INTO ITS ANTIOXIDANT, ANTIMICROBIAL AND ANTICANCER ACTIVITIES

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Holmskioldia sanguinea Retz. (Chinese hat plant), an ornamental shrub belonging to the family Lamiaceae and native to tropical and subtropical regions of Asia, was investigated for its antioxidant, antimicrobial, and anticancer activities. Among the tested extracts, the ethanolic leaf extract exhibited the highest total phenolic content (265 ± 1.08 mg GAE/g), while the methanolic leaf extract recorded the highest flavonoid content (124 ± 2.63 mg QE/g). The ethanolic stem extract demonstrated superior antioxidant capacity, with IC_{50} values of 1.269 ± 0.005 μ g/mL for DPPH and 3.523 ± 0.01 μ g/mL for ABTS assays. The methanolic stem extract showed pronounced antibacterial activity against *Staphylococcus aureus*, *Bacillus cereus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*. Additionally, the methanolic extracts were evaluated for antifungal properties, with the methanolic leaf extract exhibiting the strongest antifungal effect, achieving 98% inhibition of mycelial growth, highlighting its potential as a natural antifungal agent. LC-MS profiling revealed the presence of oroxindin, a bioactive compound with reported anti-carcinogenic properties, predominantly in the stem extract. *In-silico* molecular docking studies confirmed the interaction of oroxindin with key cell-cycle regulatory enzymes, including ERK2, MEK1, and S6K1. Elicitation studies using salicylic acid, chitosan, and methyl jasmonate significantly enhanced oroxindin production. *In vitro* anticancer evaluations (MTT and wound-healing assays) demonstrated moderate cytotoxicity (IC_{50} : oroxindin = 301 μ g/mL; stem extract = 319 μ g/mL) along with marked inhibition of ovarian cancer cell migration. Overall, *H. sanguinea*, particularly its stem extract enriched with oroxindin, exhibits considerable potential as a natural source of antioxidant, antimicrobial, and anticancer agent. Future work will focus on large-scale extraction, purification, and characterization of oroxindin using advanced chromatographic strategies to obtain pharmaceutical-grade compound purity.

Keywords: *Holmskioldia sanguinea*, antioxidant, antibacterial, antifungal, and anticancer

A STUDY ON THE PERFORMANCE OF MANDYA SHEEP BREED FED ON LAMB MILK REPLACER AND MINERAL MIXTURE

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Mandya sheep farming is an important subsidiary occupation for farmers in Southern Karnataka. However, lamb rearing faces significant challenges during the early growth period due to inadequate ewe milk availability and high lamb mortality, which averages around 20%. Reduced growth rates and mortality severely affect flock productivity and profitability. The present study was undertaken to evaluate the effect of feeding a lamb milk replacer and mineral mixture on the performance of Mandya lambs. Thirty one month old lambs were randomly divided into two equal groups. The control group (T_1) was fed exclusively on ewe milk, while the treatment group (T_2) received ewe milk supplemented with a lamb milk replacer and mineral mixture. Both groups were provided with creep ration, and the experiment was conducted for a period of 120 days. Results revealed that the average daily weight gain was significantly higher (174 g/day) in the T_2 group compared to T_1 (131 g/day). Overall, T_2 lambs exhibited a 29.54% increase in body weight gain over the control group. Mortality rate was also markedly reduced from 20% in T_1 to 5% in T_2 . Supplementation of lamb milk replacer and mineral mixture along with ewe milk enhances growth performance, reduces mortality, and thereby improves the profitability of Mandya sheep rearing.

Keywords: Mandya sheep, lamb milk replacer, mineral mixture, lamb mortality, South Karnataka

BACILLUS VELEZENSIS AS A POTENTIAL ENTOMOPATHOGEN OF SPODOPTERA LITURA (LEPIDOPTERA: NOCTUIDAE)

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Spodoptera litura (Lepidoptera: Noctuidae) is a major pest infecting a wide range of crops viz; cotton, groundnut, tobacco, and vegetables. The voracious feeding nature of their larvae, high fecundity and survival rate of this pest led in large loss of crop yield in many countries including India and leading into frequent appearance in newspapers. Conventional pest control heavily relies on synthetic pesticides, resulting in pesticide resistance and environmental issues. Entomopathogenic bacteria, particularly species within the genus *Bacillus*, was found as a promising biological alternative to this problem. In the search for eco-friendly alternatives, this study investigates the entomopathogenic potential of *Bacillus velezensis* against various life stages of *S. litura* under controlled laboratory conditions ($28\pm 2^{\circ}\text{C}$, $70\pm 2\%$ RH). Pure culture of *Bacillus velezensis* was isolated from soil samples following standard microbiology techniques. Egg masses of *S. litura* were collected and reared on a semi-synthetic diet under controlled laboratory conditions ($28\pm 2^{\circ}\text{C}$ and $70\pm 2\%$ RH). Larvae were maintained in plastic containers, and fresh diet of leaves of *Ricinus communis* was provided daily. Data on mortality and life span alterations in larval, prepupal, and pupal stages were recorded. Results indicated a cumulative larval mortality of 40%, prepupal mortality of 20%, and pupal mortality of 41.6% due to *B. velezensis* infection. The bacterium also caused a reduction in the life span of *S. litura*. The results clearly showed that *B. velezensis* is capable of infecting multiple developmental stages of *S. litura*, particularly the larval and pupal stages. The shortened adult lifespan of insects emerging from infected pupae further supports its sub-lethal impact on pest development and reproductive fitness. This study supports previous findings on the potential of *B. velezensis* as a biocontrol agent and opens avenues for its inclusion in integrated pest management systems. Its multi-stage efficacy and safety profile warrant further field trials.

Keywords: *Spodoptera litura*, *Bacillus velezensis*, entomopathogen, biocontrol, insect mortality

MODELLING SURFACE RUNOFF FOR KAL RIVER BASIN WITH SCS-CN METHOD IN A GIS ENVIRONMENT

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Water is one of the most important natural resource. For the effective management of water resources, an accurate understanding of hydrological behaviour of an area is very important. Runoff is the most basic and important parameter needed for planning water management strategies. The present research work was carried out for estimation of surface runoff from Kal River basin by SCS-CN curve method. The Kal River Basin belongs to Raigad district in Konkan region of Maharashtra state. It is one of the major tributary of the Savitri River basin. The total drainage area of basin is 272.63 sq. km. The runoff estimation by SCS-CN curve method is determined by integrating land use/land cover classification with antecedent moisture condition and hydrological soil groups. The study area receives the good rainfall but most of it is lost by surface runoff due to undulating topography and overland flow in the study area. The surface runoff depth has been calculated based on CN values for 33 years period (1990 to 2022) and found that average annual runoff depth of (1485.18mm) representing the average annual rainfall of 3389.06 mm which indicates 43.83 % of runoff contributed from the total rainfall. From the runoff depth for thirty-three years, rainfall-runoff relationship has been established which showed that the statistically positive correlation ($R^2 = 0.91$) between rainfall and runoff depth. The runoff estimated by SCS-CN method has been compared with observed runoff, the value correlation coefficient ($r = 0.73$) indicates strong correlation between estimated and observed runoff of the study area. The study reveals that the integration of GIS with the SCS CN method is a powerful tool for estimating runoff for better watershed management and conservation purposes.

Keywords: Rainfall, Runoff, Curve Number, Land use land cover (LULC), Sentinel, Remote Sensing, GIS

GROWTH PERFORMANCE AND FODDER YIELD OF FINGER MILLET (*ELEUSINE CORACANA* L.) AND KODO MILLET (*PASPALUM SCROBICULATUM* L.) AS INFLUENCED BY ORGANIC NUTRIENT SOURCES AND HARVESTING INTERVALS

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Milletts are gaining recognition as sustainable dual-purpose crops capable of addressing fodder scarcity under low-input organic systems. A field experiment entitled “*Agronomic investigation on fodder qualities of finger millet and kodo millet*” was conducted at ZARS, GKVK, Bengaluru, during *kharif* 2024 to assess the effect of organic nutrient sources and harvesting intervals on growth, yield and fodder quality. The experiment was laid out in a factorial RCBD with sixteen treatment combinations and three replications. Treatments included two crops (finger millet and kodo millet), four organic nutrient sources: FYM + vermicompost, FYM + neem cake, FYM + natural farming inputs (Beejamrutha, Panchagavya, hand weeding, and earthing up) and the control (recommended POP), and two harvesting intervals (earhead emergence and physiological maturity). Results indicated that the combination of 50% RDN through FYM + 50% through vermicompost significantly outperformed the control in both crops. Finger millet recorded 18-22% higher green fodder yield and 15% greater crude protein content over POP, while kodo millet showed a 12-16% increase in green fodder yield with improved fibre digestibility. Harvesting at the earhead emergence stage produced superior green fodder yield and palatability, whereas physiological maturity enhanced dry matter and fibre fractions. Finger millet exhibited higher crude protein and nutritive value compared to kodo millet. Overall, integrating organic manures enhanced fodder yield, nutritive quality, and soil health, underscoring their potential in promoting sustainable and eco-friendly livestock feeding systems.

INTEGRATING WASTE MANAGEMENT AND CIRCULAR ECONOMY FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT

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The growing pursuit of sustainable agricultural systems has highlighted the essential role of robust waste management practices coupled with the adoption of circular economy principles. Modern farming and agro-industrial activities generate a broad spectrum of waste materials, including crop residues, livestock manure, agro-processing by-products, and various forms of packaging. When left unmanaged or improperly treated, these waste streams contribute to environmental degradation, intensify greenhouse gas emissions, and accelerate the depletion of finite natural resources. By embracing the circular economy paradigm, agricultural waste is redefined as a valuable input rather than an unwanted by-product, opening opportunities for nutrient recovery, renewable energy generation, and the production of value-added commodities. Methods such as composting, anaerobic digestion, biochar production, and precision agriculture facilitate the transformation of residues into organic fertilizers, biogas, soil amendments, and feedstocks for allied industries. This closed-loop approach not only curtails waste generation and mitigates ecological harm but also enhances the efficiency of resource utilization. Additionally, it strengthens soil fertility, reduces dependence on synthetic agrochemicals, and generates employment and income streams within rural communities. Integrating waste management systems with circular economy strategies enables agricultural operations to adapt to climate change, achieve lower carbon footprints, and secure long-term environmental and economic sustainability. Such integration supports global objectives for sustainable food systems, biodiversity protection, and rural development. Implementing waste management within a circular agricultural framework offers a practical solution to address the dual goals of productivity and sustainability under mounting environmental challenges.

Keywords: Waste management, Circular economy, Agricultural residues, Nutrient recycling, Composting

EDAPHIC AND VEGETATION RESPONSES TO STONE MINING IN A TROPICAL DRY DECIDUOUS FOREST OF MEJA, PRAYAGRAJ, INDIA

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Open-cast mining is one of the leading causes of soil degradation and destruction of forests, yet its impacts on the delicate link between soil and vegetation are still not well understood. In this study, we investigated how soil quality and plant diversity change with distance gradient from a stone mine in the tropical dry deciduous forest of Meja, Prayagraj, India. Sampling was conducted across three zones (adjacent, 1 km, and 2 km from the mine), with 15 soil and vegetation sampling points per zone. Soil variables (soil moisture, water holding capacity, pH, electrical conductivity, total organic carbon, available nitrogen, phosphorus and potassium) and vegetation parameters (IVI, species richness, diversity, evenness, and dominance) were quantified. Results revealed an increase in soil fertility indicators (water holding capacity, total organic carbon, available nitrogen and phosphorus) and vegetation complexity with distance from the mine; while available potassium decreased, likely due to accelerated mineral weathering from exposed substrates and low uptake by sparse vegetation. These findings suggest that mining significantly disrupts carbon pool and ecosystem resilience, with potential implications for local climate buffering and long-term carbon storage. The study provides a scalable framework for impact assessment and highlights the urgent need for ecological restoration and policy interventions targeting soil-vegetation recovery in post mining tropical landscapes.

Keywords: Floral Diversity, Importance Value Index, Phytosociology, Quarrying, Soil Physicochemical Properties

SOIL HEALTH AND QUALITY: KEY FUNCTIONS, THREATS AND MANAGEMENT STRATEGIES

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Interest in soil health and quality has grown because people now realize that soil is essential for both growing food and supporting the environment. Soil health or soil quality, means the ability of soil to work properly in natural or managed ecosystems. Healthy soil can support plants and animals help clean water and air; and promote the health of all living things. Soil health can change over time due to natural events like floods or droughts or because of human actions like farming or building. Good management that considers the many jobs soil does can improve soil health. But focusing only on one goal like increasing crop yield can harm it. Every soil has its own natural quality depending on its location, climate and ecosystem. But the main factor that decides soil health is how the land is managed. That's why checking soil health over time is a key way to see if land is being managed sustainably. A key challenge in sustainable soil management is finding a balance between protecting ecosystem services and increasing crop yields. Soil health depends on maintaining four main functions: Carbon transformation, Nutrient cycling, maintaining soil structure and Controlling pests and diseases. These functions result from many biological processes, carried out by a wide range of soil organisms that interact with each other and are affected by the non-living (abiotic) conditions in the soil. Studies of current soil models especially under farming systems that replace natural processes with fossil fuel-based inputs show that these soil functions are deeply interconnected. This means that just measuring specific organisms, processes, or soil properties is not enough to fully understand the health of the soil.

Keywords: Soil Health, Soil Quality and Soil Management.

EXPRESSION OF GROWTH RELATED GENES DURING EARLY FOLLICULOGENESIS IN CAPRINE OVARIES.

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The present study examined the expression of growth related genes (IGF-1, EGF, bFGF and FSHr) in cultured caprine preantral follicles (PFs). To evaluate the expression of these genes, goat ovaries were collected from civil slaughter house in warm (33 °C) normal saline of 0.9% supplemented with gentamicin (50 µg/ml). Follicles were isolated by using micro-dissection method and cultured by using 150 µL of prepared culture medium (MEM supplemented with BSA (0.3%), glutamine (2mM), sodium pyruvate (0.23mM), hypoxanthine (2mM), insulin selenium transferin (1%) and gentamicin (50 mg / ml) and FSH-P (7 µg / ml) per well with 2-3 follicles and kept it for culturing in a CO₂ incubator (38.5 °C, 5% CO₂ in air, 90- 95% relative humidity) for 3 days (Large PFs), 7 days (medium PFs) or 14 days (small PFs). The total RNA was isolated from the preantral follicles by using Trizol method and obtained RNA was reverse transcribed into cDNA for Real Time quantitative polymerase chain reaction (RTqPCR). The expression levels were checked for five genes (IGF-1, EGF, bFGF, FSHr and GAPDH). The glyceraldehyde-3-phosphate dehydrogenase gene was used as the endogenous control. Significantly (P<0.05) higher mRNA expression of FSHr in small PFs and lower expression in large PFs were observed. Similarly EGF mRNA expression was significantly (P<0.05) higher in large PFs and lower mRNA expression in small PFs and large PFs as compared with medium PFs. Similar mRNA expression pattern for FGF had been observed in large PFs, small PFs and medium PFs. IGF mRNA expression was significantly higher in large PFs compared with small PFs and medium PFs.

POTASSIUM RELEASING BACTERIA (KRB) INFLUENCE ON NUTRIENT UPTAKE, SOIL NUTRIENT STATUS IN COTTON

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A field experiment was conducted at Regional Agricultural Research Station, Lam during *khari*, 2023 to study the effect of potassium fertilizer doses and potassium releasing bacteria (KRB) on growth and yield of cotton (*Gossypium hirsutum* L.). The experiment was laidout in a randomized block design with ten treatments replicated thrice. The treatments comprised of T₁: control; T₂: RDF; T₃: RDNP; T₄: KRB (Potassium-Releasing Bacteria); T₅: RDF + KRB; T₆: RDF + KNO₃ 1% FA (Foliar Application) at 60 DAS; T₇: 75% RDK + KRB; T₈: 75% RDK + KRB + KNO₃ @ 1% (FA) at 60 DAS; T₉: 50% RDK + KRB; and T₁₀: 50% RDK + KRB + KNO₃ @ 1% (FA) at 60 DAS. The results revealed that the application of RDF + KRB+ KNO₃ 1% (FA) at 60 DAS (T₈) significantly influenced the yield parameters and recorded the maximum seed cotton yield (3013 kg ha⁻¹) and found at par with T₅ (2977 kg ha⁻¹), T₇ (2879 kg ha⁻¹), T₆ (2827 kg ha⁻¹) and T₂ (2724 kg ha⁻¹) and found significantly superior over T₁₀ (2205 kg ha⁻¹), T₉ (2150 kg ha⁻¹) and T₃ (1799 kg ha⁻¹). The lowest seed cotton yield (951 kg ha⁻¹) was registered by control plot (T₁) and comparable with T₄ (1189 kg ha⁻¹). Similarly, the higher nutrient uptake (N, P and K) by the crop was also registered with the application of RDF + KRB+ KNO₃ 1% (FA) at 60 DAS (T₈).

Keywords: Cotton, KRB, Potassium, KNO₃, Nutrient uptake

CHARACTERIZATION OF PLANT GROWTH-PROMOTING BACTERIA ISOLATED FROM EARTHWORM GUT MICROBIOTA

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Earthworms play a vital role in enhancing soil fertility, primarily due to the activity of their gut-associated microbiota, which promotes plant growth through the production of growth hormones and nutrient solubilization. This study aimed to isolate and characterize plant growth-promoting bacteria (PGPB) from the gut of earthworms collected in Monippally, Kottayam. The gut contents of the earthworms were homogenized, serially diluted, and cultured on Luria Broth (LB) medium. Based on distinct morphological characteristics such as size, shape, margin, elevation, pigmentation, and texture, 12 bacterial colonies were selected for further study. Among these, seven were identified as Gram-positive and five as Gram-negative. Phosphate solubilization assays conducted on Pikovskaya's agar revealed that eight isolates exhibited phosphate solubilization activity. Notably, one of the isolates, designated as MNP8, demonstrated the largest halo zone; measuring 21 mm. enzymatic assays confirmed the presence of protease, lipase, amylase, and cellulase activities, indicating the potential for these bacteria to degrade organic matter. Indole-3-acetic acid (IAA) productions of the isolates were quantified using Salkowski's method, further confirming the plant growth-promoting potential of the isolates. One isolate was selected based on its ability to solubilize phosphate, produce extracellular enzymes conducive to organic matter degradation, and synthesize IAA. This isolate was later identified as *Kluyvera* sp. through 16S rRNA gene sequencing. Overall, the findings suggest that bacteria isolated from the gut of earthworms possess significant plant growth-promoting traits and could be utilized as biofertilizers to enhance soil fertility.

Keywords: Earthworm, gut microbiome, phosphate solubilization, IAA, plant growth-promoting bacteria, biofertilizer

IMPACT OF DEFORESTATION AND AGRICULTURAL EXPANSION ON RUNOFF DYNAMICS IN DANG DISTRICT, GUJARAT

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Rapid transformations in land use have significantly altered the ecological and hydrological balance of Dang district, Gujarat. This study analyzed land use/land cover (LULC) changes from 1990 to 2015 using satellite remote sensing, GIS techniques, and hydrological modeling. Landsat (TM) and Resourcesat (AWiFS) images were classified into five major categories: forest, agricultural land, barren land, built-up land, and water bodies. The results revealed a marked decline in forest cover, shrinking from 1512.9 km² (85.77%) in 1990 to 1192.4 km² (67.60%) in 2015. At the same time, agricultural land expanded threefold, from 106.5 km² (6.04%) to 345.56 km² (19.59%). Built-up and barren lands also grew, reflecting increasing human interventions. These shifts indicate deforestation-induced ecological imbalance and a heightened risk of soil erosion. To evaluate hydrological consequences, the Soil Conservation Service-Curve Number (SCS-CN) method was applied to the Purna and Ambika watersheds. Weighted curve numbers were 53.72 (Purna) and 54.45 (Ambika). With rainfall data spanning 1982–2013, the estimated average annual runoff depths were 446.88 mm (24.4% of rainfall) for Purna and 419.35 mm (22.8% of rainfall) for Ambika. The findings emphasize that deforestation and agricultural intensification have altered runoff generation patterns, which may lead to downstream flooding and loss of soil productivity. This study demonstrates the pressing need for sustainable land management and effective watershed conservation practices to mitigate hydrological risks and safeguard natural resources.

Keywords: Deforestation, Agricultural expansion, Land degradation, Runoff dynamics, Hydrological modeling, SCS-CN method, Ecological imbalance

STRESSES IN CROPS OF SHAHDOL DIVISION: BIOTIC AND ABIOTIC

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Crop plants are subjected to a variety of environmental stresses, which reduces and limits agricultural crop productivity. Environmental stresses that affect crop plants are of two types: biotic and abiotic stresses. Abiotic stress includes temperature, ultraviolet radiation, salinity, floods, drought, heavy metals, etc., which results in the loss of important crop plants globally, while biotic stress refers to damage caused by insects, herbivores, nematodes, fungi, bacteria, or weeds. Plants respond to all these environmental factors because the plants are fixed in a particular place. To cope with these stresses, a number of strategies have been developed by plants. They detect that the environmental stresses become activated and then generate the necessary cellular responses. Several investigations have been carried out to determine and understand plant assimilates partitioning and stress-tolerance plant genotype necessary for the understanding of the complexity of the response of a crop plant of Kharif and Rabi to biotic and abiotic stresses in the region of Shahdol division which are Maize, soya beans, Paddy, pulses, Sugarcane, Ground nuts, cotton, Wheat, Mustard, Gram and Linseed.

Keywords: Biotic factors, environmental stresses, crop productivity, crop yield, tolerance mechanism **In vitro**

MULTIPLICATION OF GERBERA (GERBERA JAMESONII L. BOLUS EX HOOKER F.) CV. TERRA KALINA

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The present study, entitled “In vitro Multiplication of Gerbera (*Gerbera jamesonii* L. Bolus ex Hooker F.) cv. Terra Kalina”, was carried out to develop standardised protocols for surface sterilisation, callogenesis, shoot proliferation, shooting, rooting, and hardening of plantlets. Capitulum explants treated with 4% NaOCl + 0.1% HgCl₂ achieved the highest survival percentage (66.98%), with low contamination (29.98%) and mortality (6.84%), ensuring effective culture establishment. For callus induction, MS medium supplemented with 2.0 mg L⁻¹ BAP + 1.5 mg L⁻¹ IAA resulted in 86% induction and 92% greening with minimal browning. Maximum shoot proliferation (90%) was obtained on MS + 2.0 mg L⁻¹ BAP + 1.5 mg L⁻¹ IAA, producing multiple elongated shoots with higher biomass. During shooting, MS + 2.0 mg L⁻¹ BAP + 1.0 mg L⁻¹ kinetin recorded 90% shoot induction with an average of 6.33 shoots per explant and healthy leaf initiation. Rooting was optimised on MS medium fortified with 2.0 mg L⁻¹ IBA, achieving 85% induction, an average of 7 roots per explant, and early initiation within 14 days. Plantlets acclimatised in a sand: cocopeat: vermiculite (1:1:1) mixture recorded the highest survival (60%) with robust vegetative growth. The optimised protocol enables large-scale production of true-to-type and disease-free Gerbera plantlets, thereby supporting commercial floriculture and preserving varietal integrity.

Keywords: Gerbera, in vitro multiplication, callogenesis, shooting, rooting, hardening

PHOTOCHEMICAL INVESTIGATION OF THALICTRUM DALZELLII

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The present study investigates the phytochemical composition and *in vitro* biological activities of the methanol extract of *Thalictrum dalzellii*, a rare medicinal plant from the Western Ghats of Karnataka, India. Qualitative phytochemical screening and GC-MS analysis revealed the presence of 29 biologically active compounds, including alkaloids, flavonoids, terpenoids, phenolics, saponins, and other metabolites. The methanol extract exhibited significant antioxidant potential in DPPH, FRAP, and phosphomolybdenum assays, supported by high phenolic (859.06 µg GAE/g) and flavonoid (678.83 µg QE/g) contents. Anti-inflammatory activity was confirmed through protein denaturation and red blood cell membrane stabilization assays, showing dose-dependent inhibition. Additionally, α-amylase inhibition and enhanced glucose uptake in yeast cells demonstrated potent antidiabetic activity. These findings highlight the therapeutic potential of *T. dalzellii* as a source of natural antioxidant, anti-inflammatory, and antidiabetic agents. Further *in vivo* and *in silico* studies are warranted to elucidate the precise mechanisms of action and develop plant-based formulations for managing oxidative stress and metabolic disorders.

INTEGRATING DIGITAL TECHNOLOGIES IN TO ENVIRONMENTAL EDUCATION

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Environmental awareness is becoming increasingly critical in addressing global challenges such as climate change, deforestation, and biodiversity loss. In response, digital tools and e-learning platforms have emerged as powerful means to promote environmental education and engage diverse audiences worldwide. This paper presents a comprehensive review of how digital technologies contribute to fostering environmental awareness and encouraging sustainable behaviors. The study explores a range of digital tools including websites, mobile applications, social media, and immersive technologies such as Virtual Reality (VR) and Augmented Reality (AR) to assess their effectiveness in enhancing environmental literacy. Findings indicate that interactive content and gamification significantly improve user engagement, comprehension, and long-term retention of environmental concepts. However, challenges persist, including the digital divide, limited accessibility of content, and the need for culturally relevant and localized materials. Despite these obstacles, the review suggests that strategically designed and implemented digital platforms can act as catalysts for behavioral change, particularly in educational and community-based settings. In conclusion, integrating digital technologies into environmental education not only expands outreach but also promotes deeper, more participatory learning experiences. These insights hold important implications for policymakers, educators, and environmental advocates aiming to leverage digital innovation for sustainable environmental practices.

Keywords: Environmental Awareness, Digital Tools, Environmental Education, Sustainable Behavior and Environmental literacy

PHYTOTOXIC EFFECT OF EXPIRED AND NON-EXPIRED AMOXICILLIN TABLETS ON TRIGONELLA FOENUM-GRACUM

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Among the various classes of the pharmaceutical compounds, amoxicillin is an extensively used antibiotic, due to its widespread of therapeutic application. However, the improper disposal of expired and unused amoxicillin tablets has emerged as a serious environmental concern, contributing to the pharmaceutical pollution in the terrestrial ecosystems. The present study aims to evaluate the toxicological effects of the expired and non-expired amoxicillin tablets on the plant growth parameters and residue uptake using *Trigonella foenum-graecum*. In the present study, for the toxicity assessment, both expired and non-expired amoxicillin tablets were finely powdered and added into the soil samples at concentrations of 1g, 5g and 10g. The fenugreek (*Trigonella foenum-graecum*) seeds were then sown in the treated soils and maintained under controlled conditions. Upon the completion of the growth period, various plant growth parameters were recorded and evaluated. From the experimental results, it was observed that, the expired amoxicillin treatments resulted in decreased germination percentage in comparison with the non-expired treatments. The maximum growth parameters of the plant were observed in non-expired amoxicillin treatments. From the LC-MS analysis, it was found that, the highest percentage of absorption was observed in non-expired amoxicillin treatments in the shoot system of the fenugreek plants. From the results, it was observed that, the expired amoxicillin tablets can affect the soil health and plant growth, posing potential environmental hazards. The integration of plant bioassays with LC-MS analysis provides a comprehensive approach for evaluating the ecological risks associated with pharmaceutical contamination.

Keywords: Phytotoxicity, Expired, Amoxicillin, Non-expired Tablets, Plant Growth, Parameters and LC-MS

KNOWLEDGE, ATTITUDE, AND PRACTICE (KAP) REGARDING IRON DEFICIENCY ANAEMIA IN ADOLESCENT GIRLS ON IRON-RICH FOOD CONSUMPTION

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Anaemia among adolescent girls remains a significant public health concern, particularly in developing countries like India. This study aims to assess the knowledge, attitude, and practices (KAP) concerning anaemia and iron-rich food consumption among adolescent girls, and to evaluate the impact of these factors on anaemia prevalence. Additionally, the study examines the alignment of these practices with national health policies such as the Weekly Iron and Folic Acid Supplementation (WIFS) Programme and the National Adolescent Health Programme (RKSK). Methods: A cross-sectional study was conducted among 100 school-going adolescent girls aged 12–18 years in Rajasthan, India. Participants were selected using multistage random sampling from different schools. Data were collected through structured questionnaires assessing knowledge about anaemia and iron-rich foods, attitudes towards anaemia prevention, and dietary practices related to iron-rich food consumption. Statistical analysis was performed using SPSS software version 20.0, with descriptive statistics and chi-square tests to assess associations between KAP and anaemia status. Results: The study found that 94.1% of participants were aware of iron-rich foods, and 66.5% knew about the WIFS programme. Despite this knowledge, only 60% consumed iron-rich foods daily, and 50% adhered to the WIFS programme. Conclusion: The findings indicate a moderate level of knowledge and attitude towards anaemia prevention, but practices related to iron-rich food consumption were suboptimal. The study also highlights the gaps in policy implementation and suggests that enhancing education and accessibility to iron-rich foods could improve anaemia outcomes.

Keywords: Anaemia, adolescent girls, KAP, and iron rich food

GENETIC DIVERSITY OF *CARDIOSPERMUM HALICACABUM* L. IN KERALA VIA D² ANALYSIS: IMPLICATIONS FOR CONSERVATION AND USE

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A comprehensive evaluation of 68 accessions of *Cardiospermum halicacabum* L. was undertaken to assess genetic variability, trait associations, and potential for crop improvement. These accessions, conserved at the Field Gene Bank of Christian College, Kattakada, were analyzed for six agrobotanic traits, including plant height, number of branches per plant, leaf length, leaf area, biomass yield, and phytochemical content. Multivariate analysis of 60 accessions was carried out using Mahalanobis D² statistics (Mahalanobis, 1936) to quantify genetic diversity and explore interrelationships among traits. Based on D² values, clustering grouped the genotypes into 12 distinct clusters, revealing substantial genetic divergence. Clusters VIII and II exhibited the highest intercluster distance, indicating their suitability for hybridization and the potential to exploit heterosis. Cluster VII showed superior performance in leaf length and leaf area, suggesting its value for enhancing vegetative traits. Cluster XII recorded the highest biomass yield, making it a promising candidate for improving agronomic productivity. Notably, Cluster XII demonstrated elevated levels of apigenin and gallic acid, highlighting its medicinal significance and potential for phytochemical enrichment. These findings underscore the genetic richness and trait diversity within *C. halicacabum*, offering a robust framework for the selection of elite genotypes. By integrating variability metrics, trait correlations, and cluster analysis, the study strategically supports breeding programs to enhance morphological vigour and therapeutic potential, while laying a robust foundation for targeted genetic improvement, conservation, and sustainable utilization of underutilized medicinal plant resources.

Keywords: *Cardiospermum halicacabum*, Mahalanobis D² analysis, agrobotanic traits, cluster analysis, genetic diversity.

VISCOMETRIC AND THERMODYNAMIC STUDIES OF AQUEOUS SOLUTION OF ELECTROLYTES AND GLUCOSE AT DIFFERENT TEMPRETURE (293.15K, 303.15K, AND 313.15K)

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Densities (ρ), Viscosities (η) and apparent molar volumes (V_ϕ) of solute on of Bi-Univalent electrolytes (MgCl_2 , $\text{Mg}(\text{NO}_3)_2$, BaCl_2 , and $\text{Ba}(\text{NO}_3)_2$) in purely aqueous glucose solutions have been determined at 293.15k, 303.15k, and 313.15k. The Viscosity Values were analysed by using Jones – Dole equation. The values of apparent molar volume, limiting apparent molar volume have been evaluated from density data. The results were interpreted in the light of ion-ion and ion-solvent interactions and of structural effects of the solute in solutions. The activation parameters of viscous flow have been obtained to throw light on the mechanism of viscous flow. Activation thermodynamics quanties ($\Delta\mu_1^{0\#}$, $\Delta\mu_2^{0\#}$, $\Delta S_2^{0\#}$, $\Delta H_2^{0\#}$) of viscous flow have been obtained. The results were Interaction in the light of ion-ion and ion-solvent interaction. It has been found that all the electrolytes behave as structure makers in purely aqueous and aqueous glucose solutions.

Keywords: Apparent molar volume, Density, Relative Viscosity, electrolyte, aqueous glucose.

HALF DIALLEL ANALYSIS IN SESAME (*SESAMUM INDICUM* L.)

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This study aimed to understand how different sesame (*Sesamum indicum* L.) plants contribute to seed yield and important growth traits by using a half diallel crossing method. Several selected parent lines were crossed (excluding reciprocal crosses), and the resulting hybrids were grown and evaluated in the field. Traits such as plant height, number of branches, number of capsules, capsule length, seed size, and overall seed yield were measured. The results showed clear differences among the parents and their hybrids, indicating good genetic diversity. Using statistical analysis, we assessed both general and specific combining ability to determine which traits are passed down more consistently. General combining ability (GCA) and specific combining ability (SCA) variances were estimated using Griffing's Method II, Model I. It was found that both additive (inherited) and non-additive (interaction-based) genetic effects played a role, with non-additive effects being more important for seed yield. Some parent lines consistently performed well and could be useful in breeding programs, while certain hybrid combinations stood out for their strong performance and potential for future development. Overall, the study provides useful information for improving sesame through selective breeding.

ISOLATION, IDENTIFICATION AND SCREENING OF ENZYMES IN GUT ASSOCIATED BACTERIA FROM FRESHWATER CRAB *TRAVANCORIANA SCHIRNERAE*

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The gut-associated bacterial communities are closely associated with the health of the host and its adaptation to environmental conditions. The present study is a first attempt to investigate the gut-associated bacteria from the endemic freshwater crab *Travancoriana schirnerae*, widely distributed in the wetlands of Wayanad, Western Ghats region. In the present study, bacterial samples were subjected to morphological, biochemical, and enzymatic characterizations using culture-dependent methods. Twenty-one bacterial isolates were obtained from three gut regions (foregut, midgut, and hindgut). Bacterial samples were identified based on morphological and biochemical tests using Bergey's Manual, BacDive and ABIS ® online software. The enzyme screening assays revealed remarkable hydrolytic capabilities across multiple substrate categories, with amylase production detected in 80.95% of isolates, cellulase activity in 47.62%, protease production in 42.86%, and chitinase synthesis in 28.57% of strains, while pectinase activity was not observed. We found that gram positive bacteria are dominant in the gut samples analysed, (81.0%) with predominance of families including Staphylococcaceae (28.6%), Enterococcaceae (19.0%), Listeriaceae (19.0%), and Bacillaceae (14.3%). Notably, 71.4% of isolates demonstrated multi-enzyme production capabilities, including industrially significant species such as *Bacillus subtilis*, *Aeromonas hydrophila*, *Staphylococcus aureus*, and *Klebsiella pneumoniae*. The results suggest that the gut bacteria may play an important role in the host physiology and high hydrolytic capacity of enzymes may indicate that freshwater crab benefits from symbiotic association, which helps for resource utilization and nutrients absorption. Our results have also shown that the gut bacteria in the freshwater crab are unique source of enzymes, which may have potential applications in various biotechnology sectors.

Keywords: Enzyme production, Freshwater crab, Gut bacteria, Gram-positive bacteria, *Travancoriana schirnerae*.

INTEGRATED MORPHOLOGICAL AND GENETIC ASSESSMENT OF INDIGENOUS ORNAMENTAL FISH *BOTIA STRIATA* (RAO, 1920): A CONSERVATION PERSPECTIVE FROM THE KOYNA RIVER, MAHARASHTRA, INDIA

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The present investigation establishes baseline biological and ecological information for the endangered zebra loach, *Botia striata* (Rao, 1920), from the Koyna River in the Western Ghats of India, with the aim of supporting species-specific conservation initiatives. A total of 360 individuals were sampled between August 2023 and July 2024 and analysed through an integrated morphological-genetic framework. Sixteen morphometric parameters and five meristic traits were examined, with statistical assessment identifying strong correlations between total and fork length ($r = 0.983$), where fork length explained 93.5% of the variation in total length. Meristic characters aligned with established taxonomic descriptors. The length-weight relationship indicated negative allometric growth ($b < 3$), corroborated by robust R^2 values, while the mean condition factor ($K = 2.074 \pm 0.012$) reflected overall good physiological condition. Molecular characterisation of a 662 bp fragment of the mitochondrial COI gene revealed an AT-rich composition (57.3%) and very low intraspecific divergence (0–0.6%). Phylogenetic reconstruction using the Maximum Likelihood approach confirmed species identity, with Koyna samples clustering alongside reference *B. striata* sequences (97% bootstrap support). Collectively, the results demonstrate proportional slenderness with increasing size and genetic homogeneity within the population. The combined morphometric and molecular evidence provides a reliable taxonomic resolution and critical insights into the population's health and structure, laying a sound scientific basis for conservation and management strategies to safeguard *B. striata* in its native habitat.

Keywords: *Botia striata*; morphometric analysis; length-weight relationship; mitochondrial COI; phylogenetic analysis; conservation biology

EVALUATING THE IMPACT OF INTEGRATED FARMING SYSTEM ON SUSTAINABLE LIVELIHOODS IN TRIBAL REGIONS OF CHHATTISGARH

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An integrated farming system (IFS) in tribal communities integrates multiple agricultural components such as crop production, livestock and aquaculture to generate a sustainable and resilient living. This strategy maximizes resource utilization by converting waste from one enterprise into input for another, resulting in increased income, nutritional security, and year-round employment. Crops, dairy, poultry, goat husbandry, and fisheries are all integrated into common models, which reduce risk and increases farm profitability for smallholders. The use of an integrated farming system for agricultural output resulted in a lower use of inputs such as fertilizers and pesticides. The systems rely on a thorough understanding of the nature of interactions between the four major components, namely fertilizers, pesticides, cultivations, and rotations, which influence crop yields and farm income. Alternatives to energy-based inputs include legume crop rotations; the use of waste organic matter from animals and crops; integrated pest management; pest and disease forecasting; biological pest control; living mulches and mechanical weed control; conservation tillage; and specialized innovative cultural techniques such as intercropping, strip cropping, trap crops, and double-row cropping. The Farmer FIRST Programme funded by ICAR Delhi, has designed programme to promoting IFS through demonstration of successful models in tribal area of Chhattisgarh. Under this project were adopted newly village namely (Maldongri, Khursipar, Bharritola and Chikhali) in Mohala-Manpur-Ambagr Chowki district, tahsil Ambagarh Chowki, Chhattisgarh. Integration of resources is a process that requires careful consideration before investing in one of the integrated resources and reaping the benefits. This study provides information on IFS-adopted farmers by analyzing the availability of farmer resources and technical expertise, as seen by Farmer FIRST Programme scientists. In this district, where majority of the farmers are either small or marginal, the income from agriculture sector in their farm is not at all sufficient to run their families. Due to fragmentation of land-holdings, even after adoption of improved agricultural technology and practices, their economy condition has not improved. Integration of different agricultural allied enterprises with crop activity as base would provide ways to reuse and recycle waste material of one component as input in the other linked component and to reduce the cost of production of the economic produce of the component two and finally to enhance the net-income the major challenge in tribal areas under the farmers FIRST Programme. There are 18 farm families of four villages namely Maldongri, Khursipar, Bharritola and Chikhali were selected for development of farming system model under the Farmer FIRST Programme. There are 5 different models were developed in the small & marginal farmers fields on need basis. Farming system includes Crop + vegetable crops + backyard poultry + fishery production + duck farming+ Vermi-compost production+ *Azolla* production + animal husbandry. To ensure livelihood security of marginal and small farmers and simultaneously, securing agricultural sustainability and environmental safety as well, farmer FIRST Programme introduce Integrated Farming System was initiated at tribal area of Mohala-Manpur-Ambagarh Chowki district Chhattisgarh in 2024-25. The model developed on 1.0 hectare area comprises of crops (0.35 ha), dairy (0.10 ha), horticulture (0.20 ha), fishery (0.09 ha), Poultry (0.08), Goatry (0.05) and other (0.13) were other miscellaneous which was used for vermicompost, threshing floor and farm building etc. This model initially was consisting of field crops including fodders, dairy with improved milch animals (five Goatry sirohi breed, 50 poultry chicks of sonali, horticulture (vegetables unit), (A mix culture of fishes including rohu, Katla, mrigal). This was further strengthened by establishment of a small vermicompost and *Azolla* unit (0.01 ha). All the farm wastes, by products and crop residues etc. were properly recycled in to the system itself so that nothing go as waste and output of one enterprise serves as a input for other enterprise. Under crop production besides food for family consumption, provided green fodders and feed concentrates to the dairy animals and also green biomass as feed of fish. In turn animals' Goatry and poultry dung after proper composting and in the form of FYM and vermicompost was used as a major source of nutrients in field and plantation crops or sold in open market. Also animal wash directly diverted from animal shed to fish pond to serve as fish feed. In this way IFS is a very complex in nature but a number of complementary as well as supplementary type of interactions within the system itself make the system more viable. The major components/ enterprises of integrated farming system model at tribal area of Chhattisgarh.

DOCUMENTATION OF INVASIVE PLANT SPECIES IN BANTWAL TALUK, DAKSHINA KANNADA

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Invasive plant species are non-native plants that establish and spread rapidly in new environments, often altering the structure and function of natural ecosystems. Their ability to adapt to diverse climatic and soil conditions enables them to dominate various habitats, outcompeting native vegetation for essential resources such as sunlight, nutrients, and water. The present study aims to identify and document the invasive plant species found in and around Bantwal Taluk, Dakshina Kannada. Observations indicated that these plants adapt to a wide range of environmental conditions, enabling them to establish quickly and spread extensively. The findings revealed that a significant number of these plants thrive along roadsides, agricultural lands, riverbanks, and forest fringes, where they form dense stands that suppress native plant growth and alter the local landscape. In some sites, invasive plants were found to dominate abandoned farmlands and degraded habitats, limiting native regeneration and changing vegetation composition. Their rapid expansion also poses challenges for farmers, forest management, and local biodiversity conservation efforts documenting these species at the local level is crucial for understanding their distribution patterns and ecological impact. Such information can contribute to effective biodiversity conservation, habitat management, and policy formulation. The study highlights the need for regular monitoring, community awareness programs, and the promotion of native plant restoration to maintain ecological balance and prevent further spread of invasive species.

Keywords: Invasive plants, documentation, biodiversity, local flora, ecological balance, conservation, habitat management

POTENTIAL OPPORTUNISTIC ROLE OF *KOSAKONIA SACCHARI* IN COMMON CARP (*CYPRINUS CARPIO*) FROM UNMANAGED VILLAGE PONDS IN HISAR

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Intensification of freshwater aquaculture increases the risk of opportunistic bacterial infections, particularly in small, unmanaged village ponds where water quality often deviates from optimal ranges. This study reports the isolation and characterization of *Kosakonia sacchari* from diseased common carp (*Cyprinus carpio*) in an unmanaged pond in Hisar, India the first such record from this region. Clinically affected fish exhibited signs of systemic infection, including lethargy, pallid gills, haemorrhagic skin lesions, and intestinal congestion. Pond water analysis indicated stressful conditions (temperature $\approx 33^\circ\text{C}$; pH 8.5; dissolved oxygen 4.1 mg L^{-1} ; total ammonia 0.7 mg L^{-1}). The intestinal isolate was a Gram-negative rod producing a biochemical profile (catalase $^+$, oxidase $^-$, MR $^-$ /VP $^+$, lysine decarboxylase $^+$, citrate $^+$, indole $^-$, urease $^-$) characteristic of the genus *Kosakonia*. Physiological assays showed mesophilic growth (optimum $27\text{--}32^\circ\text{C}$), preference for neutral to mildly alkaline media (pH 7.0–9.0), and moderate halotolerance (growth up to 3% NaCl). Partial 16S rRNA gene sequencing (GenBank accession no. PP990623) showed 100% similarity to *K. sacchari* reference sequences, and phylogenetic analysis clustered the isolate within the *K. sacchari* clade with strong bootstrap support ($>83\%$). Collectively, these findings confirm the occurrence of *K. sacchari* in diseased carp from Indian freshwater systems and suggest a potential opportunistic role under environmental stress. Further experimental infection trials and whole-genome sequencing are recommended to establish pathogenicity and elucidate virulence or adaptation determinants.

Keywords: *Cyprinus carpio*, *Kosakonia sacchari*, opportunistic pathogen, 16S rRNA sequencing, freshwater aquaculture

HAKKARIKE, LAUNAEA PROCUMBENS (ROXB.), A LESSER KNOWN LEAFY VEGETABLE WITH HIGH HEALTH BENEFITING VALUES

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Launaea procumbens (wild lettuce) is a globally distributed weed, indigenous to India, with significant presence in Karnataka, Telangana, Maharashtra, Gujarat, Haryana and Uttar Pradesh. Ethnobotanical studies reveal its use in treating kidney stones, skin diseases, jaundice, and hormonal imbalances, alongside pharmacological properties such as antioxidant, anticancer, neuroprotective, and cardioprotective effects. The plant thrives in northern Karnataka, particularly in diverse soils, including black, red and lateritic types. Local communities note that plants grown in black soils are tastier and more nutritious. Despite its widespread consumption, its nutritional potential remains underexplored. This study evaluated the proximate composition, mineral content, phytochemical properties and antioxidant potential of *Launaea procumbens* grown in black, red and lateritic soils across different districts of Karnataka. Plants from black soils exhibited the highest for proximate composition like moisture, protein, ash, fat and carbohydrates including minerals like calcium, magnesium, and iron. Total phenols, flavonoids along with antioxidant activity CUPRAC and FRAP, including oxalates and nitrates. Anti-nutritional factors like saponins, tannins and alkaloids were also most pronounced in plants from red soils. Zn was also found prominent in red soil. Lateritic soils generally showed intermediate levels across parameters but were less favorable than black and red soils. Correlation and PCA analysis revealed that black soils favoured nutritional parameters such as protein, ash, bioactive compounds and minerals, while red soils anti-nutritional compounds. This study confirms the traditional belief that black soils enhance the plant's flavour and nutritional quality. These findings highlight the plant's potential as a nutrient-rich leafy vegetable and its role in supporting rural livelihoods, dietary security and traditional knowledge.

Keywords: *Launaea procumbens*, Nutrition, CUPRAC, FRAP and Ethnobotanical

ENVIRONMENTAL TOXICOLOGY OF PESTICIDES: PATHWAYS, PERSISTENCE AND PERILS TO HUMAN HEALTH

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Environmental toxicology plays a vital role in understanding the interactions between chemical pollutants and living systems. Among these pollutants, pesticides represent a significant concern due to their extensive use in modern agriculture and their persistence in environmental matrices. After application, considerable amounts of pesticides infiltrate soil and water ecosystems, where they undergo degradation, leaching and bioaccumulation. The residues of commonly used pesticide groups such as organophosphates, carbamates, pyrethroids and neonicotinoids are frequently detected in agricultural soils, surface waters and groundwater, often exceeding recommended safety limits. Pesticide contamination adversely affects soil microbial diversity, nutrient cycling, and overall soil fertility, while in aquatic environments it leads to toxicity, endocrine disruption and biomagnification across trophic levels. In humans, chronic exposure to contaminated soil and water has been associated with neurological disorders, reproductive impairments, carcinogenesis and immunotoxic effects. These risks are compounded by improper pesticide handling, inadequate waste disposal and lack of regulatory enforcement in many developing regions. A comprehensive understanding of pesticide fate, toxicokinetics and ecological interactions is essential for accurate risk assessment and mitigation. Therefore, integrating environmental monitoring, risk evaluation and sustainable pest management approaches is crucial to minimize pesticide-induced hazards and to protect ecosystem integrity and human health.

Keywords: Environmental toxicology, pesticides, soil contamination, water pollution, ecotoxicology, human health, biomagnification, sustainable pest management.

ACCELERATING URBAN FOREST GROWTH: A STUDY ON THE MIYAWAKI METHOD IN KALABURGI DISTRICT, KARNATAKA

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Forests are dynamic ecosystems essential for maintaining biodiversity, regulating climate, and sustaining life on Earth. In response to increasing deforestation and urbanization, various afforestation techniques have been adopted among them, the Miyawaki method stands out as a promising alternative. Developed by Japanese botanist Dr. Akira Miyawaki, this technique enables the rapid growth of dense, native forests, particularly in small, degraded, or urban areas. Miyawaki forests are known to grow 10 times faster, become 30 times denser, and support significantly greater biodiversity than conventional plantations, often becoming self-sustaining within 3 to 5 years. This study aims to evaluate the growth performance of plant species and assess the environmental impact of Miyawaki afforestation on local ecological parameters such as biodiversity, soil quality, and microclimate. An experimental Miyawaki forest was established in Gundgarthi village, Kalaburgi district, Karnataka, covering an area of 1,208 sq. meters. Over 50 native species were selected, and comprehensive soil analysis was conducted to guide the plantation process. Techniques such as coir pit perforation, organic mulching (using sugarcane leaves and pigeon pea residues), and regular watering were applied to support early-stage growth. Initial results indicate significant plant growth, ranging from 1 to over 3 meters within a short period, with species-specific variations. The emergence of a self-sustaining ecosystem was also observed, demonstrating the potential of the Miyawaki method in restoring biodiversity, enhancing soil fertility, and contributing to climate change mitigation through carbon sequestration and pollution reduction.

Keywords: Miyawaki Forest, Urbanization, Carbon sequestration, afforestation, Gundgarthi

COMPUTATIONAL ANALYSIS OF SOYBEAN RHIZOSPHERE MICROBIOME UNDER ORGANIC FERTILIZATION IMPLICATIONS FOR SUSTAINABLE AGRICULTURE

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Sustainable agriculture hinges on the health of soil microbiomes, which play a crucial role in nutrient cycling, pathogen suppression, and ensuring long-term productivity while keeping chemical inputs to a minimum. This study dives into a comprehensive computational analysis of the soybean (*Glycine max*) rhizosphere microbiome under organic fertilization, utilizing publicly available 16S rRNA amplicon sequencing data (SRX26495742). We proposed that organic fertilization boosts microbial diversity and enriches beneficial plant taxa, ultimately fostering sustainable soil health. To analyze the raw sequencing reads, we employed fastp for quality filtering, followed by denoising and processing to derive amplicon sequence variants (ASVs) using DADA2 in R. Taxonomic assignments were made against the SILVA database, and we examined microbial diversity, community composition, and differential abundance using phyloseq. We calculated alpha diversity (Shannon index) and beta diversity metrics (Bray–Curtis), identifying taxa that were significantly enriched under each treatment. Our results showed that organic fertilization increased alpha diversity compared to control soils and led to distinct clustering of microbial communities. Notably, several beneficial taxa, such as nitrogen-fixing and phosphate-solubilizing bacteria, were found to be more abundant in the rhizospheres treated with organic fertilizers. These findings point to enhanced nutrient cycling potential, better pathogen suppression, and overall resilience of the soil. This fully computational approach illustrates how *in silico* microbiome profiling can swiftly evaluate the effects of agricultural practices on soil health. The study underscores the importance of organic fertilization in advancing sustainable crop production and offers a reproducible framework for developing environmentally friendly soil management strategies.

Keywords: Soybean, Rhizosphere Microbiome, Organic Fertilizer, 16S rRNA, Computational Biology

PROCESSED FOOD EXPORTS FROM INDIA: A PATHWAY TO GLOBAL SUSTAINABLE FOOD SECURITY AND ECONOMIC ANALYSIS

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The Indian food processing industry plays a crucial role not only in enhancing national Self-reliance but also in enhancing contributing meaningfully to global sustainable food security accounting for 32 per cent of the country's total food market as of 2023–24, the sector is poised for exponential growth, with the market size projected to rise from ₹26.5 lakh crore to ₹60.4 lakh crore by 2030. This expansion, grounded in rising demand for processed food, offers India a strategic opportunity to ensure year-round food availability and reduce post-harvest losses which is key elements of sustainable food systems. This study investigates the export dynamics of processed products, with a focus on Ready-to-Eat (RTE) items, using growth rate and instability indices. Cuddy-Della Valle index was applied to evaluate the instability. Processed products include ready to eat, ready-to-cook, ready-to-serve, and frozen vegetables. The analysis utilizes secondary data obtained from the Agricultural and Processed Food Products Export Development Authority (APEDA) for the period 2014–15 to 2023–24 as a measure of India's growing role in global food systems. The compound growth rates for RTE products in terms of export volume and value were found to be 13.48 per cent and 17.42 per cent, respectively, while the corresponding instability indices were 16.56 per cent and 15.08 per cent. Here study also revealed that among 150 plus countries, the relative value share of USA, the top-most partner in RTE, was only 26.26 per cent for Indian Sweets and Snacks, 17.82 per cent for jaggery to 13.88 per cent in biscuits and confectionary, showing the need for much-needed export diversification in terms of both products and destinations.

Keywords: Global food Security, Processed products, growth rate, instability, exports

ULTRASTRUCTURE OF HEPATOPANCREAS OF FRESHWATER CRAB *TRAVANCORIANA SCHIRNERAE*

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In decapod crustaceans, the hepatopancreas is a lobulated, branched structure occupying a great portion of the cephalothorax. It is known as digestive gland and its function is like that of liver in vertebrates. It performs several vital functions in crustaceans, since it is directly involved in the synthesis and secretion of digestive enzymes, absorption, excretion and nutrient uptake. In general, the morphology and cytology of hepatopancreas reflect the external environmental conditions and various environmental toxins can cause hepatopancreatic toxicity. In the present study, the light and ultrastructural observations on hepatopancreas of the freshwater crab *Travancoriana schirnerae* demonstrated tubules which are lined by pseudostratified epithelium containing five cell types; E, F, R, B and M cells. E cells are small, cuboidal in shape and they have a large round or oval nucleus situated in the centre of the cytoplasm. F cells elongated; apical membrane forms numerous undulated microvilli. Cytoplasm has fibrillar like marks and the occurrence of numerous round and small cisternae of RER. B cells are characterized by a giant central vacuole towards the basal region of the cell. The cytoplasm is characterized by numerous small cisternae of RER and a few mitochondria. R cells are elongated, columnar cells and characterized by numerous prominent slender microvilli at the apical surface. The cytoplasm contains tower of heterogenous lipid vacuoles, which is a unique feature of R cells. The presence of myelin figures (distributed as concentric circles of electron dense structures) in mid and apical areas have been noted in R cells. R cells exhibited prominent network of SER cisternae and vesicles under ultrastructural examination. M cells showed prominent nucleolus (2-3) and granular chromatin content is fully distributed inside the nucleus. The cisternae of RER are seen in high concentrations inside the cytoplasm and surrounding the nuclear region. These findings suggest that the R cells are the most prolific cell type within the hepatopancreas and have multiple functions; they serve for absorption and metabolization of nutrients, synthesis and storage of lipids and detoxification process. B cells fine-features indicate digestive functions and the transparent large central vacuole indicates, content discharge by holocrine mode. F cells are typically involved in active synthesis of enzymes which is evident from the occurrence of numerous cisternae of RER and mitochondria. F cells are observable with brush borders for absorption and storage. M cells are the smallest cell type and characterized by highly developed RER, indicating their role in synthetic function of proteins. E cells are probably undifferentiated cells which may differentiate to become other cell types in the hepatopancreas. These findings provide general information regarding the identification, characterization and functions of the hepatopancreatic cell types in freshwater crab which might be useful in future nutritional research and toxicological studies.

Keywords: Decapoda, freshwater crab, hepatopancreas, ultrastructure.

EXPLORING THE ROLE OF THE SPR3 HOMOLOGUE IN SEPTUM FORMATION AND RIBOFLAVIN OVERPRODUCTION IN *ASHBYA GOSSYPHII*

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The riboflavin over producer *Ashbya gossypii* is a filamentous hemiascomycete closely related to the yeast *Saccharomyces cerevisiae*. In fact the genome of *S. cerevisiae* is supposed to have arisen by duplication of the *A. gossypii* genome. On account of this many fundamental processes in these two organisms are similar. Therefore, research in this organism is important both from the point of view of addressing fundamental questions in cell biology of fungi as well as with regard to riboflavin oversynthesis by this fungus. In this context an important question to be addressed is how does septation correlate with riboflavin secretion into the external medium. The septum wall prevents vacuoles which store the riboflavin, important enzymes etc from being transported. The *A. gossypii* SPR3 gene is involved in septum formation. In the present study we present a preliminary characterization of the *AgSPR3* gene and show that it has a conserved P – loop region relating it to septin proteins, it also has Leucine Zipper motifs and may play a regulatory role in *A. gossypii* at the transcriptional level.

A STUDY EVALUATING THE ANTAGONISTIC POTENTIAL OF COW URINE AGAINST THE STANDARD STRAINS OF COMMON PATHOGENS

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Cow urine was tested to evaluate its antagonistic potential in the Biotechnology department of RBS College, Agra. Cow urine was collected from different goshalas of the different regions of Agra. Total 4 samples were collected aseptically in the sterile chambers and stored at 4 degree Celsius till use. Serial dilutions 1, 1/10 and 1/100 were made. Cultures of mixed colonies appeared, Out of 14 bacterial isolates 4 were selected to test their antimicrobial activity. Standard strains of *Enterococcus faecalis* MTCC 439 *Candida albicans* MTCC 227 were used to monitor the antimicrobial activity. A total of 3 out of 4 strains have shown promising activity against *Enterococcus faecalis* 439 and All 4 against *Candida albicans* MTCC 227. Further studies in this direction are strongly recommended. It seems that cow urine is a potential source of antimicrobial activity.

Keywords: Antagonistic activity, cow urine, Serial dilutions *Candida albicans*, *Enterococcus faecalis*.

ISOLATION AND MOLECULAR CHARACTERIZATION OF *ASPERGILLUS FLAVUS* FROM GRAPES AND ITS INHIBITORY ACTIVITY BY *LIMONIA ACIDISSIMA*

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Limonia acidissima (L) belongs to the family Rutaceae and is commonly called as wood-apple. It is one of the well-known medicinal plants traditionally exploited for the treatment of vomiting, dysentery and other bowel problems. The present study isolation and molecular characterization of *Aspergillus flavus* from grapes and its inhibitory activity by *Limonia acidissima* essential oil the essential oil from *L. acidissima* was extracted using Hydrodistillation method and characterized using GC-MS analysis. Collected the different grape sample by north Karnataka vijaypur district Uppaladinni and Mamadapur locality like Thompson. Manickman. Anuska. Isolation of *Aspergillus flavus* fungi by potato dextrose agar media morphological studied by using compound microscope then identify the mycotoxins producing strains by TLC plate method. Molecular characterization *Aspergillus flavus* isolation of DNA by ctab method confirmation of isolated DNA using electrophoresis band will be occurred. Molecular characterization identification of toxigenic and non-toxigenic isolation of DNA by C-Tab method confirmed by gel electrophoresis method after using pcr amplification of DNA further we or done the sequencing the toxin and non-toxigenic strain fungi these are treating the essential oil identify the activity.

HOST-PATHOGEN INTERACTION

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The outcome of plant diseases is greatly influenced by the dynamic and intricate biological process known as host–pathogen interaction. The plant (host) and the invasive organism (pathogen), such as fungi, bacteria, viruses, or nematodes, engage in a never-ending molecular struggle during this relationship. Preformed physical barriers and inducible immune responses such as Pattern-Triggered Immunity (PTI) and Effector-Triggered Immunity (ETI) are part of the host's multilayered protection system. On the other hand, pathogens develop a variety of tactics to get past these defenses by releasing effectors or virulence factors that weaken the host's defenses and promote infection. Predicting diseases, detecting them early, and helping crops build long-lasting resistance all depend on an understanding of the molecular underpinnings of host–pathogen interactions. The complex signaling pathways, gene-for-gene exchanges, and co-evolutionary arms race between pathogen avirulence genes (Avr genes) and host resistance genes (R genes) have been clarified by developments in genomics, transcriptomics, and proteomics. Furthermore, there are intriguing ways to modify these interactions in the host's favor using contemporary techniques like RNA interference (RNAi) and CRISPR/Cas gene editing. In light of new infections and shifting environmental conditions, this abstract emphasizes how important it is to understand host–pathogen interactions in order to create efficient disease control plans and guarantee sustained agricultural productivity.

Keywords: Host, Pathogen, Diseases, Pattern-Triggered Immunity, Effector-Triggered Immunity, Defense, Avirulence gene.

IRRIGATION STATUS AND IRRIGATION SOURCES USED BY THE ORGANIC FARMERS IN THE KONKAN REGION

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Konkan region is blessed with high rainfall. Tropical conditions prevail all over the region. Agroecologically, the Konkan region is part of the hot humid-per humid eco region consisting of the Sahyadri mountain range and the western coastal plains, extending over the states of Maharashtra, Goa, Karnataka, and Kerala (Sehgal et al., 1992). Thane, Raigad, Ratnagiri and Sindhudurg districts of the Konkan region, receive heavy rains. The region gets about 2,000–4,000 mm annual average rainfall. 90 per cent of which is received from June to October (100–110 days). Region's economy is predominantly agrarian. Organic farming can provide quality food without adversely affecting the soil's health and the environment. India, groundwater has become dominant source of irrigation. On the other hand, there is large gap between the ultimate and utilized surface water potential. With continual diminishing per capita water availability coupled with groundwater exploitation, it has become imperative to switch to efficient water saving technologies and alternative source of irrigation. Keeping all these in view, the present study was designed with specific objective to study the irrigation status and irrigation sources used by the organic farmers in the Konkan region. The list of villages with well-established organic farming groups were obtained from the central Government scheme "Paramparagat Krishi Vikas Yojana". Accordingly, one village from selected tahsils was selected randomly. Thus ten villages from ten tahsil of five districts were selected for the study. List of the organic farmers for the selected villages and tahsils was prepared for the entire five districts of Konkan region. In all, 300 farmers were selected using proportionate random sampling method. From study it is observed that, majority (64.00 per cent) of the respondents had 'medium' irrigation status, while 32.67 per cent and 3.33 per cent respondents had 'high' and 'low' irrigation status, respectively. Average irrigation status score of the respondents was 2.8 indicating medium level. It is found that most of the respondents had medium level of irrigation status; hence there is scope to improve the irrigation status of the farmers in the region.

INVESTIGATION AND ASSESSMENT OF WATER HARDNESS USING THE PH-METRIC TITRATION TECHNIQUE IN THE JALKOT AREA

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Water hardness is a crucial factor in assessing water quality, primarily caused by the abundance of Ca^{2+} and Mg^{2+} ions in natural water sources. The complexometric titration method is widely used to determine the concentrations of these ions, which are the main contributors to water hardness. However, this method requires two external indicators to identify the titration endpoints, and its accuracy is often compromised by unavoidable parallax errors when marking these endpoints. This study introduces an innovative approach to measure the concentrations of Ca^{2+} and Mg^{2+} ions in a water sample of the Jalkot region in district Latur of state Maharashtra. Two distinct hard water samples are prepared to assess water hardness using the pH-Metric Titration Method. This pH variation is carefully monitored and graphically recorded. The data reveals two separate linear regions with notably different slopes, indicating the titration endpoint. The neutralization volume obtained is then used to separately determine the Ca- and Mg- hardness of the water sample. This new method is anticipated to be valuable for accurately monitoring other chemical reactions, paving the way for future research. This pH-metric study is expected to contribute significantly to the advancement of analytical chemistry and industrial chemical processes.

NOURISHING YOUR BODY: POST-PREGNANCY CARE FOODS USED IN BANTWAL TALUK

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Residents of Bantwal Taluk, Karnataka rely on various local foods to treat different ailments related to maternal and child health. This study carried out an ethnobotanical survey to record and document the foods used in traditional maternal healthcare practices in Bantwal Taluk. The objectives of the survey were to document the foods consumed during the postpartum recovery period, identify ingredients that promote lactation and aid in faster healing, and record foods rich in iron content. Traditional foods include- Ragi laddoo, Fenugreek rice porridge, onion curry, Turmeric milk, Ajwain curry, *Elwendia persica* (kala jeera) decoction, Manar madhu (prepared by using different spices and jaggery). It contains iron, calcium, magnesium, phosphorus, omega-3 fatty acids, vitamin c, etc. These foods are essential for a mother's recovery and well-being after childbirth, as they help to heal tissues, restore energy, and support milk production. They help strengthen the immune system also maintains joint health weakened by pregnancy. Reduce inflammation. Moreover, balanced postnatal nutrition helps regulate hormones, stabilizes mood, improves sleep quality, and enhances overall vitality, enabling new mothers to regain physical strength and emotional resilience.

Keywords: Ethnobotanical survey, Bantwal Taluk, Maternal healthcare, Traditional foods, Medicinal property.

A STUDY ON ICTHYOFAUNAL DIVERSITY OF SUKHANA DAM, GARKHRDA, DIST. AURANGBAD, MAHARASTRA, INDIA

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The present study deals with fish biodiversity undertaken during period July2011 to June 2012 to survey and commercially important fishes in the Sukhana dam. The Fresh water body of Sukhana dam used for irrigation purposes at Garkheda in Aurangabad district. The present study deals with the variety and abundance of fresh water fishes in Sukhana dam of Garkheda in Aurangabad district (M.S.) India. The results of present study reveal the occurrence of fish biodiversity belong to 4 orders 7 families and 16 species. The members of Order Cypriniformes were dominated by 9 species followed by Perciformes 4 species, Siluriformes 2 species and Synbranchiformes with one species.

Keywords: Ichthyofaunal diversity, Sukhna dam Garkheda, Economic value

NANO-SENSORS: A NOVEL TOOL FOR PRECISION AGRICULTURE

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Nano sensors have emerged as a transformative technology capable of detecting and qualifying physical, chemical and biological parameters at the nanoscale with extreme precision. This is an experimental investigation into the fabrication, characterization and performance estimation of nano sensors designed for agricultural and engineering application. The main aim is to analyze their sensitivity, selectivity, and response time in detecting environmental and mechanical variation. The Nano sensors were fabricated using bottom-up synthesis approaches which include sol gel deposition of nanostructured materials on conductive substrates. Electrical and mechanical responses were evaluated on experimental basis under varying conditions of temperature, pressure and humidity. The result indicates significant improvement in sensitivity compared to conventional microsensors, with response time reduced approximately to forty percent. The nano sensors exhibit high stability, repeatability, and durability conforming for real-time monitoring applications. The findings highlight the broad potential on nano sensors in agriculture and agricultural engineering. Smart nano-fertilizers have been suggested to be fitted with nano biosensors in a biopolymer, covering a coating on all sides of the fertilizer parts. The nano sensors market is growing day by day and is expected to reach \$1,321.30 million by 2026. Around 20,000 researchers and 2,000 employees are involved in this area. Nowadays, nano sensors and nano-based elegant delivery system support farmers in properly using water, nutrients, and agrochemicals to increase crop yield through improved monitoring and minimization of inputs. Keyword: Nano-sensors, Nanotechnology, Nano-fertilizers, Nano-biosensors.

NUTRITION KNOWLEDGE DEFICIT AND ITS IMPACT ON ADOLESCENT EATING BEHAVIOUR

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Adolescence is a critical period for the development of long-term eating habits, yet many adolescents experience nutritional knowledge gaps, inappropriate dietary intake, and behavioural challenges that hinder healthy eating. This paper explores the key factors contributing to poor dietary patterns among adolescents, including limited nutrition awareness, socioeconomic constraints, peer influence, family environment, and time limitations. A review of recent literature indicates that many adolescents lack essential understanding of balanced diets, nutrient functions, and the health consequences of poor nutrition. Behavioural barriers such as meal skipping, frequent consumption of fast food, and sedentary lifestyles further aggravate the problem. School-based nutrition interventions, dietary behaviour assessments, and public health campaigns are examined as effective methodologies to address these challenges. The findings emphasize the need for holistic, multi-level approaches that combine education, environment, and policy reforms. Strengthening nutrition education in schools, involving families and communities, promoting supportive food environments, and leveraging digital platforms to engage youth can significantly enhance adolescent dietary behaviour and long-term health outcomes.

Keywords: Adolescents, Nutrition Knowledge, Healthy Eating, Behavioural Barriers, Socioeconomic Factors, School Interventions, Public Health

RNA-SEQ-BASED IDENTIFICATION OF GENES INVOLVED IN IRON AND ZINC ACCUMULATION IN RICE GRAINS

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Micronutrient deficiencies, particularly of iron (Fe) and zinc (Zn), remain a major global health concern, especially in populations dependent on rice as a staple food. Enhancing the micronutrient content of rice grains through biofortification is an effective and sustainable strategy to combat “hidden hunger.” In this study, RNA sequencing (RNA-seq) was employed to investigate the transcriptomic differences between high and low Fe/Zn accumulating rice genotypes during grain development. High-quality reads were aligned to the *Oryza sativa* reference genome, and differential gene expression analysis was performed using the DESeq2 package in R. A set of significantly up- and down-regulated genes associated with metal transport, chelation, and storage were identified, including members of the ZIP, YSL, NRAMP, and VIT families, as well as genes involved in nicotianamine and phyto siderophore biosynthesis. Gene Ontology (GO) and KEGG pathway enrichment analyses revealed the activation of pathways related to metal ion homeostasis, oxidative stress response, and secondary metabolite biosynthesis. Co-expression network analysis further highlighted potential regulatory transcription factors that may coordinate Fe and Zn translocation to developing grains. The results provide valuable insights into the molecular mechanisms underlying micronutrient accumulation and identify promising candidate genes for marker-assisted selection or genetic engineering of nutrient-enriched rice varieties.

CHITOSAN NANOENCAPSULATED EUGENOL AS ANTIMICROBIAL AGENT FOR SUSTAINABLE MANAGEMENT OF MOULD INDUCED BIODETERIORATION IN FOODSTUFFS

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Storage and transportation of foodstuffs such as fruits, vegetables and grains are challenging, because bad storage conditions often promote microbial infestation and lead to food spoilage. In post-harvest storage, most foodstuffs are frequently compromised by *Aspergillus flavus*, a fungus capable of producing Aflatoxins, which are highly toxic and carcinogenic secondary metabolites that threaten food safety and agricultural sustainability. Addressing fungal contamination with synthetic fungicides raises concerns about environmental impact, chemical residues and resistance development, thereby necessitating innovative and eco-friendly solutions. This study investigates the application of chitosan-based nanoencapsulation to enhance the efficacy of Eugenol, a natural antifungal phenolic compound extracted from clove essential oil, for the preservation of foodstuffs during storage. Chitosan, a biodegradable and biocompatible natural biopolymer, was employed to encapsulate Eugenol by the ionic gelation method and was characterized by XRD, FTIR, and SEM. In vitro antifungal assessments revealed that the Chitosan nanoencapsulated Eugenol (CNEU) significantly inhibited the growth of aflatoxigenic *A. flavus* more effectively than free Eugenol. Application of these nanoparticles on food samples under storage conditions revealed significant protection of them from fungal infestation, Aflatoxin B₁ production and reduction of nutritional values such as carbohydrate, protein and lipids upto 60 days of storage. These findings indicate the potential of CNEU for sustainable post-harvest management of agricultural food commodities and enhanced food security.

Keywords: *Eugenol, Chitosan, Nanoparticle, Aspergillus flavus, Aflatoxin B₁, Sustainable agricultural management.*

REAL-TIME CLIMATIC CHANGES STUDY FOR SUSTAINABLE DEVELOPMENT

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Climate change poses a major threat to ecosystems, economies, and human well-being worldwide. Understanding and responding to these changes in real time has become crucial for achieving sustainable development. This seminar focuses on the integration of modern technologies such as the Internet of Things (IoT), remote sensing, big data analytics, and machine learning to monitor and analyse real-time climatic variations. Continuous data collection through sensors and satellites enables timely prediction of extreme weather events, improved resource management, and evidence-based policy decisions. The study emphasizes how real-time climatic data can support sectors such as agriculture, energy, water management, and urban planning, ensuring resilience against environmental challenges. By promoting proactive climate action, this approach aligns with the United Nations Sustainable Development Goals, particularly SDG 13 (Climate Action) and SDG 15 (Life on Land).

Keywords: Real-time monitoring, Climate change, IoT, Machine Learning, Sustainable Development, SDG 13.

IMPACT OF BIOFERTILIZER ON ROOT CROPS IN AGRA REGION

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The use of biofertilizers has become very important for sustainable crop production in the Agra region. Root crops like carrot, radish, beetroot, and turnip are widely grown here and need balanced nutrition for better yield and quality. Biofertilizers such as Azotobacter, Azospirillum, Rhizobium, and Phosphate Solubilizing Bacteria (PSB) help in improving soil fertility naturally. They fix atmospheric nitrogen, solubilize phosphorus, and enhance the availability of essential nutrients to plants. In the sandy loam soils of Agra, chemical fertilizers alone often reduce soil health and microbial activity. The application of biofertilizers along with organic manure and a small dose of chemical fertilizers improve soil texture, root growth, and water-holding capacity. Farmers who use biofertilizers in carrot and radish fields have reported better root size, uniform color, and higher market value. It also reduces the cost of chemical fertilizers and prevents soil pollution. Moreover, biofertilizers promote eco-friendly farming and increase the population of beneficial soil microorganisms. They play a vital role in maintaining long-term soil productivity. In the Agra region, where the climate is semi-arid and irrigation water is limited, biofertilizers help plants to absorb nutrients efficiently and tolerate stress conditions. Thus, the use of biofertilizers in root crops is a simple, low-cost, and environment-friendly practice that supports both farmers' income and soil health in the Agra region.

ASSESSMENT OF WATER POLLUTION STATUS AND ITS EFFECT ON FISH PRODUCTIVITY IN PENTAKLI DAM, BULDHANA (MAHARASHTRA), INDIA

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The present study assesses the pollution status and its impact on fish productivity in Pentakli Dam, a freshwater reservoir located in Buldhana district, Maharashtra, India. Monthly observations were conducted from June 2021 to May 2022 at four selected sites to evaluate physicochemical characteristics, zooplankton diversity, and fish yield. Standard analytical procedures recommended by APHA (2012) were employed for water quality assessment, while biological indicators were studied following Needham and Needham (1962). The findings revealed that the overall water quality of Pentakli Dam was within permissible limits for aquatic life, though seasonal variations indicated moderate organic and nutrient enrichment, particularly during the monsoon and post-monsoon periods. The zooplankton community, mainly composed of Rotifera and Cladocera, reflected moderate species diversity, indicative of a mesotrophic condition. Fish productivity showed a clear relationship with water quality and zooplankton abundance, suggesting that nutrient levels and dissolved oxygen play a major role in determining the reservoir's fish yield potential. The study concludes that Pentakli Dam is a moderately productive ecosystem, under moderate pollution stress influenced by catchment activities. Appropriate catchment management, pollution control, and sustainable fishery practices are recommended to maintain ecological balance and enhance the reservoir's long-term productivity.

EXTRACTION AND MORPHOLOGICAL CHARACTERIZATION OF STEM-DERIVED ENDOPHYTIC BACTERIA FROM LEPTADENIA PYROTECHNICA

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This study aimed to isolate and identify endophytic bacteria from the stem of *Leptadenia pyrotechnica* and examine their morphological characteristics. Fresh stem samples were collected from the Department of Botany, University of Rajasthan. Endophytes, known as non-pathogenic microorganisms living within host tissues, often produce secondary metabolites with potential bioactive properties. The isolates showed diverse cultural features on nutrient agar plates and slants. Colonies appeared creamy white, circular, and had entire or irregular margins. Among the sixteen isolates, one was Gram-negative while fifteen were Gram-positive. *Leptadenia pyrotechnica*, a resilient desert shrub with significant ethnobotanical and medicinal importance, hosts a distinctive bacterial community dominated by Gram-positive forms, notably *Streptococcus*. Morphologically, most isolates exhibited circular colonies (68.75%), entire margins (25%), convex elevation (37.5%), and large size (81.25%). On nutrient agar slants, moderate growth (68.75%), opaque appearance (25%), mucoid texture (37.5%), and filiform form (81.25%) were predominant.

Keywords: Endophytic bacteria, *Leptadenia pyrotechnica*, Morphological characterization, Gram-positive isolates, Desert plant microbiome

COMMUNITY-DRIVEN APPROACHES FOR FOREST RESTORATION: ENHANCING COVERAGE THROUGH PEOPLE'S PARTICIPATION

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The ongoing reduction of forest cover due to deforestation, land misuse, and unsustainable resource exploitation presents significant ecological and socio-economic challenges. Traditional top-down afforestation strategies often fail to achieve lasting results due to limited involvement of local communities. This study explores the essential role of community participation in promoting forest expansion through approaches such as joint forest management, social forestry, and participatory tree planting programs. Engaging local populations in planning, decision-making, and implementation fosters a sense of ownership, strengthens stewardship, and ensures the sustainable management of forest resources, while simultaneously offering socio-economic benefits. The paper reviews multiple case studies to identify effective practices, challenges, and strategies for enhancing public involvement in forest restoration efforts. Results indicate that combining local knowledge, collective action, and participatory governance significantly enhances forest regeneration. The study underscores that community-driven approaches are not only crucial for increasing forest cover but also play a vital role in advancing environmental conservation and sustainable development goals.

Keywords: Community participation, forest restoration, joint forest management, social forestry, participatory governance, sustainable development

DIVERSITY OF SPIDERS IN DAVANAGERE CITY

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The study aimed to identify the diversity and distribution of spiders in and around the city of Davanagere. The study was conducted in the department of Zoology laboratory, Dharma Rathnakara Muddurayappa (DRM), Aided College, Davanagere-577004, from January to April 2025. The method we used is field photography only, and we used a high-megapixel camera with macro capabilities for capturing detailed images of spiders in their natural habitat. Technique: Stalk the spider slowly and be as still as possible to avoid scaring it. Take multiple photos from various angles to capture the spider's features and position. The identification of spiders was done using standard manuals, monographs, and books, respectively. A total of nine families belonging to thirteen species of spiders were documented in the study area. Among nine families, the Salticidae family is more abundant, with 15 (34.88%) compared to others.

Keywords: Diversity, Spiders, Salticidae, Davanagere

ASSESSING THE BIOFILM-FORMING ABILITY OF EPS-PRODUCING SALT-TOLERANT BACTERIA UNDER SODIC STRESS CONDITIONS

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Sodicity is one of the salt stresses that affect crop growth by altering metabolic activities. Biofilm-forming traits of salt-tolerant bacteria protect both the bacteria and the plant from stress. The present study aims to identify the best biofilm-forming isolates for crop growth and development in sodic soil. Therefore, the biofilm-forming ability of salt-tolerant bacteria was assessed under sodic stress conditions with varying incubation times. The results showed a positive correlation between the biofilm-forming ability of bacterial isolates and the biofilm/planktonic ratio across different incubation times, as well as in the control and stress-induced conditions. *Niallia circulans* L2C9L, *Bacillus velezensis* L2C3L, *Bacillus paralicheniformis* L1C5L, and *Franconibacter helveticus* L2C1L2 showed the highest biofilm-forming ability under control conditions. Similarly, *B. paralicheniformis* L1C5L, *Bacillus safensis* L5C13T, *Stenotrophomonas maltophilia* L2C7T, *Pseudomonas* sp. L5C14T exhibited the maximum biofilm formation under sodic stress conditions. Thus, the use of these biofilm-forming, salt-tolerant bacteria could be a promising tool to improve crop growth under salt stress.

HYDROTHERMAL CARBONIZATION AND THE ROLE OF HYDROCHAR IN SOIL HEALTH IMPROVEMENT

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The present study aims to highlight the process of hydrothermal carbonization (HTC) for converting organic and agricultural wastes into hydrochar and to evaluate its potential role in improving soil health and fertility. It was hypothesized that hydrochar derived from organic residues could enhance soil physico-chemical properties, nutrient retention, and microbial activity, thereby promoting sustainable crop production and carbon sequestration. Hydrothermal carbonization involves treating wet biomass such as crop residues, food waste, or animal manure in a closed reactor with water at moderate temperature (180–250 °C) and pressure (2–10 MPa). The resulting hydrochar was characterized for carbon content, nutrient composition, porosity, and adsorption capacity. Its effects on soil structure, water-holding capacity, and nutrient availability were evaluated through incubation and pot trials under controlled conditions. Hydrochar was found to be carbon-rich and porous, with improved cation exchange and adsorption capacity. Its application in soil enhanced water retention, increased available nutrients, and stimulated beneficial microbial growth. When applied along with compost, hydrochar reduced nutrient leaching and enhanced nitrogen-use efficiency. Moreover, significant carbon sequestration potential was observed, indicating its utility in climate change mitigation. Hydrochar produced via HTC represents a promising, eco-friendly soil amendment that enhances soil quality, nutrient efficiency, and carbon storage while providing a sustainable pathway for agricultural waste utilization. Its integration into soil management practices can support climate-smart and circular bio-economy approaches for sustainable agriculture.

Keywords: Hydrothermal carbonization, hydrochar, soil amendment, carbon sequestration, sustainable agriculture

TRANSCRIPTOME ANALYSIS OF RAUVOLFIA SERPENTINA REVEALS TISSUE-SPECIFIC EXPRESSION OF RESERPINE BIOSYNTHESIS GENES

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Rauvolfia serpentina, often referred to as Indian snakeroot, is a fascinating medicinal plant that has garnered significant attention in the pharmacological world, primarily because it produces reserpine. This indole alkaloid is known for its neuroactive properties and is used to treat conditions like hypertension and various neurological disorders. However, despite its importance in medicine, we still have a lot to learn about how this plant specifically synthesizes its alkaloids in different tissues. In our study, we took a closer look by conducting a comparative transcriptome analysis of the root and leaf tissues, utilizing publicly available RNA-seq datasets to pinpoint the genes involved in reserpine biosynthesis. We carefully checked the quality of the raw sequencing reads, trimmed them, and quantified the data using Salmon against the assembled transcriptome. For the differential gene expression analysis, we used DESeq2 in R, and we also performed functional enrichment through GO and KEGG pathway analyses. Our findings highlighted a clear tissue-specific expression pattern, showing that key enzymes in the indole alkaloid biosynthesis pathway—like tryptophan decarboxylase and strictosidine synthase—were significantly more active in the roots than in the leaves. The functional enrichment analysis further supported this, revealing an overrepresentation of terms related to tryptophan metabolism, monoterpenoid biosynthesis, and secondary metabolite processes. These insights lay a molecular foundation for understanding how reserpine biosynthesis is localized and regulated in *R. serpentina*, which could inform efforts in metabolic engineering and the sustainable production of important pharmacological alkaloids. This study showcases the power of transcriptome-level analysis in bridging traditional medicinal knowledge with molecular mechanisms, emphasizing the potential of *R. serpentina* as a model for exploring neuroactive plant metabolites.

Keywords: *Rauvolfia serpentina*, RNA-seq, reserpine, differential expression, alkaloid biosynthesis, neuropharmacology

COMPARATIVE STUDY ON MORPHOLOGICAL GENITAL VARIATION BETWEEN E. MATERNA AND E. PHALONIA

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This study presents a comparative analysis of the morphological genital variation between two closely related species of fruit-piercing moths, *Eudocima materna* and *Eudocima phalonia*. Utilizing a combination of morphological measurements and detailed genital dissection techniques, we examined specimens collected from various geographical locations. The investigation revealed distinct differences in the structure and dimensions of male and female genitalia, highlighting the potential role of these variations in reproductive isolation and speciation. Key morphological traits such as the shape of the valvae, the configuration of the aedeagus, and the characteristics of the ovipositor were meticulously documented. Statistical analyses demonstrated significant differences between the two species, suggesting that these genital traits may serve as reliable diagnostic features for species identification. This research contributes to the understanding of sexual dimorphism and its evolutionary implications within the Erebidae family, emphasizing the importance of genital morphology in lepidopteran taxonomy and phylogenetics. Further studies are recommended to explore the ecological and behavioral factors that may influence these morphological adaptations.

Keywords: *Eudocima materna* and *Eudocima phalonia*

ISOLATION AND CHARACTERIZATION OF EFFICIENT BIOFILM FORMING MICROBES FROM EFFLUENTS COLLECTED FROM TEXTILE AND SUGARCANE INDUSTRIES

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The textile and sugarcane industries are significant contributors to environmental pollution, releasing large volumes of untreated or partially treated effluents into nearby water bodies. These effluents contain complex mixtures of dyes, phenolic compounds, melanoidins, and other organic pollutants that pose serious risks to aquatic life and human health. The present study aimed to isolate and select efficient biofilm-forming and biodegrading microorganisms from textile and sugarcane effluents in the Loni area, Ghaziabad. Effluent and sludge samples were collected from discharge points of local industries and processed under aseptic conditions for microbial isolation using selective media. The obtained isolates were screened for their ability to form biofilms and degrade pollutants under laboratory conditions. Promising strains were further characterized for their enzymatic activities and identified using 16S rRNA gene sequencing. The isolates demonstrated strong biofilm-forming ability and remarkable biodegradation potential, effectively degrading a broad range of pollutants including reactive dyes, phenolic compounds, and organic matter. Enzymatic assays confirmed the presence of key enzymes such as laccase, azoreductase, cellulase, and peroxidase, which play crucial roles in pollutant degradation pathways. The identified microbial strains, particularly those belonging to *Pseudomonas*, *Bacillus*, and *Aspergillus* species, showed excellent adaptability and stability in effluent conditions. Overall, the study highlights the potential of indigenous biofilm-forming microbes as a sustainable and eco-friendly alternative for bioremediation of industrial effluents. The findings can be utilized to design efficient, low-cost, and environment-friendly wastewater treatment systems, thereby reducing the ecological footprint of textile and sugarcane industries in the Loni region.

Keywords: Bio-film-forming Microbes, Sugarcane and Textile Industry, Effluent and sludge samples, Wastewater.

IMPACT OF ENERGY RESTRICTION ON DNA INTEGRITY IN CRYOPRESERVED SPERM

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Cryopreservation is a commonly used technique in assisted reproductive technology, but it often results in reduced sperm motility and compromised DNA integrity. This study examines the effect of temporary energy restriction as a method to improve motility in cryopreserved human sperm. We observed a clear increase in motility parameters following this treatment. In addition, the DNA Fragmentation Index (DFI) was evaluated to assess post-treatment DNA quality and integrity. Our results indicate that temporary energy restriction not only enhances motility but may also help support DNA stability. High DFI levels are known to be associated with lower fertilization rates, even when sperm count and motility appear normal. **Methods:** This study examined DNA integrity in cryopreserved human sperm using the sperm chromatin dispersion (SCD) test, from which the DNA fragmentation index was recorded. After temporary energy restriction, each thawed semen sample was assessed and then mixed with agarose gel. The sample–gel mixture was applied to a slide, followed by the addition of the denaturation solution and lysis solution to allow controlled DNA denaturation. The slide was then treated with alcohol, which served as a fixative, and subsequently stained to enable visual identification of DNA damage. In the stained preparations, sperm exhibiting large halos around the head were classified as having minimal DNA damage, whereas sperm with small or absent halos were identified as having higher levels of DNA fragmentation. **Results:** The DNA fragmentation index (DFI) of cryopreserved semen samples that underwent temporary energy restriction was lower compared with samples that did not receive this treatment.

DEVELOPMENT OF VALUE-ADDED FOOD PRODUCT BY INCORPORATING BENGAL GRAM LEAVES POWDER AND ITS SENSORY EVALUATION

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The present investigation focused on the development of value-added food products incorporating Bengal gram leaves powder (BGLP) and their sensory evaluation. Bengal gram leaves were locally procured from Akbarpur at the village level. Bengal gram leaves were shorted, cleaned, washed, and sun-dried on clean cotton cloth until they were brittle, and then ground into a fine powder using a mixer grinder. The leaf powder was sieved and stored in an airtight container for further research. Wheat flour, refined flour, and other ingredients were procured in a single lot from the local market to maintain uniformity. The prepared BGLP was incorporated into four traditional products: Chapatti, Poori, Muthiya, and Pakora, at varying substitution levels of 5%, 10%, 15%, 20%, 25%, and 30% to assess sensory acceptability and overall product quality. The results indicated that all products were well accepted up to 15% incorporation level (T3), which was rated as “Liked very much” by sensory panel members. The overall Acceptability scores of BGLP-incorporated products ranged from 8.60 ± 0.01 to 8.84 ± 0.03 , showing high consumer preference. Specifically, the mean sensory scores for T3 products were 8.84 ± 0.03 for Chapatti, 8.77 ± 0.03 for Poori, 8.60 ± 0.01 for Muthiya, and 8.76 ± 0.03 for Pakora. Products with 15% incorporation demonstrated improved sensory attributes, including flavor, texture, and color, when compared to control samples. **Conclusion:** The study concludes that Bengal gram leaf powder can be effectively incorporated into various food formulations at up to 15% without compromising sensory quality, thereby enhancing their nutritional profile. This approach provides a straightforward and cost-effective strategy for developing functional and value-added food products, which can be beneficial for both household consumption and the food processing industry.

Keywords: Bengal gram leaves, value-added food, sensory evaluation, product development, functional foods.

SMART FOOD FUTURE: INTEGRATING SCIENCE, TECHNOLOGY, AND NUTRITION FOR A SUSTAINABLE TOMORROW

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Introduction: The intersection of science, technology, and nutrition holds transformative potential to revolutionize the global food system. The present study aims to explore the concept of a Smart Food Future by assessing how emerging technologies and nutritional innovations can jointly enhance food quality, safety, and sustainability. **Objective:** To evaluate the role of scientific and technological advancements in developing nutritionally optimized, sustainable, and intelligent food systems. **Hypothesis:** The integration of data-driven technologies with nutritional science can significantly improve food production efficiency, dietary outcomes, and consumer health. **Methodology:** A comprehensive literature review and data synthesis were conducted using peer-reviewed publications from 2015 to 2025, focusing on domains such as AI-driven agriculture, IoT-based food monitoring, biotechnology innovations, innovative packaging, and personalized nutrition platforms. Case studies were analyzed to examine the measurable impacts of these technologies on nutritional enhancement, waste reduction, and supply chain transparency. **Key Findings:** Results indicate that technology-enabled food systems can reduce agricultural resource consumption by up to 30%, improve nutrient profiling accuracy by 40%, and decrease post-harvest losses by nearly 25%. Innovative packaging and blockchain traceability have shown substantial potential in enhancing food safety and consumer trust. Personalized nutrition technologies have demonstrated improved dietary compliance and health outcomes in targeted populations. **Conclusion:** The Smart Food Future represents a paradigm shift toward a holistic, technology-empowered, and nutrition-driven food ecosystem. By effectively bridging science, technology, and nutrition, this approach can foster global food security, sustainability, and public health resilience, ultimately creating a brighter and healthier planet.

Keywords: Smart food, digital agriculture, sustainable nutrition, food innovation, food security, technology integration

HARNESSING *PEDIOCOCCUS* IN FOOD PRODUCT DEVELOPMENT: AN ANTI-INFLAMMATORY THERAPEUTIC APPROACH

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Pediococcus species are lactic acid-producing bacteria commonly associated with food fermentation and biopreservation for decades. These properties are also favourably utilized by the food industries as a starter culture. Specifically, as a promising probiotic bacteria with anti-inflammatory effects. Several in vitro and in vivo studies are evident that some strains of *Pediococcus acidilactici* suppress the pro-inflammatory cytokines (e.g., IL-1 β , IL-6, TNF- α), inhibit inducible nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2), and downregulate key signaling pathways including NF- κ B, MAPK, and STAT1. For example, an exopolysaccharide fraction of *Pediococcus pentosaceus* has been shown to reduce colonic inflammation and protect mucosal integrity, potentially treating inflammatory bowel disease. Furthermore, a synbiotic composed of inulin and *P. acidilactici* exhibits preventive and therapeutic effects on DSS-induced colitis in mice by enhancing antioxidant activity and alleviating inflammation. Thus, the incorporation of *Pediococcus* species or their metabolites e.g., EPS, bacteriocins, into food products to reduce inflammatory effects. Future studies can focus on developing consumer-acceptable foods using these strains with regulated safety rules and their gut survivability.

Keywords: *Pediococcus*, Anti-Inflammatory, Food product, *Acidilactici*, *Pentosaceus*

ISOLATION AND EVALUATION OF ENDOPHYTES FROM CHILLI (*CAPSICUM ANNUUM* L.) SEEDS FOR SEED BIOPRIMING AND QUALITY ENHANCEMENT

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Chilli (*Capsicum annuum* L.), popularly known as the “wonder spice,” is one of the most important vegetable and spice crops cultivated worldwide, particularly in tropical and subtropical regions. Belonging to the family Solanaceae, it is valued for its pungency, nutritional content, and diverse industrial uses. With growing competition in the global spice market, enhancing productivity and stress tolerance has become crucial. Endophytic microorganisms are bacteria and fungi that reside within plant tissues. They are gaining attention for their roles in promoting plant growth and conferring tolerance to abiotic stresses. Several bacterial endophytes that are isolated from seeds have shown to enhance seed vigour and alleviate biotic and abiotic stress conditions. These endophytes often produce beneficial compounds such as IAA, siderophores, HCN, solubilize phosphate which are essential for enhancing growth and alleviating stress. Seed biopriming is one of the effective methods to enhance seed quality and seedling growth. These endophytes are often transmitted vertically through seeds which show that the endophytes provide benefits across generations. In the present study, bacterial seed endophytes were isolated from the chilli seeds. The seeds were obtained from the farmers’ field. Ten different bacterial endophytes were obtained from chilli seeds. The effect of these endophytes on salinity stress was assessed. Three isolates among the 10 different isolates obtained could grow on NaCl incorporated media. The isolated endophytes were also evaluated for their potential in seed biopriming to improve germination and seed quality parameters. All the endophytes were effective in enhancing the seed germination, shoot length, root length, vigour index I and II compared to untreated control. This study highlights the potential of exploiting native endophytes from chilli seeds as a sustainable approach to enhance seed quality and stress tolerance. The findings provide a foundation for developing eco-friendly strategies to improve chilli production abiotic stress condition.

Keywords: *Capsicum annuum*, endophytes, seed biopriming, abiotic stress tolerance, seed quality

IMPACT OF HYDRATION LEVEL REGULATION ON BIODEGRADABLE WASTE DECOMPOSITION RATE IN VERMICOMPOSTING WITH DIFFERENT EARTHWORM SPECIES

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Earthworms, regarded as ecosystem engineers, play significant role in maintaining soil health and ecological balance. However, their potential in biotechnology for environmental sustainability remains underexplored. This study examines how earthworms contribute to sustainable environmental practices, particularly in organic waste management. Our findings show the effect of hydration level on the decomposition rate in vermicomposting using different substrates with *Eisenia foetida*, *Eudrilus euginae* and significance of different earthworm species in ecological role and biodegradation in environment. Further research to the biotechnological potential of earthworms in transforming biodegradable waste into high quality organic fertilizer addressing global environmental challenges.

Keywords: Hydration level, Organic waste management, decomposition rate, compost quality different earthworm species and sustainable development.

DEVELOPMENT OF AMARANTH MICROGREEN-BASED READY-TO-SERVE DRINK (RTS) AND ITS SENSORY ACCEPTABILITY

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Background: Microgreens, the fully developed cotyledons with or without true leaves, are a powerhouse of functional components and are generally grown under advanced infrastructure. **Objectives:** This study explores the cultivation of Green Amaranth Microgreens under natural sunlight, with an emphasis on sustainable methods and extending shelf life through Ready-to-Serve (RTS) beverage. **Methodology:** This study investigated Amaranth microgreens' cultivation, prioritizing sustainable practices. Cultivation was conducted utilizing natural sunlight, minimizing environmental impact and eliminating the need for specialized lighting setups. To test the feasibility of the cultivation method, the nutritional quality of sunlight-grown microgreens was also compared with other methods of cultivation. **Results:** The study revealed that the nutritional quality of sunlight-grown Amaranth microgreens was comparable in most of the parameters and even superior in some. They exhibited a good level of antioxidants (62.2% GAE), ascorbic acid (51.2 ± 0.12 mg/100g), calcium (52.15 ± 0.03 mg/100g), and iron (1.31 ± 0.01 mg/100g). The Green Amaranth Microgreens (GMAG) based RTS was formulated using different proportions of lemon (T1: 7.25; T2: 7.42; T3: 7.75; T4: 7.85). The sensory analysis of the RTS beverage from microgreens blended with lemon juice in different proportions was conducted to evaluate taste, flavor, consistency, and overall acceptability, which showed that the formulation of 25:75 was most preferred by the sensory panelists. The 100% amaranth microgreen juice exhibited the most appealing color, but was not acceptable for its taste due to grassy taste of microgreens. **Conclusion:** The study concludes that RTS drink can be a solution to the shorter shelf life of microgreens. The study concludes that cultivating microgreens under natural sunlight is a nutritional and sustainable approach for Green Amaranth Microgreens.

Keywords: Microgreens, Nutrient quality, Ready-to-serve drink, Sensory acceptability, Sustainable practices

CO-ENCAPSULATION OF MULTI-STRAIN PROBIOTICS: INNOVATIVE STRATEGY FOR GUT MICROBIOTA MODULATION

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Co-encapsulation of multi-strain probiotics is an emerging strategy for enhancing gut microbiota modulation by improving the bacterial strains survivability, synergistic effects and target delivery. Recent evidences have promoted the formulation and an encapsulation technique that shows a positive impact on enhancing the viability of probiotics in foods and within the gastrointestinal tract, thereby ensuring more live bacteria reach the colon in an active form. This review outlines the importance of co-encapsulation that restores microbial strains, suppress pathogenic bacteria and enrich the probiotic species of *Lactobacillus* and *Bifidobacterium*. It also emphasis on the formulation of multi strain probiotics with different prebiotics. However, this system demonstrates a promising effect on functional food applications through certain synergistic activities offering multiple health benefits such as gut barrier integrity, balancing immune homeostasis and other chronic disorders. It also highlights the opportunities associated with technological optimization and formulation strategies that could enhance the efficacy and commercial feasibility of probiotic-enriched functional foods.

Keywords: Synergistic, Bacteria, Co-encapsulation, Probiotics, Functional.

WILD FRUITS OF MALNAD: NATURAL HEALTH BOOSTERS FROM SAGAR TALUK

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The Malnad region of Sagar Taluk in Karnataka is well known for its rich biodiversity and wide variety of wild fruits. These fruits are not only tasty but also highly nutritious and valuable for health. Many studies have shown that wild fruits have several health-promoting activities such as antioxidant, anti-inflammatory, antimicrobial, and anticancer effects. Wild fruits like *Phyllanthus emblica* (Amla), *Garcinia indica* (Kokum), *Syzygium cumini* (Jamun), *Ziziphus oenoplia* (Wild Jujube), *Elaeocarpus serratus* (Jungle Plum), and *Carissa carandas* (Karonda) are commonly found in the Sagar area. They are rich in **phytochemicals**, especially **flavonoids** and **polyphenols**, which act as strong antioxidants that protect the body from damage caused by free radicals. These fruits are also excellent sources of **vitamins and minerals**, particularly vitamin C, vitamin A, iron, and fiber, which help improve immunity, digestion, and overall wellbeing. This study aims to **document** the diversity, nutritional value, and traditional uses of wild fruits found in Sagar Taluk. The documentation will include information on their local names, seasonal availability, and common methods of consumption. Such documentation will help preserve indigenous wisdom, encourage further exploration of their medicinal potential, and contribute to the conservation of Malnad's rich natural heritage

Keywords: Wild fruits; Malnad region; Sagar Taluk; Phytochemicals; Antioxidant activity; Traditional knowledge; Nutritional value; Documentation; Biodiversity; Health benefits

ATTITUDE AND PERCEPTION OF FARMERS TOWARDS NATURAL FARMING

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Natural farming gives us residue free food, saves environment from pollution and provide better living standards. A study was conducted in six talukas of Junagadh, Rajkot and Gir Somnath districts of Gujarat state. The number of villages was selected irrespective from each taluka on the basis of available of adopted natural farming and non-adopted natural farming farmers. Total 288 farmers selected as sample size. The result of the research finding revealed that majority of the adopted (81.94 per cent) and non-adopted (62.50 per cent) farmers had medium to high level of attitude towards natural farming. This indicated that more efforts are needed to improve and develop their attitude up to high (positive) level of non-adopted natural farming farmers. More than three fourth (75.76 per cent) of the adopted and less than one-third (30.56 per cent) of non-adopted farmers had medium to high level of perception about natural farming. This indicated that more efforts are needed to improve and develop their attitude up to high (positive) level of non-adopted natural farming farmers.

Keywords: Farmers, Attitude, perception, Natural farming, Profitability

INTEGRATED WEED MANAGEMENT IN SPINACH BEET (*BETA VULGARIS* VAR. *BENGALENSIS*)

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An experiment entitled “Integrated Weed Management in Spinach Beet (*Beta vulgaris* var. *bengalensis*)” Was conducted during winter season at Krishi Vigyan Kendra, Samba. The soil of the field was sandy loam in texture, slightly acidic in reaction, medium in organic carbon, available phosphorus and potassium but low in nitrogen. The experiment consisted of 12 treatments viz (T1) Oxyfluorfen @ 150 g/ha(Pre- emergence), (T2)Oxyfluorfen@ 150 g/ha(Pre- emergence) + 1 Hand weeding (40 DAS),(T3) pendimethalin @ 750 g/ha (Pre- emergence),(T4) pendimethalin @ 750 g/ha (Pre- emergence)+ 1 Hand weeding (40 DAS), (T5)Imazethapyr @ 70 g/ha (Pre emergence), (T6) Imazethapyr @ 70 g/ha (Pre emergence) + 1 Hand weeding (40 DAS), (T7) Oxadiargyl @ 100g/ha (pre emergence), (T9) Oxadiargyl @ 100g/ha (pre emergence) +1 Hand weeding (40 DAS) , (T9) two Hand weedings at 20 and 40 DAS,(T10) Mulching with Paddy Straw, (T11) Weedy Check ,(T12) Weed free, arranged in randomized block design with three replications. Sowing of the crop variety Jammu Spinach beet -07 was done at 27th October, 2021 . After layout, Treatments were applied to the respective experimental plots one day after sowing. The recommended dose of fertilizer for Spinach beet and vermin-compost were applied. Irrigation was applied at regular intervals in spinach beet crop as per need. The major weed flora observed in the field were *Cynodon dactylon*, *Poa annua* , *Cannabis sativa*, *Coronopus didymus*, *anagalis arvense*, *oenothera lacinata* , *Rumex dentatus* , *agremone maxicana* . The crop land was also found infested with *silybrum marianum* , *agretum conyzoides*. The experimental results revealed that weed free (T12) plot recorded significantly higher plant height, leaf length, leaf width, leaf area index. However, among the different weed management treatments

INTEGRATED APPROACHES FOR MITIGATING GREENHOUSE GAS EMISSIONS FROM RICE-BASED AGROECOSYSTEMS

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Rice-based agroecosystems are a significant source of global Green House Gas (GHG) emissions, particularly methane (CH₄) and nitrous oxide (N₂ O), which contribute substantially to agricultural climate forcing. The dual challenge of ensuring food security while mitigating emissions necessitates the development of integrated and sustainable management approaches. This review synthesizes current knowledge on mitigation strategies aimed at reducing GHG emissions from rice cultivation systems through the integration of soil, water, and nutrient management practices. Key interventions include alternate wetting and drying (AWD) irrigation, site-specific nutrient management, incorporation of organic amendments, and the use of biochar and microbial inoculants. The synergistic combination of these practices has been shown to improve soil aeration, enhance carbon sequestration, and regulate nitrogen transformation pathways, thereby minimizing CH₄ and N₂ O fluxes. The review further explores the role of crop residue management, controlled fertilizer application, and improved cultivar selection in achieving a balance between productivity and emission reduction. Advances in remote sensing, process-based modeling, and life cycle assessment (LCA) tools are also discussed as valuable frameworks for quantifying mitigation potential and guiding climate-smart policy interventions. The integrated approach highlights the importance of context-specific solutions tailored to local agroecological conditions and socioeconomic constraints. Future research should emphasize field-scale validation of mitigation technologies, long-term monitoring, and multi-criteria assessments linking emission reduction with yield sustainability and resource efficiency. Overall, adopting holistic management strategies within rice-based systems represents a viable pathway toward low-carbon agriculture and climate-resilient food production.

Keywords: Rice agroecosystem, greenhouse gas, methane, nitrous oxide, alternate wetting and drying, biochar, climate-smart agriculture, sustainable intensification.

A NOVEL APPROACH OF DEVELOPMENT AND EVALUATION OF BIOORGANIC FERTILIZER FORMULATIONS SUITABLE FOR ORGANIC PRODUCTION OF TOMATO

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Bioorganic fertilizers (BOFs) are emerging as effective and sustainable alternatives to traditional chemical fertilizers, offering significant advancements in modern agricultural practices. In the present study, three different BOF formulations (BOF 1, BOF 2, and BOF 3) were developed using specific organic inputs and incubated for 60 days to evaluate their nutrient release patterns. Among the formulations, BOF 2 showed superior performance, with notable increases in organic carbon (8.82%) and nutrient release: nitrogen (8.43%), phosphorus (8.20%), potassium (14.42%), calcium (19.66%), magnesium (14.29%), and micronutrients (7.14% – 9.53%). A field experiment was conducted at the Eastern Block of Tamil Nadu Agricultural University via a randomized block design with three replications by different concentrations of BOF compared with existing and inorganic packages. BOF application improved root architecture, resulting in enhanced lateral branching and root hair development, which facilitated better nutrient and water uptake. Metagenomic analysis revealed increased microbial diversity in BOF-treated soils, which contributed to nutrient cycling and plant uptake and improved pest and disease tolerance. Field trial results demonstrated that BOF applied at 1000 kg/ha resulted in the highest tomato yield (36.8 t/ha) and a benefit–cost (BC) ratio of 3.41, outperforming the standard organic package and matching the effectiveness of inorganic fertilizer regimes. On-farm trials conducted across six different locations confirmed these findings, with treatment (BOF @ 1000 kg/ha) resulting in the highest average yield (34.61 t/ha), significantly exceeding both the existing organic package and farmer practices. This yield improvement is attributed to increased nutrient availability, increased microbial activity, and improved root development supported by the BOF. Overall, these findings underscore the potential of bioorganic fertilizers as viable, sustainable inputs for enhancing crop productivity in organic farming systems across diverse agroclimatic zones.

Keywords: Bioorganic fertilizer, Formulation, Root architecture, Metagenomics, and Tomato yield

OPTIMIZING ELEPHANT FOOT YAM CULTIVATION: PRECISION MODELLING WITH DSSAT

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The elephant foot yam, known as the "king of tubers," is a long-duration tropical tuber crop with a wide range of uses. Its unique growth requirements and economic importance, presents both challenges and opportunities for farmers and researchers. Precision in cultivation practices becomes paramount to ensure sustainable yields and efficient resource utilization. DSSAT, with its ability to simulate and predict crop growth dynamics under varying environmental and management scenarios, emerges as a valuable ally in this pursuit of precision agriculture. In this experiment, a simulation model in DSSAT environment was developed in elephant foot yam for predicting its growth and yield. This experiment was conducted with three main plots with different dates of planting (D₁ - 15 days before actual date of planting, D₂ - Actual date of planting and D₃ - 15 days after actual date of planting) and three subplots with different doses of nitrogen (N₁ – RDF (80 kg), N₂ - 25% more than RDF (100 kg) and N₃ - 25% less than RDF (60 kg)) in a split plot design with three replications. The elephant foot yam variety CO 1 was planted at a spacing of 90 × 60 cm. calibrating the CO 1 cultivar for growth and yield exhibited a lower error value of RMSE (1.36), nRMSE (3.411) and MAE (1.15) were observed. Also, higher d (0.98), R² (0.9) and Nash Sutcliffe model efficiency coefficient (0.932) indicated an excellent prediction for predicted and observed yield. A higher value for d (0.98), R² (0.9) and Nash Sutcliffe model efficiency coefficient (0.929) and lower values for RMSE (1.37), nRMSE (3.335726) and MAE (1.18) during model validation indicated a higher accuracy for predicted and observed yield. In the era of climate change, the stimulated DSSAT model for elephant foot yam can be used for its growth and yield prediction in the future.

Keywords: Crop modelling, DSSAT, elephant foot yam, growth, yield

GENOME EDITING-MEDIATED DEVELOPMENT OF DURABLE OROBANCHE RESISTANCE LINE IN INDIAN MUSTARD (BRASSICA JUNCEA)

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Orobanche spp. (broomrapes) are obligate root-parasitic plants that cause substantial yield losses in mustard (Brassica spp.) by germinating in response to host-derived signals, attaching to roots, and diverting nutrients through specialized haustoria. Current management strategies, including herbicides, trap crops, and cultural practices, provide limited and inconsistent control due to the long-lived seed bank and high host specificity of the parasite. Therefore, developing resistant cultivars represents a sustainable and long-term solution. Advances in genome editing offer an opportunity to achieve durable resistance by precisely modifying plant susceptibility (S) genes required for successful parasite establishment. Key targets include genes in the strigolactone (SL) biosynthesis and exudation pathways, which are major determinants of broomrape seed germination. Candidate genes such as D27, CCD7, CCD8, MAX1, and strigolactone transporter PDR1-like ABC transporters can be edited to reduce SL production or secretion, thereby suppressing parasite germination. Additionally, genes involved in host-parasite interface formation and cell-wall loosening, such as expansin-like proteins (EXPA family), pectin methylesterases (PMEs), and xyloglucan endotransglycosylase/ hydrolases (XTHs), represent strategic S-gene targets to hinder haustorial penetration. Hormonal regulators implicated in parasitism, including D14 (strigolactone receptor) and auxin/cytokinin signaling components, further expand the suite of modifiable loci. CRISPR/Cas-based knockout, base editing, and multiplexing approaches are proposed to simultaneously disrupt these pathways while minimizing adverse effects on plant development. Transgene-free edited lines can be developed through transient transformation or RNP-based delivery for regulatory compliance and field deployment. Validation under controlled and field conditions will assess parasite germination, attachment frequency, biomass accumulation, and yield performance. This strategy aims to generate mustard cultivars with stable and durable resistance to Orobanche spp., offering an innovative genetic solution for improved productivity and resilience in broomrape-infested regions.

Keywords: Orobanche resistance, Mustard (Brassica spp.), CRISPR/Cas genome editing, Susceptibility (S) genes, Susceptibility (S) genes, Transgene-free edited crops, Durable resistance, Strigolactone transporter (PDR1), CCD7 / CCD8 / MAX1

GREEN SYNTHESIS OF METAL NANOPARTICLES USING MORINGA OLEIFERA EXTRACT: A SUSTAINABLE APPROACH

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The green synthesis of nanoparticles has arisen as an environmentally benign and sustainable alternative to traditional chemical and physical processes, reducing the reliance on hazardous reagents and critical circumstances. Moringa oleifera, a plant celebrated for its abundant phytochemical composition, as a natural reducing and stabilising agent in the synthesis of metal nanoparticles. The aqueous leaf extract of M. oleifera, which comprises bioactive components like flavonoids, phenolics, alkaloids, and ascorbic acid, enabled the fast bioreduction of metal ions into stable nanoparticles under ambient circumstances. The synthesis of nanoparticles can be validated by a visible colour change and characterised via UV-Vis spectroscopy, FTIR, XRD, SEM, and TEM investigations to ascertain their optical, structural, and morphological features. The synthesised nanoparticles show uniform dispersion, elevated crystallinity, and nanoscale dimensions. FTIR spectra demonstrated the role of plant metabolites in capping and stabilisation, revealing the presence of hydroxyl, carbonyl, and amine groups. The biosynthesised nanoparticles exhibited significant antioxidant and antibacterial properties, indicating their potential utility in biomedical, agricultural, and environmental fields. Moringa oleifera promotes the sustainability of nanoparticle production while providing biocompatibility and functional diversity from its phytoconstituents. M. oleifera is a viable candidate for scalable, eco-friendly nanoparticle production, aiding in the advancement of safe and sustainable nanotechnological advancements.

Keywords: Moringa oleifera, green synthesis, metal nanoparticles, phytochemicals, antimicrobial activity

EFFECT OF PESTICIDES ON HUMAN HEALTH

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Pesticides are chemical constituents used to prevent or control pests, including insects, rodents, fungi, weed, and other unwanted organisms. Pesticides are widely used to control pests but their widespread use raises concerns regarding potential health risks for humans and other animals. Pesticides elements have now perpetually entered our atmosphere and subsequently contaminated water, food and soil, leading to health threats ranging from acute to chronic toxicities. There are several routes through which pesticides can be ingested, inhaled, and absorbed resulting in acute and long term health consequences. Pesticides produce different types of toxicity including, neurotoxicity, mutagenicity, carcinogenicity, teratogenicity, and endocrine disruption. The human body gets exposure to pesticides either directly or indirectly. By using pesticides on crops, humans come in directly contact with them and they affect the skin, eyes, mouth, and respiratory tract, and cause acute reactions such as headache, irritation, vomiting, and rashes on the skin. The severity of these pesticides on human health depends upon exposure time and concentration. The consumption of such vegetables and fruits that are grown in pesticide contaminated soil and water used for long term, accumulation increase the concentration of toxins inside the body organs and cause chronic diseases like cancer, asthma, necrosis, reproductive disorder and cardiac disease. The quaternary nitrogen compounds such as parquat are associated with neurodegenerative diseases like Parkinson's. Similarly, pesticide group of carbamates inhibits the acetyl cholinesterase (AChE) activity and its used as biomarker of neurotoxicity. Breast cancer is the most common in all cancer types and is associated with organophosphorus that affect cellular growth and proliferation. Pesticides interact with DNA and cause conformational changes that could induce gene mutation and lead to adverse health effects.

Keywords: Pesticide, atmosphere, toxicity, human health

ECOLOGY AND DIVERSITY OF EARTHWORMS IN DIFFERENT LAND USING IN MARATHWADA REGION OF MAHARASHTRA

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In Marathwada region of (Maharashtra) India, very few studies on earthworm biodiversity have been done. This paper studies done in this region in 2020 to 2023 understand the total number of earthworm species in context of their ecology in different land use systems. It reveals a total 14 species and 8 genera in this region with families such as Octochaetidae, Megascolecidae, and Ocnerodrilidae being well-represented. These studies show that earthworm diversity is linked to soil and moisture conditions, with species like *Dichogaster bolau*, *Lampito mauritii*, *E. Fetida* and *Polypheretima elongata* being common, often found in both natural and human-modified habitats like agricultural fields, garbage, and near sewage. *Metaphire posthuma* and *Lampito mauritii* were found in all observed pedoecosystems (soil ecosystems) in a study in a nearby arid region.

Keywords: Earthworm, diversity and ecology, Land use systems, Marathwada

DIVERSITY OF FRESHWATER FISHES AND OCCURRENCE FROM GIRIJA DAM, YESGAON, OF DIST. AURANGABAD MH, INDIA

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Girja dam, Yesgaon near to Khultabad, Dist. Aurangabad MH, water resource for helpful for the agriculture and fisheries it has good water storage capacity, the reservoir is good source of fish fauna. The present study on Fish diversity of Girja dam was carried out from January 2022 to December 2023. During the present investigation, fishes were collected and identified. The aim of this study was to reveal the diversity of fish species in this dam. The results of present investigation reveal the occurrence of 14 fish species belonging to the members of Order Cypriniformes, family Cyprinidae were dominated by 11 species followed by Perciformes, family Channidae with 02 species and family Cichlidae 01 specis. From present study, we concluded that Girja d is good source of food fish diversity

Keywords: Girja dam, Cypriniformes, Cichlidae, Cyprinidae

MECHANIZATION OPERATIONS OF SUGARCANE FOR NATURAL RESOURCE CONSERVATION

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Mechanization in sugarcane is crucial and helpful for enhancing sugarcane productivity and conserving the natural resources during the pandemic era of COVID-19. Mechanization is the utilization of modern power drawn implements for different operations in the field. Sugarcane (*Saccharum* spp. hybrid complex) is the most important cash and agro-industrial crop that is being cultivated in around 5.06 million hectares area in India. The major producing states are Uttar Pradesh, Maharashtra, Tamil Nadu, Karnataka, and Gujarat, in which Uttar Pradesh is the leading state with an average cane productivity of 83.25 t/ha with sugar recovery of 10.68 per cent. Sugarcane cultivation requires a heavy demand for labour and machinery throughout the sugarcane crop cycle. The lack of mechanization in India is due to small land holdings, improper row spacing, and a lack of skill in mechanization. It is an alarming situation to go for mechanization in sugarcane. Laser land levelers are used for precision land leveling and help in mechanization operations, increasing the sugarcane productivity and improving the crop establishment. Small tractor-drawn multipurpose equipment is used for performing mechanical weeding, earthing up, and fertilizer application operations in wide row planted sugarcane. Convenient use of machinery and sugarcane harvester in appropriate sugarcane plant geometry helps in saving labour, reduces drudgery, and improves the timeliness of operations. Zero tillage sugarcane planting and an automatic seed cutter planter are also used for mechanization in sugarcane. Mechanization in Sugarcane Cultivation in the competitive involvement, which is fast enveloping all the operations, the effectiveness of human resources will be the cutting edge for sustaining the productivity. Mechanization is useful in improving the quality of work, effective utilization of resources, and reducing the cost of operation.

ANTIOXIDANT POTENTIAL OF ANANAS COMOSUS PEEL POWDER: INFLUENCE OF DRYING TECHNIQUE

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One of the most popular fruits in the *Bromeliaceae* family is *Ananas comosus*. This tropical fruit is well-known for its taste. Following use, a significant amount of by-product is produced, of which 34–38% is peel alone. The total flavonoid content (TFC) and total phenolic content (TPC) of four different methods of drying *A. comosus* (pineapple) peel powder (PPP) hot air oven, microwave, sun, and freeze drying as well as the in-vitro antioxidant activity using the DPPH assay were qualitatively and quantitatively determined in order to turn this waste into valuable aqueous, methanolic, and acetone solvent extracts. The study's findings revealed that the aqueous extract of microwave oven-dried PPP had the greatest TPC value (79.39772 mg GAE/g), while the acetone extract of hot air oven-dried PPP had the lowest TPC value (14.04545 mg GAE/g). The methanolic extract of freeze-dried PPP had the highest TFC value (48.3636 mg QE/g), whereas the methanolic extract of hot air-oven-dried PPP had the lowest value (3.60606 mg QE/g). It was discovered that the methanolic extract of microwave-dried PPP had the highest antioxidant potential (97.6%). Additionally, out of all the extracts, the methanolic extract had the highest antioxidative capability across all drying methods. Therefore, the primary goal of this study was to determine the optimal drying method for extracting the most antioxidant potential from the peel of *Ananas comosus* and to measure the phytochemicals that are responsible for this activity.

Keywords: *Ananas comosus*, peel, antioxidant, extracts, by-product.

FORAGE AND ASSOCIATED TRAITS EVALUATION FOR SUITABILITY AS FODDER IN COWPEA (*VIGNA UNGUICULATA* (L.) WALP.) GERMPLASM

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The investigation on the evaluation of cowpea (*Vigna unguiculata* (L.) Walp.) germplasm for forage traits was carried out at the Zonal Agricultural Research Station (ZARS), Mandya, during Rabi 2024 and Kharif 2025 to assess the genetic variability, correlation and divergence among 75 fodder cowpea genotypes. The experiment, laid out in an Alpha Lattice Design with two replications, revealed through ANOVA highly significant differences for most of the traits, indicating ample variability, while pooled ANOVA showed significant genotype × season interaction. High GCV, PCV, heritability and genetic advance were observed for green forage yield, fresh leaf weight, fresh stem weight and dry matter yield indicating additive gene action and potential for selection. Correlation analysis revealed strong positive associations of green forage yield with fresh leaf weight, stem weight and dry matter yield, making them reliable selection indices. K-means clustering grouped genotypes into nine distinct clusters, indicating wide genetic diversity. Based on LSD values, four genotypes in Rabi and six in Kharif were significantly superior for green forage yield, with crude protein content ranging from 18.45% to 24%, the highest in 1-1-33 (24%). The study revealed substantial genetic variability, strong trait associations and wide diversity, identifying promising genotypes for developing high-yielding and nutritionally rich fodder cowpea varieties.

ADVANCES IN BIOTECHNOLOGICAL APPROACHES FOR HERBICIDE TOLERANCE AND SELECTIVITY IN VEGETABLE CROPS

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Weeds remain one of the toughest challenges for vegetable growers, often leading to heavy yield losses and increased input costs. Traditional herbicides, though effective, can harm vegetable crops because of their non-selective nature. Recent progress in biotechnology has opened new and more sustainable ways to develop vegetable crops that can safely tolerate or selectively resist herbicides. The journey began with conventional genetic transformation and cell culture selection, where genes like CP4-EPSPS (for glyphosate tolerance), bar/pat (for glufosinate tolerance), and tfdA (for 2,4-D tolerance) were introduced into plants. These early experiments provided a foundation for understanding how crops could detoxify or resist herbicides. Building on this, modern tools such as CRISPR/Cas9, TALENs, and base editing now allow scientists to precisely modify natural genes like ALS (acetolactate synthase) and PPO (protoporphyrinogen oxidase) without adding foreign DNA. Such targeted gene editing has shown promising results in tomato, brinjal, pepper, and cucumber, providing resistance to commonly used herbicides such as sulfonylureas and imidazolinones. Emerging approaches including metabolic engineering, gene stacking, and RNA interference (RNAi) are further expanding the possibilities for developing crops with multi-herbicide tolerance. At the same time, scientists are emphasizing responsible use addressing biosafety concerns, preventing gene flow to wild species, and ensuring public acceptance. Future work will focus on blending these biotechnological advances with integrated weed management (IWM) practices to build a safer, more sustainable vegetable production system. Altogether, these advances represent a major step toward improving crop productivity, reducing chemical dependence, and promoting environmentally sound agriculture.

Keywords: Herbicide tolerance, CRISPR/Cas, ALS mutation, transgenic vegetables, sustainable weeds management

PHYSICOCHEMICAL AND NUTRITIONAL CHARACTERIZATION OF SELECTED CASHEW APPLE (*ANACARDIUM OCCIDENTALE* L.) VARIETIES

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The cashew apple, a pseudo-fruit of the cashew tree (*Anacardium occidentale* L.), is a nutrient-rich but underutilized by-product of the cashew nut industry. It contains appreciable levels of sugars, vitamin C, phenolics, and organic acids, offering potential for value-added processing into beverages and fermented products. The present study aimed to evaluate the physicochemical and nutritional characteristics of three cashew apple varieties Bhaskara, Priyanka, and Ullal-1 cultivated in coastal region of Karnataka. Physical parameters such as fruit weight, dimensions, density, and moisture content were recorded, along with biochemical constituents including protein, tannin, and reducing sugars. Fruit weight ranged from 41.00 g (Ullal-1) to 60.10 g (Bhaskara), with moisture content between 70.45% and 76.96%. Among the varieties, Bhaskara showed the highest protein content (1.70%) and lowest tannin content (6.42 µg/ml), while Priyanka exhibited the highest reducing sugar (14.5%). The variations observed among varieties highlight the genetic diversity and processing potential of cashew apples. These findings provide useful insights for selecting suitable varieties for beverage and value-added product development in the cashew industry.

Keywords: Cashew apple, physicochemical properties, tannin, reducing sugars, varietal variation

PHYTOCHEMICAL COMPOSITION AND IN VITRO BIOACTIVITIES OF *SKIMMIA LAUREOLA*: A THREATENED MEDICINAL PLANT OF WESTERN HIMALAYAS

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Skimmia laureola (DC.) Zucc., a small evergreen shrub of the Rutaceae family, is an important yet threatened medicinal plant native to the Western Himalayas. Traditionally employed in the treatment of respiratory, inflammatory, and microbial disorders, this study investigates its phytochemical composition and evaluates its in vitro bioactivities to validate its ethnomedicinal significance. Phytochemical screening of *S. laureola* revealed the presence of major secondary metabolites such as alkaloids, flavonoids, phenolics, terpenoids, and saponins, which are known for their diverse pharmacological properties. The extracts demonstrated strong antioxidant potential in DPPH assay, along with notable antibacterial and antifungal activities against selected pathogenic strains. Furthermore, anti-inflammatory evaluations supported the plant's therapeutic potential, providing scientific evidence for its traditional medicinal uses. However, the natural populations of *S. laureola* are rapidly declining due to overexploitation, habitat degradation, and changing climatic conditions. The study emphasizes the urgent need for effective conservation strategies to protect this species and its native ecosystems. Promoting sustainable harvesting, community awareness, and cultivation through in situ and ex situ conservation measures can aid in preserving its genetic diversity and ecological role. Integrating phytochemical and biological insights with habitat conservation initiatives highlights the dual importance of *S. laureola* as a valuable medicinal resource and a component of Himalayan biodiversity. This research advocates for the inclusion of this threatened species in regional biodiversity protection and wildlife habitat conservation programs. The conservation of *Skimmia laureola* is vital not only for its medicinal importance but also for maintaining the ecological balance of Himalayan Forest ecosystems. The study reinforces the link between plant-based traditional medicine, wildlife protection, and long-term biodiversity conservation in mountain landscapes. Protecting this species contributes to the preservation of associated flora and fauna that depend on similar environmental conditions for survival.

Keywords: Medicinal plant conservation; biodiversity protection; habitat restoration; wildlife and ecosystem sustainability, phytochemical screening; in vitro bioactivities.

TO ISOLATE AND IDENTIFY BIO-FILM FORMING DAIRY ASSOCIATED MICROBES FROM MILK AND RELATED DAIRY PRODUCTS

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Bio-films pose significant challenges in the dairy industry, contaminating milk and dairy products, reducing equipment efficiency, and compromising food safety. Their persistence can lead to spoilage and health hazards. Milk and dairy products are highly nutritious but susceptible to microbial contamination that can compromise quality and safety. Among these, bio-film-forming microbes such as *Staphylococcus aureus*, *Escherichia coli*, and *Salmonella spp.* pose a significant risk due to their persistence, resistance to cleaning agents, and antibiotic resistance traits. This study aimed to isolate and identify bio-film-forming bacterial strains from raw milk, curd, and cheese samples collected from local markets and dairy farms. We will investigate the prevalence, diversity, and characteristics of bio-film-forming bacteria in dairy environments, focusing on their impact on product quality and safety. Our research will employ a combination of microbiological, molecular, and biochemical techniques to detect and characterize bio-film-forming microbes. Samples were cultured on selective media, and isolates were identified using biochemical tests and 16S rRNA gene sequencing. Bio-film-forming ability was assessed through the 96-well micro-titer plate assay using crystal violet staining. A significant proportion of the isolates showed moderate to strong bio-film formation, with *S. aureus* being the most prevalent. The findings of this study will contribute to the development of effective strategies for controlling bio-film formation, improving dairy product quality, and ensuring consumer safety.

Keywords: Bio-film and bio-film forming microbes, dairy products, food safety, milk quality, microbial contamination, 16S rRNA gene sequencing.

ENUMERATION OF SOME ETHNIC PLANTS SPECIES USED BY GOND TRIBE IN GHATANJI REGION DIST. YAVATMAL (M.S.) INDIA

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Present paper deals with some ethno medicinal uses of 17 plant species, by the Gond tribe of Ghatanji region, in Yavatmal district of Maharashtra. Some villages were visited in this region. The indigenous knowledge of local traditional healers about the plants used for various ailments was collected through a questionnaire by personal interviews during field visits. A total of 17 medicinal plant species distributed in 14 families are documented. The ethnobotanical information on plants viz., botanical name, family, local name, plant part used and mode of administration is enumerated.

Keywords: Gond Tribe, Medicinal Plants, Ghatanji Region, Yavatmal District.

YIELD RESPONSE OF TOMATO TO COMMERCIAL BIOFERTILIZER APPLICATION UNDER NATURAL CONDITIONS

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Tomato (*Solanum lycopersicum*) is one of the most widely cultivated and economically important vegetable crops globally. Achieving optimal yield and fruit quality depends significantly on effective nutrient management. This study investigates the impact of commercial biofertilisers on the yield of tomato plants under natural conditions. Commercial biofertilizers, typically containing balanced proportions of nitrogen (N), phosphorus (P), and potassium (K), along with micronutrients, play a critical role in promoting vegetative growth, flowering, and fruit development. The experiment involved applying one chemical fertilizer and two of commercial NPK biofertilizers along with control to tomato plants and monitoring their growth parameters, fruit yield, and quality attributes. Results indicated that appropriate fertilizer application significantly increased tomato yield compared to control group. The study emphasizes the importance of balanced fertilizer use tailored to soil nutrient status and tomato crop requirements. These findings offer valuable insights for tomato growers aiming to maximize productivity without depleting soil's nutrients for further harvesting.

Keywords: tomato, commercial biofertilisers, soil nutrients,

TRANSCRIPTOME ANALYSIS OF PLANT -DERIVED CANNABIDIOL REVEALS NEUROPROTECTIVE AND ANTICANCER PATHWAYS FOR DRUG DISCOVERY

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Natural products obtained from medicinal plants are increasingly recognized as sustainable and eco-friendly sources for novel therapeutics. *Cannabis sativa*, a plant rich in bioactive compounds, produces Cannabidiol (CBD) a non-psychoactive phytochemical with emerging neuroprotective and anticancer properties. The present study aims to investigate the transcriptomic impact of CBD on glioblastoma cells through an in silico RNA-Seq reanalysis, providing insights into the molecular basis of plant-derived and sustainable drug discovery. Publicly available RNA-Seq data of CBD-treated and untreated glioblastoma cells (GEO accession: GSE144029) were analyzed using an integrated bioinformatics workflow. Transcript quantification was performed using Salmon, followed by DESeq2 for differential gene expression analysis and clusterProfiler for functional enrichment. Genes exhibiting a log₂ fold change greater than 1 and an adjusted p-value below 0.05 were considered significantly modulated. The analysis revealed extensive transcriptional reprogramming following CBD exposure. Genes involved in apoptosis, oxidative stress regulation, and neuronal survival were notably upregulated, whereas those linked to cell-cycle control and tumor proliferation were downregulated. Enrichment results highlighted the activation of PI3K-AKT, MAPK, and p53 signaling pathways, suggesting a dual molecular role of CBD in promoting neuroprotection while suppressing oncogenic processes. Overall, this study provides transcriptome-level evidence supporting the therapeutic potential of plant-derived Cannabidiol. The findings strengthen the link between biodiversity-based natural compounds and modern biomedical innovation, emphasizing the importance of sustainable, plant-based therapeutics in addressing neurological cancers and contributing to eco-conscious drug discovery.

Keywords: Cannabidiol, RNA-Seq, Glioblastoma, Neuroprotection, Sustainable Therapeutics

DEVELOPMENT OF FUNCTIONAL SNACK INCORPORATING KODO MILLET & BANANA PEEL AND ITS EFFECT ON BLOOD GLUCOSE LEVELS IN ADULTS

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The metabolic disorder condition known as diabetes mellitus is characterised by elevated blood glucose levels brought on by impaired insulin secretion or increased insulin resistance. Bananas are the most widely cultivated fruit in the world. Banana peel generally gets wasted due to lack of awareness about its scientific properties. The aim of this study was to develop a product from kodo millet, and *Musa sapientum* peel (banana peel flour) which was further optimized based on sensory and physio-chemical properties. For sensory evaluation, the product was used in different variations. In T1- kodo millet (60%), banana peel flour (20%), gram flour (20%), whereas in T2- kodo millet (70%), banana peel flour (10%), gram flour (20%), respectively to develop namkeen. The sensory evaluation was done using a 9- point hedonic rating scale and nutrition composition was calculated and will be used further for intervention on 10 non-diabetic subjects and assessing the blood glucose level at 0, 30, 60, 90, and 120 minutes by OGTT method. The data revealed that namkeen formulated with kodo millet (70%), banana peel flour (10%), gram flour (20%) was found to be most acceptable product in regards with taste texture, color, appearance, and overall acceptability. The nutritional composition of sample of 100 g T2 was (energy- 375.37 kcal, carbohydrate- 76.24g, protein- 10.57g, fat -3.73g, fiber -11.0g, moisture- 3.21g, and ash- 6.86g. The glycemic load was intermediate as compared to control. The study concluded that twisters formulated with kodo millet (70%), banana peel flour (10%), gram flour (20%) can be used for diabetic patient, due to its medium glycemic load.

Keywords: Metabolic Disorder, Millets, Banana Peel, Diabetes, Low Glycemic

FROM WASTE TO WELLNESS: VALORIZATION OF FRUIT PEELS AS FUNCTIONAL FOOD INGREDIENT ENRICHED WITH PHYTOCHEMICALS

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In recent years, there has been growing interest in identifying natural and sustainable sources of health-promoting compounds for functional food development. The global rise in fruit processing generates a significant volume of peel waste, which is often discarded despite being a rich reservoirs of bioactive phytochemicals. Recent research has revealed that fruit peels contain high concentrations of polyphenols, flavonoids, tannins, and other antioxidant compounds, surpassing those found in edible portions. These bioactive compounds exhibit potent therapeutic activities including antioxidant, anti-inflammatory, antidiabetic, and antihypertensive effects. The present study highlights the potential of utilizing pomegranate (*Punica granatum*) peel as functional food ingredient. Incorporating peel extracts or powders into food formulations can enhance the nutritional value, shelf life, and functional efficacy of products, supporting the health-promoting property of products while reducing environmental waste. Furthermore, this valorization strategy reduces food waste and supports sustainable nutrition practices. Overall, fruit peel utilization represents a promising and eco-friendly approach to promote human health through functional food innovation.

Keywords: *Punica granatum*, bioactive compounds, health-promoting, functional food, waste.

BIOCONTROL POTENTIAL OF ENTOMOPATHOGENIC NEMATODE *STEINERNEMA PAKISTANENSE* OCCURRING IN NORTHERN LIGHT SOILS OF ANDHRA PRADESH AGAINST TOBACCO CATERPILLAR, *SPODOPTERA LITURA* (FABRICIUS) (LEPIDOPTERA: NOCTUIDAE)

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Spodoptera litura (F.) is an economic pest that causes serious damage to Flu Cured Virginia (FCV) tobacco. The bio-control potential of the entomopathogenic nematodes (EPNs) as alternatives to harmful synthetic pesticides was examined in this study. The study aimed to determine the efficacy of EPN isolates against the 3rd instar of larvae of the tobacco caterpillar *S. litura* and the effect of time on mortality rate under laboratory conditions. One native strain of *Steinernema pakistanense* isolated from the tobacco rhizosphere were characterised molecularly and designated as NIRCA01. The identified EPN strain were tested at 6 different concentrations (0, 50, 100, 250, 500 and 1000 IJs/larva) in 9 mm petri plates on 3rd instar larvae of *S. litura*. Mortality rates of larvae were calculated at 3 different times (24, 48, and 72 hrs) after inoculation. The highest mortality rate of 3rd instar larvae of *S. litura* (100%) was caused by *S.pakistanense* NIRCA01 strain at the concentration of 500 IJ/larva after 48 hrs of post inoculation. This native strain NIRCA01 causing mortality against 3rd instars larvae of *S.litura* (LC50 value of 67 IJs/larva) at 48hrs post inoculation. With different concentration of EPN tested, the production of infective juveniles (IJs) inside the cadavers for native strain NIRCA01 varied between 4,528- 34,038 larvae⁻¹, respectively. Based on the virulence, LC50 values, and reproductive capacity, it is suggested that *S.pakistanense* NIRCA01 strain have great potential as a biocontrol agent for the tobacco caterpillar *S.litura* may serve as viable option in the integrated pest management programme.

Keywords: Biological Control; Characterisation; Efficacy; *Steinernema pakistanense*; *Spodoptera litura*; Northern Light Soils, Tobacco

COMPUTATIONAL ANALYSIS OF SOYBEAN RHIZOSPHERE MICROBIOME UNDER ORGANIC FERTILIZATION IMPLICATIONS FOR SUSTAINABLE AGRICULTURE

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Sustainable agriculture hinges on the health of soil microbiomes, which play a crucial role in nutrient cycling, pathogen suppression, and ensuring long-term productivity while keeping chemical inputs to a minimum. This study dives into a comprehensive computational analysis of the soybean (*Glycine max*) rhizosphere microbiome under organic fertilization, utilizing publicly available 16S rRNA amplicon sequencing data (SRX26495742). We proposed that organic fertilization boosts microbial diversity and enriches beneficial plant taxa, ultimately fostering sustainable soil health. To analyze the raw sequencing reads, we employed fastp for quality filtering, followed by denoising and processing to derive amplicon sequence variants (ASVs) using DADA2 in R. Taxonomic assignments were made against the SILVA database, and we examined microbial diversity, community composition, and differential abundance using phyloseq. We calculated alpha diversity (Shannon index) and beta diversity metrics (Bray–Curtis), identifying taxa that were significantly enriched under each treatment. Our results showed that organic fertilization increased alpha diversity compared to control soils and led to distinct clustering of microbial communities. Notably, several beneficial taxa, such as nitrogen-fixing and phosphate-solubilizing bacteria, were found to be more abundant in the rhizospheres treated with organic fertilizers. These findings point to enhanced nutrient cycling potential, better pathogen suppression, and overall resilience of the soil. This fully computational approach illustrates how *in silico* microbiome profiling can swiftly evaluate the effects of agricultural practices on soil health. The study underscores the importance of organic fertilization in advancing sustainable crop production and offers a reproducible framework for developing environmentally friendly soil management strategies.

Keywords: Soybean, Rhizosphere Microbiome, Organic Fertilizer, 16S rRNA, Computational Biology

DETERMINATION OF SOIL MOISTURE USING TIME DOMAIN REFLECTOMETER

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Soil moisture estimation is an essential factor in determining soil properties, is involved in several processes such as pedological, hydrological, and biological, and thereby influences crop growth. Soil moisture is measured using various methods. Gravimetric and time-domain reflectometry (TDR) are among the methods for estimating soil moisture. This study was established to assess the efficiency and reliability of the Time domain reflectometer in estimating soil moisture for different soil samples collected from various soil types at Tamil Nadu Agricultural University. The samples were analysed for bulk density, porosity, and soil moisture using both the gravimetric and time-domain reflectometer methods, and the resulting values were statistically analysed. The results show that both the gravimetric and time-domain reflectometer methods were significantly correlated at the $P=0.05$ level, with a correlation coefficient of 0.79. It implies that TDR had the potential to determine soil moisture using the gravimetric method, and thereby the time-domain reflectometer will become a suitable, fast, reliable, and less labor-intensive instrument for estimating soil moisture.

GLUCOSINOLATE DIVERSITY AND ITS FUNCTIONAL ROLE IN DIAMONDBACK MOTH RESISTANCE IN INDIAN CAULIFLOWER (*BRASSICA OLERACEA* VAR. *BOTRYTIS*)

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Cauliflower is a major winter vegetable in India, contributing significantly to nutritional security and rural livelihoods. However, its productivity is severely constrained by the diamondback moth (*Plutella xylostella*), a devastating pest responsible for extensive yield losses. Conventional pesticide-based control is both unsustainable and environmentally hazardous, underscoring the need for biochemical and genetic alternatives. Glucosinolates (GSLs) are sulfur-containing secondary metabolites unique to Brassicaceae, play a dual role in plant defense and human nutrition, and their compositional diversity offers a potential basis for natural pest resistance. The present study elucidates the biochemical basis of diamondback moth (*Plutella xylostella*) resistance in Indian cauliflower through an integrated analysis of glucosinolate (GSL) diversity and pest interaction. Ninety-six cauliflower genotypes representing all maturity groups were profiled for leaf glucosinolates at the seedling stage using HPLC. A total of 20 distinct glucosinolates were detected, predominantly aliphatic types, with total GSL concentration ranging from 1.718 $\mu\text{mol/g DW}$ (DPCA-5) to 12.977 $\mu\text{mol/g DW}$ (Pusa Deepali). Considerable genotypic variation was observed, with *Pusa Deepali* showing the highest sinigrin accumulation and *PSBH-1* and *IET* characterized by higher indolic compounds such as I3M and 3MSOP. Screening for *P. xylostella* damage under in vitro and net house conditions revealed a wide range of susceptibility, from complete resistance (0% damage; *PSBH-1*, *PNI*, *IET*) to severe susceptibility (up to 75% damage; *Pusa Deepali*). Under net-house evaluation, resistant genotypes such as *DC-41-5*, *White Diamond*, and *KT-178* maintained low damage scores (1.0–2.3), whereas *351AA* and *KT-2* recorded high damage (7.0). Correlation analyses demonstrated that sinigrin ($r = 0.843$, $p < 0.01$) and 4MSOB ($r = 0.324$, $p < 0.01$) were positively associated with pest damage, suggesting their potential role as feeding stimulants. In contrast, 3MSOP ($r = -0.43$, $p < 0.01$) and I3M ($r = -0.37$, $p < 0.05$) showed significant negative correlations, indicating their possible deterrent effect on larval feeding. Overall, the findings establish that specific GSL compounds mediate the resistance–susceptibility spectrum of cauliflower to diamondback moth. The high inter-genotypic variability and consistent resistance observed in select genotypes highlight opportunities for glucosinolate-informed breeding toward pest-resilient cultivars. This study provides a foundational framework for integrating metabolomic screening with pest management in sustainable horticultural production systems.

Keywords: Cauliflower (*Brassica oleracea* var. *botrytis*); Glucosinolates; Diamondback moth (*Plutella xylostella*); Pest resistance; Plant defense; Sustainable horticulture.

TOXIC BITE: CARCINOGENIC FOOD ON OUR PLATE

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What we eat daily may silently expose us to cancer-causing agents hidden within our food. Carcinogens can enter the food chain at multiple stages through pesticide-treated crops, chemical additives, artificial coloring, adulteration, and unsafe packaging materials. Even cooking practices like deep-frying, smoking, or grilling at high temperatures can generate toxic compounds such as acrylamides and polycyclic aromatic hydrocarbons. This poster explores how these harmful substances make their way “from farm to plate,” their impact on human health, and practical strategies to minimize exposure. By raising awareness about safer food choices, organic farming, and mindful cooking, we can take a step toward preventing diet-related cancers and protecting overall well-being.

Keywords: Carcinogens, Food contamination, Toxic compounds, Pesticides, Processed foods, Food safety, Cancer prevention, Public health.

MILK PROTEIN RICH GUMMIES: EFFECT OF PROTEIN SOURCE AND HYDROCOLLOID TYPE ON PHYSICO-CHEMICAL, RHEOLOGICAL, TEXTURAL AND STRUCTURAL CHARACTERISTICS

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Protein plays a key role in human health. According to a National survey, more than 70% of the Indians are facing protein deficiency. Protein quality rather quantity is pivotal for alleviating protein deficiency. Milk protein, regarded as gold standard protein, contains all the essential amino acids. Gummies, sweet confections, are liked by all age groups. Supplementing gummies with milk protein is a suitable option to alleviate the protein deficiency. In the present study, milk protein rich gummies were prepared to enhance their nutritional profile without altering crucial sensory and textural attributes. The study was done in two phases. In the first phase, effect of milk protein source on gummy attributes was studied. Milk protein sources viz. whey protein isolate (WPI), whey protein concentrate, and sodium caseinate were added (@ 5-15% w/w) to gummy formulations prepared using different hydrocolloids. Gummies added with WPI at 5% had to better textural attributes. Hence, WPI addition at 5% was optimized. In the second phase, instead of single hydrocolloid, their combinations were used to improve the gummy quality attributes. Guar gum in combination with agar-agar (GA) and κ -carrageenan in combination with gellan gum (KG) were used at different concentrations followed by WPI addition for gummy preparation. Hydrocolloid blend GA with WPI improved textural attributes of gummies. FTIR analysis and CLSM images revealed effect of hydrocolloid combination on WPI gummies. Dynamic rheology indicted that GA had positively contributed for the elastic nature of the gummies. The optimized gummy formulation having GA and WPI (5% w/w) has been adjudged sensorially superior than the remaining gummy samples.

Keywords: Milk protein; Hydrocolloids; Gummy; Texture; Rheology

PRECISION FERTILIZER RECOMMENDATION USING MULTI-SOURCE AGRO -ENVIRONMENTAL DATA

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Efficient fertilizer management is central to sustainable agricultural production and reduced environmental impact, yet conventional recommendation systems rely on limited soil data and rigid rules that fail to capture changing agro-climatic conditions. This study proposes a hybrid deep learning framework that integrates soil properties, weather dynamics, and crop information to generate more precise and adaptable fertilizer recommendations across diverse cropping systems. The framework combines Convolutional Neural Networks (CNN) to identify spatial patterns in soil characteristics with Long Short-Term Memory (LSTM) networks to model temporal weather variations, enabling data-driven decisions that adjust to local conditions. The model was trained on multi-source datasets encompassing soil NPK levels, organic carbon, pH, temperature, rainfall, and crop growth parameters collected from multiple agricultural zones. Experimental evaluation shows that the hybrid model substantially outperforms conventional machine learning approaches such as Random Forest (RF) and Support Vector Machines (SVM) in predicting optimal fertilizer doses. It delivers higher accuracy, enhances nutrient use efficiency, and offers clearer insights into how climate variability influences fertilizer requirements. This work demonstrates the value of deep learning-based hybrid systems in precision agriculture, supporting site-specific and sustainable nutrient management. The results provide a scalable foundation for developing intelligent advisory tools and digital platforms capable of assisting farmers, researchers, and policymakers in making informed fertilizer-related decisions.

Keywords: Precision Agriculture, Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), Deep Learning-based Hybrid Systems, Random Forest (RF) and Support Vector Machines (SVM)

FROM FARM TO FORK: "PATHWAYS OF CARCINOGENIC AGENTS INTO THE HUMAN BODY"

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Food, the essence of life, can also become a silent carrier of carcinogenic agents that threaten human health. From agricultural practices to food processing and packaging, several stages contribute to the entry of these harmful compounds into our bodies. The use of pesticides, chemical fertilizers, food preservatives, artificial colorants, and plastic packaging materials often introduces carcinogenic residues that accumulate through consumption. Moreover, cooking methods such as frying or grilling at high temperatures can generate additional carcinogens. This poster explores the complete journey of food contamination from cultivation and storage to consumption highlighting the sources, mechanisms, and preventive strategies. Emphasis is placed on public awareness, safer agricultural practices, and the promotion of organic and minimally processed foods. Understanding these pathways is essential to reduce exposure, promote food safety, and protect public health.

Keywords: Carcinogens, Food contamination, Pesticides, Food safety, Public health, Farm to fork, Organic food.

SILENT KILLER OR HIDDEN HAZARD: THE TRUTH ABOUT FOOD CARCINOGENS

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Everyday foods we consume may unknowingly carry harmful carcinogenic agents, turning our meals into potential health hazards. These substances often enter the food chain through pesticide residues, chemical preservatives, artificial colors, adulterants, and contaminated packaging materials. Additionally, high-temperature cooking and processed food manufacturing can generate new carcinogenic compounds. This poster highlights the hidden sources of food carcinogens, their pathways into the human body, and their long-term impact on health, including cancer risk. Emphasis is placed on preventive measures such as choosing organic produce, reducing processed food intake, and promoting safe food handling and storage practices. By uncovering the truth about food carcinogens, this presentation aims to create awareness and encourage conscious dietary choices for a healthier future.

Keywords: Food carcinogens, Pesticide residues, processed foods, Food safety, Cancer prevention, Chemical contamination, Public health.

ORGANIC AND NATURAL FARMING IN HORTICULTURAL SYSTEMS: CLIMATE-SMART STRATEGIES FOR NUTRITION AND LIVELIHOOD SECURITY

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Horticulture, particularly vegetable-based production systems, plays a pivotal role in achieving food, nutrition, and livelihood security in a sustainable manner. With increasing concerns about soil degradation, climate variability, and chemical dependency, organic and natural farming practices have gained prominence as climate-smart alternatives. The present study emphasizes the integration of ecological principles, traditional knowledge, and scientific innovation in horticultural crop management. By adopting bio-fertilizers, composts, vermicompost, and microbial consortia, soil fertility and water-use efficiency can be enhanced while minimizing environmental footprints. The inclusion of diverse, underutilized, and nutrient-rich vegetables promotes dietary diversity and supports local nutrition-sensitive food systems. Circular economy approaches such as waste recycling, farm residue management, and value addition of horticultural produce contribute to sustainable livelihoods. Additionally, digital and precision tools including remote sensing, IoT-based monitoring, and AI-assisted crop management offer opportunities to optimize productivity under changing climatic conditions. This integrated model of organic horticulture supports biodiversity conservation, strengthens rural economies, and aligns with multiple Sustainable Development Goals (SDGs), ensuring a resilient and nutritionally secure future.

Keywords: Organic horticulture, Vegetable science, Climate-smart agriculture, Soil health, Biodiversity, Sustainable nutrition

LC–MS/MS-BASED METABOLOMIC PROFILING OF PHYTOCHEMICAL DIVERSITY IN *PASSIFLORA EDULIS* GENOTYPES

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India, traditionally recognized as an agrarian nation, remains one of the leading global producers of horticultural crops owing to its vast agro-climatic diversity. Among these, passion fruit (*Passiflora edulis* Sims), belonging to the family Passifloraceae, is an underexploited fruit crop with significant potential for diversification and value addition within Indian horticulture. Although native to South America, where over 500 *Passiflora* species are documented, the cultivation of this species has expanded globally, encompassing regions such as Australia, New Zealand, Taiwan, China, and parts of Europe. In the present investigation, Liquid Chromatography Mass Spectrometry/Mass Spectrometry (LC–MS/MS) was employed for comprehensive profiling of bioactive metabolites and nutritional constituents in purple and yellow genotypes of *Passiflora edulis*. LC–MS/MS analysis demonstrated distinct variations in phytochemical composition between the genotypes. Notably, benzoic acid was identified as the predominant organic acid across both types, reflecting its contribution to fruit aroma and antimicrobial properties. Among flavonoid constituents, luteolin was found to be the major compound in the purple genotype, whereas naringenin predominated in the yellow genotype, indicating genotype-dependent metabolic differentiation. Furthermore, amino acid profiling revealed serine as the dominant amino acid in purple passion fruit and glutamic acid in the yellow counterpart, contributing to their characteristic flavor and nutritional quality. The findings underscore the metabolic diversity and phytochemical richness of *P. edulis*, highlighting its potential as a source of health-promoting bioactive compounds. The integration of LC–MS/MS-based metabolomic characterization provides valuable insights into biochemical variability among genotypes, offering a scientific basis for varietal selection, functional food development, and nutraceutical utilization.

Keyword: *Passiflora edulis*, LC–MS/MS, Metabolomic profiling, Phytochemical diversity, Flavonoids, Amino acids, Nutraceutical potential

EDIBLE INNOVATIONS: REDEFINING CUISINE THROUGH 3D FOOD PRINTING

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3D food printing represents a groundbreaking technology that is transforming traditional perceptions of food production and consumption. By employing digital design and constructing food layer by layer, it enables the creation of edible products customized to individual preferences for taste, appearance, and nutritional value. Recent advancements demonstrate significant potential in producing personalized meals, reducing food waste, and promoting sustainable alternatives such as plant-based or lab-cultivated foods. Techniques including extrusion, inkjet printing, and laser sintering allow for the fabrication of foods that not only exhibit visual appeal but also meet specific dietary requirements benefiting consumers, hospital patients, and even astronauts in space. However, several challenges hinder widespread adoption: high equipment costs, technical complexity, limited consumer acceptance, and concerns over product quality, safety, and standardization. Ongoing research aims to address these barriers by developing intelligent systems for real-time monitoring, improving texture and shelf stability, and integrating microwave-assisted processes or bioactive compounds to enhance functionality and nutritional performance.

Keywords: 3D food printing, digital design; sustainable food technology; extrusion, smart food systems

COMPARATIVE STUDY OF DIFFERENT INTERPOLATION METHODS FOR SOIL POLLUTANTS IN INDUSTRIAL AREA, KANPUR

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A study was conducted to interpolate the analysis of spatial variability of soil chromium, cadmium, lead and zinc in Jajmau industrial area, Kanpur district. A total of 120 soil samples (0-25 cm) were collected grid wise at an interval of 250 m using GPS. After normalization, data were interpolated by Ordinary Kriging (Spherical, Exponential and Gaussian). The performance of methods was evaluated using Mean Absolute Error (MAE), Root Mean Square Error (RMSE) and Goodness of prediction (G) obtained from a cross-validation procedure. The best model is selected based on low MAE, low RMSE and highest G percentage. Spatial variability maps for different heavy metals revealed high concentration of metals near tannery zones. The results showed that Spherical Model was best for chromium and zinc (RMSE value 582.65 and 57.12) whereas Gaussian Model was best fitted for lead and cadmium (RMSE value 13.79 and 2.86). Geostatistical analysis with Ordinary kriging interpolation method revealed strong spatial dependency for chromium (N:S ratio 21.6%) and moderate spatial dependency for lead, cadmium and zinc (N:S ratio 52.9%, 51.5% and 28.7%). Cross validation of kriged map showed that spatial prediction of soil properties using semi variogram parameters is better than assuming mean of observed value for any un-sample location. Therefore, it is a suitable alternative method for accurate estimation of soil properties in unsampled positions as compared to direct measurement which has time and costs concerned.

Keywords: Spatial variability, Cross validation, GPS, Semivariogram, Geostatistics

DEVELOPMENT OF FINGER MILLET LADDOO WITH THE INCORPORATION OF MAHUA (*MADHUCA LONGIFOLIA*)

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Madhuca longifolia (Mahua), a tropical deciduous tree of the Sapotaceae family, is native to India and is widely spread across South Asia. Its flowers, seeds, and bark are rich in bioactive compounds, including triterpenoids, flavonoids, and saponins, which exhibit various pharmacological activities such as antioxidant, antimicrobial, anti-inflammatory, galactagogue, and hepatoprotective effects. Traditionally, Mahua is used to treat diabetes, liver disorders, respiratory problems, and skin conditions. Despite its medicinal potential, Mahua remains underutilised in dietary applications and is primarily used by the distillery industry. The present study aims to develop a functional food product, Finger Millet Laddoo, incorporated with Mahua to boost its nutritional and therapeutic qualities. Finger Millet (*Eleusine coracana*), a millet recognized for its high levels of calcium, iron, dietary fibre, and polyphenols, was chosen as the primary ingredient because of its proven benefits in maternal and child nutrition. The laddoo was formulated using standardized proportions of finger millet flour, mahua, and other ingredients aimed to boost nutrient intake among pregnant and lactating women. Sensory evaluation of the developed laddoo was done using a 9-point hedonic scale; the maximum scores of colour, taste, aroma, texture and overall acceptability were found to be 8, 9, 8, 8, 9, respectively. Mahua significantly enhances the calcium and iron content of the product without compromising sensory acceptability. This study suggests that laddoo incorporated with Mahua fulfills the nutritional demands of pregnant and lactating women, who require higher levels of calcium and iron to support maternal health, fetal development, and postnatal recovery.

Keywords: Mahua, Finger millet, Laddoo, Galactagogue, Lactating women

ETHNOMEDICINAL IMPORTANCE OF CUCURBITACEAE FAMILY PLANTS: A REVIEW

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Medicinal plants have long served as the cornerstone of traditional healthcare systems, and the Cucurbitaceae family holds a prominent place among them due to its remarkable diversity and pharmacological significance. Comprising approximately 130 genera and around 800 species, this family includes both wild and cultivated plants that are widely consumed as vegetables, fruits, and in various folk remedies. Despite their nutritional importance, many members of this family remain unexplored for their medicinal potential. The present study aims to document and evaluate the ethnomedicinal properties of less-studied species of the Cucurbitaceae family, with the hypothesis that these plants possess significant bioactive compounds that can be utilized for therapeutic purposes. Ethnobotanical surveys and an extensive review of existing literature were conducted to record the traditional uses, plant parts employed, and their reported pharmacological activities. The compiled data were analyzed and correlated with available phytochemical evidence to validate the medicinal claims. The findings revealed that species such as *Momordica charantia*, *Cucurbita pepo*, *Cucumis sativus*, *Citrullus colocynthis*, and *Lagenaria siceraria* exhibit potent purgative, antihelmintic, hepatoprotective, anti-inflammatory, and cytotoxic properties. These pharmacological actions are largely attributed to cucurbitacins, a group of oxygenated tetracyclic triterpenoids known for their bitterness and diverse biological activities. The ethnobotanical knowledge gathered highlights the integral role of Cucurbitaceae plants in treating gastrointestinal, metabolic, and inflammatory disorders among local communities. The study concludes that the Cucurbitaceae family represents a promising source of bioactive compounds and holds immense potential for the development of novel herbal formulations. Further phytochemical and pharmacological investigations are essential to scientifically validate traditional claims and support the sustainable utilization of these valuable medicinal resources.

Keywords: Cucurbitaceae, Ethnomedicine, Cucurbitacin, Herbal Medicine, Phytochemistry.

PHYTOCHEMICAL AND ETHNOMEDICINAL IMPORTANCE OF LESS KNOWN PLANTS OF FABACEAE FAMILY: A REVIEW

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The Fabaceae (Leguminosae) family, comprising over 19,000 species across approximately 730 genera, represents one of the most diverse and pharmacologically significant groups of flowering plants. Members of this family have long been integral to traditional medicine worldwide, employed in the treatment of various human and veterinary ailments. This review exhibits the phytochemical diversity, ethnomedicinal relevance, and therapeutic potential of Fabaceae members, with particular attention to lesser-known plants such as *Psophocarpus tetragonolobus*, *Pithecellobium dulce*, *Macrotyloma uniflorum*, *Sesbania grandiflora*, *Rhynchosia minima*, and *Acacia nilotica*. Phytochemical analyses reveal that these plants are rich in secondary metabolites including flavonoids, alkaloids, saponins, tannins, terpenoids, glycosides, phenolic acids, and prenylated flavonoids, compounds that are widely recognized for their pharmacological efficacy and contribute to their wide spectrum of biological activities. Ethnomedicinal documentation shows their use in treating ailments such as wounds, digestive and reproductive disorders, infections, and inflammatory conditions. Scientific investigations further substantiate these traditional applications, revealing potent antioxidant, anti-inflammatory, antimicrobial, antidiabetic, hepatoprotective, antifertility, and anticancer properties of Fabaceae-derived extracts and compounds. The strong convergence between ethnobotanical knowledge and scientific evidence highlights the remarkable therapeutic potential of this plant family, emphasizes its significance as a promising source for future pharmaceutical research and drug development. These lesser known plants of Fabaceae family hold immense potential in pharmaceutical research due to their wide range of biologically active compounds. These natural constituents exhibit various therapeutic properties, making them valuable candidates for developing novel and sustainable medicines. Continued phytochemical and pharmacological investigations into these species could facilitate the discovery of new, sustainable, and affordable drugs, thereby contributing to future innovations in global healthcare.

Keywords: Fabaceae, phytochemicals, ethnomedicine, secondary metabolites, flavonoids, bioactive compounds

INFLUENCE OF PURE SOLVENTS ON ANTIOXIDANT ACTIVITY OF *CORDIA MYXA* L. FRUIT EXTRACT

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Cordia myxa L., commonly known as the Assyrian plum, belongs to the Boraginaceae family and is traditionally used to treat various ailments. This plant produces spherical fruits and is recognized for its rich antioxidant and mineral content. However, its full medicinal potential remains underappreciated, and its consumption is limited due to seasonal availability and a lack of awareness. Therefore, the present study aims to assess its antioxidant profile in *Cordia myxa* fruit in different solvents, namely distilled water, ethanol, methanol, DMSO, Acetone at 100% concentrations. Antioxidant activities of the fruit were studied through, Total Phenolic Content, Total Flavonoid Content, DPPH free radical scavenging activity, ferric reducing antioxidant power and metal chelating activity. The highest phenolic content (64.44 ± 2.8 mg GAE/g) and DPPH activity ($40.98 \pm 0.98\%$), flavonoids content (13.98 ± 1.0 mg QE/g) and ferric reducing antioxidant power (5.64 ± 0.74) were obtained in acetone, whereas metal chelating activity ($43.774 \pm 1.0\%$) was shown by ethanolic extract. These results show that acetone was especially effective in extracting beneficial compounds from the fruit, compared to the other solvents. This suggests that acetone could be a useful choice for preparing extract with strong antioxidant properties and also the study confirmed that the antioxidant activity of *Cordia myxa* is attributed to both flavonoid and phenols. The fruit contains several antioxidant activities which could be used for several health benefits.

Keywords: *Cordia myxa*, solvents, flavonoid, extract, antioxidant, fruit.

DIVERSITY AND ANTIMICROBIAL POTENTIAL OF ENDOPHYTIC FUNGI ASSOCIATED WITH *ARGYREIA CUNEATA* FROM THE KARIGATTA HILLS, KARNATAKA, INDIA

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The present study investigated the diversity, colonization frequency, and antimicrobial potential of endophytic fungi isolated from *Argyrea cuneata*, a medicinal plant collected from the Karigatta Hills, Ganjam, Srirangapatna (12.4247° N, 76.7195° E), Karnataka, India, during July 2022. Healthy plant samples were collected and authenticated, and voucher specimens (UOMBOT24AC256) were deposited at the Department of Studies in Botany, University of Mysore. Endophytic fungi were isolated from surface-sterilized leaves, stems, and flowers, with 200 segments from each plant part. The leaves exhibited the highest colonization rate (31.5%) and isolation rate (0.41), followed by stems (26.16%, 0.35) and flowers (13.3%, 0.165), indicating that leaves provide a more favorable niche for fungal endophytes. A total of 13 fungal taxa were identified, showing variable colonization frequencies (CF) across plant parts. *Alternaria alternata* (CF: 12% in stems) and *Fusarium verticillioides* (4.5% in leaves) were among the most frequent isolates, while *Trichoderma* spp. and *Penicillium oxalicum* showed limited distribution, occurring only in leaves. The data revealed that *Alternaria alternata* and *Aspergillus niger* preferred stem tissues, whereas *Aspergillus tubingensis*, *Fusarium verticillioides*, *Cladosporium silenes*, *Trichoderma* spp., *Nigrospora oryzae*, and *Rhizopus oryzae* were more prevalent in leaves. The antimicrobial potential of the isolates was evaluated against bacterial pathogens (*Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus cereus*, and *Lactobacillus* sp.) and fungal pathogens (*Aspergillus niger*, *A. flavus*, *Rhizopus stolonifer*, and *Trichoderma harzianum*). Among the isolates, *Colletotrichum gloeosporioides* exhibited the strongest antibacterial and antifungal activities across all test organisms, followed by *Cladosporium silenes*, *Curvularia oryzae*, *Mucor orantomantis*, and *Nigrospora oryzae*. In antifungal assays, *C. gloeosporioides* (22.67 ± 2.52 mm), *C. silenes* (22 ± 2.65 mm), and *N. oryzae* (21 ± 1 mm) showed significant inhibition against *A. niger*, while *P. oxalicum* displayed the highest inhibition (24 ± 1 mm) against *A. flavus*. Overall, *Colletotrichum gloeosporioides*, *Cladosporium silenes*, and *Curvularia oryzae* demonstrated broad-spectrum antifungal and antibacterial properties, suggesting their potential as sources of bioactive secondary metabolites for pharmaceutical or agricultural applications. This study highlights the rich endophytic fungal diversity of *Argyrea cuneata* and underscores its significance as a promising reservoir of antimicrobial agents.

FORMULATION AND EVALUATION OF HERBAL BASED ANTI - ACNE NANO GEL USING CITRUS SINESIS AND CURCUBITA MAXIMA

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People all around the world suffer from acne, a common dermatological condition that is mainly treated with chemicals and synthetic drugs that may have unfavourable side effects. This paper addresses the development of herbal extractions-based anti-acne gel and highlights current developments and findings in the field. The nano-gel product was investigated using transmission electron microscopy, X-ray diffraction, UV-vis spectroscopy, FTIR, MTT and *in-vitro* scratch assay techniques. The aim of this work was to develop and evaluate a herbal-based nano-gel for its use to treat acne. To make the nano-gel, potent medicinal plants like *Citrus sinesis* and *Curcubita maxima* were blended together.

Keywords: Nanoparticle, anti-acne, MTT, Scratch assay, *Citrus sinesis*, *Curcubita maxima*

EXPLOITATION OF BENEFICIAL MICROBES FOR THE BIOCONTROL OF FUNGAL DISEASES IN AROMATIC AND MEDICINAL PLANTS

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Biological control of plant diseases is the suppression of plant pathogens by using living organisms or their products, acting as sustainable alternative to chemical pesticides. In the present investigation use of plant leaves extracts and biological control agents have been used to control fungal diseases of some aromatic and medicinal plants. Plant Leaves extract of *Euphorbia hirta* L, *Glossocardia boswellia* *Eucalyptus citriodora*, *Azadirachta indica* *Polyanthia longifolia*, *Solanum nigrum*, *Glossocardia bosvallera*, *Vinca rosea*. *Allium cepa*, *Calotropis procera*, *Datura stramonium*, *Ipomea carnea*, *Ocimum sanctum* *Parthenium hysterophorus*, *Polyalthia longifolia* and *Punica granatum* against *Fusarium oxysporum f.sp.asparagi* and *Rhizoctonia solani* causing root rot and seedling blight of Shatavari (*Asparagus officinalis*). Leaf Extract of 0.50, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, and 4.0% was prepared by using distilled water. The seeds were dipped in leaf extract for 5 minutes and placed on moist blotter paper in petridishes. Sterilized distilled water was added Time to time to moistened the blotter paper. These plates were incubated at room temperature. The seed mycoflora and germination was recorded for 10 days and the results are presented in the form of seed mycoflora and germination. The Efficacy of plant leaves extract against seed borne pathogen of *Asparagus officinalis* i.e. *Fusarium oxysporum f.sp.asparagi* and *Rhizoctonia solani* was studied by using food poisoning technique. Among the different plant leaves extract *Eucalyptus citriodora*, *Azadirachta indica* and *Ocimum sanctum* were more inhibitory than other plant leaves extract for *Asparagus officinalis* pathogens i.e. *Fusarium oxysporum asparagi*. The *Parthenium historiflorus*, *Azadirachta indica* and *Ipomea carnea* were inhibitory to *Rhizoctonia solani*. For bio control, different bio control agents i.e. *Tricoderma viride*, *Tricoderma harzianum* and *Aspergillus flavus* were inhibitorier against *Fusarium oxysporum asparagi* and *Rhizoctonia solani* causing root rot and seedling blight of *Asparagus officinalis*. In *Adulasa* (*Adathoda zylanica*), effect of acetone, alcohol and aqueous leaves extract of four different plant leaves viz. *Poyalthia longifolia*, *Allium cepa*, *Azadirachta indica* and *Datura stromonium* was observed against *Alternaria alternate*, *Colletotrichum capsici* and *Colletotrichum dematrum*. It was found that the acetone leaves extract was most inhibitory than alcoholic and aqueous leaves extract against fungal pathogens. The present investigation shows that as the leaves extract concentration increases, percent inhibition also increases. It is also found that acetone extract of leaves of all four plants was most inhibitory viz. followed by alcoholic and aqueous extract of leaves.

Keywords: Biological control, fungal diseases, medicinal plants, leaf extracts

GC-MS PROFILING AND BIOACTIVITY OF DEFENSE-RESPONSIVE METABOLITES FROM ENDOPHYTIC *FUSARIUM SOLANI* OF *TINOSPORA CORDIFOLIA*

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Medicinal plants are hosts to an infinite number of microorganisms, commonly referred to as endophytes which are rich in bioactive metabolites yielding favorable biological activities. The endophytes are known to have a profound impact on their host plant by promoting the accumulation of secondary metabolites which are beneficial to humankind. In the present study, the fungal endophyte, *Fusarium solani* (ABR4) from the medicinal plant *Tinospora cordifolia*, was assessed for its bioactive secondary metabolites employing fermentation on a solid rice medium. The crude ABR4 fungal extract was sequentially purified using the solvent extraction method and characterized using different spectroscopic and analytical techniques namely TLC, UV spectroscopic analysis, HRESI-MS, FTIR, and GC-MS analysis. The GC-MS analysis revealed the presence of pyridine, benzoic acid, 4-[(trimethylsilyl)oxy]-trimethylsilyl ester, hexadecanoic acid trimethylsilyl ester, and oleic acid trimethylsilyl ester. The cytotoxic ability of ABR4 was evaluated by MTT assay against lung cancer (A549) and breast cancer (MCF-7) cell lines. The compounds did not exhibit significant cytotoxicity against the tested cell lines. The endophytic ABR4 extract was evaluated for its antimicrobial potential against human pathogens (*S. aureus*, *B. cereus*, *E. coli*, *S. typhimurium*, *P. aeruginosa*, and *C. albicans*) by recording 47 to 54% inhibition. Taken together, the endophytic fungal strain ABR4 demonstrated a remarkable antimicrobial activity against the tested pathogens. Furthermore, the functional metabolites isolated from the endophytic strain ABR4 reveal its broader usage as antimicrobial agents for newer drug development in the pharmaceutical industry.

Keywords: Endophytic fungi, *Fusarium solani*, *Tinospora cordifolia*, GC-MS analysis, bioactive metabolites, Antimicrobial agents

IN VITRO SCREENING OF ANTICANCER POTENTIAL OF COMPOUNDS USING MCF-7 CELL LINE

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The Michigan Cancer Foundation-7 (MCF-7) cell line originates from human breast adenocarcinoma and was established in 1970 by Dr. Soule at the Michigan Cancer Foundation in Detroit, USA. It is widely recognized as a model for hormone-dependent breast cancer due to its estrogen receptor-positive (ER+) status. MCF-7 cells are extensively used to study hormone-responsive breast cancer, particularly focusing on estrogen receptor (ER) signaling. Their hormone sensitivity makes them a valuable model for investigating the role of hormones in tumor growth and response to therapy. MCF-7 cells are a standard in vitro system for assessing the efficacy and cytotoxicity of anticancer agents and chemotherapeutic compounds, particularly those targeting hormone-sensitive breast cancers. These cells are widely used to study mechanisms of cell proliferation, apoptosis, and cell cycle regulation. Their stable growth and well-characterized signaling pathways enhance their utility in cancer research. The MCF-7 cell line is also frequently employed in studies of gene expression, oncogene activity, and tumor suppressor gene function. It serves as a valuable tool for understanding the molecular mechanisms involved in breast cancer development and progression. MTT Assay - MCF-7 -- RH" illustrates the cytotoxic effect of a tested compound (labeled as RH) on MCF-7 human breast cancer cells at varying concentrations (0 to 1000 µg/ml), RH as *Rhizomnium punctatum* (Hedw.) T. Kop. *Rhizomnium punctatum* thrives in moist, shaded habitats on soil, logs, or rocks in temperate, humid regions with acidic to neutral substrates.

Keywords: Bryophyte, In Vitro Screening, MCF-7 cell line

EFFECTIVENESS OF NATURAL ANTIFUNGAL ACTIVITY OF MEDICINAL PLANT LEAF EXTRACTS AGAINST ISOLATES OF PATHOGEN ASSOCIATED ON *CUCUMIS SATIVUS*

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The use of chemical pesticides for controlling various plant diseases is still a common practice especially in developing countries. Although with the application of chemical fungicides, plant diseases can be controlled but the hazardous impacts of such products in human health and environment are well known. Moreover, with their excess applications pest resistance may exist. Natural plant products have been found effective in *Cucumis sativus* plant fruit disease managements and could be safely incorporated as suitable alternatives for synthetic fungicides. The plant leaf extracts revealed marked reduction in mycelial growth and sporulation of the *Phytophthora capsici* fungi isolate. Growth inhibition of *Phytophthora capsici* increased linearly with an increase in concentration of the Plant leaf extract. Among all the tested botanicals, the pathogen's growth was significantly inhibited by 75% *Withania somnifera* (growth inhibition of 76.9%). Further research and field trials should be conducted to select appropriate concentrations of botanical extracts to control the disease pathogen economically and sustainably.

Keywords: Antifungal activity *Cucumis sativus* fruit rot fungi *Phytophthora capsici*, *Withania somnifera*, Plant leaf extract, growth inhibition, sporulation

CLIMATE-SMART ADAPTATION IN OILSEED CROPS: INTEGRATING AGRICULTURAL AND ECOLOGICAL STRATEGIES FOR RESILIENCE

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South Asia, home to diverse agro-ecologies and a large agrarian population, is highly vulnerable to climate change impacts. Oilseed crops such as groundnut (*Arachis hypogaea*), mustard (*Brassica juncea*), sesame (*Sesamum indicum*), soybean (*Glycine max*), safflower (*Carthamus tinctorius*) and sunflower (*Helianthus annuus*) are particularly sensitive to climatic variability, with yield losses driven by erratic rainfall, terminal heat stress, recurrent droughts, and episodic flooding. Given their central role in edible oil security and rural livelihoods, developing climate-resilient strategies for oilseed production is a critical regional priority. Climate-smart agriculture (CSA) provides a robust framework to address these challenges through the adoption of conservation tillage, stress-resilient genotypes, efficient water and nutrient management, and diversification of oilseed-based cropping systems. Advances in genomics-assisted breeding and molecular marker technologies have enabled the development of drought- and heat-tolerant oilseed varieties, while precision irrigation and nutrient management enhance input-use efficiency under variable climates. Complementary ecological approaches including soil organic carbon enrichment, integrated pest management, watershed restoration, and agroforestry-based intercropping strengthen ecosystem services vital for oilseed productivity, such as pollination, natural pest suppression, and microclimate stabilization. The integration of CSA with agroecological principles is particularly relevant for South Asian smallholders, who rely heavily on rainfed oilseed cultivation. Remote sensing, GIS-based climate forecasting, and decision-support tools can guide adaptive practices at farm to landscape scales, while participatory seed systems and community-based natural resource management enhance local adaptive capacity. Policy support is essential to scale these interventions, including targeted investments in climate-resilient infrastructure, weather-indexed crop insurance, and incentives for sustainable land-use practices. By converging agricultural innovations with ecological resilience, South Asian oilseed systems can buffer climatic shocks, sustain productivity, and contribute to regional food and nutritional security. This integrated approach aligns with the Sustainable Development Goals and offers a pathway toward climate-resilient oilseed production in one of the world's most climate-vulnerable regions.

Keywords: Adaptation, Oilseed, Climate-smart agriculture, Stress-resilient, Nutritional security

INVISIBLE THREATS: MICROPLASTIC EXPOSURE AND ITS CONSEQUENCES FOR FISH HEALTH

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Microplastics, defined as plastic particles less than 5 mm in size, have emerged as a significant pollutant in aquatic ecosystems, raising concerns about their impacts on fish health and food security. Fish are exposed to microplastics through ingestion, gill contact, and trophic transfer, leading to a range of physiological, histopathological, and immunological effects. Ingestion of microplastics can cause intestinal blockage, reduced feeding efficiency, and impaired nutrient absorption, ultimately affecting growth and survival. At the cellular level, microplastic exposure has been associated with oxidative stress, inflammation, and altered gene expression linked to immunity and metabolism. Histopathological changes such as gill lamellae damage, liver degeneration, and intestinal lesions have been reported in several fish species. Furthermore, microplastics can act as carriers of heavy metals, hydrophobic organic contaminants, and pathogenic microorganisms, thereby compounding their toxicity. In natural habitats, continuous exposure to microplastics compromises fish health by disrupting feeding behavior, reducing swimming efficiency, altering predator-prey interactions, and weakening resistance to infections. Chronic exposure in the wild may also impair reproductive success and population stability, with cascading effects on aquatic biodiversity. These effects not only threaten fish welfare and ecosystem balance but also pose risks to aquaculture productivity and human consumers through bioaccumulation along the food chain. Understanding the mechanisms underlying microplastic toxicity in fish is therefore essential for developing effective mitigation strategies and sustainable fisheries management.

Keywords: Microplastic, Fish health, biodiversity, bioaccumulation

EVALUATION OF THE BOTANICALS ON ENZYME DETERMINATION ON INFECTED BY ROOT-KNOT NEMATODE, *MELOIDOGYNE INCOGNITA* IN BRINJAL

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The root-knot nematode, *Meloidogyne incognita* is widely prevalent in vegetable-growing regions and causes significant yield losses by damaging the root system, which leads to stunted plant growth and reduced fruit quality in brinjal crops. In India, *M. incognita* causes about 21% yield loss in brinjal, resulting in estimated annual agricultural losses of approximately ₹210 crore. A pot culture experiment was conducted in the cage house of the Department of Nematology, College of Agriculture, MPUAT, Udaipur, Rajasthan, to evaluate the effect of different plant leaf extracts Tulsi, Pyrethrum, Datura, Ashwagandha and Congress grass applied as seedling dips at @ 10% concentration on the enzyme determinations of *Meloidogyne incognita*-infected brinjal. Enzyme levels (Peroxidase, Polyphenol oxidase and Phenylalanine ammonia lyase) were determined after 14 and 28 days of transplanting. All the botanical leaf extracts significantly increased the activities of peroxidase (PO), polyphenol oxidase (PPO) and phenylalanine ammonia lyase (PAL) compared to the control. The seedling treatment with Datura at 10% was found to be the most effective among all treatments. At 14 and 28 days post-treatment, the highest increases in PO, PPO and PAL activities (4.007 $\mu\text{mol/min/g}$, 0.024 $\mu\text{mol/min/g}$ and 0.233 $\mu\text{mol/min/g}$; 5.014 $\mu\text{mol/min/g}$, 0.033 $\mu\text{mol/min/g}$ and 0.364 $\mu\text{mol/min/g}$, respectively) were observed in the Datura treatment, followed by Pyrethrum at 10% (3.720 $\mu\text{mol/min/g}$, 0.019 $\mu\text{mol/min/g}$ and 0.201 $\mu\text{mol/min/g}$; 4.764 $\mu\text{mol/min/g}$, 0.029 $\mu\text{mol/min/g}$ and 0.314 $\mu\text{mol/min/g}$) and Congress grass at 10% (3.336 $\mu\text{mol/min/g}$, 0.015 $\mu\text{mol/min/g}$ and 0.172 $\mu\text{mol/min/g}$; 4.228 $\mu\text{mol/min/g}$, 0.023 $\mu\text{mol/min/g}$ and 0.279 $\mu\text{mol/min/g}$). The minimum enzyme activities (1.754 $\mu\text{mol/min/g}$, 0.007 $\mu\text{mol/min/g}$ and 0.079 $\mu\text{mol/min/g}$; 2.176 $\mu\text{mol/min/g}$, 0.010 $\mu\text{mol/min/g}$ and 0.094 $\mu\text{mol/min/g}$) were recorded in the control at 14 and 28 days, respectively. In conclusion, all the botanical extracts at 10% concentration increased PO, PPO and PAL activities in brinjal plants infected by root-knot nematode. Plant extracts can activate the plant's defense system against nematodes and directly reduce the nematode population, thereby improving plant health and yield.

Keywords: Botanicals, Enzyme determination, Brinjal and *Meloidogyne incognita*

HERBAL BIOMEDICINES AND THEIR ROLE IN SUSTAINABLE AQUACULTURE

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Aquaculture has been considered as one of the most rapidly animal food-producing industries that provide to the world's well-being and wealth. Medicinal plants have been known as immunostimulants for thousands of years. Globally, people understand the adverse effects of antibiotics and are now shifting to natural products. Many herbal and animal originated extracts prove their potential as anti-stress, antioxidant, antibacterial, anti-fungal and viral, appetite stimulator, potent immunomodulator and growth promoter. They reduce the chances of emergence of pathogens which may cause serious threat to fish health and environment. Yet the diseases, pathogens and pest can be treated with chemicals and antibiotics, but due to their residual side effect and bio magnification in the body of fish force the researchers to search suitable alternatives for healthy fish, environment and sustainable fish production. Herbal compounds such as phenolics, polyphenols, alkaloids, quinones, terpenoids, lectines and polypeptides have been shown to be very effective alternatives to antibiotics and other synthetic compounds.

Keywords: Antioxidant, Anti stress, Antiviral, Appetite Stimulants, Growth promoter, Immunostimulants

A STUDY ON AVIAN DIVERSITY IN BAHRAICH DISTRICT OF UTTAR PRADESH

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Bird diversity is one of the most reliable indicators of the ecological health of any environment and plays a crucial role in the food chain and food web, maintaining nature's balance, and assisting in pollination and seed dispersal. Field visit conducted at different time period of day and number of bird species recorded with the help of binocular and camera. This research focus on the avifauna diversity in Bahraich district of Uttar Pradesh. The study was conducted resulting in a total of bird species identified, representing 13 distinct orders: Passeriformes, Columbiformes, Psittaciformes, Accipitriformes, Gruiformes, Piciformes, Cuculiformes, Charadriiformes, Pelecaniformes, Strigiformes, Bucerotiformes, Galliformes, and Coraciiformes. The most frequently observed species during the study were Common Myna, Jungle Babbler, Rock Dove, Rose-ringed Parakeet, Indian Grey Hornbill, and Red Wattled Lapwing. Notable rarities recorded were the Spotted Owlet, Western Asian Koel, and White-breasted Kingfisher. The findings suggest that increased efforts toward biodiversity and ecosystem conservation are essential to make this habitat more accommodating for various migratory species.

Keywords: Avian Biodiversity, Ecological indicator, Conservation

POLLINATOR DIVERSITY IN DIFFERENT ECOSYSTEMS

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Pollination services are essential to plant reproductive success and thus play an important role in the maintenance of plant communities. In natural ecosystems, pollinator diversity enhances pollination during environmental and climatic perturbations, thus alleviating pollen limitation. In agricultural ecosystems, pollinator diversity increases the quality and quantity of crop yield. Pollinators comprise highly diverse groups of animal species that transfer pollen in flowering plants. The most diverse and abundant pollinators are insects. Lepidoptera is estimated to consist of more than 140,000 species, Coleoptera about 77,300, and Hymenoptera around 70,000. The least diverse groups of insect pollinators are Diptera and Thysanoptera. Plant-pollinator interactions are valued mutualisms in agricultural food production and provide indispensable ecosystem functions that support global biodiversity.

Keywords: Agricultural; Coleoptera; Diptera; Lepidoptera; Pollination

CARBON CAPTURE FOR A SUSTAINABLE TOMORROW

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Climate change is one of the most urgent global Challenges of the 21st century, primarily driven by the continuous rise in carbon dioxide (CO₂) emissions. While renewable energy expansion is vital for the carbonization, it cannot fully eliminate industrial and fossil based emissions. Carbon Capture, Utilization and storage (CCUS) technologies offer a promising solution to bridge the gap between industrial growth and environmental sustainability, Net-zero future. Carbon capture system enable the direct removal of CO₂ from large emission sources such as power plants, cement industries and steel manufacturing units, preventing its release into the atmosphere. Advanced innovations such as Direct Air Capture (DAC) and Bioenergy with carbon capture and storage (BECCS) extend capacity further by enabling the removal of CO₂ directly from the atmosphere, contributing to negative emissions. Despite challenges of cost and scalability growing research, green finance and international co-operation are making carbon capture an essential pathway towards cleaner and sustainable tomorrow. From a global perspective, countries are increasingly integrating CCUS with in their Paris Agreement and Net zero commitments. These technologies not only mitigate emissions. But also support the creation of a circular carbon economy, transforming waste carbon into economic value. Despite Challenges like high operational costs, energy intensity and limited infrasture international co-operation, policy incentives and green financing are accelerating its adoption. This paper explores the principles, technologies and strategic role of carbon capture in shaping a sustainable tomorrow.

Keywords: Carbon capture, CCUS, sustainable Development, Net Zero, climate Change, Circular carbon Economy.

AGROFORESTRY-A HOLISTIC APPROACH FOR CONSERVATION AND SUSTAINABLE DEVELOPMENT

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Agroforestry, the land-use system which integrates trees along with crops and livestock, is increasingly recognized as a conservation-based land use system capable for restoring ecological balance while sustaining rural livelihoods. The main focus lies in assessing the role of agroforestry in biodiversity conservation, soil health improvement, climate resilience and livelihood enhancement across different agroecological regions. It is assumed that diversified agroforestry systems provide great ecological and economic benefits compared to the conventional monocropping farming practices. Data collected from global and national database indicates that about one billion hectares of agricultural land possess a significant amount of tree cover, contributing to improved soil structure, nutrient cycling, carbon sequestration and micro-climate regulation. The above and below-ground biodiversity was supported by Agrisilviculture and Silvo-pastoral systems by creating stable habitats and improving soil organic content by 20-45%. Smart Agroforestry practices in tropical regions demonstrated significant rise in crop productivity and water retention and contributing directly to improved food security and year-round income to the farmers. Case studies from India and Indonesia showed that communities adopting agroforestry witnessed rise of about 40% income while gaining resilience during drought years. Despite its potential benefits, farmers face challenges which includes lack of technical knowledge and awareness, longer gestation period of trees (farmers need short duration crops so they can get fast return from the produce). Also, the land tenure issues, inadequate extension support and limited market linkages limits the adoption of such practices. Strengthening research-extension networks, promoting agroforestry models and imparting training and education to the native communities can increase rate of adoption of agroforestry.

Keywords: Agrisilviculture, Agroforestry, carbon sequestration, climate resilience, ecological balance, Silvo-pastoral systems

COMMUNITY-DRIVEN APPROACHES FOR FOREST RESTORATION: ENHANCING COVERAGE THROUGH PEOPLE'S PARTICIPATION

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The ongoing reduction of forest cover due to deforestation, land misuse, and unsustainable resource exploitation presents significant ecological and socio-economic challenges. Traditional top-down afforestation strategies often fail to achieve lasting results due to limited involvement of local communities. This study explores the essential role of community participation in promoting forest expansion through approaches such as joint forest management, social forestry, and participatory tree planting programs. Engaging local populations in planning, decision-making, and implementation fosters a sense of ownership, strengthens stewardship, and ensures the sustainable management of forest resources, while simultaneously offering socio-economic benefits. The paper reviews multiple case studies to identify effective practices, challenges, and strategies for enhancing public involvement in forest restoration efforts. Results indicate that combining local knowledge, collective action, and participatory governance significantly enhances forest regeneration. The study underscores that community-driven approaches are not only crucial for increasing forest cover but also play a vital role in advancing environmental conservation and sustainable development goals.

Keywords: Community participation, forest restoration, joint forest management, social forestry, participatory governance, sustainable development

APPROACHES TO COMBAT BIOTIC AND ABIOTIC STRESSES IN RICE

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Rice is a staple food consumed by the majority of people around the world. It is severely affected by the biotic and abiotic stresses and its combined effect, resulting in an increased susceptibility of the plant to pathogens. Such stresses tend to have a significant impact on plant's lifespan and Agriculture crop productivity. Climate change in recent years is a major contributor to both biotic and abiotic stresses in crops. Abiotic stresses such as UV radiation, high and low temperatures, salinity, drought, flood, heavy metal toxicity etc results in significant global reduction. On the other hand, biotic stresses include insect pests, fungi and sometime weeds. These escalate the difficulties and tackling these difficulties becomes a major challenge. Proteomics and Metabolomics is studied which help to identify the protein and metabolites related to specific defence mechanism. It was found that when rice is subjected to biotic stresses, there is a change in protein and metabolic activities during plant defence mechanism and production of specific secondary metabolites was also reported. Another approach which is multiomics help in understanding the molecular basis of resistance and how other novel breeding strategies can be employed to improve crop resilience to both biotic and abiotic stresses. Beside such approaches, protein-protein interaction and phylogenetic analysis aids in understanding evolutionary relationship and functional interaction among genes. These comprehensive approaches help in understanding regulatory network and pathway maps, identify potential target for improving resistance through breeding strategies.

Keywords: Abiotic stress, Biotic stress, Climate Change, Metabolomics, Multiomics, Proteomics, Rice

SIGNIFICANCE OF INTEGRATED MANAGEMENT PRACTICES FOR SUSTAINABLE FARM PRODUCTIVITY AND SOIL HEALTH

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Recent approaches to soil fertility management in India are shifting from the chemical management to organic agriculture, because of both ecological and economic concern. Maintaining the soil health ensures sustainability in crop productivity. Use of organic manures will help to improve physico-chemical properties of the soils. Organic manures provide a good substrate for the growth of microorganisms and maintain a favourable nutritional balance and soil physical properties. To achieve long way sustainability in production, one such strategy to maintain soil fertility for sustainable production of cereal crops is through the judicious use of organic fertilizers (Prasad, 1996 and Bobde *et al.*, 1998). It has also been brought out that the use of organic fertilizers meets the need of micro nutrients of crops (Joshi *et al.*, 2000). Lourduraj (2000) has also reported that the application of organic manures significantly enhanced the growth attributes and yield of wheat as compared to the application of inorganic fertilizers. The inorganic fertilizer application enhances plant growth and yield because it response quickly. Therefore, farmers apply the maximum amount of inorganic fertilizers to their crops to achieve a higher yield. To minimize this situation, a combination of inorganic fertilizer with biological ingredients can be a better alternative for crop cultivation. The continuous use of high level of chemical fertilizers has been led to the problem of soil degradation, which is being proven detrimental to crop production in our country. The highest available and total nitrogen and phosphorus was recorded under the treatment combination conventional tillage + 60% recommended dose of fertilizers through biocompost+20% through neem cake+20% through biofertilizers. The available and total nitrogen and phosphorus in soil were found to be higher in the second year as compared to first year. The nutrient concentration was also recorded highest in the treatment conventional tillage+60% recommended dose of fertilizers through biocompost + 20% through neem cake+20% through biofertilizers. The maize grain and straw yield, nutrient uptake, protein content, secondary nutrients and micronutrients were recorded higher in the treatment combination conventional tillage+60% recommended dose of fertilizers through biocompost+20% through neem cake+20% through biofertilizers. An application of organic fertilizers in combination with bio fertilizer, cow dung (CD) and poultry manure (PM) may increase the yield and yield contributing characters such as number of pods, 100-seed weight, grain yield, straw yield and biological yield, hence ultimately resulting in increased productivity of soybean (Shirpukar *et al.*, 2006). Use of organic manures alone will help to improve physico-chemical properties of the soils (Maheshbabu *et al.*, 2008). Moreover, the addition of manures to the soil may also increase the fertilizer-use efficiency, stimulate the proliferation of diverse group of soil microorganisms and play an important role in the maintenance of ecological balance of the rhizosphere. Soil organic matter is the single most important constituent that influences the soil fertility, soil formation, soil biology, physical and chemical properties of soil which in turn reflects in to crop yield (Walker *et al.*, 2004). Organic farming systems rely on the management of soil organic matter to enhance the chemical, biological and physical properties of soil (Ramesh *et al.*, 2005). The improved soil biological activity is also known to play a key role in suppressing weeds, pest and diseases (IFOAM, 1998).

WILD SOLANUM SPECIES AS POTENTIAL RESISTANCE SOURCES TO RED SPIDER MITE (*TETRANYCHUS URTICAE*)

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The study aimed to identify resistant sources among wild *Solanum* species against the red spider mite (*Tetranychus urticae*). Seven wild *Solanum* species - *S. aethiopicum*, *S. indicum*, *S. integrifolium*, *S. macrocarpon*, *S. mammosum*, *S. torvum* and *S. viarum* were evaluated for their morphological and biochemical traits conferring resistance to *T. urticae*. *S. viarum* and *S. mammosum* exhibited complete resistance, showing no mite infestation throughout the study, and were classified as highly resistant. *S. macrocarpon* recorded the highest infestation (146–178 mites per 4 cm² leaf area) and was categorized as moderately susceptible due to its trichome-less leaves. The high trichome densities of *S. viarum* (1065–1145/cm²) and *S. mammosum* (791–887/cm²) contributed to their resistance. Biochemical analysis revealed that these resistant species had moderate chlorophyll, total protein, and total sugar contents but significantly higher total phenols, peroxidase, PAL and proline activities. In contrast, *S. macrocarpon* had low chlorophyll and phenol contents, high protein and sugars, and low enzyme activities, correlating with its susceptibility. These resistant wild species can serve as valuable genetic resources for developing red spider mite-resistant brinjal cultivars.

Keywords: *Solanum*, brinjal, *Tetranychus*, red spider mites

GC–MS CHARACTERIZATION OF BIOACTIVE METABOLITES FROM THE ENDOPHYTIC FUNGUS *ASPERGILLUS VERSICOLOR* ISOLATED FROM *THUNBERGIA ERECTA*

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Endophytic fungi are known to produce diverse bioactive metabolites with potential pharmaceutical applications. This study focused on the endophytic fungus *Aspergillus versicolor* (TE2) isolated from *Thunbergia erecta* to identify its bioactive compounds. The ethyl acetate extract of the fungal culture was fractionated by column chromatography using a gradient of n-hexane, ethyl acetate, and methanol. Among the fractions, the methanol extract exhibited the highest antibacterial activity against *Bacillus subtilis*. Gas Chromatography–Mass Spectrometry (GC–MS), Fourier Transform Infrared Spectroscopy (FT-IR), and ¹H NMR analyses confirmed Bis(2-ethylhexyl) phthalate as the major compound. This phthalate ester is reported to possess antimicrobial and antioxidant properties, indicating that *A. versicolor* from *T. erecta* represents a promising source of pharmaceutically important secondary metabolites.

Keywords: Endophytic fungi, *Aspergillus versicolor*; *Thunbergia erecta*, Bis(2-ethylhexyl) phthalate and Antimicrobial activity

GENETIC PROFILING OF RICE (*ORYZA SATIVA* L.) GENOTYPES FOR PERFORMANCE UNDER LOW PHOSPHORUS SOIL CONDITIONS

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Phosphorus is essential macronutrients for plant's growth and development. In this study, 46 rice genotypes were screened for tolerance to low soil phosphorus at ARS, Gangavathi during 2022 (*khari*f). The experiment was laid out in split plot design consisting two main treatments (0% and 50% application of recommended dosage of phosphorus) and 46 sub treatments (varieties) including both tolerant and susceptible checks. ANOVA revealed significant difference between phosphorus content, varieties and phosphorus-variety interaction. The high PCV and GCV with high heritability and genetic advance were observed for traits like number of spikelets/panicle, number of tillers per plant, shoot fresh weight, shoot dry weight, root fresh weight and root dry weight. The correlation of traits like plant height, panicle length, kernel length, shoot length, number of spikelets/panicle, root fresh weight and root dry weight were significantly positive with grain yield. Screening for phosphorus tolerance was done based on *per cent* yield reduction ratio, whereas the promising tolerant genotypes are in the order of Vandana followed by IET-31101, IET-31114, Swarna, IET-31099 and IET-29558. Genotyping was done for *pup1* QTL using K46-1 and K46-2 SSR markers which confirms the devoid of *pup1* QTL in 5 genotypes which shows low tolerance to phosphorus deficiency. Together with phenotypic data, genotyping was used to identify the presence of particular gene for promising trait like phosphorus tolerance in rice.

Key words: Phosphorus, Rice, Correlation, *Pup1* QTL, Grain yield

DEFINING THE OPTIMAL ENVIRONMENTAL AND NUTRITIONAL REQUIREMENTS FOR *BIPOLARIS MAYDIS*: A FOUNDATION FOR SUSTAINABLE DISEASE CONTROL

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Maize (*Zea mays* L.), belonging to the Poaceae family, is a vital cereal crop that has earned the title of 'queen of cereals' due to its high genetic yield potential and adaptability. Despite its global importance, maize production is seriously hampered by a spectrum of fungal, bacterial, and viral diseases. Among these, Maydis leaf blight (MLB), caused by *Bipolaris maydis* (Y. Nisik. & C. Miyake), is a pervasive cause of significant crop loss. The foundation of sustainable control lies in a detailed understanding of the pathogen's biological requirements, which allows for disease management and minimizes reliance on broad-spectrum chemical treatments. This study was designed to systematically define the precise environmental and nutritional factors governing the maximum growth of *B. maydis*. The investigation revealed that *B. maydis* exhibits its most prolific growth only when exposed to a continuous light period (24 hours), an alkaline pH level of 8, and an elevated optimal temperature of 30^o C. These findings confirm the critical influence of macro-environmental conditions on the pathogen's ability to multiply and cause widespread infection. Furthermore, nutritional analysis demonstrated a distinct preference for 2.0% glucose as its primary energy source, showing superiority over sucrose. The fungus also exhibited its highest growth when utilizing 2.0% sodium nitrate as the most effective nitrogen source, surpassing potassium nitrate. Collectively, these data provide the essential physiological baseline for developing sustainable disease management protocols. By identifying the exact conditions and nutrients that favour *B. maydis*, researchers can refine disease forecasting models, select resistant host varieties, and implement targeted cultural controls that disrupt the pathogen's lifecycle at its weakest points.

Keywords: Maydis leaf blight, pathogen, physiology, nutrition.

SUSTAINABLE MANAGEMENT OF MAYDIS LEAF BLIGHT (*BIPOLARIS MAYDIS*) IN MAIZE THROUGH EXOGENOUS APPLICATION OF PLANT DEFENCE ACTIVATORS

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Maize (*Zea mays* L.), a member of the Poaceae family, is a vital cereal crop adapted to different agro-climatic conditions. Maize conferred the title of "queen of cereals" due to its high genetic yield potential. However, fungal, bacterial, and viral diseases pose significant challenges to maize production. Among these, Maydis leaf blight (MLB), caused by *Bipolaris maydis* (Y. Nisik. & C. Miyake), is a widespread and yield-limiting disease. While conventional chemical fungicides have been used for control, a more sustainable approach in managing MLB involves the application of plant defense activators. To investigate the efficacy of various plant defense activators in inducing systemic resistance, an experiment was conducted under greenhouse conditions using a completely randomized design (CRD) with the susceptible maize variety 900M GOLD. The elicitors included both biotic (*Trichoderma viridae*, *Pseudomonas fluorescens*, Neem, Pongamia) and abiotic elicitors (Salicylic acid (SA), Benzoic acid (BA) and Chitosan) were applied exogenously on maize both before and after the pathogen inoculation. The activity of key biochemical defense parameters, viz., total phenol, polyphenol oxidase (PPO), and peroxidase (POD), which were evaluated using a spectrophotometer at 24 and 48 hours following elicitor application. This study indicated that pathogen inoculation significantly increased total phenol, POD, and PPO content across all treatments compared to levels measured before inoculation. The highest levels were observed 48 hours after treatment with 1 mM SA on pathogen inoculated plants, followed by BA and chitosan. Thus, these elicitors offer a promising eco-friendly alternative to conventional chemical fungicides, promoting sustainable disease management practices.

Keywords: Maydis leaf blight, salicylic acid, induced resistance, elicitors.

CONSERVATION OF BIO-DIVERSITY: A BSI PERSPECTIVE

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“If Conservation of Natural Resources goes wrong, nothing else will go Right”

Botanical Survey of India (BSI) under Ministry of Environment, Forest and Climate Change, (MOEF&CC) New Delhi is entrusted with carrying out Survey, Documentation and Conservation of Floristic Diversity of our Country. With its Head Quarter at Kolkata, it also hoards four important divisions like Acharya Jagadishchandra Bose Indian Botanic Garden (AJCBIG), Central National herbarium (CNH), Central Botanical Laboratory (CBL) and Indian Museum at Kolkata along with 11 Regional Centers spread all over India. Among these, the Southern Regional Centre (SRC), Coimbatore bears the record for effectively documenting and conserving the floristic diversity of Peninsular India. The “Biodiversity” is an Umbrella term which encompasses all the living entities which are categorized by themselves. It is nothing but “Variety of life on Earth”. Today, Biodiversity has become a Sovereign Property of any Nation under consideration. Preservation and Conservation of biodiversity has become a necessity rather than a fashion as it is a resource on which all human existence depends. Further, sustainable use of biodiversity is also very important as it influences all the four important facets of life like, *Economical, Environmental, Social and Cultural facets*. Mc Manus and Norse (1980) defined biodiversity as the “sum total of Genes, Species and Ecosystems in a given region”. As nature’s gift the tropical countries are rich in Biodiversity compared to temperate countries. About 60 to 70% of the world’s biodiversity is being contributed by tropical countries only. Such countries are referred to as Megadiverse countries and they include some countries like – Brazil, China, Mexico, Australia, India, Peru, Ecuador, Zaire, Columbia, Indonesia, Malaysia and Madagascar. Biodiversity is at constant threat due to various man-made activities as well as natural calamities. Anthropogenic activities like, Urbanization, Deforestation and Refrigeration are eroding biodiversity on one side, while natural calamities like Forest fire, Floods and Tsunamis are also destroying biodiversity on the other side at an alarming rate. These types of destructions are to be stopped immediately, otherwise the results will be more serious than any Thermo Nuclear Reaction. More recently, Heywood (1997) has added a new category called “Cultural Diversity” otherwise named as “Ethnobotany” or Traditional Knowledge, which stands for the total inter-relationship of human beings with surrounding plants. This category is gaining priority especially in the fields like “Bioprospection” and “Newer Drug Development Programmes”. Hence it is stated that Biodiversity is Bicentric in its origin and Anthropocentric in its direction. Nevertheless, India is one of the richest Nation in terms of biodiversity as well as traditional knowledge. India is gifted with two groups of Islands viz., Andaman & Nicobar (A&N) Islands and Lakshadweep Islands, Mountain Ranges like Himalayas and Western Ghats, which are affording highest plant-animal diversity. Documentation of floral and cultural diversity of these Hotspots is carried out besides conserving them in Botanical Gardens and Regional Herbaria. A&N Islands, are very significant in the realms of Rich vegetation, Trade and commerce, Marine Research, Naval Developments as well as Anthropological Studies. The most fascinating feature of the vegetation of A&N Islands is its richness and 14% of endemism associated with six aboriginal tribes like, Great Andamanese, Onges, Jarawas, Sentinelese, Shompens and Nicobarese acting as a great emporium for Ethnobotanical Studies. Further not only plants, from animal point of view also A&N Islands are very unique. The Floristic Components and Ethnobotanical aspects of A&N Islands are being presented. Conservation of biodiversity benefits in preserving the Food Chain and Genetic Entities of plants and animals. It provides immediate benefits to society in the form of Recreation and Tourism besides acting as an Insurance Coverage for future generations.

RELATIONSHIP AMONG GROWTH ATTRIBUTES OF *TECTONA GRANDIS* SEEDLINGS UNDER VARYING STUMP SIZES AND NUTRIENT LEVELS

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Teak is a valuable tropical hardwood species with high economic importance. However, declining soil nutrient levels in nurseries have become a major limiting factor affecting seedling growth and quality. This research aimed to evaluate the correlation between various growth parameters under different stump thickness and nutrient treatments. The experiment was carried out at Shivaram Karanth Forest Nursery, Yadaguppa village, Sirsi, using a Factorial Randomized Block Design (FRBD) with three stump thickness levels and ten nutrient treatments, replicated thrice and totalling 900 stumps. Growth parameters including plant height, collar diameter, number of leaves, leaf area, root length, total fresh weight, and total dry weight were recorded and analyzed. Results indicated that there was Strong positive correlations were observed between plant height and collar diameter (0.860), number of leaves (0.884), and leaf area with root length (0.816) and survival percentage (0.909). Total dry weight was highly correlated with total fresh weight (0.824). Larger stumps (D₃) significantly improved seedling growth due to higher stored energy and nutrient reserves. Among nutrient treatments, T₂ (1g N: 2g P: 1g K) showed the best performance, highlighting the importance of balanced nutrient application. The study concludes that using larger stumps combined with balanced nutrient application, particularly the D₃T₂ combination, enhances growth and survival of teak seedlings. This integrated approach is recommended for producing quality planting material and improving teak plantation productivity.

Keywords: Stump thickness, Integrated Nutrient Management (INM), Growth attributes, Correlation

ROLE OF CYTOKININS AND GIBBERELLINS IN FLOWER INDUCTION OF CUCURBITS

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Flower induction in cucurbitaceous crops is a complex physiological process regulated by the interaction of endogenous hormones, particularly cytokinins and gibberellins. These phytohormones play contrasting yet complementary roles in controlling sex expression, floral initiation, and fruit set. Cytokinins are known to promote femaleness by stimulating the conversion of staminate to pistillate flowers, whereas gibberellins generally enhance maleness by stimulating stamen development and inhibiting carpel formation. Experimental studies in *Cucumis sativus* L. (cucumber) demonstrated that foliar application of benzyl adenine (BA) at 50 ppm increased the number of pistillate flowers by 35–42% and reduced the node number to the first female flower from 10.3 to 6.8, thereby promoting early flowering. Conversely, gibberellic acid (GA₃) application at 100 ppm induced male flowering, with a 45–60% increase in staminate flowers compared to control. In bitter melon (*Momordica charantia* L.) and bottle gourd (*Lagenaria siceraria*), cytokinin treatments significantly enhanced female flower ratio and fruit yield, while gibberellin application promoted vegetative elongation and delayed female flower initiation. Recent molecular studies indicate that cytokinins upregulate the expression of CsACS2 and CsACS11 genes involved in ethylene biosynthesis, thereby indirectly influencing femaleness, while gibberellins activate CsGA20ox and CsGA3ox genes, promoting maleness through suppression of ethylene signaling. Thus, the coordinated regulation of cytokinin and gibberellin pathways is crucial for balancing sex expression and optimizing flowering in cucurbits. The exogenous manipulation of these hormones provides an effective strategy for enhancing fruit set, improving yield, and achieving synchronization of flowering for hybrid seed production in cucurbitaceous crops.

Keywords: Cytokinins, gibberellins, flower induction, sex expression, cucurbits, ethylene regulation

STANDARDIZATION AND EVALUATION OF MIXED FRUIT POWDER AS A POWER PUNCH MIX

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The present study focuses on the standardization and evaluation of a mixed fruit powder formulated from banana, mango, pineapple, and papaya to develop a nutrient-rich “Power Punch Mix.” Fully ripened fruits were washed, sliced, and dehydrated using tray drier at the temperature of 55-60 °C for 10-12 hours and pulverised after blending with maltodextrin as a carrier to improve powder yield and prevent stickiness. The final mixed powder was analysed for physico-chemical properties (moisture content, water activity, pH, solubility index, and color values), nutritional parameters (total soluble solids, ascorbic acid content, and antioxidant activity), and microbiological safety. Sensory evaluation using a 9-point hedonic scale was conducted to assess colour, aroma, taste, and overall acceptability after reconstitution into a beverage. The optimized formulation contained a balanced combination of banana for body and sweetness, mango for flavour and carotenoids, pineapple for acidity and vitamin C, and papaya for dietary fibre and beta-carotene. Results showed that Mixed fruit powder possessed Physico-chemical properties of Mixed Fruit Powder showed 3.21% moisture, 0.28 water activity (a_w), 0.52 g/mL bulk density, 4.21 pH (reconstituted drink), 94.36% Solubility index, colour parameters (L^* 78.42, a^* 6.15, b^* 28.96), whereas nutritional parameters such as 18.4° Brix TSS, ascorbic acid (42.18 mg/100 g), Antioxidant activity (DPPH inhibition- 64.27%) and sensory evaluation of Overall acceptability (9-point hedonic) as 8.1 with good flowability and safe microbial limits for extended shelf stability. The study concludes that mixed fruit powder developed from banana, mango, pineapple, and papaya can serve as a convenient, nutritious, and shelf-stable beverage mix with potential for commercial application.

INFLUENCE OF STUMP DIAMETER THICKNESS AND NUTRIENT APPLICATION ON SEEDLING BIOMASS ATTRIBUTES IN *PTEROCARPUS SANTALINUS* LINN.F

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Pterocarpus santalinus Linn. f., a highly valued and endangered timber species of the Eastern Ghats, requires optimal nursery management to ensure successful establishment. This study evaluated the influence of stump diameter thickness and nutrient management on seedling biomass accumulation in *P. santalinus*. A factorial randomized block design with three stump diameter classes (< 3 mm, 3–5 mm, > 5 mm) and eight nutrient treatments was laid out at Gudagur Forest Nursery, Haveri district. The results demonstrated a significant effect of stump diameter and nutrient treatments on fresh and dry biomass at 180 days after treatment. The largest stump diameter class (D_3 > 5 mm) recorded the highest total fresh biomass (12.33 g) and dry biomass (5.78 g), while the smallest stumps had the lowest biomass accumulation. Among nutrient treatments, T_6 (0.5 g NPK + 33 g poultry manure per seedling) was most effective, resulting in 13.25 g of fresh biomass and 6.54 g of dry biomass. The interaction between D_3 and T_6 ($D_3 T_6$) produced the maximum total fresh biomass (16.97 g) and dry biomass (8.80 g), indicating synergistic effects of stump size and integrated nutrient management. The findings highlight that using larger stump diameters in combination with balanced nutrient inputs ($D_3 T_6$) can significantly enhance early seedling vigor and biomass production. This has practical implications for large-scale propagation and reforestation programs involving *P. santalinus*.

Keywords: *Pterocarpus santalinus*, stump diameter, nutrient management, biomass, integrated nursery management.

CANDIDATE MICROBES FOR CROP PROTECTION: SPECIAL REFERENCE TO POMEGRANATE AND BANANA

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Candidate microbes for plant disease management include bacteria like *Bacillus*, *Pseudomonas*, and *Streptomyces*, and fungi such as *Trichoderma* and mycorrhizal fungi, which act as biocontrol agents. These microbes protect plants through various mechanisms, including the production of antimicrobial compounds, competition for resources, and triggering the plant's own defense systems. Wilt diseases are major limitations of many horticulture crops over the years. In the present paper two wilt pathogens *Ceratocystis fimbriata* and *Fusarium oxysporum* f.sp. *cubense* infecting pomegranate and Nanjangud rasabale, a GI variety are taken as an exemplary study as how these are limiting the cultivation and area expansion over the years in Karnataka. Pomegranate being the cash crop in the state of Karnataka, an almost 5000 acres of area is replaced every year due to wilt and shifting into other crops. One time treatment with tebuconazole followed by treatment with bioagents consortia; *T. harzianum* (50 g/plant) + *P. fluorescens* (50 g/plant) + *P. lilacinus* (20 g/plant) *B. bassiana* (20g/plant) + *Aspergillus niger* (15 g/plant) + VAM Fungi *Rhizophagus irregularis* (20 g/plant) along with neem cake 1kg + 30 kg of compost per plant providing the best management as it was demonstrated in different places across the state. In another case, Nanjangud banana (NR), a GI variety shrinks to the area less than 6 acres due to wilt pathogen and farmers reluctant to take up further cultivation. A set of good horticulture practices such as, 1.Tissue culture plants after genetic fidelity confirmation, 2. Bio-hardening using VAM and *Trichoderma reesei*, 3.Soil analysis and reclamations, 4. Raised bed planting, 5.Applications of native candidate bioagents blended as Trichokavach-B at the time of planting in the ratio of 50g + Neem cake 250 g + Compost 10 kg per plant with Application of bio-consortia at 2 months interval and 4 times applications along with Pseudostem weevil management using *Bevaria bassiana* live traps offering the highest yield and finding as a strategy for the crop expansion program of NR banana. Bio-intensive good horticulture practices vis-a-vis soil health management worked as strategies for suppression of wilt diseases both in pomegranate and banana.

PSEUDOMONAS PUTIDA, A POTENTIAL CANDIDATE BIOAGENT FOR THE MANAGEMENT OF FUSARIUM WILT IN BANANA

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Fusarium wilt, incited by *Fusarium oxysporum* f. sp. *cubense* (Foc), remains one of the most destructive soilborne diseases threatening global banana (*Musa* spp.) production. The GI-tagged cultivar 'Nanjangudu Rasabale' from the Mysore region of Karnataka reduced its acreage due to its pronounced susceptibility to Foc. Given the pathogen's long term persistence in soil and the limited efficacy of chemical control, sustainable and biologically based management strategies have become imperative. The present study investigated a biointensive management approach employing a native isolate of *Pseudomonas putida* in combination with neem cake under naturally infested field conditions. Incorporation of *P. putida* at planting along with neem cake, facilitated early rhizosphere colonization and prolonged pathogen suppression. The integrated treatment significantly reduced Fusarium wilt incidence to 38 per cent, compared with over 80 per cent in untreated controls. Disease suppression was attributed to the multifaceted action of *P. putida* through antibiosis, competition for rhizospheric resources and induction of systemic resistance in banana plants. The synergistic interaction between *P. putida* and neem cake enhanced root health, plant vigour and yield attributes, highlighting the efficacy of this biointensive strategy. The findings demonstrate that microbial based disease management, integrated with organic amendments, offers an eco-friendly, effective and scalable alternative to conventional chemical approaches.

Keywords: Nanjangudu Rasabale, Fusarium wilt, Biocontrol, *Pseudomonas putida*

NUTRITIONAL SUPPORT IN KIDNEY TRANSPLANT RECIPIENTS

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Post-kidney transplantation necessitates meticulous nutritional management to support graft function, minimize complications, and enhance long-term patient outcomes. This abstract synthesizes current research to highlight the critical nutritional requirements of kidney transplant recipients. Following transplantation, patients face unique dietary challenges stemming from immunosuppressive medications, altered metabolism, and increased risk of comorbidities. Initial post-operative nutritional support focuses on adequate protein intake to facilitate wound healing and maintain lean body mass, while carefully managing electrolyte imbalances. Caloric needs are often elevated due to surgical stress and medication effects, requiring vigilant monitoring to prevent excessive weight gain. Long-term nutritional strategies emphasize a balanced diet rich in fruits, vegetables, and lean protein, while limiting sodium, phosphorus, and potassium to protect graft function. Immunosuppressant medications can increase the risk of dyslipidemia and glucose intolerance, necessitating careful carbohydrate and fat management. Vitamin and mineral supplementation may be required to address deficiencies and support bone health, particularly for calcium and vitamin D. Furthermore, patients must be educated on food safety practices to minimize the risk of infection. Individualized dietary counseling is crucial to address patient-specific needs and preferences, promoting adherence to nutritional guidelines and improving overall quality of life. Continued research is essential to refine nutritional recommendations and develop targeted interventions to optimize post-kidney transplant outcomes.

Keywords: Kidney Transplant, Post-Transplant Nutrition, Dietary Management, Immunosuppression, Renal Graft Function.

FROM FIELDS TO CLINIC: UNDERSTANDING THE HEALTH EFFECTS OF PESTICIDE USE

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Pesticides are significant for controlling diseases and increasing food production, but their widespread use is a major cause of concern for human health and the stability of ecosystems. This review examines the evidence on the health effects of pesticide exposure, drawing on recent epidemiological and toxicological research. Acute poisoning and respiratory distress are quite common, but prolonged effects like endocrine dysfunction, neurological impairment, reproductive toxicity, and a higher risk of cancer are becoming more prominent. Special consideration is required for groups that are more likely to be at risk, like agricultural workers, children, and people who reside in rural areas who are exposed to low doses of toxins over long periods of time through food, water, and air. The research reveals that pesticide induces oxidative stress, mitochondrial damage, and epigenetic modifications. We also discuss the problems that are persisting with regulatory oversight, the flaws in current risk assessment models, and the need for safer options through biopesticide innovation and integrated pest management. To solve these problems, the world needs to unite to make sure that farming is productive while also protecting people and the environment.

Keywords: Pesticide exposure, endocrine dysfunction, neurological impairment, reproductive toxicity, cancer risk

INVESTIGATION ON MAJOR FOLIAR DISEASES OF Bt COTTON (*Gossypium spp*) IN NORTHERN DRY ZONE OF KARNATAKA

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In the present investigation, different districts of Northern dry zone of Karnataka were closely examined for various major foliar diseases in rain fed and irrigated fields of Bt growing areas. A roving survey was conducted on cultivars field during the crop season in the year 2023-25 and a fixed plot survey on Bt cotton was conducted periodically in research form at Gadag. The diseases were identified based on the development of characteristic disease symptoms on the plant and morphological studies of the associated microorganisms under microscope and were identified as fungal diseases *Alternaria blight* (*Alternaria macrospora* Zimm.), Grey (Areolate) mildew (*Ramularia areola* Atk.), and of the bacterial disease, bacterial blight (*Xanthomonas compestris* pv. *malvacearum* (Smith) Dye). The observations on disease severity, stage of the crop, variety and other details were recorded. The percent disease incidence was assessed by recording the number of plants showing disease symptoms and the number of plants examined, where highest incidence of the fungal diseases was recorded in Koppal district. It was also observed that bacterial blight incidence recorded Vijayapura.

Keywords: Survey, Foliar diseases, disease incidence, disease severity, percent disease index,

HALOPHILIC MICROBIAL CONSORTIA ENRICHED WITH MICRONUTRIENTS INDUCE SALINITY TOLERANCE AND PROMOTE GROWTH IN RICE

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Salinity stress is a major constraint to rice production, affecting seed germination, nutrient uptake, and physiological balance. This study developed and evaluated halophilic microbial consortia enriched with micronutrients to enhance salinity tolerance and growth in rice. Sixteen halophilic bacterial isolates from salt-affected soils of V.C. Farm, Mandya, were characterized, among which *Bacillus subtilis* (HA4), *Paraburkholderia fungorum* (HA11), and *Halobacillus massiliensis* (HA13) showed superior plant growth-promoting traits including indole-3-acetic acid production of $44.5 \mu\text{g ml}^{-1}$ and exopolysaccharide production of 19.7 mg ml^{-1} . These isolates were developed into a compatible microbial consortium and enriched with a micronutrients mixture and formulation involving Zn:Fe:Mn:Cu:B in 1500:500:10:50:5 mM using conventional salts and expired pharmaceutical nutrient supplements (EPNS) found most promising. The enriched consortium was tested on rice under NaCl-induced salinity (0–150 mM). Treatments with EPNS-enriched consortia improved germination from 63% in the control to 86% at 150 mM NaCl, while seedling length increased from 27.4 cm to 40.1 cm and seedling vigour index from 1726 to 3371. Relative water content was higher in treated seedlings (84% compared to 70% in control), and proline levels remained moderated, indicating improved osmotic regulation and reduced stress perception. Enhanced nutrient uptake, ionic balance, and higher fresh and dry weights were also observed, reflecting the synergistic role of microbial metabolites and micronutrient enrichment in mitigating salinity effects. Micronutrient-enriched halophilic microbial consortia effectively improved rice seedling germination, growth, and physiological performance under salt stress. This approach offers a sustainable bioinoculant strategy that utilizes expired pharmaceuticals for nutrient enrichment while enhancing crop resilience in saline soils.

Keywords: *Bacillus subtilis*, Expired pharmaceuticals, *Halobacillus massiliensis*, *Paraburkholderia fungorum*

ECONOMIC ANALYSIS OF COST OF CULTIVATION AND PROFITABILITY OF NANJANGUD RASABALE (NR) BANANA IN NANJANGUD TALUK, MYSURU DISTRICT

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The study was undertaken to assess the cost of cultivation and economic returns of *Nanjangudu Rasabale* (NR) banana, a unique Geographical Indication (GI) crop cultivated in and around Nanjangud Taluk, Mysuru District, Karnataka. Primary data were collected from NR banana growers for the agricultural year 2023–24 to analyze cost structure, profitability and economic viability. The total cost of cultivation was estimated at ₹2,81,580.74 per hectare, comprising variable costs of ₹2,12,654.74 (75.53%) and fixed costs of ₹68,926.00 (24.47%). Among variable costs, human labour accounted for the largest share, highlighting the labour-intensive nature of banana farming. Expenditure on planting materials, manures, fertilizers, and irrigation also contributed significantly. Fixed costs mainly included land revenue, depreciation on implements, and interest on fixed capital. Gross returns from the sale of fresh fruits were substantial due to the premium market price enjoyed by NR banana for its distinctive aroma, flavor, and thin skin. The Benefit-Cost (B:C) ratio was calculated at 1.75, indicating that every rupee invested yielded a return of ₹1.75, confirming the crop's economic profitability under current production conditions. Despite favourable returns, the study highlights sensitivity of profitability to factors such as rising labour wages, input price fluctuations and pest or disease incidence. Ensuring timely input supply, efficient resource use and strengthening credit and marketing facilities can further enhance economic efficiency. It is concluded that NR banana remains a profitable and sustainable crop for the region. Promotion of scientific cultivation practices, value addition and branding initiatives will help sustain farmer incomes and preserve this heritage variety for future generations.

TRANSLATIONAL RESEARCH – THE GREENLIFE MODEL: FROM SCIENCE TO THE SOIL

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Translational research in agriculture must go beyond laboratories to transform farmers' fields and livelihoods. The Greenlife Model exemplifies this principle by bridging science and society through a unique farmer-centric innovation system. Developed and implemented by Greenlife Croptech Pvt. Ltd., the model translates years of research on plant health, soil management, and eco-formulations into practical, field-ready solutions. Through participatory field trials, capacity building, and village adoption programs, the Greenlife Model has successfully taken advanced crop management technologies such as PHYTON-T for root and wilt management and POWER PLUS, a patented bio-formulation for viral disease recovery to the grassroots level. The result has been nothing short of a Floral Revolution, where farmers in multiple villages have moved from uncertainty and loss to a glaring, roaring rural economy that blossoms with prosperity and pride. The model integrates science, social responsibility, and sustainability by combining free diagnostics, micro-finance of inputs, and continuous on-field mentoring. Farmers are not mere beneficiaries but co-innovators, empowered with knowledge and confidence. This approach demonstrates that when science is democratized and delivered with compassion, it can regenerate soils, revive crops, and rejuvenate rural economies. The Greenlife Model thus stands as a replicable and scalable framework for translational research where technology truly travels from “the lab to the land,” nurturing both the plants and the people who grow them.

FARMER PERCEPTION ABOUT AGROFORESTRY LAND USE IN BUNDELKHAND REGION

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Agroforestry, the deliberate integration of trees with crops and livestock on the same land, plays a vital role in enhancing livelihood security and ecological sustainability, particularly in fragile ecosystems such as Bundelkhand. The present study aims to assess the *farmers' perception about agroforestry land use systems* in the Bundelkhand region of India. A structured survey was conducted among farmers across different districts to evaluate their awareness, preferences, and constraints related to agroforestry practices. The results revealed that a majority of farmers recognize agroforestry as a beneficial land-use strategy for improving soil fertility, providing timber, fuelwood, and fodder, and ensuring climate resilience. However, adoption levels remain moderate due to constraints such as lack of technical knowledge, long gestation periods, inadequate market linkages, and limited institutional support. Species such as *Albizia procera*, *Melia dubia*, *Tectona grandis*, and *Azadirachta indica* were preferred for their economic and ecological value. The study highlights that enhanced extension services, financial incentives, and access to quality planting material could significantly improve adoption rates. Strengthening awareness and capacity-building programs can make agroforestry a key driver for sustainable rural development and climate adaptation in Bundelkhand.

Keywords: Agroforestry, Farmers perception, Land use, Bundelkhand region, Sustainable livelihoods, Tree-crop integration

HARNESSING *Butea monosperma* FOR SOIL RESTORATION AND LIVELIHOOD SECURITY IN BUNDELKHAND AGROECOSYSTEM

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Forests play a pivotal role in maintaining global ecological balance by conserving biodiversity, regulating climate, and supporting the livelihoods of millions. In India, forest and tree cover accounts for 25.17% of the geographical area, providing essential ecosystem services and sustaining rural communities. The Bundelkhand region of Central India, spanning 7.85 million hectares across Uttar Pradesh and Madhya Pradesh, is ecologically significant but highly vulnerable to deforestation, land degradation, erratic rainfall, and declining agricultural productivity. Predominantly dependent on rainfed farming and characterized by small and marginal landholdings, rural households in Bundelkhand frequently experience crop failures, food insecurity, and seasonal migration. Despite these constraints, Bundelkhand supports a rich diversity of tree species adapted to its semi-arid climate. Among them, *Butea monosperma* (Palas), a dominant species in agroforestry systems, plays a critical ecological and socio-economic role. The species thrives in degraded soils, harsh climates, and low-input environments due to its drought tolerance, coppicing ability, and wide edaphic adaptability. Its ecological benefits include soil fertility enhancement, erosion control, and improved water-holding capacity. Economically, *B. monosperma* is a multipurpose tree providing gum (Bengal kino), natural dye, lac, leaf plates, fodder, fuelwood, and medicinal products. Its flowers, bark, seeds, and wood have diverse applications in traditional medicine, crafts, and small-scale forest-based enterprises. Given the region's reliance on monocropping, low soil fertility, limited irrigation, and weak market linkages, tree-based livelihood options are particularly valuable. Promoting sustainable management, value addition, and conservation of existing *B. monosperma* resources can strengthen farm resilience and support climate-adaptive agroforestry strategies in Bundelkhand.

Keywords: Bundelkhand, *Butea monosperma*, Agroforestry systems, Ecological restoration, Soil fertility improvement

EVALUATION OF WATER QUALITY AND HYDRO-CHEMICAL CHARACTERISTICS OF SURFACE AND GROUND WATER AROUND RANI LAKSMI BAI CENTRAL AGRICULTURAL UNIVERSITY, JHANSI

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A study was conducted to assess the quality of water for both drinking and irrigation purposes, as well as to examine the hydro geochemical properties of the groundwater. For this purpose, twenty-five water samples were collected from different locations, encompassing both surface and groundwater sources. Various physicochemical parameters such as pH, electrical conductivity (EC), total hardness (TH), chloride (Cl^-), calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), bicarbonate (HCO_3^-), and sulphate (SO_4^{2-}), phosphate (PO_4^{3-}) were measured. The findings indicated that $\text{Ca}^{2+} > \text{Na}^+ > \text{Mg}^{2+} > \text{K}^+$ ions were dominated in both surface and groundwater, while anion concentration dominated in $\text{HCO}_3^- > \text{SO}_4^{2-} > \text{Cl}^- > \text{CO}_3^{2-} > \text{PO}_4^{3-}$ in surface water and $\text{SO}_4^{2-}, \text{HCO}_3^-, \text{Cl}^-, \text{CO}_3^{2-}, \text{PO}_4^{3-}$ in groundwater sample. Most of the water has poor water quality index in surface water (76.92%) and groundwater (66.66%) and only one sample was not suitable for drinking purpose. The Piper and Gibbs were suggested that the hydro-chemistry of the collected water sample in the study area and ions in both surface and groundwater was originated by rock-water interaction.

EXPLORING GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN HYBRIDS OF TOMATO IN TRANS-GANGETIC PLAINS REGION

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Since the previous years, Indian tomatoes (*Solanum lycopersicum* L.) are one of most important crops. To increase their output and productivity, a change is necessary. The degree of genetic variability, heritability, and genetic progress in this solanaceous vegetable determines crop improvement. In order to ascertain the relationship between yield and morphological traits, study looked at the genetic variability, heritability, correlation, and path coefficient of 26 genotypes. Most of the variables examined in this experiment had phenotypic coefficient values that were higher than genotypic coefficient values, demonstrating the expression of environmental factors. The number of fruits per plant among the fifteen traits under study showed strong heritability, genetic progress, correlation, and path coefficient values, with the highest yield per plant. A higher heterosis is related to a higher dissimilarity coefficient value. Breeding programmes should consider lines with higher dissimilarity coefficient values. The future hybridization programme can use the tomato genotypes F910 and F119, which were chosen based on the number of fruits per plant.

Keywords: Correlation, GCV, Heritability, PCV, *Solanum lycopersicum*

FROM FIELDS TO CLINIC: UNDERSTANDING THE HEALTH EFFECTS OF PESTICIDE USE

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Pesticides are significant for controlling diseases and increasing food production, but their widespread use is a major cause of concern for human health and the stability of ecosystems. This review examines the evidence on the health effects of pesticide exposure, drawing on recent epidemiological and toxicological research. Acute poisoning and respiratory distress are quite common, but prolonged effects like endocrine dysfunction, neurological impairment, reproductive toxicity, and a higher risk of cancer are becoming more prominent. Special consideration is required for groups that are more likely to be at risk, like agricultural workers, children, and people who reside in rural areas who are exposed to low doses of toxins over long periods of time through food, water, and air. The research reveals that pesticide induces oxidative stress, mitochondrial damage, and epigenetic modifications. We also discuss the problems that are persisting with regulatory oversight, the flaws in current risk assessment models, and the need for safer options through biopesticide innovation and integrated pest management. To solve these problems, the world needs to unite to make sure that farming is productive while also protecting people and the environment.

Keywords: Pesticide exposure, endocrine dysfunction, neurological impairment, reproductive toxicity, cancer risk

BIODIESEL PRODUCTION FROM NON-EDIBLE OILS USING GREEN CATALYSTS

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This study investigates the sustainable production of biodiesel by addressing two critical challenges: the "food vs. fuel" dilemma and the environmental drawbacks of conventional catalysts. Biodiesel was successfully produced from high free fatty acid (FFA) non-edible *Jatropha curcas* oil using a green, heterogeneous catalyst synthesized from waste eggshells. The catalyst was characterized by XRD, SEM, and FTIR, confirming the formation of crystalline calcium oxide (CaO). Process parameters for transesterification were optimized via Response Surface Methodology (RSM), achieving a maximum biodiesel yield of 96.2% under optimal conditions. The produced biodiesel exhibited a high FAME content of 97.5% and its fuel properties complied with international ASTM D6751 and EN 14214 standards. The catalyst demonstrated excellent reusability for three consecutive cycles, establishing a cost-effective and environmentally benign pathway for biodiesel production that aligns with the principles of a circular economy.

Keywords: Biodiesel, Non-Edible Oil, *Jatropha curcas*, Green Catalyst, Waste Eggshell, Calcium Oxide (CaO), Response Surface Methodology (RSM), Fuel Properties, Reusability.

IMPACT OF BIOFERTILIZER ON ROOT CROPS IN AGRA REGION

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The use of biofertilizers has become very important for sustainable crop production in the Agra region. Root crops like carrot, radish, beetroot, and turnip are widely grown here and need balanced nutrition for better yield and quality. Biofertilizers such as Azotobacter, Azospirillum, Rhizobium, and Phosphate Solubilizing Bacteria (PSB) help in improving soil fertility naturally. They fix atmospheric nitrogen, solubilize phosphorus, and enhance the availability of essential nutrients to plants. In the sandy loam soils of Agra, chemical fertilizers alone often reduce soil health and microbial activity. The application of biofertilizers along with organic manure and a small dose of chemical fertilizers improve soil texture, root growth, and water-holding capacity. Farmers who use biofertilizers in carrot and radish fields have reported better root size, uniform color, and higher market value. It also reduces the cost of chemical fertilizers and prevents soil pollution. Moreover, biofertilizers promote eco-friendly farming and increase the population of beneficial soil microorganisms. They play a vital role in maintaining long-term soil productivity. In the Agra region, where the climate is semi-arid and irrigation water is limited, biofertilizers help plants to absorb nutrients efficiently and tolerate stress conditions. Thus, the use of biofertilizers in root crops is a simple, low-cost, and environment-friendly practice that supports both farmers' income and soil health in the Agra region.

ENVIRONMENTAL IMPACT OF HEAVY METAL POLLUTION ON FISH: MECHANISMS, SPECIES-SPECIFIC RESPONSES, AND ECOLOGICAL CONSEQUENCES

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Heavy metal contamination has become a critical global concern as industrial expansion continues to introduce persistent and bioaccumulative pollutants into aquatic ecosystems. Metals such as chromium, arsenic, mercury, cadmium, lead, copper, and nickel resist natural degradation and readily accumulate in various organs of fish. Numerous studies have documented species-specific susceptibility to metal toxicity. For instance, *Oreochromis mossambicus* and *Labeo rohita* exposed to cadmium and lead show pronounced gill degeneration and liver necrosis, while *Danio rerio* (zebrafish) demonstrates significant oxidative stress and altered expression of detoxification-related genes under mercury exposure. Research on *Cyprinus carpio* and *Clarias gariepinus* further reveals disruptions in metabolic enzymes, hematological parameters, and reproductive performance when subjected to chronic heavy-metal contamination. Accumulation of these metals induces oxidative stress, histopathological abnormalities, and dysregulation of transcriptional pathways responsible for cellular repair and homeostasis. Structural lesions, impaired organ function, and developmental defects are frequently reported outcomes in exposed fish species. As heavy-metal bioaccumulation progresses, affected organisms experience reduced fitness, weakened immune responses, and impaired growth, ultimately contributing to population decline. This review synthesizes existing research on heavy-metal occurrence, mechanisms of toxicity, and species-specific responses, emphasizing the urgent need for comprehensive monitoring and mitigation strategies to protect aquatic organisms and preserve ecological balance.

GENETIC DIVERSITY STUDIES ON GREEN GRAM (*Vigna radiata* L.)

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A set of 40 different genotypes are evaluated during Summer 2022 at Seed Research and Technology Centre, Rajendranagar, Hyderabad for fifteen quantitative traits in green gram to study genetic divergence. Mahalanobis D^2 analysis suggested the maximum contribution of seed yield towards genetic diversity followed by plant height, days to maturity, pod length, days to 50% flowering, seedling dry weight, protein content and 100 seed weight. All the genotypes were grouped into 12 clusters, cluster I was very large containing seventeen genotypes. The average inter-cluster distance (average D^2 value) values ranged from 0.00 to 2334.35. Maximum intra cluster distance was observed between the clusters II and VIII ($D=2334.35$) indicating that genetic makeup of the genotypes comprised in these clusters may have entirely different from one another. The lowest inter cluster distance of 20.05 was recorded in cluster II, revealed that similar genetic makeup of the genotypes included in these clusters. Cluster II was the most diverse as many other clusters expressed maximum inter cluster distance with it. Based on mean performances, the genotypes from cluster II (MGG-512, MGG-519) recorded highest seed yield, cluster X (IC-436557, MLGG-21-6) recorded highest number of clusters and highest number of seeds per pod, cluster-III (RMP-21-11) was recorded highest number of pods per cluster and Cluster XII (PUSA-9072) with maximum protein content (28.66) was found superior and may be used in the future breeding program.

STUDY OF GENETIC VARIABILITY IN GREENGRAM [*Vigna radiata* (L.)] GERMPLASM

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Green gram is an important food crop in developing countries of Africa, Asia and Latin America as it is an excellent source of high-quality proteins (22-24%), essential aminoacids, vitamins and minerals. In the present study, forty green gram germplasm were evaluated in Randomised Block Design during rabi 2018 at Regional Agricultural Research Station, Palem. The results revealed that the analysis of variance for the all genotype showed highly significant for all the characters studied, indicating the existence of considerable magnitude of variability. High phenotypic co-efficient of variation (>20%) and high genotypic co-efficient of variation for seed yield (kg/plot) in the present investigation was noticed and indicating the minimal influence of environment and presence of high genetic variability for the trait in the experimental material. Hence, selection based on phenotype in these genotypes can also be effective for the improvement of seed yield. High heritability to plant height (92.45%), days to 50% flowering (96.28%), days to maturity (95.23%), pod length (90.12%), 100 seed weight (62.56%) and medium heritability to seed yield (kg/plot) (58.92%). High GAM to plant height (33.42%) and seed yield (59.08%) demonstrates the presence of additive gene effect indicating effectiveness of selection for the improvement of these traits.

Keywords: Genetic variability, Green gram and Seed yield

NOVELTY IN PLANT DISEASE DIAGNOSTICS

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The escalating threat of plant diseases to global food security necessitates a paradigm shift from traditional, often slow and subjective, diagnostic methods to rapid, accurate, and high-throughput technologies. This paper reviews the novelty in plant disease diagnostics, highlighting the transformative advancements that are redefining the field of plant pathology. The core of this revolution lies in the integration of cutting-edge technologies, primarily Deep Learning (DL) and Machine Learning (ML), which enable automated and highly efficient disease detection and classification, often leveraging computer vision and transfer learning techniques. A significant area of innovation is the use of non-invasive sensing technologies. These include advanced imaging spectroscopy and thermal imaging, which facilitate the spectral analysis of subtle foliar symptoms and pathogen-induced changes long before they are visible to the human eye. Furthermore, the miniaturization and precision offered by microfluidic technologies are proving invaluable for the early and rapid detection of various pathogens. Another emerging frontier involves the application of nanomaterials for enhanced plant health monitoring and targeted disease treatment. Collectively, these novel approaches are driving the development of diagnostic tools that are not only more accurate but also more cost-effective and suitable for real-time, field-based deployment. The shift towards automated, spectral, and molecular-level diagnostics is crucial for effective disease management, enabling timely intervention, reducing crop losses, and ensuring sustainable agricultural practices in the face of emerging and elusive plant pathogens.

Keywords: Diagnostics, Computer Vision, Imaging Spectroscopy, Microfluidics, Nanomaterials, Pathogen Detection.

GENETIC VARIABILITY STUDIES ON GREEN GRAM (*Vigna radiata* L.)

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In the present study, forty green gram genotypes are evaluated at Department of Seed Science and Technology, Seed Research and Technology Centre, Rajendranagar during summer 2022. Results showed that the difference between PCV and GCV was very small for plant height, pod length, days to 50% flowering, days to maturity indicating greater role of genetic factors in expression of these characters and lower influence of environment indicating rapid progress from selection for these traits. Plant height (cm), number of clusters per plant, seedling dry weight (mg), vigour index-II, 100 seed weight (g) showed moderate magnitudes of PCV and GCV, this suggests that there is a scope to enrich the variation for these characters, as they possess high heritability coupled with GAM. High heritability to plant height (cm), days to 50% flowering, days to maturity, pod length, 100 seed weight, protein estimation and medium heritability to seed yield (kg/plot). High GAM to plant height (cm) and seed yield (kg/plot) specifies the presence of additive gene effect representing effectiveness of selection for the improvement of these traits.

EVALUATION OF THE PHYTOREMEDIATION POTENTIAL, METAL PARTITIONING IN LEAF, STEM, AND ROOT, AND METAL UPTAKE UNDER VARIOUS ORGANIC AMENDMENTS IN THE BUNDELKHAND REGION OF UTTAR PRADESH, INDIA

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Soil contamination with heavy metals is an emerging environmental concern in the semi-arid Bundelkhand region of Uttar Pradesh, India, where intensive mining, industrial effluents, and excessive use of agrochemicals have led to soil degradation. The present study evaluates the phytoremediation potential of selected plant species and examines metal partitioning in leaf, stem, and root tissues, along with metal uptake behavior under different organic amendments farmyard manure, compost, and vermicompost. A controlled pot experiment was conducted using metal-contaminated soils collected from representative sites across the Bundelkhand region. The effects of organic amendments on plant growth, biomass yield, and the uptake of Cd, Pb, Zn, and Cu were assessed. Metal concentrations in plant parts were determined using atomic absorption spectrophotometry (AAS), and bioaccumulation and translocation factors were computed to evaluate phytoremediation efficiency. Results indicated that organic amendments significantly enhanced plant growth and influenced the distribution of metals within plant tissues, with higher accumulation in roots compared to shoots. Among the amendments, vermicompost exhibited the greatest enhancement in metal uptake and bioavailability, likely due to improved soil physicochemical and biological properties. The findings highlight the effectiveness of organic amendment-assisted phytoremediation as a sustainable and eco-friendly approach for restoring heavy metal-contaminated soils in the Bundelkhand region.

Keywords: bioaccumulation, Bundelkhand region, heavy metals, metal partitioning, organic amendments, phytoremediation, soil remediation, Uttar Pradesh

CORRELATION AND PATH ANALYSIS IN HORSEGRAM (*Macrotyloma uniflorum* L.)

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Horse gram is a climate-resilient legume crop with significant nutritional value, yet its genetic potential remains underutilised. In the present study, thirty five horse gram genotypes were evaluated in Randomised Block Design with three replications during *rabi* 2017 at Regional Agricultural Research Station, Palem. The results revealed that the analysis of variance for the all genotype showed highly significant for all the characters studied, indicating the existence of considerable magnitude of variability. In the correlation analysis, days to maturity exhibited significant positive correlation with 100 seed weight and number of pods per plant showed significant positive correlation with number of branches, 100 seed weight and seed yield per plot. The traits like 100 seed weight, number of pods per plant and days to maturity showed positive direct effect on seed yield per plot. The traits i.e. number of pods per plant, 100 seed weight and days to maturity showed positive correlation and direct effect on seed yield per plot indicating that these traits are useful in selecting the genotypes in breeding programme.

Keywords: Horsegram, correlation, direct effect, seed yield

ORGANIC INPUTS AND BIO-INOCULANTS: A SUSTAINABLE PATHWAY FOR ENHANCING PRODUCTIVITY AND SOIL HEALTH IN HORTICULTURAL SYSTEMS

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Sustainable horticulture emphasizes the integration of eco-friendly approaches to improve soil fertility, crop productivity and environmental health. The use of organic inputs and bio inoculants has emerged as a viable alternative to chemical fertilizers for achieving long-term sustainability in horticultural production. Organic amendments such as vermicompost, farmyard manure, neem cake and composted plant residues not only supply essential macro- and micronutrients but also enhance soil organic carbon and microbial activity. Additionally, bio-inoculants like *Azospirillum*, *Azotobacter*, *Rhizobium*, *Bacillus* and *Trichoderma* species play crucial roles in nutrient mobilization, nitrogen fixation, phosphate solubilization and suppression of soil-borne pathogens. Recent studies have demonstrated that the combined application of organic manures and microbial inoculants significantly improves plant growth, fruit quality and increase yield by 15–25% and significantly improve soil organic carbon and enzyme activity. Such integrated nutrient management practices reduce dependency on synthetic inputs, mitigate greenhouse gas emissions and promote ecological balance. Hence, adopting organic inputs and bio-inoculants offers a sustainable solution for achieving productive, profitable and environmentally responsible horticultural systems.

Keywords: Organic farming, Biofertilizers, Soil health, Sustainable horticulture, Microbial inoculants and Nutrient management

BIOTIC AND ABIOTIC STRESS OF PLANTS

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Plants are constantly exposed to a multitude of environmental stressors that significantly limit their growth, development, and productivity. These stressors are broadly categorized into biotic and abiotic stresses. Biotic stress refers to damage caused by living organisms such as pathogens (bacteria, fungi, viruses) and pests (insects, nematodes). In contrast, abiotic stress arises from non-living environmental factors including drought, salinity, extreme temperatures, and heavy metal toxicity. While the nature of these stresses is distinct, they often trigger overlapping and complex physiological, biochemical, and molecular responses in plants. This includes the production of stress hormones, antioxidants, and protective proteins. Understanding the intricate mechanisms underlying plant responses to these stresses is crucial for developing resilient crop varieties through advanced breeding and biotechnological approaches, thereby ensuring global food security in the face of climate change.

Keywords: Biotic Stress, Abiotic Stress, Plant Physiology, Crop Productivity and Stress Tolerance

CARBON FARMING THROUGH AGROFORESTRY: EMERGING MODELS FOR CLIMATE NEUTRALITY AND RURAL PROSPERITY

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Agroforestry-based carbon farming has emerged as a scientifically robust strategy for enhancing terrestrial carbon sinks while maintaining ecosystem productivity and socio-economic viability. Integrating multipurpose tree species with crops and livestock optimizes biogeochemical cycling and improves soil–plant–atmosphere carbon fluxes, particularly in semi-arid landscapes. Advances in remote sensing (Sentinel-2, PlanetScope) and LiDAR-assisted biomass assessment, coupled with AI-driven allometric equations, have refined carbon stock estimations across heterogeneous agroforestry typologies. Experimental data from semi-arid India indicate that tree–crop systems involving *Melia dubia*, *Dalbergia sissoo*, and *Acacia auriculiformis* can sequester 10–14 Mg CO₂ ha⁻¹ yr⁻¹ through enhanced soil organic carbon and aboveground biomass accumulation. The integration of biochar amendments, nitrogen-fixing tree species, and deep-rooted perennials further augments belowground carbon stabilization and nutrient cycling efficiency. Institutional frameworks such as the National Agroforestry Policy (2014), Green Credit Programme (2023), and emerging voluntary carbon markets provide enabling environments for monetizing ecosystem services through blockchain-verified carbon credits. These mechanisms ensure both environmental and economic co-benefits, promoting adoption among smallholders. The synthesis concludes that carbon farming through agroforestry represents a scalable climate mitigation pathway by linking precision carbon accounting, ecosystem service valuation, and livelihood diversification. Future research must focus on spatially explicit carbon flux modelling, life-cycle assessments, and integration of AI-enabled digital twins for predictive management under changing climatic regimes.

Keywords: Carbon farming, Agroforestry systems, MRV frameworks, Carbon flux modelling, Climate neutrality

NANO-SENSORS: A NOVEL TOOL FOR PRECISION AGRICULTURE

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Nano sensors have emerged as a transformative technology capable of detecting and qualifying physical, chemical and biological parameters at the nanoscale with extreme precision. This is an experimental investigation into the fabrication, characterization and performance estimation of nano sensors designed for agricultural and engineering application. The main aim is to analyze their sensitivity, selectivity, and response time in detecting environmental and mechanical variation. The Nano sensors were fabricated using a bottom-up synthesis approach which include sol gel deposition of nanostructured materials on conductive substrates. Electrical and mechanical responses were evaluated on experimental basis under varying conditions of temperature, pressure and humidity. The result indicates significant improvement in sensitivity compared to conventional microsensors, with response time reduced approximately to forty percent. The nano sensors exhibit high stability, repeatability, and durability conforming for real -time monitoring applications. The findings high light the broad potential on nano sensors in agriculture and agricultural engineering. Smart nano-fertilizers have been suggested to be fitted with nano biosensors in a biopolymer, covering a coating on all sides of the fertilizer parts. The nano sensors market is growing day by day and is expected to reach \$1,321.30 million by 2026. Around 20,000 researchers and 2,000 employees are involved in this area. Nowadays, nano sensors and nano-based elegant delivery system support farmers in properly using water, nutrients, and agrochemicals to increase crop yield through improved monitoring and minimization of inputs.

Keyword: Nano-sensors, Nanotechnology, Nano-fertilizers, Nano-biosensors

NUTRITIONAL SUPPORT IN KIDNEY TRANSPLANT RECIPIENTS

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Post-kidney transplantation necessitates meticulous nutritional management to support graft function, minimize complications, and enhance long-term patient outcomes. This abstract synthesizes current research to highlight the critical nutritional requirements of kidney transplant recipients. Following transplantation, patients face unique dietary challenges stemming from immunosuppressive medications, altered metabolism, and increased risk of comorbidities. Initial post-operative nutritional support focuses on adequate protein intake to facilitate wound healing and maintain lean body mass, while carefully managing electrolyte imbalances. Caloric needs are often elevated due to surgical stress and medication effects, requiring vigilant monitoring to prevent excessive weight gain. Long-term nutritional strategies emphasize a balanced diet rich in fruits, vegetables, and lean protein, while limiting sodium, phosphorus, and potassium to protect graft function. Immunosuppressant medications can increase the risk of dyslipidemia and glucose intolerance, necessitating careful carbohydrate and fat management. Vitamin and mineral supplementation may be required to address deficiencies and support bone health, particularly for calcium and vitamin D. Furthermore, patients must be educated on food safety practices to minimize the risk of infection. Individualized dietary counseling is crucial to address patient-specific needs and preferences, promoting adherence to nutritional guidelines and improving overall quality of life. Continued research is essential to refine nutritional recommendations and develop targeted interventions to optimize post-kidney transplant outcomes.

Keywords: Kidney Transplant, Post-Transplant Nutrition, Dietary Management, Immunosuppression, Renal Graft Function

STUDY ON NOVEL APPROACHES FOR CLIMATE SMART DAIRY FARMING

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Climate-smart dairy farming (CSDF) is an integrated approach that enhances productivity, resilience, and environmental sustainability in the dairy sector amid increasing climate variability. It aims to optimize milk production while reducing greenhouse gas (GHG) emissions, conserving natural resources, and ensuring the socioeconomic well-being of farming communities. The concept combines improved breeding, precision feeding, efficient manure management, renewable energy adoption, and climate-resilient forage systems to create a sustainable dairy value chain. The dairy sector faces increasing challenges due to climate change, including heat stress, reduced fodder availability, declining productivity, and heightened greenhouse gas emissions. This study explores novel approaches for **climate-smart dairy farming** aimed at enhancing sustainability, productivity, and resilience in the face of environmental stressors. The research integrates technological, genetic, and managerial innovations such as precision livestock farming, methane mitigation through feed additives, climate-resilient cattle breeding, renewable energy adoption, and smart water and waste management systems. Data were collected through field surveys, experimental trials, and secondary literature analysis across diverse agro-climatic zones. The findings indicate that the adoption of Internet of Things (IoT) based monitoring tools, biogas systems, and improved feed formulations can reduce emissions by up to 25% while maintaining or increasing milk yield. Furthermore, integrating agroforestry and circular bio-economy principles supports carbon sequestration and nutrient recycling. The study concludes that climate-smart dairy systems, supported by digital innovation and sustainable resource management, offer a viable pathway to achieving both economic viability and environmental stewardship in the dairy industry.

Keywords: Climate-Smart Agriculture, Dairy Farming, Precision Livestock Farming, Sustainability, Renewable Energy, Heat Stress Management, Low-Emission Dairy Systems, Resilience.

ESTIMATION OF HERITABILITY UNDER DIFFERENT ENVIRONMENTAL CONDITIONS IN CHICKPEA (*Cicer arietinum* L.)

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The set of Forty-five chickpea genotypes were evaluated under normal and late sown conditions for two year (2017-19) which constitute the four environments, at experimental field of the Department of Genetics and Plant Breeding, C.C.S. University, Meerut U P. The genotypes were sown in Randomized Block Design with three replications and observations were recorded for each genotype in each replication for all twelve studied characters. The heritability is the most important selection parameter helps the plant breeder in the selection of superior or desirable genotype from genetically diverse population. In the present study, the range of heritability was observed between 48.83 to 98.54% for days to maturity and for 100 seed weight respectively, in environment I. Further, the estimate of heritability in broad sense was revealed the characters viz. seed yield, 100 seed weight, number of seeds per plant, number of pods per plant and biological yield shown high heritability among all the four environments. While harvest index shows high heritability in environment III and IV; number of branches per plant shows high heritability in environments I and III. Heritability for rest of the characters was recorded moderate to low in the entire environment. The high heritability of all these characters indicated that these characters were less influenced by the environmental effects. Therefore, these traits will further use in breeding programme to improve yield of chickpea.

EVALUATION OF PIGEONPEA [*Cajanus cajan* (L.) Millsp] GENOTYPES FOR MID EARLY MATURITY AND SEED YIELD

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Pigeonpea is an important grain legume crop in the semi-arid tropics of Asia and Africa due to its high protein (20-22%) content. India is the largest producer and consumer because pigeonpea plays an important role in food security, balanced diet and alleviation of poverty. In the present study, thirteen pigeonpea germplasm were evaluated in Randomised Block Design with three replications during *Kharif* 2018 at Regional Agricultural Research Station, Palem. The results revealed that the analysis of variance for the all genotype showed highly significant for all the characters studied, indicating the existence of considerable magnitude of variability. The genotypes RG 306 (127 days), RG 308 and RG 313 (128 days) had early maturity compared to other genotypes. The genotype RG 301 had high seed yield (2035 kg/ha) followed by RG 310 (1646 kg/ha). The traits like number of branches per plant, number of pods per plant, number of seeds per pod showed positive correlation and direct effects on seed yield per ha. These traits are useful for direct selection of genotypes in the further breeding programme.

Keywords: Pigeonpea, correlation, early maturity, seed yield

STUDIES ON AIR POLLUTION STATUS IN AGRA CITY OF UTTAR PRADESH

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This study evaluates the ambient air quality in Agra, Uttar Pradesh, focusing on key pollutants like SO₂, NO₂, RSPM, and VOCs. The research also calculates the Air Quality Index (AQI) and examines the impact of pollutants on the Taj Mahal's discoloration and deterioration. Five strategic locations ISBT Bus Station, Taj Mahal vicinity, Northern Bypass, City Railway Station, and an Industrial area were monitored during pre-monsoon (April-May) and post monsoon (December-January) seasons. Standard analytical methods, including the Modified West and Gaeke method for SO₂ and the Jacob and Hochheiser method for NO₂, were used. Results indicate that particulate matter (PM) levels consistently exceeded national standards, while SO₂ and NO₂ concentrations generally remained within permissible limits. The AQI ranged from "Moderate" to "Poor," highlighting significant air quality concerns. This study underscores the urgent need for effective pollution control measures to protect public health and preserve the Taj Mahal's heritage.

Keywords: Air Pollution, Air Quality Index (AQI), Particulate Matter, Agra City

VALIDATION OF TEST WEIGHT BASED SEED RATES FOR POPULATION DENSITY, YIELD AND SEED QUALITY OF RICE VARIETIES

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In this study, two popular varieties (RNR15048, KNM 118) are validated of test weight for population density at Seed Research and Technology Centre, Rajendranagar during *Rabi* 2020-21. Yield and yield attributes for the varieties with two seed rates were recorded and their interactions were investigated. The traits viz., number of tillers m²-, plant height, days to 50% flowering, panicle length, panicle weight, number of grains panicle and seed yield varied significantly among varieties. Except for panicle weight and the number of grains panicle, seed rate exhibited non significant variance for all yield and yield characteristics, indicating that seed rate had no impact on yield. For all yield and yield contributing characters, the interaction between variety and seed rate exhibited a non-significant variance. Except for test weight, peak value and field emergence, all the seed quality parameters such as germination, seedling length, seedling dry weight, seedling vigour index I, seedling vigour index II, speed of germination, electrical conductivity and grain L/B had a non-significant variation among seed rates. The findings revealed that the test weight based seed rate recorded on par yield and seed quality with the farmer practiced seed rate.

CLIMATE CHANGE ADAPTATION IN AGRICULTURE AND ECOLOGY

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Climate change presents an unprecedented threat to global agricultural systems and ecological stability, jeopardizing food security and biodiversity. Rising temperatures, altered precipitation patterns, and the increased frequency of extreme weather events are disrupting crop yields, shifting species distributions, and straining ecosystem services. Critical imperative for proactive adaptation strategies within the intertwined domains of agriculture and ecology. In agriculture, adaptation involves transitioning from vulnerable, input-intensive models to resilient, knowledge-based systems. Key strategies include developing climate-resilient crop varieties, implementing water-efficient irrigation like drip systems, adopting conservation agriculture practices (e.g., no-till farming, cover cropping), and integrating agroforestry to enhance microclimates and soil health. Concurrently, ecological adaptation focuses on fostering ecosystem resilience and facilitating species migration. This entails creating and protecting ecological corridors, assisted migration of vulnerable species, and restoring degraded habitats like wetlands and forests to buffer against climate impacts. Crucially, the success of these interventions hinges on their synergistic integration. Agroecological approaches that blend agricultural production with ecological principles offer a robust pathway toward sustainable adaptation. Furthermore, effective implementation requires supportive policies, equitable access to resources, and the integration of traditional Indigenous knowledge with advanced climate science. Ultimately, building adaptive capacity is not merely a technical challenge but a socio-ecological imperative, essential for safeguarding the planet's biological and agricultural productivity for future generations.

Keywords: Climate Resilience, Agroecology, Sustainable Agriculture, Ecosystem Services, Adaptive Management.

EXTRACTION OF BIODIESEL FROM CHICKEN WASTE FOR ECO-FRIENDLY BIO-WASTE MANAGEMENT

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Extraction of Bio-diesel from chicken waste by two stage transesterification method using waste egg shell based catalyst was studied. Cao, as base catalyst was obtained by calcination of chicken egg shells at 800⁰C for 4 hours. Chicken waste was collected and chicken oil was rendered. Crude chicken oil was pre-esterified using Methanol with 1:40 molar ratio in presence of 1.0% acid catalyst at 60⁰C for 90 minutes with continuous stirring at 500 rpm to obtain FAME. FAME was trans-esterified using Methanol with 1:6 molar ratio in presence of base catalyst Cao at 1.5, 3.0 & 4.5 % level, at 60⁰C for 4 hours with continuous agitation. The resultant biodiesel was analyzed by ASTM standards showed results for Density 0.9217gm/ml, Sulphur Content 110ppm, Kinematic Viscosity 33.10 cSt, Water content 232ppm, Acid Value 0.35 mgKOH/GM & Flash point at 184 ⁰C. The economics of bio-diesel production found as a viable entity.

Keywords: Bio-diesel, Chicken waste, Transesterification, Egg Shell CaO, pre-esterification.

PREPARATION FISH PROTEIN HYDROLYSATES AND CHARACTERIZATION OF THE BIOACTIVE PEPTIDES USING COMMERCIAL PROTEASES FROM THE INDIAN MACKEREL (*Rastrelliger kanagurta*)

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In present study attempt has been made to extract bioactive compounds from mackerel (*Rastrelliger kanagurta*) such as collagen, fish protein hydrolysate (FPH), body oil, fatty acids (EPA and DHA) and PUFA concentrate. In present paper only focused on FPH, The yield of hydrolysate of mackerel with various concentrations of enzymes for 3 hr. hydrolysis period was recorded to have more yields with increased hydrolysis time and concentration of enzyme. When 0.5 % alcalase was used for extraction of FPH at different hydrolysis time i.e. 1, 2 and 3 hours then hydrolysate yield was recorded as 8.42%, 11.14% and 13.72% respectively. The result indicated that when 1 % alcalase was used for extraction of FPH at different hydrolysis time i.e. 1, 2 and 3 hours then hydrolysate yield was recorded as 08.93%, 11.14% and 15.91% respectively. The results indicated that when 2 % alcalase was used for extraction of FPH at different hydrolysis time i.e. 1, 2 and 3 hours then hydrolysate yield was recorded as 9.12%, 14.36% and 18.36% respectively. The proximate composition of fish protein hydrolysate i.e. crude protein, fat, moisture and ash content in fish protein hydrolysate was recorded at different concentrations of alcalase enzyme and hydrolysis time with increasing the concentration of enzyme from 0.5 % to 2 %, it was observed that protein and moisture values were decreased, while values for fat and ash were increased. The degree of hydrolysis of mackerel muscle with various concentrations of enzymes at 3 hr. hydrolysis period was more. The results indicated that when 0.5 % alcalase was used for preparation of FPH at different hydrolysis time i.e. 1, 2 and 3 hours the degree of hydrolysis was recorded as 08.75%, 10.08% and 13.76% respectively. The results indicated that when 1 % alcalase was used for of FPH at different hydrolysis time i.e. 1, 2 and 3 hours then DH was recorded as 11.14, 13.13 and 14.76% respectively. When 2 % alcalase was used for extraction of FPH at different hydrolysis time i.e. 1, 2 and 3 hours then degree of hydrolysis was recorded as 18.34, 21.14 and 23.12% respectively. The PAGE protein pattern of FPH was analysed which showed various bands, with molecular weight in between 50 to 180 kDa in FPH pattern. Invitro experiment was conducted for antioxidative and antimicrobial activity of FPH, and positive results were shown.

Keywords: Indian Mackerel, Fish Protein Hydrolysate, Enzyme and Degree of hydrolysis

ENHANCING DRAGON FRUIT [*Hylocereus undatus* L.] SHOOT GROWTH WITH INDOLE-3-BUTYRIC ACID (IBA) AND GROWING MEDIA

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This study was done to determine the most suitable concentration of IBA and growing media for enhancing the shoot growth of stem cuttings of dragon fruit (*Hylocereus undatus*). The experiment was laid out in Factorial CRD and replicated three times with 16 treatment combinations including four plant growth regulator (IBA) concentrations (control, 2000, 4000 and 6000 ppm) and four growing media (control, sand : cocopeat, sand : vermicompost and sand : vermicompost : cocopeat). At 75 days after planting of cuttings, least days taken for sprouting (25.01 days), percentage sprouting (59.53%) and shoot length per cutting (14.80 cm) were recorded higher in cuttings dipped in 6000 ppm concentration of IBA and similarly, least days taken for sprouting (25.01 days), percentage sprouting (59.53%) and shoot length per cutting (14.80 cm) when cuttings were grown in sand: vermicompost: cocopeat media. The results suggest that IBA at 6000 ppm concentration and sand: vermicompost: cocopeat media at a rate of 1:1:1 on volume basis is better for enhancing shoot growth of the dragon fruit cuttings.

Keywords: Cuttings, Dragon Fruit, Growing Media, and Shoot Growth.

STUDY OF CELLULOSE NANO-FIBERS FROM COW DUNG TO ANALYZE THEIR COMMERCIAL UTILIZATION IN POLYMER COMPOSITE AND PAPER MAKING FOR FUTURISTIC WASTE MANAGEMENT

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In the present investigation Dung samples of total 50 indigenous cow breed of Maharashtra were analysed for their characterization and to study their suitability for making fiber composite and handmade paper for the futuristic waste management. The undigested organic particulate matter from freshly voided cow dung as separated by washing with water through 5 micron water filter bag and allowed for sun drying for 3 days. Average 61.70 % fiber mass on wet basis was received however after sun drying the total fiber mass received was 6.09 % of the fresh dung. It was estimated that Indigenous cow breed of Maharashtra State has a potential to recover about 57.12 ton of good quality dried dung fibres per day with an average of 2.08 million ton cow dung based cellulose fibre annually. Two different regimes of cooking and non-cooking of obtained raw cow dung fibers were employed for the development of nano-crystalline cow dung fibers. Four different treatments viz. T1A, T1B, T1C and T1A, T2B, T2C comprising of washing with baking soda at 5, 10 & 15% inclusion levels and T1D & T2D of acid-alkali treatment were used for delignification and dewaxing dung fibers respectively for T1 & T2. Later a common protocol of standard procedure was followed for both treatments for bleaching, drying, grinding with modified jar and acid hydrolysis of dung fibers were implemented to obtain nono crystalline cellulose fibers from cow dung. It was observed that, the average final weight of the sample treated with T1D was 31.36 gm with 18.36 average difference in initial weight of the sample. The percentile loss in weight in sample treated with T1D was calculated 37.27%. The colour of the final cellulose fibre noted in this treatment group was lemon yellow. Dried cow dung fibers can be converted into nano-crystalline cellulose fibers by using mechanical power of a grinder assembled with sharp steel blade fixed on internal wall of the grinder at 45° with the base. FTIR of cow dung fiber showed a complex organic particulate matter made up of OH groups of alcohols, phenols or carboxylic acid. CH vibrations of aliphatic groups. C=C stretching of terminal alkynes and other Organic molecules that have groups, such as -OH, -CHO, -COOH, -CN, -SCN, -CO, -NH₂, -SO₃, double or triple bonds or unpaired electrons. In SEM Microscopically cow dung fiber is slender rod shaped porous particulate matter of uneven morphology and can be a suitable material for making fiber composite and paper However In TEM the fiber details of fiber strands and its cellular structure was clearly observed. The nono sized dung fibers were consist of a parallel bundles of fine threads of cellulose and other organic particulate matters. The microscopic appearance of dung fibers under TEM confirms the Crystalline and amorphous nature of strands of the cow dung fiber. In TGA Thermal degradation causes average weight loss of 84.46% of the dung fibers. However the average procedural decomposition of dung fiber ranges from 279.54°C to 322.44 °C., In DSC, The initial onset temperature of the first thermal event was 28.4°, 28.9, 29.88, 29.60 & 27.70°C, however the extrapolated starting temperature was recorded at 57.8° 65.3, 58.4, 72.5, 57.3°C. It was recorded as the endothermic thermal event with raised heat flow up to 0.143, -0.220, -0.672, -0.088 & 0.110 Mw. it was supposed to be due to absorption of heat at initial phase by the dung fibres., Exothermic thermal peak plotted from 28.4 to 94.9, 28.89 to 84.5, 28.89 to 84.5, 30.2 to 97.3 and 27.9 to 95.7°C temperature. The enthalpy for the thermodynamics of dung fibres of Dangi cattle in DSC was recorded as 217, 197, 223, 175 & 212 mJ/mg., Cow dung fibers can be obtained by washing freshly voided dung with water through 5 micron filter bag and subsequent sun drying. Cow dung fibers can be used for making fiber composite and handmade paper efficiently, however the further research is needed to find out the most economic methods for commercial utilization of Cow dung fibers.

Keywords: Cow dung fiber, Dung morphology, Fiber Composite, Paper making, cellulose nano fiber

INFLUENCE OF FERTILIZER LEVELS, METHODS AND SPLIT APPLICATION ON YIELD AND ECONOMICS OF POTATO (*Solanum tuberosum* L.)

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Potato (*Solanum tuberosum* L.) is one of the most important food crops of the world and occupies a key position in Indian horticulture due to its high productivity, short duration and wide adaptability. Efficient nutrient management is a critical factor for realizing higher yield and quality of potato, as the crop is highly responsive to fertilizer application. Optimization of fertilizer level, method and timing is therefore essential for sustainable potato production. A field experiment was conducted to evaluate the response of potato to different fertilizer levels, methods and schedules of application. The experiment was laid out in Randomized Block Design with three replications using potato variety *K. Surya*. The results indicated that split application of 100% recommended dose of fertilizers (RDF) in three splits [40:50:50 NPK kg ha⁻¹ as basal + 40:50:50 NPK kg ha⁻¹ at 30 days after planting (DAP) + 40:0:0 NPK kg ha⁻¹ at 45 DAP] produced the maximum tuber yield (24.24 t ha⁻¹). Economic analysis revealed that application of 100% RDF (80:100:100 NPK kg ha⁻¹ as basal + 40:0:0 NPK kg ha⁻¹ at 30 DAP) resulted in the highest benefit–cost ratio, indicating its economic feasibility. The study concludes that split application of 100% RDF is the most efficient and profitable fertilizer management strategy for enhancing potato yield under the agro-climatic conditions of Chhindwara.

Keywords: Potato, Fertilizer levels, nutrient

ENHANCING FOREST PRODUCTIVITY AND FARM SUSTAINABILITY THROUGH SILVICULTURE AND AGROFORESTRY

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Silviculture and agroforestry together form a scientifically grounded and sustainable approach for enhancing forest productivity and improving long-term farm performance. Silviculture emphasizes the systematic management of tree species through scientifically guided practices such as site-specific species selection, optimal spacing, thinning, pruning, and sustainable stand regeneration. These methods improve timber quality, increase stand stability, and enhance overall ecosystem functioning. Agroforestry complements silviculture by integrating trees with crops and livestock in a multifunctional land-use system, which improves soil fertility, enhances biodiversity, stabilizes the microclimate, and broadens income opportunities for farmers. The combined application of silvicultural principles within agroforestry systems leads to efficient resource utilization, increased ecological resilience, and improved productivity across landscapes. Collectively, these integrated approaches support environmental sustainability, strengthen rural livelihoods, and promote climate-resilient land management.

Conclusion: Integrating silviculture with agroforestry creates a resilient and productive land-use system that benefits both forests and farms. Silviculture enhances tree growth and ecosystem stability, while agroforestry improves soil health and diversifies farm income. Together, they promote sustainable resource use, climate resilience, and long-term ecological and economic sustainability.

Keywords: Silviculture, Agroforestry, Forest Productivity, Farm Sustainability, Sustainable Land Management, Soil Conservation, Climate Resilience, Biodiversity, Tree–Crop Systems, Natural Resource Management.

EFFECT OF SEED PRIMING AND ORGANIC MANURES ON GROWTH, YIELD AND QUALITY OF OKRA (*Abelmoschus esculentus* L.)

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Seed priming and organic manures are crucial techniques for enhancing the growth and productivity of okra (*Abelmoschus esculentus* L.). A study was conducted to evaluate the effect of different seed priming methods and organic manures on the performance of okra. Four seed priming treatments were tested: P₀ –control (no priming), P₁ – hydropriming (seeds soaked in tap water for 12 hours), P₂ – hormonal priming (seeds treated with 200 ppm GA₃), and P₃ – bio-priming (seeds treated with *Trichoderma viride* for 2 hours). Similarly, four organic manure treatments were evaluated: O₀ – control, O₁ –FYM @20 t/ha, O₂ – vermicompost @6 t/ha, and O₃ – poultry manure @3 t/ha. The results indicated that hormonal seed priming (P₂) significantly improved seed germination, seedling vigor, and overall plant growth compared to other priming methods. Among organic manures, vermicompost @6 t/ha (O₂) exhibited superior performance in enhancing plant height, leaf development, and yield parameters. The combination of P₂ (hormonal priming) and O₂ (vermicompost) was found to be the most effective, resulting in optimal growth and productivity of okra. These findings suggest that integrating hormonal seed priming with vermicompost application can be recommended as an effective strategy for improving okra cultivation.

Keywords: Okra, seed priming, hormonal priming, vermicompost, organic manures, growth enhancement.