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Proceedings of the

International Conference on Environment, Agriculture, Horticulture & Life Sciences

27th and 28th August 2026

Theme: "Science, Innovation and Sustainability for a Better Planet"

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Verso Page

Proceedings of the

International Conference on Environment, Agriculture, Horticulture & Life Sciences - (ICEAHLS 2026)

27th and 28th August 2026

Agricultural College & Research Institute (AC & RI), Tamil Nadu Agricultural University(T-NAU) Madurai, Tamil Nadu, India

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PREFACE:

It gives us immense pleasure to present the Abstract Proceedings of the International Conference on Environment, Agriculture, Horticulture & Life Sciences (ICEAHLS 2026) held on 27th–28th August 2026 at the Agricultural College & Research Institute (AC&RI), Tamil Nadu Agricultural university(TNAU) Madurai, Tamil Nadu, India.

The conference serves as a global platform for researchers, academicians, scientists, industry experts, policymakers, entrepreneurs, and students to exchange innovative ideas, research findings, and practical experiences in the fields of Environment, Agriculture, Horticulture, and Life Sciences. The event aims to foster interdisciplinary collaboration and promote sustainable solutions to address emerging global challenges.

The abstracts included in this proceedings volume represent diverse research contributions from participants across various universities, research institutions, industries, and organizations worldwide. These contributions highlight recent advancements, innovative technologies, and sustainable practices that can contribute to scientific progress and societal development.

We sincerely thank all keynote speakers, invited speakers, session chairs, reviewers, advisory committee members, organizing committee members, sponsors, collaborating institutions, and participants for their valuable contributions and support in making this conference a success. We hope that this proceedings volume will serve as a useful reference for researchers, professionals, and students, and inspire future collaborations and scientific endeavors. We extend our best wishes to all participants for their continued success in research, innovation, and knowledge dissemination.

-International Conference on Environment, Agriculture, Horticulture & Life Sciences

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About Conference:

The **International Conference on Environment, Agriculture, Horticulture & Life Sciences (ICEAHLS),** organized by the **International Association for Innovation and Scientific Research (IAISR),** will be held on **27th and 28th August 2026** at **AC & RI, Madurai,** Tamil Nadu, India under the theme "Science, Innovation and Sustainability for a Better Planet."

The conference is being organized in association with the **Faculty of Built Environment,& Surveying, Universiti Teknologi Malaysia (UTM), Malaysia, Agricultural College & Research Institute (AC & RI), Madurai, and the Horticultural College & Research Institute (HC & RI), Periyakulam, both constituent colleges of the Tamil Nadu Agricultural University (TNAU)**, along with the International Association for Innovation and Scientific Research (IAISR)

The International Conference on Environment, Agriculture, Horticulture & Life Sciences (ICEAHLS) aims to foster the dynamic exchange of knowledge, experience, and innovative ideas among researchers, academicians, industry professionals, and policymakers across a broad range of disciplines. Will serves as a global platform for researchers, practitioners, and policymakers to connect, exchange ideas, and shape a future where science, innovation, and environmental stewardship go hand in hand for the benefit of people and the planet.

About IAISR:

The International Association for Innovation and Scientific Research (IAISR) is a global professional body dedicated to advancing research, innovation, and interdisciplinary collaboration across science, technology, and sustainable development. IAISR organizes international conferences, workshops, and training programs that connect researchers and professionals from around the world, fostering a culture of knowledge exchange and innovation for societal progress.

IAISR: ADVANCING KNOWLEDGE, TRANSFORMING TOMORROW

VISION AND MISSION OF IAISR:

IAISR plays a pivotal role in fostering a technological revolution and driving the sustainable development of science, engineering, and technology. Our vision is to serve as a critical platform for the global technical community, empowering professionals worldwide and being universally recognized for the transformative contributions of technology and technical experts in improving global conditions.

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UTM, Malaysia

The Faculty of Built Environment & Surveying (FABU) at Universiti Teknologi Malaysia (UTM) is a leading academic and research hub dedicated to advancing knowledge and innovation in the built environment, planning, architecture, construction, geomatics, and surveying disciplines. FABU is committed to producing highly skilled professionals, researchers, and leaders who contribute to sustainable development, smart cities, and resilient infrastructure at national and global levels. The faculty offers multidisciplinary undergraduate and postgraduate programmes that integrate theory, practical training, and industry engagement. Programmes are designed to meet international standards and address real-world challenges in the built environment sector.

Research & Innovation FABU actively promotes cutting-edge research in areas such as: Sustainable urban development, Smart and resilient cities, Geomatics and geospatial technologies, Construction management and innovation, Environmental planning and design. The faculty collaborates with international universities, associations, research institutes, government agencies, and industry partners to drive impactful research and knowledge transfer.

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

About AC &RI:

Madurai Agricultural College was started during 1965 and upgraded to PG centre during 1969. It became a constituent college of the Tamil Nadu Agricultural University, after its formation in 1971 and came to be known as Agricultural College and Research Institute, Madurai in 1980. The campus celebrates its Diamond Jubilee this year from October 2025 to November 2026. It is the second largest Agricultural College Campus in Tamil Nadu Agricultural University. The college, has the following departments' viz., Agricultural Economics, Agricultural Engineering, Agricultural Entomology, Agricultural Extension and Rural Sociology, Agricultural Microbiology, Agronomy, Biotechnology, Horticulture, Plant Breeding and Genetics, Plant Pathology, Seed Science and Technology and Soils & Environment to provide Agricultural Education and also a Krishi Vigyan Kendra in the college campus to disseminate the findings among farmers.

The establishment of the Institute is an important landmark in expanding education as well as scientific research in Agriculture in Southern Tamil Nadu. This Institute has always been an enduring symbol of the best agricultural research and has assiduously maintained the highest standards of academic excellence matching the best in the world. This campus was adjudged as the Best College in TNAU four times during 2002, 2008, 2017 and 2021.

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About HC &RI:

HC & RI is a pioneer constituent college of Tamil Nadu Agricultural University concentrating research and development programmes in horticultural crops. The institute was started during 1962 as a Horticultural Research Station for conducting research in horticultural crops particularly fruits, vegetables and Plantation crops. During the year 1975 ICAR, New Delhi recognized the station and provided AICRP (Fruits) for conducting citrus research in South India. Later, the institute was upgraded as Horticultural College and Research Institute, for academic and research excellence. The institute has contributed & released horticulture varieties and technologies in mandatory and fruits, vegetables, flowers, medicinal and aromatic crops for the benefit of scientists and the farmers. In International and National level, HC&RI, Periyakulam is the scientific referred institute for widening of plant genetic resources many and technological interventions.

About IPS:

The scientific society has been initiated and inaugurated by Deputy Director General (Horticulture) Indian Council of Agricultural Research during 2024 in the International Conference in Precision Horticulture at Periyakulam, Tamil Nadu for exclusively fruit research and development with the main theme of nutritional security in India. The society have more than 200 life members and patron throughout Nation. The society providing awards and recognition of Indian pomologist those contributed excellent research and development in fruit crops

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About Vallabhbhai Patel Farmers Welfare Trust, Madurai

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Welcome Message

प्रो. संजय कुमार सिंह
उप महानिदेशक (बागवानी विज्ञान)
Prof. S.K. Singh
FNAAS, FIAHS, FDBT
Deputy Director General (Horticultural Science)

भाकृअनुप
ICAR

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INDIAN COUNCIL OF AGRICULTURAL RESEARCH
KRISHI ANUSANDHAN BHAVAN-II,
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MESSAGE

Agriculture has been the backbone of human civilization and continues to play a pivotal role in India's economy, food and nutritional security, and rural livelihoods. Horticulture has emerged as a major growth engine within the agricultural sector, contributing significantly to farm income, employment generation, nutritional security and economic development. India is the second-largest producer of fruits and vegetables in the world, after China, and is endowed with diverse agro-climatic conditions that provide immense opportunities for the cultivation of a wide range of horticultural crops.

Horticulture contributes nearly 33% to the agricultural Gross Domestic Product while occupying only about 13.1 % of the gross cropped area, highlighting its importance in enhancing the productivity and profitability of Indian agriculture. With the growing demand for quality food, changing consumer preferences and emerging opportunities in domestic and international markets, there is a need to further strengthen the horticultural sector through science, technology and innovation.

Achieving the goal of doubling farmers' income requires the adoption and large-scale dissemination of innovative, cost-effective and climate-resilient technologies. Precision production and protection technologies, protected cultivation, mechanization, organic and sustainable production practices, efficient resource management, post-harvest management, value addition and reduction of post-harvest losses are essential for improving the productivity, quality and profitability of horticultural crops. Strengthening linkages among research institutions, extension agencies, entrepreneurs, industry and farmers will be crucial for translating scientific advances into field-level impact.

In this context, it is a matter of great pleasure that the Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, is organizing the International Conference on Environment, Agriculture, Horticulture and Life Sciences from 27-28 August 2026. The conference provides an excellent platform for scientists, academicians, scholars, entrepreneurs, nursery and allied sectors, extension professionals and farmers to exchange knowledge, share innovations and deliberate on emerging challenges and opportunities.

The twelve thematic areas of the conference comprehensively address contemporary issues and innovations in environment, agriculture, horticulture and life sciences, with particular relevance to enhancing productivity, quality, value-addition, sustainability and export potential. Such a multidisciplinary forum will certainly contribute to strengthening scientific collaboration and promoting the effective transfer of technologies for the benefit of farming communities.

I am pleased to extend my warm greetings and best wishes to all the participants, organizers and stakeholders of this International Conference. I am confident that the deliberations and outcomes of the conference will contribute meaningfully to the sustainable development of horticulture and agriculture.

I wish the International Conference on Environment, Agriculture, Horticulture and Life Sciences a grand success.

14/08/26

(Sanjay Kumar Singh)

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TAMIL NADU AGRICULTURAL UNIVERSITY

Dr. M. Raveendran, Ph.D.
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FOREWORD

It gives me immense pleasure to learn that the International Association for Innovation and Scientific Research (IAISR), a non-profit professional association committed to advancing research and innovation in Agricultural, Medical and Life Sciences, is organizing this International Conference on "Science, Innovation and Sustainability for a Better Planet.

Over the past century, Tamil Nadu Agricultural University has evolved into a premier institution with a strong commitment to excellence in teaching, research, innovation and extension. We firmly believe that scientific advancement, interdisciplinary collaboration and knowledge sharing are essential to addressing the complex challenges confronting agriculture, the environment, human health and society.

The theme of this conference, "Science, Innovation and Sustainability for a Better Planet," is both timely and significant. The world is facing unprecedented challenges arising from climate change, environmental degradation, natural resource depletion, food and nutritional insecurity, emerging diseases and rapid technological transformation. Addressing these challenges requires scientific knowledge to be translated into innovative, inclusive and sustainable solutions.

As we come together to share knowledge and forge new partnerships, we must recognize that sustainability is a collective responsibility. Governments, academic and research institutions, industries, civil society and communities must work together to transform scientific discoveries into solutions that benefit people and protect the planet. Conferences such as this provide an important avenue for fostering such collaborations and inspiring the next generation of researchers and innovators.

I am confident that the deliberations of this conference will be intellectually stimulating and outcome-oriented, leading to new ideas, enduring collaborations, innovative technologies and impactful solutions for a sustainable future. I hope that the knowledge and partnerships emerging from this forum will contribute meaningfully to the advancement of science and to the well-being of society.

May this conference inspire scientific excellence, innovation, collaboration and collective action for a healthier, more resilient and sustainable planet.

Best wishes for a successful and memorable conference.

TAMIL NADU AGRICULTURAL UNIVERSITY
AGRICULTURAL COLLEGE AND RESEARCH INSTITUTE
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Date: 14.08.2026

MESSAGE

Agriculture remains the backbone of the Indian economy and a major source of livelihood, food and nutritional security, rural development and employment. In view of emerging challenges such as climate change, food security and sustainable resource management, scientific advancement, innovation, technology and knowledge sharing in agriculture and allied sectors are essential.

It gives me immense pleasure to welcome all distinguished participants to the **International Conference on Environment, Agriculture, Horticulture and Life Sciences**, being organized at the **Agricultural College and Research Institute, Madurai, on 27–28 August 2026**. The two-day conference brings together **scientists, academicians, researchers, scholars, students, entrepreneurs and other stakeholders** to share research findings, innovative ideas and expertise and to promote academic and professional collaborations.

The conference covers **12 contemporary themes**, including agriculture and environmental sciences; horticulture and forestry; food science and biotechnology; animal and veterinary sciences; waste and water management; economics, education and rural development; biological and molecular sciences; microbiology and immunology; biotechnology and bioinformatics; human life sciences and health; emerging technologies; and life sciences for sustainable development. **Lead and invited lectures, oral and poster presentations, and scientific interactions** will provide an enriching platform for knowledge exchange.

I gratefully acknowledge the encouragement and support of the **Registrar and Acting Vice-Chancellor, Tamil Nadu Agricultural University, Coimbatore**, the **Hon'ble DDG (Horticulture), ICAR, New Delhi**, and the **Director of Research, TNAU**. I also sincerely thank the **International Association for Innovation and Scientific Research** for selecting **AC & RI, Madurai, and HC&RI, Periyakulam, as academic partners**, and all University officers, faculty, scientists, organizing committee members and staff for their valuable contributions.

Special appreciation is extended to the distinguished speakers and scientists from India and abroad for sharing their expertise both **in person and online**. I am confident that this conference will **foster new collaborations, stimulate innovative research and advance sustainable agriculture, horticulture, environment and life sciences for the benefit of society and the farming community**.

I extend my warm greetings and best wishes to all participants and wish the **International Conference a grand success**.

P. Chandra 14/8/26

(P. CHANDRAMANI)

INDIAN POMOLOGICAL SOCIETY

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Date : 14.08.2026

MESSAGE

I am delighted to extend my warmest greetings to all participants of the **"International Conference on Environment, Agriculture, Horticulture and Life Sciences (ICEAHLS-2026)"**, organized by the AC & RI, Madurai and HC & RI, Periyakulam, Tamil Nadu Agricultural University in collaboration with International Association for Innovation and Scientific Research (IAISR) to address the challenges and opportunities in agriculture and horticulture through advanced technologies. I feel proud that Indian Pomological Society is a promotional partner for this important international event.

As the world faces unprecedented environmental challenges, the role of production strategies in ensuring the nutritional security and sustainability have never been more critical. Precision production, focusing on optimising resources use, improving yield and reducing environmental impacts, is crucial to sustainable production. The advancement in agriculture and horticulturehas the potential to revolutionize the way we grow and manage our crops, ensuring that we can meet the nutritional needs of growing global population while preserving our planet for future generation.

This conference brings experts, researchers, and practitioners from different spheres of the globe to share their knowledge and insights on the latest technologies and practices in production of agricultural and horticultural crops. Through such collaborations and exchanges, one can drive innovation and make meaningful progress towards building safe and sustainable value chain.

I congratulate the organizers for bringing together such a diverse and knowledgeable group of participants. I am confident that this conference discussions and outcomes will contribute significantly to the advancement of research and its application in sustainable production system.

(S.SARASWATHY)

Welcoming Address

International Conference on Environment, Agriculture, Horticulture and Life Sciences (ICEAHLS 2026)
Theme: "Science, Innovation and Sustainability for a Better Planet"
27–28 August 2026 | TNAU, Madurai, India | Hybrid Mode

Distinguished Organisers -IAISR, respected academics, fellow researchers, industry representatives, esteemed delegates, ladies and gentlemen.
A very good morning to everyone. It is a great honour and privilege for me to join you as a Speaker at the **International Conference on Environment, Agriculture, Horticulture and Life Sciences 2026,** ICEAHLS 2026. I would like to express my sincere appreciation to the organisers, particularly IAISR, the host institutions, collaborating partners TNAU, and everyone involved in bringing together this important international academic platform. I am also delighted to see researchers, academics, practitioners, students and professionals from different disciplines and geographical backgrounds gathered under the timely theme, "Science, Innovation and Sustainability for a Better Planet." This theme is particularly significant because the challenges facing our societies today cannot be addressed within disciplinary boundaries. Climate change, environmental degradation, food security, resource scarcity, rapid urbanisation and changing patterns of land use are deeply interconnected. Agriculture, environmental management, horticulture, life sciences, technology, economics and the built environment must therefore increasingly work together. Sustainability should no longer be viewed merely as an environmental objective. It is fundamentally a question of how we manage scarce resources, allocate land, support communities, encourage innovation and create economic systems that remain viable for future generations. From my own field of real estate, property economics and land economics, the relationship between land and sustainability is particularly important. Land is a finite resource. Decisions concerning how land is valued, developed, allocated and managed have long-term consequences for agricultural productivity, environmental conservation, urban development, housing, infrastructure and economic growth. For this reason, there is an increasing need to move beyond conventional approaches that treat agriculture, environmental conservation and urban development as separate areas of policy. Sustainable development requires an integrated understanding of the economic, environmental and social value of land. Technological innovation is also transforming this relationship. Artificial intelligence, geospatial technologies, remote sensing, big-data analytics, smart agriculture and advanced environmental monitoring are providing new capabilities for understanding land and resource systems. However, technology itself is not the final objective. Its value depends on whether it enables better decisions, more efficient resource allocation, greater resilience and more equitable outcomes. This is where conferences such as ICEAHLS 2026 become particularly important. A conference should not simply be a venue for presenting completed research. It should provide an intellectual space where ideas are questioned, methodologies are strengthened, interdisciplinary connections are established and research is translated into practical solutions. I therefore encourage all participants, particularly our emerging researchers and students, to make full use of these two days. Engage actively with the presentations. Ask questions. Exchange perspectives with colleagues outside your immediate discipline. Most importantly, consider how your research can contribute not only to academic knowledge but also to addressing real challenges faced by governments, industries and communities. International and interdisciplinary collaboration will become increasingly important as sustainability challenges intensify. The environmental challenges experienced in one country may differ in scale and context from those experienced elsewhere, but many of their underlying drivers are shared. Knowledge developed in agriculture may inform land-use policy. Advances in environmental science may influence property development decisions. Innovations in horticulture and life sciences may contribute to food security and community resilience. Economic analysis can help determine whether these innovations can be implemented efficiently and sustainably. This interconnectedness is precisely why the theme of ICEAHLS 2026 is so relevant. As researchers, we should ultimately ask ourselves a fundamental question: How can our knowledge create measurable improvements in the way societies manage their resources and prepare for the future? Research achieves its greatest value when scientific evidence informs policy, innovation improves practice, and knowledge produces tangible benefits for society. I would therefore like to congratulate the organising committee for establishing this multidisciplinary platform and for bringing together scholars and practitioners around such an important agenda. I also extend my appreciation to all keynote speakers, presenters, participants and partners whose contributions make this conference possible. I look forward to sharing my perspectives during my keynote session and, equally importantly, learning from the research, experiences and insights presented by colleagues throughout ICEAHLS 2026. May this conference generate meaningful discussions, new research collaborations, stronger international networks and practical ideas that extend well beyond these two days. Once again, thank you for the kind invitation and for the opportunity to be part of ICEAHLS 2026. I wish the organisers and all participants a highly productive and successful conference.

Thank you, and I wish everyone an excellent ICEAHLS 2026

(Dr. Muhammad Najib Razali)
Universiti Teknologi Malaysia

International Association for Innovation and Scientific Research (IAISR)

WELCOME MESSAGE

I am delighted to extend my warmest greetings and a very cordial welcome to all participants of the **International Conference on Environment, Agriculture, Horticulture & Life Sciences (ICEAHLS)**, organized by the **International Association for Innovation and Scientific Research (IAISR)** in Faculty of Built Environment,& Surveying, Universiti Teknologi Malaysia (UTM), Malaysia, Agricultural College & Research Institute (AC & RI), Madurai, and the Horticultural College & Research Institute (HC & RI), Periyakulam, both constituent colleges of the Tamil Nadu Agricultural University (TNAU) at **Agricultural College and Research Institute, Madurai, Tamil Nadu, India**, on **27–28 August 2026.**

It is a matter of great pride for IAISR to bring together researchers, scientists, academicians, students, industry professionals, practitioners, and experts from diverse disciplines onto a common platform dedicated to knowledge sharing, scientific exchange, and innovation. The conference provides an opportunity to explore emerging developments and innovative approaches in environment, agriculture, horticulture, food, biological sciences, and life sciences. The world today is experiencing rapidly evolving environmental, agricultural, and societal challenges. Ensuring food and nutritional security, promoting sustainable agricultural practices, conserving natural resources, addressing climate-related challenges, and advancing technologies for a better quality of life require collaborative and interdisciplinary efforts. Scientific research, technological innovation, and knowledge-driven solutions have an essential role to play in addressing these challenges and building a more sustainable future. **ICEAHLS 2026** is envisioned as a platform where ideas can be exchanged freely, innovative research can be presented, and meaningful collaborations can be established. The diverse contributions included in this conference proceedings reflect the dedication and intellectual efforts of researchers and professionals working towards advancing knowledge and developing practical solutions for present and future challenges.

On behalf of the International Association for Innovation and Scientific Research (IAISR), I sincerely appreciate the valuable support and cooperation extended by **TNAU, Coimbatore, AC & RI, Madurai,** and **HC & RI, Periyakulam, UTM Malaysia,** express my gratitude to all Lead & Invited speakers, session chairs, reviewers, organizing committee members, delegates, presenters, volunteers, and participants whose contributions have made this conference possible.

I am confident that ICEAHLS 2026 will provide an enriching academic experience and encourage new ideas, interdisciplinary partnerships, and opportunities for future research and innovation. May the discussions and interactions during this conference inspire us to work collectively towards a more sustainable, innovative, and resilient future.

We sincerely thank **Cureus Journal – Springer Nature** for extending a valuable publication opportunity to the participants of ICEAHLS 2026. This collaboration provides an important platform for researchers to disseminate their scholarly work and further contribute to the global scientific community.

I extend my heartfelt welcome to all participants and wish you a fruitful, inspiring, and memorable conference experience.

Mr. Navin Kumar
(CPO IAISR)

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Speaker Abstracts

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Natural Flowers for Sustainable Development of Landscaping and Floriculture Industry

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[2]RVS Padmavathy College of Horticulture, Sempatty, Dindigul Tamil Nadu, India

Abstract

Earth was a beautiful landscape but man has ruthlessly exploited for his greed specially, in the last century. The widespread use of plastics in day today life for decoration is ever increasing habit among the livelihood which leads to affecting farmer's income and floriculture industry drastically besides it's significantly contributed to environmental degradation. Horticultural plants species are reduce pollution and play a vital role in environmental sustainability and act as a bio indicators. Some species of horticultural importance have evergreen, large leaved, rough bark, ecologically compatible, require minimum care, low water requirement, habit, pollution tolerance and dust scavenging capacity. They can absorb pollutants, release oxygen, and contribute to overall air and water quality. Nowadays, use of plastics extended in bouquet preparation, decoration of marriage hall, ornamentals plant species, worship god, potted plants, banana leaves, airports, hotels and even in some botanical gardens which is directly or indirectly affecting the flower growers and floriculture industry. In contrast, natural flowers or use of dry flowers presents a sustainable alternative for plastics emphasizing the integration of biodegradable materials, ecological design principles, and adoption of traditional practices in which possible to protect the environment. Despite challenges related to economic feasibility and scalability, policy interventions, consumer awareness, are driving the transition toward greener solutions. This paper will address the use of plastics and alternatives for sustainable development of flower growers and floriculture industry.

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Nano Fertilizers in Achieving Balanced Cotton Nutrition

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Division of Crop Production, ICAR- Central Institute for Cotton Research, Nagpur, Maharashtra State. India

Abstract

The demand for fertilizer is increasing, up to 300 kg ha^{-1} in cotton (Gossypium spp.). In the 21st century, few studies have emphasized the use of nano fertilizers (NF). NF are nanoparticles (NP) and nanomembranes that can directly augment or supply required nutrients for plant growth, offering higher surface area and nutrient use efficiency. This study focuses on the development of NF research in cotton production covering basic, fundamental, applied, and biosafety aspects over the last decade (2015–2025) and their application in achieving balanced nutrition. It also aims to address the knowledge gap in cotton nutrient management by illustrating existing data and providing a detailed analysis of NF. The study highlights synthesis, characterization, nutrient release, and efficacy of various NF. It elaborates on the response of novel NF including nano clays, nano-urea, nano zeourea, nano DAP, nano zinc, nano copper, nano magnesium, nano sulphur, nano lime, nano gypsum, nano-biofertilizers, nano composites, biochar, organo-mineral complexes and smart delivery systems in cotton. Application methods include seed treatment, soil application, and foliar spraying.NF provide slow and regulated delivery of nutrients, preventing nutrient loss. They are absorbed via roots and stomata, assisting a 10% increase in yield and farmers' incomes. Their combined use can reduce the subsidy burden for fertilizers. Adoption of granular or liquid NP formulations offers wide opportunities for effective use in cotton metabolism.NF are slow-release fertilizers and emerging supplements to conventional fertilizers. They improve bioavailability, maintain soil health, promote sustainable agriculture, and enhance food security. Their use decreases nutrient loss by trapping nutrients in pore structures, contributing to more efficient and environmentally friendly cotton production.

Keywords: Gossypium, Nano formulations, Nanotechnology, Nutrient Management

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Bio-intensive Management of Fruit Borer, *Conogethes punctiferalis* (Guenee) in Guava

Sandeep Singh
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Abstract

Guava, *Psidium guajava* L., is grown in tropical as well as subtropical regions of the globe, owing to its wider adaptability. Fruit borer, *Conogethes punctiferalis* (Guenee) (Lepidoptera: Cerambidae) has become a major pest of guava in India (Singh et al. 2023). *Conogethes punctiferalis* is a polyphagous borer pest, known to feed on more than 120 species of wild as well as cultivated plants (Gundappa et al 2018). It is a multivoltine insect pest. The female moths feed, oviposit and develop primarily in buds and fruits of all kinds of host plants. Among the fruit crops, it has been reported on mango, banana, guava, citrus, sapota, pomegranate, grape, apple and peach (Singh and Kaur 2015). In Punjab (India), it has been reported on various fruit crops such as guava, mango, pear, peach, plum, litchi and pomegranate (Singh *et al* 2018).

The larvae feed and pupate inside guava fruits and the pest-ridden fruits get dried and drop off at early stages. Other symptoms of the damage caused by this pest includes deformation of fruits at the point of entry of larvae. It feeds on seeds and the pulp of guava fruits, which weakens the fruit and it ultimately falls down. The hanging of excreta within the silken webs is a distinguishing symptom, from which the damage caused by the borer can be easily identified (Singh *et al* 2018).

Keeping in view increasing incidence of this pest on guava in Punjab (India), trials on its bio-intensive management were conducted in guava orchards of Punjab Agricultural University (PAU), Ludhiana, during 2019 to 2023 Among the homemade botanical formulations evaluated, homemade *neem* formulation @ 18 ml/L was most efficient in reducing per cent fruit infestation over control. There was 51.04 per cent reduction in damage over control, 1.55 MT increase in yield over control. *Trichogramma chilonis* @ 2000 parasitised eggs/ tree was most successful in containing the damage done by this pest in guava fruits in both rainy and winter season experiments conducted at Fruit Research Farm, PAU, Ludhiana and University Seed Farm, Ladhowal, respectively. There was 73.57 per cent reduction in damage over control and 1.70 MT increase in yield over control in rainy season crop at PAU, Ludhiana. In winter season experiment, there was 62.50 per cent reduction in damage, andc1.98 MT increase in yield at USF, Ladhowal. The best treatments were integrated into a Bio-intensive IPM modules and among the various BIPM modules, Module 3 consisting of burying infested fruits in augmentoria, installing light trap, clean cultivation, two sprays of homemade *neem* formulation @ 18 ml/L and three releases of *T. chilonis* @ 2000 parasitised eggs/tree was best, giving maximum reduction in damage over control at both the locations and achieving maximum net returns over control. There was 63.92 per cent reduction in damage over control and 2.23 MT increase in yield over control at PAU, Ludhiana. There was 65.35 per cent reduction in fruit damage and 2.36 MT increase in yield at USF, Ladhowal.

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Assessment of The Combination of Bamboo and Abaca Fibers into A Fiber Reinforced Polymer (Frp) As an Alternative Sustainable Jacketing Solution for Structural Retrofitting

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Abstract

The study analyzes the feasibility of using a combination of bamboo-abaca fiber FRP for structural retrofitting of reinforced concrete (RC) beam. The study is focused on the growing need to explore new environmental-friendly and economically viable options to use instead of conventional materials like steel and synthetic FRP used for retrofitting of structures. A set of experiments was performed according to the standards developed in ASTM regarding determining tensile strengths of individual fibers (bamboo and abaca) as well as their composite forms and flexural capacity of RC beams. According to experimental findings, the abaca fiber shows the maximum mean tensile strength with the value of 8.35 MPa, while the second place is taken by the hybrid bamboo-abaca fiber with the mean value of 5.03 MPa and the lowest one was observed for the bamboo fiber with the value of 2.86 MPa. Regarding flexural capacity, the highest modulus of rupture was registered in case of RC beams with retrofitting based on abaca fiber with the value of 12.32 MPa, which exceeded that of control and other fiber combinations. Interaction between fibers in case of hybrid composition was shown to have some impact on mechanical characteristics. The difference in values was explained by different mechanical behavior due to different fiber orientation, moisture content and bonding effectiveness. Thus, the research proved that natural fiber FRP could be used effectively in practice, especially in case of using abaca fiber as a local source of material

Keywords: Fiber Reinforced Polymer (FRP), Bamboo Fiber, Abaca Fiber, Structural Retrofitting, Reinforced Concrete, Tensile Strength, Flexural Strength, Sustainable Materials, Natural Fiber Composite

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An Integrated Data Analysis and Computational Approach to reveal Gene Signatures for Paediatric Tuberculosis Meningitis related to Non-Tuberculosis Patients

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Abstract

The burden of global disease continues to be dominated by tuberculosis. Tuberculosis meningitis (TBM) is its most important manifestation and occurs among both adults and children, with both high levels of morbidity and mortality. TBM kills up to half of the affected children, and of those who survive up to 53.9 percent will be left with some form of neurological damage. Poor outcome for TBM is largely associated with delayed diagnosis and the administration of anti-tuberculosis drugs. So, better identification of patients and timely initiation of successful therapy are essential to reduce TB in children. The ultimate goal of this research study was to find new markers which would help diagnose TB meningitis early in children, with RNA-seq being used to explore datasets of different tissues. Emphasis is placed on utilising machine learning approaches, numerous statistics and Bioinformatics with consideration given to the analysis of fixed cut-off values or p-values, to select a list of Differentially Expressed Genes (DEGs). Consequently, three new biomarkers were identified by combining the findings from RNASeq and machine learning, utilizing algorithms like multi-layer perceptron, support vector machine (SVM), and random forest (RF) to suggest the optimal model with high accuracy and performance for the identification of the new biomarkers. It was understood that the RF model surpassed the other classifiers by achieving an accuracy score of 1.0 in identifying new biomarkers of Tuberculosis meningitis in children. Then computational analysis of these genes was done with the potential drugs used for treating Tuberculosis meningitis using AutoDockTools software. This research study aligns with SDG-3: Good Health and Well-being.

Keywords: Tuberculosis meningitis (TBM), Differentially Expressed Genes (DEGs), Machine Learning, Multi-Layer Perceptron (MLP), Support Vector Machine (SVM), Random Forest.

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Studies on Acid lime (*Citrus aurantifolia* Swingle) cultivars for commercial seedlings production

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Department of Horticulture, AC & RI, Madurai, Tamil Nadu, India

Abstract

The present investigation entitled "Studies on acid lime (*Citrus aurantifolia* Swingle) cultivars for commercial seedlings production" was carried out at College Orchard, Department of Horticulture, Agricultural College and Research Institute, Madurai during 2026. The aim of the present investigation to evaluate the performance of acid lime cultivars (SNKL-1, Balaji, PKM-1 and Vikram) under different seed treatment methods (GA_3, NAA, Cow dung) for commercial seedling production. The results revealed that among the treatments, GA_3 @ 200 ppm (T_2) recorded the highest values for seed germination and seedling growth in all the cultivars. In SNKL-1, T_2 (200 ppm of GA3) recorded the highest germination percentage (77.24%), seedling height (21.80 cm), number of leaves per seedling (8.80), shoot length (10.93 cm), root length (10.87 cm) and seedling vigour index (1684.63). Similarly, T_2 recorded the highest germination percentage and vigour index in cv. Balaji (72.47 %; 1373.13) followed by PKM-1 (69.72 %; 570.31) Vikram (64.80%; 829.44). However, the lowest values observed in control (T7). The present study concluded that among the cultivars, SNKL-1 exhibited superior seedling performance for vigorous seedling production when compared with other cultivars and treatments.

Keywords: Acid lime, *Citrus aurantifolia* Swingle, growth regulators, Germination percentage, vigour indiex.

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Abstracts

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A Innovative Practical Approach to a Solution to Plastics and Other Waste Pollution to Maintain Clean Air and Sanitation and Environmental Protection in Balangir Town Balangir District in State of Odisha

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Abstract

The earth is only planet life exit due to Air, water, soil, ecosystem environment that why it called living world, Indian called mother earth. Air contain Oxygen for respiration, body contain 60-70 % water, get food and Selter Waste is a major cause of pollution, if burns lead Air Pollution, affect respiration, if dumping unsanitary landfills contributes to contamination of drinking water and cause infection and transmit diseases. The dry waste flows up to sea, ocean and contaminate it which endanger to life in water and dumps to soil makes soil infertile, unsuitable for farming and plantation, blocks ground water. The pollution is also one of the causes of global warming and climatic changes That's why effective waste management which suitable to Environment without polluting and hampering the life on earth. The solution which controls pollution, save waste, save environment, save earth, Innovation by Dr. Manmohan Bagh professionally Anesthesiologist and critical care with pain physician and passionately working as Environmental Activist since 2015. The Innovation highlights is Recycling and Utilization of Waste' decentralized model's success in fostering stakeholder reengagement, behavioral change and resource recovery. The principle behind the management is to stop waste related pollution, aiming to reduce dumping reduce Burning, reduce land filling reduce pollution. The activities includes door to door collection, road collection, collection from dumping yards, transferred to segregation center, segregations to different items channelized for Recycling and other used where it not creates Pollution.

Keywords: Dry waste management, Material recovery facility, Plastic waste, Recycling

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Prevalence and Clinical Profile of Hyper tension Among Adults with Tuberculosis: A Cross-Sectional Study at a Tertiary Care Centre Telangana

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Abstract

Background: Tuberculosis (TB) remains a significant cause of morbidity among Adults in developing countries. While comorbid conditions such as malnutrition and HIV are well recognized, the association between tuberculosis and hypertension in Adults has not been adequately explored. Early identification of hypertension in Adults TB patients is important to prevent long-term cardiovascular complications.

Aim: To determine the prevalence and clinical profile of hypertension among Adults with microbiologically confirmed tuberculosis at a tertiary care centre in Telangana.

Materials and Methods: This hospital-based cross-sectional study was conducted over a period of one month and included 50 Adults aged 18–40 years with microbiologically confirmed tuberculosis. Diagnosis was established using smear microscopy, CBNAAT. Blood pressure was measured using standard guidelines and categorized as normal, prehypertension, or hypertension. Clinical, demographic, microbiological, and nutritional data were collected and analyzed using appropriate statistical methods.

Results: Out of 50 Adults, the majority belonged to the 18–40 years age group (40%), with a male predominance (56%). Pulmonary TB was observed in 60% of cases. CBNAAT showed the highest diagnostic yield (90%), followed by culture (64%) and smear microscopy (40%). The prevalence of hypertension was 16%, while 20% had prehypertension. Hypertension was more common in smear-positive (25%) and culture-positive (18.7%) cases. A higher proportion of hypertensive Adults were undernourished (75%). No statistically significant association was found between hypertension and type of TB ($p > 0.05$).

Conclusion: Hypertension is relatively common among Adults with tuberculosis and appears to be associated with higher microbiological burden and poor nutritional status. Routine blood pressure monitoring should be incorporated into the clinical evaluation of TB patients to enable early detection and management.

Keywords: Tuberculosis, Hypertension,CBNAAT, Microbiological diagnosis, TB

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Estimation of Evapotranspiration in Dediapada Taluka using Remote Sensing and GIS Techniques

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Abstract

Evapotranspiration (ET) plays a crucial role in the hydrological cycle and is an important parameter for irrigation planning, water resource management, and climate studies. Accurate estimation of evapotranspiration helps in understanding crop water requirements and improving agricultural water management practices. The present study focuses on the estimation of evapotranspiration in the **Narmada district of Gujarat** using Remote Sensing and Geographic Information System (GIS) techniques. Satellite data from **Landsat-8** and **MODIS (MOD11)** were utilized to estimate land surface temperature (LST) and evapotranspiration for the winter seasons of **2020–21, 2021–22, and 2022–23**. Meteorological data such as air temperature, humidity, wind speed, rainfall, sunshine hours, and pan evaporation were collected from the Cotton Research Station, NAU, Bharuch. The FAO-56 Hargreaves method was applied to compute reference evapotranspiration, while satellite-derived LST and NDVI were used to estimate actual evapotranspiration through regression analysis and spatial modelling in ArcGIS software. The results indicated a strong correlation between satellite-derived temperature and observed temperature values. Comparative analysis showed that evapotranspiration estimated using Landsat-8 data closely matched the observed evapotranspiration values, whereas MODIS-based estimates showed greater variation due to differences in spatial and temporal resolution. The study demonstrates that remote sensing and GIS techniques provide an efficient and reliable approach for large-scale evapotranspiration estimation. Overall, the findings highlight the usefulness of satellite data in monitoring water consumption and supporting irrigation planning and sustainable water resource management in agricultural regions.

Keywords: Evapotranspiration, Remote sensing & GIS, South Gujarat, Water resources

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The Principle of Receivable-Based National Development: A Doctrinal Shift from Debt-Financed State Development

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Abstract

This study proposes a paradigm shift in development financing - from debt - based to receivable - based models. Debt - financed development has created long-term dependency, fiscal fragility, and reduced sovereignty. The article introduces receivable-based national development, where the state acts as a sovereign creditor, mobilizing assets such as taxation, natural resources, SOE revenues, and international claims. Result: Stronger fiscal sovereignty, reduced dependency, and intergenerational justice.

Keywords: Sovereign Debt, Receivables, Fiscal Sovereignty, Political Economy, DeveloPment Theory

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Performance Analysis of Brinjal KKM 1 Cultivation in Southern Districts of Tamil Nadu

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Abstract

Existing study was aimed to analyze input use pattern, costs, returns and profitability in Brinjal KKM 1 production of Thoothukudi, Tirunelveli and Tenkasi districts of Tamil Nadu. The sample of 60 Brinjal growers were selected from study area 20 in each district for which input-output data were collected in the year 2023-24. Standard cost concept was used to study the cost of cultivation, to analyze the data in the present study tabular analysis, and frequency and Garet's Ranking Technique method were used. The results of study revealed that per hectare total cost with regards to Brinjal KKM 1 was Rs. 1,16,110/- while cost A was Rs. 61,825/- and cost B was Rs. 1,04,610/-. The different measures of farm income were also estimated at their respective costs, benefit cost ratio and per quintal cost of production. Gross return was Rs. 2,63,200/-. It was clear that, farm business income, family labour income and net profit were Rs. 2,01,375/-, Rs. 1,58,590/- and Rs. 1,47,090/-, respectively. It was clear that; Benefit Cost Ratio was 2.26 in brinjal farm. Per quintal cost of production of brinjal was Rs. 782. Majority (60 per cent) of the respondents in the study area were cent percent satisfied with brinjal KKM 1 cultivation. The major problems in cultivation of brinjal were lack of water for irrigation, non-availability of credit, lack of scientific knowledge among farmers, high cost of seeds, pests and diseases, awareness on optimum use of fertilizers, and high cost of labour etc., Government and extension agencies should ensure the proper distribution of soil health card and create awareness on how to use, how much to use and when to use the fertilizers. Awareness should be created among the farmers for pest, disease and weed infestation and their management. For this, cost effective and easy to prepare organic pesticides should be made popular in the villages via large scale demonstration in agricultural fairs and awareness campaign.

Keywords: Performance, Brinjal, Cost, Returns, Profitability, Benefit Cost Ratio, Constraints

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Optimization and Characterization of $PrAHyd_{240}$-Based Curcumin Nanoemulsion with Improved Shelf Stability and In Vitro Digestion Profile

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Abstract

Food proteins act as excellent stabilisers by forming a strong, cohesive membrane around the droplet through intermolecular interactions. In this study, the emulsifying potential of the fish protein hydrolysate Channa punctata (PrAHyd240) was evaluated by formulating a curcumin-loaded nanoemulsion. PrAHyd240, short peptides exhibit significant bioactive potential, which has been exploited for formulating protein-based nanoemulsions. After 240 min of hydrolysis, the protein hydrolysate (PrAHyd240) showed the maximum degree of hydrolysis, i.e. 26.61 ± 0.16%. The study reveals that PrAHyd240 possesses functional properties. The short peptides has superiors antioxidant and antihypertensive potential. Thus, the potential of Channa punctata protein hydrolysate (PrAHyd240) prompted us to utilise and introduce it as a novel natural emulsifier for fabricating a biphasic nanoemulsion. Formulation and process parameters like oil, surfactant, curcumin content, and sonication time were optimized. Nanoemulsion formulation fabricated with 0.75 % of PrAHyd240 possesses the droplet size 179.5 ± 0.86 nm, which is much lower than 422.3 ± 1.21 nm, prepared with commercial surfactants Tween20: span 80 at a 1:1 ratio. A comparative assessment reveals that the presence of PrAHyd240 enhances the shelf-life stability of the formulation at both storage temperatures, 37 °C and 4 °C. Results show that at lower pH and at high ion concentration, the droplet diameter and the ζ-potential slightly increase. The inclusion of PrAHyd240 as the emulsifier induces the encapsulation potential to > 80%. The DPPH scavenging potential of the PrAHyd240 fabricated nanoemulsion increases to 92.47 ± 1.02% compared to native curcumin, i.e., 44.71 ± 1.32% In vitro digestion study reveals that PrAHyd240 induces the slow and steady release of curcumin after 5 h of simulated in vitro digestion.

Keywords: Channa punctata, Nanoemulsion, Encapsulation, bioactive, bioavailability.

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Indigenous Herbal Remedy for Subclinical Mastitis in Dairy Cows: an Exploratory Study

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Abstract

Subclinical mastitis, a common production disease of dairy cattle, causes economic loss to dairy farmers. Major contributing factors are poor hygiene, inadequate nutrition, and bacterial microorganisms' infections. Suspected cows are subjected to the Modified California Mastitis Test performed with the participation of the farmer to ascertain the status of subclinical infection in the quarter. The test is based on the increased somatic cell counts as well as the increased alkalinity of milk. Sixty dairy cattle, 240 quarters were screened for CMT, on examination, a total of 106 quarters were affected, diagnosed affected by subclinical mastitis condition. A prevalence rate of 44.16 percent was recorded. Based on selective culture media and the Gram staining technique, affected animal milk samples were cultured for identifying bacterial species. Out of 60 samples, Staphylococcus spp., Streptococcus spp., & Escherichia coli were found to be 53.33 per cent, 13.33 per cent, & 3.33 per cent, respectively, and combined infections of Escherichia coli & Staphylococcus spp. and Staphylococcus spp. & Streptococcus spp. were found to be 10.00% & 3.33%, respectively. Indigenous herbal supplement, i.e., thirty grams of Kovaichedi [Coccinia grandis] leaf powder was mixed with feed and fed to dairy animals for five days. Observation was monitored through the Modified California Mastitis Test in milk samples for five days, and results were recorded. Before treatment, a total of 106 quarters were affected by mastitis. After the supplementation of Coccinia grandis, 44 quarters were affected. Remarkably, 62 quarters were fully recovered, representing a recovery rate of 59 per cent. The study concluded that Kovaichedi herbal powder administration is effective in controlling subclinical mastitis in cows.

Keywords: Coccinia grandis, Dairy cattle, Subclinical mastitis

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Prevalence of Digital Eye Strain and Effectiveness of Eye Relaxation Techniques Among Nursing Students

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Abstract

Introduction: A growing health issue among students is Digital Eye Strain (DES), often called Computer Vision Syndrome, which is brought on by extended use of digital gadgets like laptops and smartphones. Its symptoms, which can negatively impact academic performance and general well-being, include eye strain, headache, dryness, inflammation, and blurred vision. Simple and efficient therapies are needed to lessen these symptoms in light of the growing reliance on digital learning. The objectives of this study was to assess the prevalence of Digital Eye Strain and to evaluate the effectiveness of eye relaxation techniques among nursing students. Materials and methods: A quantitative study with a descriptive and preexperimental one group pretest posttest design was conducted among 100 nursing students selected through convenient sampling. The Computer Vision Syndrome Questionnaire (CVS-Q) was used to measure digital eye strain. Eye relaxation techniques including the 20-20-20 rule, blinking exercises, eye focusing exercise and palming were demonstrated and practiced by all participants for 7 days. The same instrument was used for the posttest evaluation. Results: The prevalence of digital eye strain among nursing students was found to be 84%. The mean pretest score (7.65 ± 2.93) was reduced to 1.92 ± 1.39 in the posttest following the intervention. The reduction in scores was statistically highly significant ($t = 3.22$, $p = 0.001$). A moderate positive correlation ($r = 0.309$) was observed between screen time and digital eye strain scores, indicating that increased screen usage was associated with higher symptom severity. Significant associations were observed between pre-test digital eye strain scores and variables such as average screen time ($p = 0.0024$), device use before sleep ($p = 0.0454$), wearing spectacles ($p = 0.0109$), and pre-existing eye problems ($p = 0.0268$) at $p < 0.05$ level of significance. The results show that digital eye strain is common among nursing students and that eye relaxing techniques can effectively reduce symptoms. Conclusion: Nursing students can reduce their digital eye strain by using easy, affordable, and efficient eye relaxing techniques. Long term visual discomfort can be avoided and eye health can be improved by incorporating these activities in to daily routines.

Keywords: Computer vision syndrome, Eye strain, Digital eye strain, Eye relaxation techniques, Nursing students

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Unraveling the Mechanisms of Salinity Tolerance Amelioration in Plants Inoculated with Isolated Halotolerant PGPR

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Abstract

Inoculation of Plant Growth Promoting Rhizobacteria (PGPR) is an ecofriendly, sustainable and cost-effective approach for increased growth and productivity of agricultural crops. Further, PGPR are also known to protect the plants from oxidative damage caused by varied abiotic stress conditions. We have isolated few halotolerant bacteria from salt affected rhizospheric soils of Salicornia europaea L. of Tuticorin district of Tamil Nadu, India out of which at least four bacterial isolates have shown plant growth promoting traits and exhibited increased root growth and better development of tomato and rice plants upon inoculation under laboratory conditions. In the current study, the role of isolated halotolerant PGPR Staphylococcus sciuri ET101 and Providencia rettgeri ST202 in protection of photosynthesis in rice and tomato plants during salinity stress was evaluated by analysing changes in photosynthetic rates, ROS levels, antioxidant defense and activation of redox dissipation pathways. Compared to uninoculated plants, the PGPR inoculated plants have shown significant enhancement in growth along with higher photosynthetic rates under normal and salinity stress conditions. Further, increased expression of genes encoding antioxidant enzymes for efficient ROS detoxification and less oxidative damage were observed in leaves of PGPR inoculated plants. The decrease in chloroplastic CO_2 concentration and low mesophyll conductance leading to significant decrease in rate of photosynthesis in uninoculated plants during salinity stress was alleviated upon inoculation with isolated PGPR with higher carboxylation rates and higher photorespiration. Further, significant increase in expression of genes involved in photorespiratory process, cyclic electron flow, and alternative oxidase pathway of mitochondrial oxidative electron transport observed in leaves of PGPR inoculated plants indicates activation of redox dissipation pathways in inoculated plants during salinity stress. Cumulatively, our results suggest that isolated PGPR have the potential in protecting photosynthesis through activation of redox dissipation pathways for preventing oxidative damage under normal and salinity stress conditions.

Keywords: Oxidative Damage, Photosynthesis, Plant Growth Promoting Bacteria, Redox dissipation, Salinity Stress

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Attitude Towards Herbal Garden Among Nursing Students

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Abstract

A herbal garden is an area set aside for the cultivation of medicinal and aromatic plants (MAPs), which provide both therapeutic and preventive health benefits. In addition to raising awareness of traditional medical systems like Ayurveda, these gardens serve as living archives for study, education, and conservation. In order to promote sustainable and holistic practices among aspiring medical practitioners, there has been a growing interest in incorporating herbal knowledge into healthcare education in recent years. The study's objectives were to increase awareness of the value of herbal gardens and motivate nursing students to take an active role in starting them on college property. Materials and methods: Non experimental Descriptive design was used for this study.100 nursing students participated in the study, convenient sampling technique was used. Likert scale was used to collect data which was constructed by the researcher and validated by experts. Results: The findings revealed that 59% of the students had a favorable attitude, 40% had a moderately favorable attitude, and 1% had an unfavorable attitude towards herbal gardens. The overall mean attitude score was 76.08 ± 10.03, indicating a favorable attitude among the participants. Statistical analysis showed a significant association between type of family and attitude ($p = 0.0425$, $p < 0.05$), and between history of herbal treatment and attitude ($p = 0.0088$, $p < 0.05$). Conclusion: Based on the study's findings, nursing students have a generally positive opinion of herbal gardens. Initiatives for herbal gardens in educational institutions may promote awareness, enhance traditional knowledge, and promote the everyday use of therapeutic herbs.

Keywords: Herbal garden, Attitude, Herbal medicines, Nursing students

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Public and Private Investment Trends in Agricultural Research and Development in India: Problems, Gaps and Emerging Opportunities

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Abstract

Agricultural Research and Development (R&D) significantly improves agricultural productivity, strengthens food security, and promotes sustainable rural development in India. Given rapid technological shifts, climate-related challenges, and increasing pressure on agricultural resources, investment in agricultural R&D has become increasingly important for long-term sectoral growth and innovation. This study evaluates the trends and patterns of public and private investment in agricultural R&D in India from 2014-15 to 2023-24 and identifies the major problems, gaps, and emerging opportunities associated with these investments, which are crucial for shaping effective policies.

The study uses secondary data from official government reports, the Department of Agricultural Research and Education (DARE) budget documents, ICAR publications, and relevant research articles. It applies statistical tools, such as trend analysis and Compound Annual Growth Rate (CAGR), to assess the investment's growth pattern over the selected time frame. The analysis shows that public investment remains the primary source of agricultural R&D funding in India, while private investment has gradually increased in recent years, particularly in technology-driven segments, indicating significant emerging opportunities for stakeholders.

The study also highlights developments in biotechnology, digital agriculture, climate-resilient farming technologies, and policy reforms that can strengthen the agricultural innovation ecosystem. These findings offer an evidence-based framework for policymakers to improve investment strategies and promote sustainable agricultural development in India.

Keywords: Agricultural R&D, Public Investment, Private Investment, CAGR, India

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Bioefficacies of Essential Oils Against Microbes Associated with Street Food

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Abstract

Street food contamination is a major public health concern, especially in areas with limited food safety regulations. This study evaluated the antimicrobial activity of five essential oils (clove, lemongrass, mint, oregano, and black cardamom) against bacteria isolated from street food samples collected from local vendors. A total of 24 samples yielded 80 isolates out of which 12 were selected for further study, including seven gram-negative and five gram-positive species. The oils were tested at concentrations of 20–100% (w/v) using the well diffusion method, and activity was measured as zones of inhibition (ZOI). Statistical analysis was performed using one-way ANOVA ($p < 0.001$). Clove oil showed strong antimicrobial activity against both gram-positive and gram-negative bacteria, with inhibition zones up to 18.0 ± 0 mm (Moraxella sp.) and 16.6 ±0.47 mm (Acinetobacter sp.). Mint oil exhibited the highest overall activity, reaching 19.3 ±0.47 mm against Bacillus sp., followed by black cardamom (up to 18.0 ±0 mm) against Bacillus sp. and oregano (maximum 16.0 ±0.82 mm) against Proteus I sp. Lemongrass oil was the least effective, with a maximum ZOI of 15.6 ±0.47 mm. Gram-positive bacteria, particularly Bacillus sp. and Staphylococcus sp., were more susceptible (up to 19.3± 0.47 mm and 15.3± 0.47 mm), whereas gram-negative species like Pseudomonas sp. and Acinetobacter sp. showed higher resistance with minimum ZOIs of 11.0±0.82 mm and 13.0 ±0.81 mm. Overall, clove and mint oils were the most effective, while lemongrass showed the lowest activity. These results validate that concentration-dependent antibacterial qualities of clove, mint, and black cardamom EOs, which can inhibit a wide range of foodborne pathogens. Their application as natural preservatives in street food settings presents a promising, cost-effective strategy to reduce microbial contamination, could help extend shelf life and enhance food safety.

Keywords: Antimicrobial Activity, Essential Oils, Street Food, Natural Preservatives

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Genetic Diversity Analysis in Germplasm Lines of Pearl Millet (*Pennisetum glaucum* L.)

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Abstract

The present investigation was conducted to evaluate diversity the yield and yield related traits using principal component analysis in 97 germplasm lines of bajra and three checks collected from Agricultural Research Station, Ananthapur, A.P. during kharif, 2024 in an alpha lattice design with two replications to study genetic divergence based on 14 quantitative and qualitative traits. Analysis of variance reflected appreciable variability among the all the genotypes for almost all the characters. Principal component analysis indicated five principal components were with Eigen value greater than 1.00 and accounted for a total variation of 66.4 percent. The analysis revealed that PC1 showed the highest variance of 21.95% with major contribution by traits like grain yield per plant, panicle length and panicle girth. PC2 showed second highest variance of 15.13% with major contribution by days to 50% flowering and days to maturity. PC3 showed third highest variance of 11.68% and majorly contributed by zinc content and iron content. PC3 is followed by PC4 and PC5 with a variance of 9.07 percent and 8.51 percent, respectively. The biplot denoted that PC1 showed negative relation with iron content, zinc content and relative water content. While, PC2 showed negative relation with days to 50% flowering, days to maturity and SPAD chlorophyll meter readings and both the components showed positive relation with grain yield per plant, panicle length, panicle girth, number of productive tillers per plant, harvest index, thousand grain weight and plant height. Based on relative contributions of different characters grain yield, harvest index, test weight are good discriminatory characters. Most of principal components are related to morphological and yield attributing characters; hence these characters can be used to identify diverse genotypes for pearl millet improvement through hybridization programme.

Keywords: Pearl millet, germplasm, principal component analysis, Eigen values, Biplot and diversity

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Enhanced Lipase Production by Pseudomonas aeruginosa Isolated from Palm Kernel Cake and Its Industrial Potential

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Abstract

Lipases break down into free fatty acids and alcohol. These enzymes show significant attention due to their wide range of biotechnological applications. Among them, bacterial lipases are especially important because of their strong industrial relevance. They are widely used in the food and dairy industries for processes such as hydrolysis of milk fat, cheese ripening, flavor improvement, and breakdown of fats in butter and cream. In the present study, Palm Kernel Cake (PKC) sample collected from Kollam, Kerala, were used as a source and screened for lipase production using Tributyrin agar plates. Among the isolates, strain R1 showed the highest lipolytic activity and was selected for further study. Based on morphological and biochemical characteristics, the isolate was identified as belonging to the genus Pseudomonas. Thus by 16S rRNA gene sequencing and BLAST analysis identified it as Pseudomonas aeruginosa. The production of lipase was optimized using the p-nitrophenyl palmitate (pNPP) assay by studying different parameters such as pH, carbon source, substrate, surfactant, nitrogen sources, metal ions, inoculum size, incubation temperature, and incubation time. The highest enzyme activity was observed at pH 6.0, temperature of 30 °C, incubation period of 48 hours, and an inoculum size of 16 mL. The most suitable conditions showed that the medium composition for lipase production was Malt extract 1g; $NH_4H_2PO_4$ 0.1g; NaCl 0.29g; $MgSO_4.7H_2O$ 0.04g; Starch 1g; Gum Acacia 1g; D/W 100ml; pH 6 at 30oC. The wash performance test showed that the produced lipase was effective in removing oily stains from cloth when used along with detergents, indicating its usefulness in detergent applications.

Keywords: Palm kernel cake, Pseudomonas aeruginosa, p-nitrophenyl palmitate, wash performance test

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Exploring the Role of Rhizophagus Proliferus in Soil Carbon Dynamics and Plant Health: Implications for Agricultural and Environmental Sustainability

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Abstract

Rhizophagus proliferus (AMF) exhibits notable saprophytic activities, distinguishing it as an important contributor to soil and plant health. AM fungi help in the soil carbon dynamics by exerting a demand for plant carbon (C) and facilitating its distribution via below-ground hyphal biomass and spores by producing glycoproteins. Despite their substantial role in enhancing net primary productivity and augmenting the accumulation of photosynthetically fixed C in soil, the potential interactions of AMF with soil and their effects on soil carbon cycling remain largely unexplored.

Here, we investigated the beneficial impact of Rhizophagus proliferus on soil organic carbon and host plant Oryza sativa, under in-vivo condition. Our observations revealed substantial enhancement in total and available organic carbon, nitrogen, phosphorus, potassium and macroaggregates in the soil of treatment sets inoculated with Rhizophagus proliferus compared to control sets. Additionally, a two-fold increase in both plant height and root length was observed in treatment sets. These findings indicate the increase in soil carbon storage facilitated by higher hyphal biomass and soil aggregates in the treated soil.

Our study offers a foundation for further exploration into the relationship between Rhizophagus proliferus and soil carbon dynamics and their influence on carbon assimilation by supporting sustainable agriculture.

Keywords: Arbuscular mycorrhizal (AM) fungi, Carbon sequestration, Rhizophagus proliferus, Soil organic carbon, Plant development

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Metabolic Reprogramming Confers Partial Resistance to Sclerotinia sclerotiorum in Egyptian Clover

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Abstract

Stem rot, caused by Sclerotinia sclerotiorum, poses a serious threat to Egyptian clover (Trifolium alexandrinum L.), severely impacting productivity. To better understand host pathogen dynamics, this study elucidated the interaction between S. sclerotiorum and Egyptian clover with emphasis on metabolic alterations. Twenty-day-old seedlings of five clover varieties were inoculated with S. sclerotiorum and monitored at 0, 24, 72, and 120 hours post inoculation (hpi). Varietal responses to infection varied and categorised as Moderately Resistant (MR) (BL-43, HB-2, BB-2) and susceptible (S) (JHB-17-1, JHB-17-2) varieties. The pathogen secretes oxalic acid in conjunction with cell wall–degrading enzymes (CWDEs) that weaken host tissues to facilitate penetration and colonization. Susceptible varieties exhibited elevated level of oxalic acid and CWDE, peaking at 72 hpi indicating aggressive fungal colonization. In response to infection, clover varieties regulated their defence machinery with biochemical profiling revealing that MR varieties accumulated higher levels of non-enzymatic metabolites (soluble protein, proline, glutathione, ascorbic acid, chlorophyll, hydrogen peroxide), whereas susceptible varieties showed greater accumulation of sugars, malondialdehyde, and free amino acids. These metabolic adaptations in MR clover varieties appear to suppress the secretory arsenal function of S. sclerotiorum, thereby attenuating fungal invasion.

Keywords: Cell wall degrading enzyme, Egyptian clover, Oxalic acid, Sclerotinia sclerotiorum, Stem rot

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Long-term Injudicious use of Agrochemical Fertilizers and their Impact on Soil Health for Sustainable Productivity in Manipur

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Abstract

The present investigation accounts the agrochemical fertilizers consumption in Manipur from 2010–11 to 2023–24, evidences a fluctuation yet increases cumulative in the soil, with nitrogen dominating the nutrient profile and inequalities across different districts. Nitrogen (N) use varied considerably, with 10.67 thousand tonnes in 2010–11 and extending to 5.10 thousand tonnes in 2011–12, rising steadily to a peak of 15.23 thousand tonnes in 2022–23, followed by a decline to 11.78 thousand tonnes in 2023–24. Phosphorus (P_2O_5) consumption remained low until 2015 (2.15 thousand tonnes) and recorded a high of 4.82 thousand tonnes in 2018, but significantly decreased to 0.45 thousand tonnes in 2019, later recovering to 4.11 thousand tonnes in 2022–23 and declining again to 1.72 thousand tonnes in 2023–24. Potassium (K_2O) showed a similar inconsistent pattern, rising from 0.36 thousand tonnes in 2010–11 to 4.56 thousand tonnes in 2018, then falling drastically to 0.10 thousand tonnes in 2019 before stabilizing at 2.30 thousand tonnes in 2022–23 and 0.94 thousand tonnes in 2023–24. District-wise analysis revealed higher consumption in the valley districts. During Kharif 2022, Bishnupur (4.42 thousand tonnes of urea) and Thoubal (4.41 thousand tonnes) reported the highest use, followed by Imphal West (2.85 thousand tonnes) and Imphal East (2.58 thousand tonnes), whereas hill districts like Churachandpur (0.87 thousand tonnes) and Senapati (1.05 thousand tonnes) recorded much lower levels. A similar trend persisted in Rabi 2022–23, where Bishnupur (2.28 thousand tonnes urea, 0.57 thousand tonnes MOP, 0.64 thousand tonnes SSP) and Thoubal (2.27 thousand tonnes urea, 0.36 thousand tonnes MOP, 0.64 thousand tonnes SSP) dominated consumption, while Churachandpur and Senapati remained among the lowest. The dominance of nitrogen fertilizers, uneven phosphorus and potassium application, and district-level disparities bring out nutrient imbalances that threaten soil health. Long term use of all these agrochemical fertilizers demands a huge amount of lime ($CaCO_3$) to neutralize the acids caused by them in the soil however the farmers does not have the idea and in lieu of it they consider it as expenses of extra money. Acidity, i.e. low soil pH limits the availability of essential nutrients like P, Ca, and Mg; reduced microbial activity causing negatively impact to microbial biodiversity, affecting soil fertility, impaired soil structure, decrease crop yields, and increased risk of soil borne diseases. The study emphasizes judicious agrochemical fertilizers as nutrient inputs with organic manure and biofertilizers to sustain crop productivity, improve long-term soil fertility, and soil health in crop fields of Manipur.

Keywords: Injudicious, Soil biodiversity, Acidification, Biofertilizers, Organic manures

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Comparative Metabolite Profiling of Wild (*Trichosanthes cucumerina*) and Cultivated Snake Gourd (*Trichosanthes anguina* L.)

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Abstract

Snake gourd (*Trichosanthes anguina* L.) is an underutilized vegetable crop with significant nutritional and therapeutic potential. The present study aimed to perform a comparative metabolite profiling of wild (*Trichosanthes cucumerina*) cultivar and cultivated (*Trichosanthes anguina* L.) genotypes of snake gourd to understand variations in bioactive and volatile compounds. Metabolite analysis revealed distinct differences in the composition and functional properties of compounds between wild and cultivated types.

In wild snake gourd, dimethyl palmitamine (hexadecyl dimethylamine) was identified as a major volatile compound, exhibiting strong antifungal activity and contributing to plant defense through jasmonic acid-mediated signalling pathways. In contrast, cultivated genotypes showed a higher prevalence of compounds such as 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl (DDMP), which is associated with antioxidant activity and flavor development via Maillard reactions. Other metabolites, including dimethylglycine and 2-hydroxyisocaproic acid (HICA), were detected in both types, indicating their roles in nutritional enhancement and antimicrobial activity, respectively. HICA demonstrated antibacterial properties through disruption of microbial cell membranes, suggesting potential applications in food safety.

Additionally, 5-hydroxymethylfurfural (HMF) was identified, contributing to flavor and processing characteristics. The presence of major fatty acids such as hexadecanoic acid (palmitic acid), octadecanoic acid (stearic acid), and tetradecanoic acid (myristic acid) highlights the nutritional value of both wild and cultivated forms.

Overall, the comparative metabolite profiling revealed that wild genotypes are enriched with defense-related compounds, whereas cultivated types possess metabolites associated with improved flavor and nutritional quality. These findings emphasize the importance of wild genetic resources for crop improvement and support the potential of snake gourd as a functional food with nutraceutical applications.

Keywords: Snake gourd, Comparative metabolite profiling, Wild and cultivated, Bioactive compounds, Nutraceuticals

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Role of Minor Forest Produce (MFP) in Livelihood Security of Tribal Farmers in Chhattisgarh

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Abstract

Minor Forest Produce (MFP) plays a crucial role in supporting the livelihoods of tribal communities in forest-rich states like Chhattisgarh. A large proportion of the tribal population depends on the collection and sale of MFP such as tendu leaves, mahua, tamarind, and lac for income and subsistence. This study aims to examine the role of MFP in enhancing livelihood security among tribal farmers in Chhattisgarh. The study is based on secondary data collected from government reports and research publications. The findings indicate that MFP provides significant income and employment opportunities, particularly during lean agricultural seasons, thereby contributing to economic and food security. Government initiatives such as Minimum Support Price (MSP) have improved income stability. However, challenges such as price fluctuations, lack of value addition, inadequate storage facilities, and exploitation by intermediaries continue to limit its potential. The study concludes that strengthening market linkages, infrastructure, and policy support can enhance the contribution of MFP towards sustainable rural development.

Keywords: Minor Forest Produce, Livelihood Security, Tribal Farmers, Chhattisgarh, Sustainable Development

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Promoting Sustainable Agribusiness and Strengthening the Value Chain of GI-Tagged Cumbum Paneer Grapes in Theni District

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Abstract

Cumbum Panneer Thratchai grapes received the Geographical Indication (GI) tag in 2023, recognizing their unique regional identity and superior quality. Despite this distinction, the grapes are highly perishable and prone to significant post-harvest losses. This issue is further compounded by limited awareness among farmers about the importance and potential of value addition. To address these challenges, the adoption of value chain management practices is essential to extend shelf life, minimize losses, and promote the development of value-added products. The initiative aimed to develop value-added products from the Muscat variety while fostering entrepreneurship in grape processing. A total of 125 farmers participated in five skill development training sessions and exposure visits to ICAR-NRCG, Pune, where they gained knowledge on processing techniques, product development, branding, labeling, licensing, financial linkages, and marketing strategies. As a result, 15 entrepreneurs were successfully established in grape value addition, each earning an average monthly income of ₹12,500. Furthermore, the participants' knowledge levels significantly improved from 15% to 64%. These outcomes demonstrate that value addition initiatives not only enhance farmers' income but also strengthen their knowledge, confidence, and resilience, contributing to sustainable livelihoods.

Keywords: Muscat Hamburg, Dry Grapes, Tamil Nadu GI Tag Grapes, Value Addition in Grapes

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Textile Sustainability for a Better Planet: Exploration of Plant Base Natural Dyeing with Shibori Art

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Abstract

Fashion has become appearing for people and essential mode of presenting yourself in the world fashion, fast fashion in different sector as you know. Most of companies are using chemical and synthetic dyes in their textile production process. It is important to include the following industries are leather, cosmetic, pharmaceutical sector, food product, etc. That Industries produce wastewater using vast amounts of water and toxic chemicals that pollute waterways. Water used directly for irrigation or absorb in soil. Synthetic Dyes are harmful to plants, animals and humans, due to its impact on environment and public health issue increasing allergy, cancer risk.

Hence we will going to discuss on natural dyes coming from historical and rich traditional root that utilize parts of plants, minerals, animals and micro-organisms to produce pigments. Upcoming advancements in modern technology with sustainability have interest revive in natural colors.

The focuses on locally available flowers like Butea Monosperma (Palash Flower), Clitoria Ternatea (Blue Butterfly Pea Flower), Hibiscus Sabdariffa (Ambadi Flower), Nyctanthes Arbor Tristis (Parijat Flower). Eco-friendly (natural) dyes are alternative for chemical dyes because it is biodegradable, which increases that it can be utilised without harming the environment. Hence to make is commercial it requires modern techniques with scientific touch to overcome limitations like consistency, colour range, colour fastness etc. Innovations in eco-friendly dyeing advancement processes are also paving the way more sustainable fashion and reduce chemical waste. Global awareness of it is necessary.

Our aim is to develop Shibori Art using natural dyes with help of sustainable eco-friendly resources and to develop natural dye kit. In the dyeing process we select cotton fabric and Natural dyed using select Shibori Arts like Itajime, Arashi, and Kumo, Nui to develop different patterns. This arts results shows real and natural patterns on cloth.

Keywords: Sustainability, Natural Dye, Shibori Arts, Dye Kit.

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Plants Extracts: As Bioherbicide in Sustainable Weed Management: A Review

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Abstract

Crop plants yield losses due to weeds vary considerably depending on the crop, weed management strategies, weed composition, infestation period, and abiotic factors (e.g., climate and soil edaphic factors. Weeds cause on average 15 to 66% yield losses in direct-seeded rice, 18 to 65% in maize, 50 to 76% in soybean and 45 to 71% in groundnut. The constant use of synthetic herbicides on the same field to control weeds over a prolonged period has been shown to cause herbicide resistance, residue in crops, ecological imbalance between harmful and beneficial organisms and environmental pollution. Recently, bioherbicides have been regarded as a crucial weed control element. The first evidence of bioherbicide development was documented in the mid-1970s with the discovery of mycoherbicides. Plant extracts, which are traditionally used for medical purposes, serve as an alternative for developing bioherbicides. The application of sorghum water extract caused a 40% reduction in the biomass of Echinochloa crus-galli, resulting in an 18% rice yield increase. It has been found that the extracts from the leaf, stem, flower, and root of Brassica nigra (L.) were found to strongly inhibit the germination, growth, and radicle length of Avena fatua L. The inhibitory effect is believed to be mainly due to the high concentrations of glucosinolates, the bitter sulphur-containing compounds. These compounds be enzymatically hydrolyzed to isothiocyanates, thiocyanates, and nitriles, yielding new biologically active particles with the potential to reduce various weeds. The leaves extracts of Pisum sativum L. control the growth of Polygonum persicaria L., Amaranthus hybridus, Galinsoga parviflora Cav., Chenopodium album, and also Medicago sativa L. control the germination of Artemisia vulgaris L. The essential oils extracted from Cistus ladanifer L. were found to control Amaranthus hybridus, Portulaca oleracea L., Chenopodium album, Conyza Canadensis, Parietaria judaica L. The allelochemicals produced by plants are viz., organic acids, aldehydes, lactones, ketones, fatty acids, amino acids, quinines, flavonoids, phenolics, coumarins, tannins, terpenoids, alkaloids, purines, and others. Allelochemicals with harmful effects are a significant part of plant protection against weeds. Hence, it has been concluded that weed growth are suppressed by disrupting regular cell activity and the secretion of toxic metabolites from the bioherbicidal agent.

Keywords: Weeds, Bioherbicides, Plant extracts, Glucosinolates, Allelochemicals

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Integrating Value-Added Products and Sustainable Packaging Technologies for Enhancing Profitability and Entrepreneurship Development among Farmers

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Abstract

The increasing demand for value-added agricultural products, driven by rising health awareness and changing consumer preferences, offers significant opportunities for enhancing farmers' income and rural entrepreneurship. However, limited awareness and accessibility of post-harvest technologies, value addition techniques, and modern packaging methods hinder farmers from fully utilizing these opportunities. This study emphasizes the integration of value-added product development with sustainable and innovative packaging technologies to improve marketability and profitability. It highlights the importance of attractive, eco-friendly, and renewable packaging materials in capturing both domestic and international markets while addressing environmental concerns such as plastic waste. The study also underlines the need for effective dissemination of knowledge through training programs, government schemes, and institutional support systems. Encouraging youth involvement in packaging innovation and agri-based enterprises can further strengthen rural economic development. By bridging the gap between production, value addition, and market access, this approach promotes sustainable agriculture, reduces post-harvest losses, and fosters entrepreneurship among farmers.

Keywords: Value addition, Sustainable packaging, Post-harvest technology, Farmer entrepreneurship, Rural development, Agri business

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Optimization and Characterization of a Carnauba Wax-Sodium Alginate Composite Coating for the Post-Harvest Preservation of Custard Apple (Annona squamosa)

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Abstract

Custard apple (Annona squamosa) is characterized by an extremely short shelf life of 2–3 days due to rapid ripening and high susceptibility to post-harvest fungal pathogens. This study focuses on the development and optimization of a carnauba wax and sodium alginate-based coating intended as a carrier for antimicrobial essential oils. The research first optimized the coating matrix, evaluating 1%, 2% and 3% carnauba wax formulations for their stability and protective efficiency. Characterization results confirmed that the all-wax formulation achieved superior stability over 72 hours with no phase separation, forming a robust polymer-lipid network. In vivo trials on custard apples demonstrated that the 3% wax coating significantly reduced physiological weight loss to 2.80%, compared to 9.20% in the untreated control. Furthermore, the 3% coating maintained high biochemical quality, retaining 93.96% of antioxidant activity and significantly higher levels of total phenolic and flavonoid contents by the fourth day of storage. These findings establish the 3% carnauba wax matrix as an ideal protective carrier. The next phase of research involves the integration of the optimized essential oil concentration into this wax matrix to create a synergistic defense system against both moisture loss and microbial decay.

Keywords: Custard apple (Annona squamosa L.); Post-harvest preservation; Edible coatings; Carnauba Wax; Shelf-life extension

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Plant Functional Traits and Savanna Fire Management: Mapping Global Trends and Opportunities in Indonesia

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Abstract

Fire is a key factor in the dynamics of savanna ecosystems. Plant functional traits are now widely considered an approach for predicting vegetation responses to repeated disturbances. This study aims to analyze global research trends, conceptual developments, and future opportunities related to plant functional traits and savanna fire management. A total of 243 papers published between 2003 and 2026 from 95 sources were analyzed using Biblioshiny and VOSviewer. Scientific production increased sharply after 2010 and peaked in 2021. Brazil and the United States were the main contributors, while the United States and Australia had the highest citation impact. The most influential sources were New Phytologist and Journal of Ecology. Keyword and thematic analysis revealed three main domains: fire as a driver of disturbance, functional traits as a response mechanism, and tropical savannas as the primary ecological context. Recent themes have shifted toward climate change, resilience, flammability, and ecosystem persistence. International collaborations link the Americas, Africa, Europe, and Oceania, while Asia remains underrepresented. These findings indicate a significant opportunity for Indonesia to develop as a tropical savanna study area, namely, how to manage adaptive fires and restoration based on the plant traits approach.

Keywords: Plant functional traits, Savanna fire management, Bibliometric analysis, Tropical savanna, Indonesia

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Enhanced Sustainable Microwave Assisted Extraction Optimization of Anthocyanin From Allium Cepa Peels Using NADES: Glycerol - Citric Acid and Study on Its Degradation Kinetics

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Abstract

This study aims to increase the sustainability in the extraction of anthocyanins from peels of onion, an abundant food waste. Natural Deep Eutectic Solvents (NADES) when combined with microwave assisted extraction regarded as a reliable green methodology due to its reduced negative effects on environment and extraction time. In the current study NADES prepared using 50% Glycerol solution acidified with citric acid where glycerol, the Hydrogen Bond Donor (HBD) and Citric acid, the hydrogen bond acceptor (HBA) were coupled with Microwave Assisted Extraction (MAE) and optimized using Box Behnken Design of Experiment of Response Surface Methodology. Parameters including Solid to Liquid ratio (X1), Extraction time (X2) and Microwave power (X3) were studied. The maximum yield optimized was 40.48 mg/L with critical parameter values to be 1/21.14 g/mL, 1.93 mins and 544.95 W (R2 = 0.99593, pValue <0.0001 mg/L). The yield was further studied for Total Phenolics, Total Flavonoids and Antioxidant Activity against 2,2-diphenyl-1-picrylhydrazyl (DPPH). When the extracts were stored at 4, 25 and 40 0C Celsius degradation of anthocyanin followed a first order kinetics (R2 = 0.9978, R2 = 0.9908 and R2 = 0.9766) with a half life of 11.90, 10.46 and 3.83 days respectively. Estimated activation energy of 21.041 kJ mol-1 indicates thermal sensitivity of anthocyanins.

Keywords: Anthocyanins, Onion peels, Natural deep eutectic solvents, Microwave assisted extraction

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Mutation Breeding in Pigeon pea

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Abstract

Pigeon pea (or) Red gram (Cajanus cajans) belongs to family of Fabaceae. They are rich in Iron, Amino acids (Lysine, Thronine, cystine, Agrinine etc.) and Potassium, Calcium, & Iodine. Importance of Pigeon pea plays a major role in human diet it also helps in food security, balance diet & alleviation of poverty etc. Mutation is a sudden heritable change. It is a conventional method of breeding. conventional breeding one of the best method of breeding in crop improvement is Mutation Breeding it is Non hazardous, environmentally friendly, producing plants that are often indistinguishable from thoses created through traditional cross breeding. The agent which is causing mutation are called mutgens. This cause major change in the genotype and Phenotypic character. The mutgens are gamma rays, EMS (Ethyl Methane Sulfonate). Current research works are done based upon the prominent mutants like branched, tall, dwarf, dark black pod, early flowering, early maturing two seeded, three seeded and high yielding mutants. There are two varieties of pigeon pea i.e., BDN 708 and BSMR 853 were used to induce mutagenesis. Mutation breeding can spread over three generation. The various types of viable mutants obtained in pigeon pea comprises high yielding, tall, dwarf, branched, early flowering, and avoid scattering of seeds. Most of the crop improvement programs attempted through conventional breeding methods have exploited only the natural variability available in the germplasm. Induced mutagenesis can be efficiently employed as an alternative to induce the variability in morphological and physiological characters. They mostly use Gamma rays and Ethyl Methane Sulfonate (EMS) in induced mutation. Varieties in the mutation breeding in pigeon pea are CO1, CO5, ICPL – 270 and CO4. ICPL is wilt resistant variety & CO4 growth and yield of pigeon pea.

Keywords: Mutation, Mutgens, Induced mutagenesis, Gamma rays

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Exploring the Industrial Potential of True Cinnamon (Cinnamomum verum) Germplasm for Leaf Trade

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Abstract

Cinnamomum is an important genus, species of which are characterized by aromatic leaves, fruits, bark and root. A number of these species are being utilized for food, medicine and fragrance industries worldwide. C. verum, commonly known as Ceylon cinnamon or true cinnamon, is one of the ancient spices valued for its medicinally potent aromatic bark. The typical harvesting operation of bark in this species involves scraping of outermost layer of tissues when the branch thickness is about 35-40 mm to get quality produce. This results in low productivity thereby deterring the farmers from taking up its cultivation. While harvesting the branches, the leaves are rarely utilized for commercial purpose and the present study investigates the variability present in 24 accessions of cinnamon for important leaf traits in comparison with Konkan Tej as check. Perusal of data from three years' analysis suggested variability for leaf length (9.83-14.80 cm), leaf width (4.75-6.31 cm), petiole length (1.10-1.71 cm) and leaf weight (0.96-1.47 g). Further, two years analysis of quality traits also suggested exploitable variability, mainly for leaf dry recovery (47.25-56.08%), leaf essential oil content (0.78-2.94%) and leaf oleoresin content (8.27-13.18%). GC-MS profiling of essential oil revealed wide variations for Eugenol content (59.54-85.67%) and six accessions showed higher Eugenol content than the check. Based on perennial evaluation, promising accessions have been shortlisted for further utilization. Utilization of leaves as a source of Eugenol rich oil could help the farmers in getting additional income while making cinnamon cultivation a profitable venture.

Keywords: Dry recovery, Essential oil, Eugenol, Morphology, Oleoresin

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Endemic Garcinia dhanikhariensis S.K. Srivastava from Andaman Islands: A Potential Rootstock for Garcinia Species

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Abstract

Andaman and Nicobar Islands in the Bay of Bengal harbour native diversity of angiosperms including taxa of horticultural significance. Of these, Garcinia dhanikhariensis is an endemic species, fruits of which have been identified as novel source of anthocyanins, hydroxycitric acid and other antioxidant compounds. It has been christened as Andaman Kokum and is being promoted as a novel fruit crop under warm and humid conditions of the Andaman Islands. However, the species being dioecious in nature, promotion of grafted plants was envisaged. Grafting of Andaman Kokum on own rootstock suggested self-compatibility of the species. Further, the species was also found to be compatible with G. gummi-gutta and G. indica as rootstocks. Further, in order to explore the potential of this species as a rootstock for various Garcinia species, inter-specific grafts using G. kydia, and G. gummi-gutta as scion were made and maintained in potted conditions to study their growth characteristics. After one year of planting, maximum plant height (105.73 cm) and number of branches (17) were recorded in G. kydia grafted on G. dhanikhariensis, while maximum collar thickness (6.93 cm) and mean canopy spread (97.40 cm) were recorded in G. gummi-gutta grafted on G. dhanikhariensis rootstock. Leaf parameters including leaf length, leaf width, leaf area, leaf weight were also superior when G. dhanikhariensis was used as a rootstock for both G. kydia and G. gummi-gutta. Thus, the study revealed the potential of endemic G. dhanikhariensis as a rootstock for mass multiplication of studied species.

Keywords: Andaman Kokum, Compatibility, Kokum, Kydia mangosteen, Malabar tamarind

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Essential Oil Nanoemulsion: A Sustainable Solution for Postharvest Management of Sapodilla (Manilkara zapota)

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Abstract

Sapodilla (Manilkara zapota) is a popular tropical fruit in India, valued for its pleasant taste and rich nutrient content. However, its climacteric nature makes it highly perishable, with significant postharvest losses attributed to fungal pathogens such as Lasiodiplodia theobromae and Rhizopus oryzae. In this study, essential oil (EO) nanoemulsions of thyme, ajwain, star anise, wild bergamot, and oregano were prepared using the low-energy Phase Inversion Composition (PIC) method. The antifungal activity of these nanoemulsions was evaluated against the pathogenic fungi isolated from sapodilla fruits. The fungicidal activity was assessed through the radial growth inhibition of mycelium on an agar medium. The results demonstrated the efficacy of EO nanoemulsion in inhibiting fungal pathogens, highlighting their potential as eco-friendly and biodegradable antifungal agents. Nanoemulsion serves as effective carriers for essential oils, enabling reduced concentrations of bioactive components while maintaining biological activity. These findings suggest that EO nanoemulsion can provide a sustainable alternative to chemical fungicides, offering a safer solution for the pharmaceutical, cosmetic, and agrochemical industries. This approach not only addresses postharvest losses in sapodilla but also promotes the broader use of natural and environmentally friendly products for fungal management.

Keywords: Low energy emulsification; Nanoencapsulation; Essential oil

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Deciphering Pesticide-Induced Alterations in Soil Microbiome Structure and Function in Northern India

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Abstract

Soil microbiomes are fundamental to ecosystem functioning, driving key processes such as nutrient cycling, organic matter decomposition, and maintenance of soil fertility. However, the widespread and intensive use of chemical pesticides in modern agriculture poses a significant threat to these microbial communities. The present study aims to decipher the impact of pesticide application on soil microbiome structure and functional attributes in agricultural regions of Northern India. Soil samples were collected from fields with varying pesticide exposure histories, including conventionally managed and low-input systems. Microbial diversity and community composition were assessed using culture-dependent and molecular approaches, alongside evaluation of key soil enzymatic activities such as dehydrogenase, phosphatase, and urease. The findings revealed a marked shift in microbial community structure under prolonged pesticide exposure, characterized by reduced diversity and suppression of beneficial microbial taxa involved in nutrient cycling. Functional analysis indicated a decline in enzymatic activities, reflecting impaired soil metabolic potential. The study underscores the detrimental effects of excessive pesticide usage on soil microbial ecology and highlights the need for sustainable agricultural practices. Adoption of eco-friendly alternatives, including integrated pest management (IPM) and organic amendments, can mitigate adverse impacts and promote soil health restoration. These findings contribute to a deeper understanding of agrochemical stress on soil ecosystems and support the development of strategies for sustainable agriculture in the region. Keywords: Soil Microbiome, Pesticides, Microbial Diversity, Enzymatic Activity, Soil Health, Northern India.

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Biochemical Diversity and Pungency Profiling in Chilli (*Capsicum annuum* L.) Genotypes for Crop Improvement

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Abstract

Chilli (*Capsicum annuum* L.) holds significant value in the food and processing industries due to its characteristic pungency and bioactive compounds. The present study aimed to assess biochemical variability among chilli genotypes and to identify promising lines with superior quality traits. Thirty genotypes were evaluated at Tamil Nadu Agricultural University, Coimbatore, during 2024–2025 in a randomised block design with three replications. Significant differences among genotypes were observed for all traits. High-Performance Liquid Chromatography (HPLC) was employed to quantify capsaicin, total phenols, and total flavonoids. Capsaicin ranged from 3,150 to 113,985 Scoville Heat Units (SHU), reflecting wide variation in pungency. Total phenolic content ranged from 91.70 to 184.20 mg/kg, while total flavonoid content varied between 1420.90 and 3110.10 mg/kg. Correlation and principal component analysis revealed strong associations among biochemical traits and facilitated the identification of distinct genotypes. Among the evaluated lines, CBE-CA-007, CBE-CA-014, and CBE-CA-013 were identified as superior lines based on their biochemical profiles and can be utilised in breeding programmes aimed at enhancing pungency and nutritional quality in chilli.

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Cooperative Foraging Social Spider Stegodyphus sarasinorum can be placed around the Wire Fences of Agricultural Lands for the Biological Control of Insect Pests

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Abstract

The social spider Stegodyphus sarasinorum (Araneae: Eresidae) exhibits complex cooperative behaviours including nest construction, web maintenance and hunting insects' pry that trapped on the web. The cooperative spider's colonies are strongly female-biased, typically consisting of 3–7 males and 50 females. We recorded consumption of 390 individuals of insects by the spiders. The insect preys belong to 42 insect taxa across 12 orders, with Lepidoptera (35%) dominating the diet, followed by Hemiptera (19%) and Orthoptera (12%). Larger and heavier prey elicited higher number of spiders to the trapped place due to the vibration of web, with prey weight showing a strong positive correlation with the number of attacking spiders ($r = 0.80$, $p < 0.0001$), indicating that it is the primary driver for attracting spiders for the collective response. Attack behaviour was highly coordinated, with spiders preferentially targeting prey appendages (46%) to facilitate rapid immobilization. Most capture events involved fewer than 20 individuals (n =30), although larger prey triggered mass recruitment. Overall, S. sarasinorum demonstrates a highly organized cooperative system characterized by division of labour, adaptive foraging strategies, and effective prey exploitation. These traits underscore its ecological importance as a generalist predator and highlight its potential role in regulating insect pest populations in various agricultural ecosystems. The presence of S. sarasinorum web around the metal wire fences in the agricultural field will reduce the attack of insect pests and also reduce the cost spend for the purchase of pesticides spent for the insect control.

Keywords: Agricultural Field, Biological Control, Foraging Behaviour, Prey Capture, Social Spider, Wire Fences.

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Ploidy Determination and Cytological Validation in Banana (Musa spp.) Breeding Populations

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Abstract

In banana, the cultivar Ney Poovan, a dessert type belonging to the AB genome group, is highly popular across all banana-growing regions of India. It is cultivated under various local names such as Elakki Bale, Njali Poovan, Safed Velchi (in North-Eastern states), Ney Kadali, Vadakkan Kadali, Elarasi, and Deva Bale in India, and as 'Ranel' in Sri Lanka, 'Kisubi' in Uganda, 'Apple', 'Farine France', and Lady's Finger in the West Indies. Despite its high consumer preference, the cultivar produces relatively low bunch weight (12–15 kg) and is highly susceptible to Fusarium wilt. Development of a triploid Ney Poovan is a promising strategy to enhance yield and introgress resistance genes. However, improvement through conventional breeding is constrained due to its parthenocarpic nature and sterility in both male and female organs. In this context, tetraploid × diploid (4x × 2x) breeding serves as an effective approach for generating improved triploid hybrids. In the present study, a pollen-fertile tetraploid Ney Poovan, developed through androgenesis via spontaneous chromosome doubling of unreduced gametes in anther culture, was crossed with Calcutta 4 (Musa acuminata), a wild diploid known for its broad-spectrum biotic resistance. The resulting hybrid progenies were screened for parthenocarpy. Among them, a subset exhibited parthenocarpic fruit development, while others were categorized as seeded types (79) or pencil types (87) lacking fruit filling. Ploidy analysis of these progenies was performed using a Sysmex CyFlow® Cube 8 flow cytometer with Propidium Iodide (PI) staining. Three ploidy levels tetraploid (5%), triploid (1%), and diploid (4%) were identified. Notably, all parthenocarpic progenies were triploid, whereas seeded and pencil-type progenies exhibited either tetraploid or diploid status. These findings indicate that ploidy analysis can serve as a reliable tool for early identification of parthenocarpic progenies derived from tetraploid × diploid crosses in banana. Further studies are required to confirm the successful introgression of resistance genes from Calcutta 4 into the parthenocarpic progenies. Additionally, efforts are underway to characterize seeded and pencil-type progenies using molecular approaches, including whole genome resequencing (WGRS), to identify trait-associated SSR and SNP markers.

Keywords: Ploidy Analysis, Parthenocarpy, Molecular breeding, SSR Marker, Banana breeding

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Discovery and Genomic Characterisation of a Novel Trehalulose-Producing Metschnikowiasp. from Stingless Bee (Heterotrigona itama) Microbiota

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Abstract

Trehalulose is a rare sucrose isomer with a low glycaemic index, offering significant potential as a healthier alternative sweetener for applications in the food, pharmaceutical, and nutraceutical industries. With increasing demand for sustainable and health-promoting sugar alternatives, biological production routes have gained growing interest. Stingless bee honey has been identified as a natural source of trehalulose; however, the biological origin and underlying mechanisms of its formation remain poorly understood. This study aimed to isolate and identify trehalulose-producing microorganisms associated with stingless bee (Heterotrigona itama) and to investigate the genetic basis of trehalulose production. Microbial isolation yielded diverse bacterial and yeast communities, which were screened for trehalulose-producing capability. A yeast isolate belonging to the genus Metschnikowia demonstrated promising enzymatic activity to convert sucrose into trehalulose, as confirmed by enzymatic assays, thin layer chromatography and HPLC-ELSD analysis. Timecourse analysis indicated that trehalulose production was growth-associated, with peak activity during early stationary phase. To further investigate the molecular basis of this capability, genome-level analysis was performed, revealing a repertoire of carbohydrateactive enzymes and candidate genes associated with carbohydrate metabolism and functional sugar biosynthesis. These findings suggest the involvement of a putative carbohydrate-active enzyme contributing to trehalulose formation. This study reports the discovery of a novel trehalulose-producing Metschnikowia sp. from stingless bee microbiota, providing new insights into the biological origin of trehalulose in natural systems. The findings highlight bee-associated microorganisms as a sustainable and underexplored source of biocatalysts, offering strong potential for the development of functional sugar production.

Keywords: Trehalulose, stingless bee, low-glycaemic, functional sugar, Metschnikowia

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Small Shells, Big Signals: Assessing Coastal Ecosystem Health through Foraminifera

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Abstract

Benthic foraminifera serve as reliable bioindicators of environmental quality due to their sensitivity to ecological disturbances and anthropogenic stressors. In line with the conference theme focusing on sustainability and environmental resilience, this study investigates the diversity and distribution of benthic foraminifera along the coastal regions of Southern India to evaluate ecosystem health. Seasonal sediment and water samples were collected from multiple locations and analyzed for foraminiferal assemblages and heavy metal concentrations. Key environmental parameters, including temperature, salinity, pH, and sediment characteristics, were assessed to understand their influence on species distribution. The assemblages were dominated by Ammonia beccarii, Elphidium crispum, and Quinqueloculina seminulum, with total counts ranging from 265 to 300 individuals per sample. Among these, Ammonia beccarii exhibited the highest abundance, reaching up to 150 individuals, while Quinqueloculina seminulum showed comparatively lower counts. Notably, the elevated dominance of Ammonia beccarii in island regions indicates potential environmental stress linked to pollution or nutrient enrichment. Significant spatial variation in species composition was strongly correlated with physicochemical parameters, emphasizing the effectiveness of benthic foraminifera as indicators of environmental change. The integration of biological and geochemical data in this study highlights an innovative approach to ecosystem monitoring. These findings contribute valuable baseline data for sustainable coastal management and support the development of informed conservation strategies aimed at protecting fragile marine and coral reef ecosystems.

Keywords: Benthic foraminifera, bioindicators, ecosystem health, heavy metals, environmental sustainability, Southern India

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Development, Optimization and Advanced Characterization of Jackfruit Seed-Based Milk Analogue: A Sustainable Functional Dairy Alternative

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Abstract

The increasing demand for sustainable and lactose-free dairy alternatives has accelerated the exploration of plant-based milk analogues derived from underutilized agro-industrial resources. In this study, seeds of Artocarpus heterophyllus were utilized for the development of a novel plant-based milk analogue through systematic process optimization and comprehensive physicochemical, structural, and functional characterization.
Response Surface Methodology (RSM) integrated with a five-factor Box–Behnken design was employed to optimize key processing variables, including seed concentration (20–50 g/100 mL), soaking time (6–18 h), thermal treatment (10–20 min), xanthan gum concentration (0–0.5% w/v), and enzymatic hydrolysis using α-amylase. The optimized formulation (~20 g/100 mL seed concentration, ~6 h soaking, ~18 min boiling, ~0.0002% xanthan gum with enzymatic treatment) achieved a high extraction efficiency and an overall desirability index of 0.821, confirming model robustness ($p < 0.05$).
Physicochemical analysis revealed that the developed jackfruit seed-based milk analogue exhibited pH≈ 6.60, total soluble solids ≈ 6.44–7.4 °Brix, emulsion stability ≈ 53.81%, and water activity ≈ 0.937, indicating functional comparability with conventional dairy systems. The formulation demonstrated higher viscosity (~7.12 cP) and slight acidity, attributed to its starch-rich composition and processing conditions. Enzymatic hydrolysis significantly enhanced starch degradation, improving physicochemical homogeneity and extraction yield, while controlled hydrocolloid incorporation optimized emulsion stability without compromising sensory attributes. Sensory evaluation indicated moderate acceptability with an overall hedonic score of ~6.69, suggesting promising consumer potential.
Nutritional analysis revealed high moisture content (~95.9%) along with the presence of bioactive compounds, including phenolics, flavonoids, and saponins, contributing to antioxidant activity (ABTS:~131.75 mg TE/100 g; DPPH inhibition: ~28–37%), which may support oxidative stress reduction and associated health benefits. Additionally, the optimized process effectively reduced anti-nutritional factors (phytates, tannins, and saponins), enhancing nutrient bioavailability.
Advanced multi-technique characterization demonstrated significant structural and functional modifications: FTIR analysis indicated changes in molecular interactions and functional group distribution, suggesting structural reorganization; SEM micrographs revealed improved surface uniformity and reduced aggregation, indicating enhanced matrix formation; XRD patterns suggested partial disruption of crystalline regions, reflecting increased amorphous character; TGA and DSC confirmed enhanced thermal stability and altered thermal transitions, indicating improved structural integrity; while particle size analysis (~90.25 nm dominant population) and zeta potential (–28.7 mV) indicated improved colloidal stability and dispersion behavior.
Microbial analysis highlighted that the high-water activity and nutrient-rich composition may support microbial growth, emphasizing the need for appropriate preservation strategies. Overall, this study establishes an integrated and scalable approach for the development of a structurally stable, nutritionally enriched, and sustainable plant-based dairy alternative with promising industrial and commercial applicability in the emerging functional food sector.

Keywords: Jackfruit seed milk analogue; Response Surface Methodology; Enzymatic hydrolysis; Structural characterization; Colloidal stability; Sustainable food systems

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Deciphering Ionome and Metabolome Signatures in Jasminum sps

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Abstract

Jasmine is a one the most highly cultivated loose flowers in India, added to its high export value for its mystical fragrance in the international luxury perfume industry. Among the highly cultivated species Jasminum sambac (Madurai Malli) and Jasminum trifoliatum also called as Jasminum azoricum (Mysuru mallige) possess Geographical indication (GI) status due to their regional significance and unique quality attributes. Since the commercial value of jasmine primarily lies in essential oil and its traditional use, a first of its kind study was conducted to delve into the intricate relationship between metabolome profile of essential oil in jasmine flowers and the elemental composition of soil, leaves in Jasminum sambac and Jasminum trifoliatum, Jasminum grandiflorum (Spanish jasmine) and Jasminum auriculatum (Indian jasmine). The soil, leaf and flower samples were analyzed using Inductively Coupled Mass Spectrophotometry (ICP-MS) to determine the 30 elements, that include the macro, micro and trace elements. Concurrently, essential oils were extracted from the flowers of their respective species through the solvent extraction method, and metabolome analysis of these oils was profiled using GC-MS. The resulted data was correlated and the conclusions were drawn. The study revealed hitherto undeciphered information of elemental influence on essential oil and metabolome of Jasmine making it a novel study and an underexplored integration and incorporation of multi-omics in floriculture industry.

Keywords: Jasminum, Jasminum spp, Ionomics, Metabolome, Essential oil, ICP-MS, GC-MS

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Bioprospecting Stingless Bee Microbiota for Antimicrobial Compounds, Functional Enzymes, and Sustainable Bioengineering Applications

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Abstract

Stingless bees (Heterotrigona itama) represent a unique and underexplored ecological niche harbouring diverse microbial communities with significant biotechnological potential. This study explores stingless bee-associated microbiota through a systematic bioprospecting approach to identify bioactive compounds, functional microbes, and sustainable bioengineering solutions. Microbial isolation from stingless bee honey, bee bread, and related products revealed a diverse bacterial population dominated by Bacillus spp. Selected isolates exhibited strong antimicrobial activity against clinically relevant pathogens, including methicillin-resistant Staphylococcus aureus (MRSA). A prominent strain, Bacillus velezensis PD9, demonstrated broad-spectrum antimicrobial activity, supported by genome-guided analysis and metabolite profiling identifying bioactive compounds such as lipopeptides. This work has led to a patented approach targeting ESKAPE pathogens. In parallel, selected isolates demonstrated probiotic potential and safety for food and health applications. Enzyme bioprospecting further revealed a carbohydrate-active enzyme capable of converting sucrose into trehalulose, a low-glycaemic functional sugar. Additionally, bacterial isolates exhibited calcium carbonate precipitation ability, highlighting potential for microbially induced calcite precipitation (MICP) in self-healing concrete. Collectively, this study highlights stingless bee microbiota as a sustainable source of innovations addressing antimicrobial resistance, functional food development, and environmental biotechnology.

Keywords: Microbial bioprospecting, Stingless bee microbiota, Trehalulose, Sustainable biotechnology, Antimicrobial compounds.

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Improved Pruning Practices to Increase Tree Health and Benefits While Decreasing Tree Risk in Urban Trees

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Abstract

Developing cities face many growing pains, including decreased air quality, heat island effects, and water deficits. To combat these issues, localities and governments are setting objectives to increase tree canopy cover, often relying on tree plantation initiatives as the primary method to achieve these objectives. However, to turn new trees into growing canopies, these trees have to be properly managed. Current management and pruning practices often produce counterproductive results, creating weaker and less healthy trees that provide fewer benefits. This is a major obstacle to achieving tree canopy cover objectives that can be overcome by introducing effective tree pruning methods. This requires understanding how trees function as biological systems in order to increase tree health and tree benefits while reducing tree risk. There are many aspects of tree biology that should be considered while managing trees, but my presentation will focus on the two topics most relevant to pruning: auxin signalling and the compartmentalization of dysfunction. Drawing on these concepts, I will describe how to amend common pruning practices to align with tree biology. Furthermore, I will connect this summary of tree biology to international arboricultural standards and published Best Management Practices to give a framework for managing urban trees using proper pruning. Specifically, in order to match pruning practices to current scientific understanding of tree biology, the following changes will help: using saws instead of machetes/axes, making proper pruning cuts, and using rope access systems or lift machinery. Making these changes will promote the ability of pruned trees to compartmentalize dysfunction and decrease disruptions to auxin dynamics, leaving the trees healthier, more beneficial to their cities, and less risky to their surroundings.

Keywords: Canopy cover, Trees, Climate Adaptation, Pruning.

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One Health, One Threat: Integrating Environmental and Clinical Perspectives on Antimicrobial Resistance

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Abstract

Antimicrobial Resistance (AMR) represents a systemic threat to global health security and the UN Sustainable Development Goals, specifically SDG 3. Linked to 1.27 million deaths in 2019, AMR is projected to cause 10 million annual deaths by 2050. This crisis is fuelled by a "One Health" feedback loop: livestock and aquaculture consume 70% of global antimicrobials, excreting up to 90% of residues into terrestrial and aquatic ecosystems. These environments, particularly marine "plastispheres" and sediments, act as reservoirs where Horizontal Gene Transfer (HGT) facilitates the spread of resistance genes across species, including zoonotic pathogens like Campylobacter and Shigella.

Wildlife and climate-driven events further accelerate this dissemination across geographic borders. Despite global governance scores rising to 44.5/100, a critical "implementation gap" exists, with policy impacts often delayed by five years. Effective mitigation requires a transition from fragmented National Action Plans to integrated multisectoral surveillance of clinical, veterinary, and overlooked environmental reservoirs (e.g., aerosols and non-human primates). To protect the 2030 sustainability agenda, global strategies must shift toward robust accountability mechanisms and sustainable alternatives, including bacteriophages, probiotics, and advanced wastewater treatments like ozonation to break the cycle of transmission.

Keywords: Antimicrobial Resistance, SDG, Plastispheres, National Action Plans, Surveillance

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Drum-Based Mango Cultivation: A Sustainable Approach to Urban Farming

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Abstract

Urban space constraints have necessitated the development of container-based fruit cultivation techniques, with mango emerging as a promising crop for drum-based cultivation. This study aimed to standardize mango cultivation techniques using plastic drums for urban and terrace gardens. The experiment was conducted at the Agricultural Information and Sales Center, Kozhikode, under Kerala Agricultural University from May 2023 onwards. One-year-old mango grafts (Banganappally, Rumaniya, Kolumb, Olour, and Priyur) were planted in 100-liter plastic drums under open field conditions. The potting mixture consisted of fertile soil, cocopeat, and organic manure in a 1:1:1 ratio, with drums filled up to three-fourths capacity and irrigated regularly. Flowering was observed in the first year, while fruiting commenced in the second year. By the third year, Banganappally emerged as the most superior variety, combining high yield (28 fruits per plant), larger fruit size (average 295 g), and early maturity, making it highly suitable for urban cultivation. Kolumb also recorded high yield (26 fruits per plant) but produced smaller fruits (average 140 g). Rumaniya exhibited good yield (25 fruits per plant) along with superior canopy architecture and aesthetic appeal, making it ideal for urban and terrace gardening. The study highlights drum-based mango cultivation as a practical, scalable, and efficient solution for sustainable urban fruit production.

Keywords: Urban agriculture, Drum cultivation, Fruit crops, Container gardening, Sustainable farming, Terrace gardening.

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Enhancing Growth Performance and Economic Returns in Nellore Lambs through Maternal Nutrition and Early Creep Feeding: Evidence from a Field Demonstration

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Abstract

A Front Line Demonstration (FLD) was conducted in 2023 at C.K. Dinne mandal of YSR Kadapa district, Andhra Pradesh, to evaluate the impact of maternal nutrition and early creep feeding on Nellore Jodipi sheep under smallholder conditions. The study involved 100 ewes and their lambs. The intervention included concentrate supplementation to ewes during late gestation and early lactation, along with creep feed containing 22% crude protein offered to lambs from 15 to 90 days of age. Supplemented ewes showed improved body weight and body condition score at lambing, leading to better fetal development and higher lamb birth weights. Lambs receiving creep feed exhibited significantly higher weaning weights and average daily gains, along with reduced pre-weaning mortality. Economic analysis indicated higher input costs but improved profitability, with the benefit–cost ratio increasing from 1.25 under traditional practices to 1.48 under the intervention. The study demonstrates that strategic nutritional management enhances growth performance, survivability, and economic returns, making it a viable approach for improving smallholder sheep production systems.

Keywords: Nellore sheep, Creep feeding, Maternal nutrition, Lamb growth, Economic returns, FLD

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Studies on Nutritional and Sensory Characteristics of Bamboo Sprouts Powder Incorporated Biscuit

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Abstract

Bamboo sprouts are a nutritious food rich in protein and dietary fibre, low in carbohydrates and fats, and with good mineral and vitamin profiles. Present study focused on the use of bamboo sprouts powder for the production of baked goods owing to their enormous health benefits. Formulations were developed with different proportions of refined wheat flour, Bamboo sprout powder and Sprouted soya bean flour in the ratios T0100% Refined Wheat Flour (100 %), T_1 40%Refined Wheat Flour: Bamboo sprouts powder, Sprouted Soy Bean Flour (40:40:20), T_2 Refined Wheat Flour: Bamboo sprouts powder : Sprouted Soy Bean Flour; (50:30:20)and T_3 Refined Wheat Flour: Bamboo sprouts powder : Sprouted Soy Bean Flour; (50:40:10) respectively. The biscuits weight ranged from 10.62g to 11.14g with biscuits that contained the highest percentage of bamboo sprouts powder (T3) having the least weight while biscuits with the least percentage of bamboo sprouts powder (T1). The diameter and thickness of the produced biscuits ranged from 44.62 to 4.89 (cm) and from 1.33 to 1.45(cm) respectively. The moisture content was ranged from 5.73 to 6.58. The control (T0) had the high moisture content 5.73% on the initial day of analysis. At the end of the storage period (45 days) the moisture content was lower in T2 (6.02 %) sample. Initially the protein content was ranged from 7 to 9 % of control and 24 to 26.5 % in T2 samples. Initially the fat content maintained from 29 to 32 per cent. The T2 had the highest fat content 32 per cent on the initial day of analysis and the T1 control treatment had the minimum fat content of 29 per cent. The initial crude fiber content was maintained from 2.74 to 3.3 per cent. The T2 had the highest crude fiber content 3.5% on the initial day of analysis and the T0 control treatment had the minimum crude fiber content of 2.74%. The free fatty acid content of bamboo shoot biscuits ranged from 0.12 to 0.32%. The sensory evaluation for colour, flavor, taste texture and overall acceptability were high in biscuits.

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The microbial load viz., total plate count, yeast and mould count of bamboo sprouts flour biscuits was Below Detectable Level (BDL) on 0 day (initial) of storage period. At the end of the 45 days of storage, the bamboo shoot flour biscuits showed high in total plate count (8 cfu/ml) of T1 sample when compared to T12 sample. Bamboo sprouts that are rich in nutrients and bioactive compounds can be used for the enrichment of bakery products such as biscuit to produce healthy snacks.

Keywords: Bamboo sprouts, Processing, Fortification, Biscuit, Sensory and Microbial quality

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Population-Level Pesticide Exposure Mapping for Identifying Potential Hotspots of Exposure Risk Using a Scalable Geospatial Framework in Thiruvarur District, Tamil Nadu

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Abstract

Sustainable management of agricultural pesticides is essential for protecting environmental and human health, particularly in agriculturally intensive regions. The present study employed geospatial overlay analysis using ArcGIS to determine the overlap between pesticide application intensity and population distribution. The grid cell was used for assessing human exposure risk by identifying potential human exposure hotspots. Cropspecific pesticide application rates were aggregated to generate a Pesticide Hazard Index (PHI) that represents the spatial intensity of pesticide use. To evaluate potential human exposure, PHI was combined with proportional population data to derive a Pesticide Exposure Index (PEI). The results revealed that spatial variability among agricultural regions, with high levels of hazardous spots in south and central regions of the Thiruvarur district. Population inclusion in the analysis identified the new exposure hotspots, suggesting that population is a major determinant of potential exposure. This research demonstrates that combining environmental and demographic factors using Geographic Information System (GIS) technique is a valuable tool for exposure evaluation. The research findings might help to provide informed decisions on interventions and sustainable agricultural practices in reducing pesticides burden on environmental and human health. The findings were based on modelled datasets and can be useful for assessing exposure risk in other regions as well to develop integrated approaches in environmental and rural health protection in accordance with Sustainable Development Goal 3: Good health and wellbeing (Target 3.9). Overall, this work supports the goals of science-driven innovation and sustainable practices by using a geospatial framework tool to guide pesticide management strategies that reduce environmental and health risks in agricultural landscapes.

Keywords: Pesticide exposure risk, Spatial analysis, Sustainable development, Environmental health, Agriculture.

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Integrated Screening of Banana Germplasm and Streptomyces-Based Biocontrol for Sustainable Management of Fusarium Wilt

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Abstract

Fusarium wilt caused by Fusarium oxysporum f. sp. cubense (Foc) is a major constraint in banana production worldwide. The present study was conducted during 2023–2025 to identify resistant banana germplasm and evaluate microbial biocontrol strategies for sustainable disease management. Twenty banana accessions representing different genome groups (AA, AB, AAA, AAB, ABB, and AAAB) were screened for growth, yield, quality, and resistance traits. Significant variability was observed among accessions, with triploid cultivars exhibiting superior yield performance, while diploid accessions such as Matti and Tongat showed enhanced resistance to Fusarium wilt. Biochemical analyses under challenged inoculation with Foc isolate TFOC6 revealed elevated activities of peroxidase, phenylalanine ammonia lyase, polyphenol oxidase, total phenols, and lignin in Tongat, indicating stronger defense responses. A rhizosphere isolate, Streptomyces rochei AMBEAROOT2, obtained from resistant cultivars, demonstrated 62.3% mycelial inhibition against Foc TFOC6 and possessed multiple plant growth-promoting traits. Molecular docking and molecular dynamics analyses confirmed strong binding interactions between metabolites of S. rochei AMBEAROOT2 and Foc virulence proteins, comparable to the fungicide Tebuconazole. Greenhouse and field studies showed that application of S. rochei AMBEAROOT2 significantly improved plant growth, physiological traits, yield, and defense enzyme activity, while markedly reducing disease severity. Field validation at Chinnamanur and Gudalur confirmed enhanced productivity and fruit quality in Grand Naine with reduced Fusarium wilt incidence. The study demonstrates the potential of integrating resistant germplasm and microbial biocontrol for eco-friendly Fusarium wilt management in banana.

Keywords: Banana germplasm; Fusarium wilt; Streptomyces rochei; Biocontrol

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Impact of Ultra-Processed Food Consumption on Weight Management and Cardiometabolic Risk Among Young Adults

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Abstract

Introduction: The rapid increase in UPF intake has become an important challenge for public health in today's world. The reason is that UPFs consist of processed foods containing lots of sugar, salt, and trans-fats, but not fibre and other essential micronutrients. The vulnerability of young adults to this trend can be attributed to their busy lifestyles, academic workloads, and the convenience of ready meals. Thus, a high intake of such foods may lead to metabolic disorders, thus posing a question concerning how such nutrition affects one's weight management and cardiovascular function.

Research Objective: This review explores the connection between ultra-processed food intake and weight management outcomes in the young adult population. The primary hypothesis suggests that a high dependence on these foods correlates with an increase in Body Mass Index (BMI), abdominal fat accumulation, and a high risk of cardiometabolic issues.

Methodology: This analysis utilised a narrative review of peer-reviewed literature published between 2018 and 2025. Data was gathered from databases such as PubMed and Scopus, focusing on observational studies and clinical trials that examined the intersection of dietary processing levels, body composition, and metabolic markers. The review specifically targeted studies involving adolescents and young adults to capture the impact of these habits during a critical developmental window.

Key Findings: The evidence consistently indicates a strong positive link between heavy UPF consumption and negative weight outcomes. Key observations from the data include:

*Physical Indicators: Individuals with the highest intake of packaged snacks, fast food, and soda consistently showed higher BMI and waist circumference measurements compared to those eating whole or minimally processed foods.

*Metabolic Health: Beyond simple weight gain, high UPF diets are associated with insulin resistance, hypertension, and chronic low-grade inflammation.

*Biological Signalling: These foods appear to bypass natural satiety signals. Because they are designed for high palatability and rapid consumption, they often lead to "passive over eating" and disrupted appetite regulation.

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*Microbiome Impact: Emerging research suggests that the additives and lack of fibre in industrial foods may alter gut microbiota, further complicating metabolic function and weight maintenance

Conclusion: The data suggest that the modern dependence on ultra-processed foods is a primary contributor to unhealthy weight gain and metabolic dysfunction among young adults. Reducing the intake of these products is not just a matter of calorie counting; it is about improving the nutritional quality of the diet to protect against long-term cardiovascular disease.

To combat this trend, public health initiatives should prioritise food literacy and promote the accessibility of whole, nutrient-dense alternatives. While current findings are compelling, more longitudinal research is needed to fully understand the long-term biological mechanisms through which these industrial foods influence human metabolism.

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Gut Microbiota Modulation Through Dietary and Probiotic Interventions in Adults with Depression and Anxiety: A Systematic Review of Gut-Brain Axis Mechanisms and Therapeutic Efficacy

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Abstract

The central nervous system (CNS) function is collectively regulated by neuronal, endocrine and immune pathways within a complex bidirectional communication system called the gut-brain axis. Emerging evidence suggests that gut dysbiosis, characterised by reduced microbial diversity, decreased production of Short-Chain Fatty Acids (SCFAs) and compromised intestinal barrier integrity, contributes to the pathophysiology of depression and anxiety. However, despite rising interest, a consolidated synthesis of dietary and probiotic interventions targeting this axis in adults with neuropsychiatric disorders is still limited. The objective of this systematic review was to assess mechanistic and clinical evidence for the efficacy of dietary and probiotic interventions in modulating the gut-brain axis and alleviating symptoms of depression and anxiety in adulthood. A systematic review of studies examined the effects of probiotics (Lactobacillus and Bifidobacterium species), prebiotics, dietary fibre and combined synbiotic interventions on gut microbiota composition, neurotransmitter metabolism, HPA axis regulation and validated psychological outcomes in adult populations. The evidence reviewed here suggests that targeted probiotic supplementation and high-fibre dietary patterns significantly enrich populations of SCFA-producing commensals, restores tight junction integrity and attenuates systemic and neuroinflammation via reduced LPS translocation and pro-inflammatory cytokine signalling. Microbially-mediated enhancement of serotonin precursor availability and GABA synthesis were key neurochemical mechanisms underlying observed reduction in anxiety and depressive symptomatology. Dietary and probiotic interventions are evidence-based and modifiable approaches for gut-brain axis optimisation in adults with depression and anxiety. Incorporating an individual microbiome profile into future precision nutrition frameworks holds great promise for personalised neuropsychiatric management.

Keywords: Gut Microbiota, Probiotics, Prebiotics, Depression, Anxiety, Neuroinflammation, Short-Chain Fatty Acids.

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Food Packaging in Fast-Food Industry and Environmental Issues: A Study in the Twin Cities of Odisha (Cuttack & Bhubaneswar)

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Abstract

Globalizations as well as liberalization are the key factors for the emerging trends of fast food industries in every corner of the world. The shareholders of companies including Domino's Pizza, McDonald's, Burger King, KFC, Pizza Hut and many more are growing rapidly across the globe due to globalization and economic liberalization. Rising trends of fast food industry impinges environmental crisis in multiple ways. The research is conducted in the selected 10 Fast-Food Restaurants (FFRs) in the twin cities of Odisha. Fast-food giants deliver speedy meals, but they have been super slow in responding to their out-sized environmental foot-prints. Packaging materials make up a majority of the litter that settles on our beaches and other waterways. There are billions of pounds of plastic ground into trillions of pieces in our oceans. However, only minimal of these plastics are visible on the surface; the rest is swirling below or has settled onto the ocean bed. Most of our fast food parceled in a range of synthetic materials from ceramics and glass to paper, cardboard and plastics. The most common and most worrying is the extensive use of rigid plastic and glass. This type of waste does not easily break down in the environment. Usually, plastic or aluminum foil swaddles our takeout food. Most restaurants wrap the food again with paper or put it into Styrofoam containers, then put these containers into plastic or paper bags. Within these bags, you often find plastic cutlery, straws and napkins. The rise of fast food is one of the main culprits behind the epidemic of obesity, diabetes, heart disease, and other serious illnesses of the modern world. Not only does fast food destroy our health, it is also slowly killing us by accelerating climate change, emission of VOCs, Water contamination and global warming at large.

Keywords: Globalization, Liberalization, Fast Food, Environmental Crisis, Global Warming

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Optimization of Hydroponic System and Electrical Conductivity of Hydroponic Nutrient Solution for Quality Gladiolus Production

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Abstract

An investigation was conducted at the Department of Horticulture, Assam Agricultural University, Jorhat, to identify the most suitable hydroponic system and nutrient solution concentration for quality flower production in gladiolus. The experiment was laid out in a completely randomized design with different hydroponic systems including Nutrient Film Technique (NFT), water culture and aggregate systems with different media along with varying Electrical Conductivity (EC) levels of nutrient solution. The results revealed that most growth parameters such as sprouting of corm, plant height, leaf number, leaf area and leaf biomass were significantly superior in the water culture system with EC 2.0 dS/m. Flowering parameters including spike emergence, spike length, rachis length, floret size, spike weight and vase life were recorded maximum under water culture combined with EC 1.5 dS/m. Root characters were best expressed under water culture with EC 1.0 dS/m, whereas corm yield and physiological attributes showed superior performance at EC 2.0 dS/m. Among the growing media used in aggregate hydroponics, cocopeat consistently produced better results compared to sand and sawdust. The findings indicate that hydroponic cultivation, particularly water culture with appropriate nutrient concentration, can significantly enhance growth, flowering and corm production in gladiolus.

Keywords: Gladiolus, Hydroponics, Water culture, Electrical conductivity, Nutrient solution, Flower production

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Perilla frutescens Seed: A Comprehensive Review of Composition, Processing, and Functional Food Applications

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Abstract

Perilla (Perilla frutescens L.) is an unused oilseed crop, plantaceous resource, that is grown for centuries in Asia for food and traditional medicine use because of its rich nutritional values. This review comprehensively consolidates existing knowledge on the various major components of research involved with the perilla seed, from germplasm characterization to value-added product development. Germplasm diversity and the impact of geographical parameters including elevation, climate and soil on seed composition are first discussed, revealing that with elevation there is an increase in α-linolenic acid (ALA) content. The nutritional composition is described, in particular the proportions of the total oil (35-45%) and total protein (35-45%) in defatted meal, the profile of fatty acids (ALA 52-64%), the ratio of ω6/ω3 fatty acids (1.5-1.9), the content of bioactive compounds (γ-tocopherol 661-730 mg/kg, rosmarinic acid 703-2965 μg/g), phytosterols, and flavonoids. Oil extraction methods from the seed of perilla have been reviewed systematically from traditional cold pressing method, using solvents to fresh emerging green extraction methods such as microwave assisting, supercritical CO_2, ultrasound, aqueous enzymatic, and smashing tissue method, and the yield, bioactive retention, environmental impacts have been discussed critically. This is followed by a review of stabilization methods against the natural oxidative instability of perilla oil: encapsulation (spray drying, freeze drying, coacervation, liposomes), oleogelation (direct wax-based method, indirect emulsion-templated method), microemulsion, and natural antioxidant (rosemary extract, tocopherols). Practical methods, such as roasting pretreatment or mixing with stable oils (stable fats) are also mentioned. Valorization of defatted perilla meal through microorganisms—such as Bacillus subtilis, Aspergillus oryzae, and mixed cultures—are thoroughly explained; these microorganisms increase the protein digestibility; produce bioactive peptides; reduce antinutrients up to 68% (for phytate); and enhance mineral bioaccessibility. Review of production of protein isolates and concentrates from perilla meal and techno-functional properties of the isolates for food application were also conducted. A focused review of perilla food products found in the literature – traditional foods (oil, roasted seeds, pickled leaves); baked goods (breads, cookies, cakes); snack bars; beverages (plant based milk, saboun probiotic drinks); meat and dairy alternatives, pasta, noodles, and pasta sauce. Last but not least, major research gaps are highlighted, such as the lack of systematic germplasm characterization from various districts of Uttarakhand, low-temperature oleogelation of regionally characterized perilla oil, integrated product development; oleogel stabilized perilla oil and fermented perilla meal from the same source, and human clinical trials to validate health benefits. The overview presented here, bases on the literature, is a source for fundamental information for researchers, food

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technologists and industries to develop sustainable and zero-waste model idea for perilla seed biorefinery with harvesting the whole perilla seed.

This paper summarizes the excellent germplasm diversity of perilla plants species, methods for extracting their oil, using their defatted meal as a raw material for valorization, and ways to produce perilla oil-based food products. In this paper, the excellent germplasm diversity of perilla plants species, extraction technologies, use of perilla defatted meal as raw material for valorization, and production of perilla food products using perilla oil are summarized alongside with the utilization of a perilla biorefinery for functional foods.

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Bacillus odyssey (JQ337959): Alkaline Protease-producing Bacterium

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Abstract

The alkaline Lonar Lake represents a unique ecological niche harboring diverse extremophilic microorganisms capable of producing industrially valuable extracellular enzymes such as amylases, lipases, cellulases, and proteases. Among the enzyme-producing bacteria isolated from the lake, Bacillus odysseyi emerged as a promising source of alkaline protease with significant biotechnological potential. The present study focused on the isolation, optimization, and characterization of alkaline protease produced by Bacillus odysseyi, which was identified by 16S rRNA gene sequencing. The strain demonstrated maximum enzyme production under alkaline and thermophilic conditions, with optimal activity at pH 9.5–10.0 and temperatures of 70–75°C. Protease production was further enhanced by lactose and maltose as carbon sources, soybean cake as an organic nitrogen source, urea as an inorganic nitrogen source, and supplementation with L-glycine and Mg^{2+} ions. Maximum enzyme yield was achieved after 72 hours of incubation at 37°C, 120 rpm agitation, and a 5% inoculum level. The remarkable thermostability and alkaliphilic nature of the enzyme highlight its suitability for a wide range of industrial applications, including detergents, food processing, pharmaceuticals, leather treatment, silver recovery, and peptide synthesis. These findings underscore the immense potential of Lonar Lake extremophiles as sustainable sources of commercially important enzymes.

Keywords: Alkaline Protease, Bacillus odysseyi, Environmental factors, Nutritional conditions.

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Carbon Sequestration Dynamics of a Biodiversity Heritage Site: An Assessment of the GKVK Campus Ecosystem

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Abstract

A detailed carbon sequestration assessment of the GKVK campus, University of Agricultural Sciences, Bangalore were conducted. The study quantifies the terrestrial carbon sequestration potential of the 560-hectare Gandhi Krishi Vignana Kendra (GKVK) campus, a Biodiversity Heritage Site in Bangalore. A random quadrat sampling method (2.5% intensity) across a 167-hectare core study area were used to measure above-ground and below-ground biomass, Soil Organic Carbon (SOC) and litter accumulation. Land-use analysis shows that agroforestry and agriculture farms (200 ha) and permanent forest cover (167 ha) dominate the landscape, functioning as formidable biological sinks. The average campus biomass was quantified at 40.09 Mg ha^{-1}, translating to 73.57 Mg ha^{-1} of carbon dioxide equivalent (CO_2e). Mature plantation zones exhibited the highest carbon density, with total biomass peaking at 98.5 Mg ha^{-1}. Species-specific assessments identified Mangifera indica (Mango) and Tectona grandis (Teak) as superior carbon reservoirs, sequestering 11.29 Mg ha^{-1} CO_2e and 8.58 Mg ha^{-1} CO_2e, respectively. Subterranean carbon pools significantly strengthen this capacity; topsoil (0-30 cm) SOC reached a high of 1.71 per cent in dense forest blocks, supported by robust annual litter accumulation rates up to 4,683.97 kg $ha^{-1}yr^{-1}$. Integrating terrestrial carbon pools, the GKVK campus landscape demonstrates a total carbon sequestration potential of 2,58,090 Mg CO_2e, with dedicated forest blocks alone accounting for 81,167.28 Mg CO_2e. Coupled with renewable energy offsets from campus solar infrastructure, the total climate mitigation impact reaches 2,60,841.91 Mg CO_2e. These findings empirically validate the immense environmental value of university green infrastructure. By prioritizing native, high-biomass tree species and integrating agroforestry into land management, higher education institutions can transition from merely reducing operational footprints to actively driving regional carbon neutrality.

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Sustainable Utilization of Palash *(Butea mono sperma)* Petals in Herbal Tea Preparation: A Climate-Smart Functional Beverage Approach

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Abstract

The increasing challenges of climate change, biodiversity loss, environmental degradation, and food insecurity have intensified the need for sustainable and climate-smart food systems. Utilization of underexploited indigenous plant resources offers an effective strategy for developing environmentally sustainable food products while supporting biodiversity conservation and rural livelihoods. Palash (Butea monosperma), commonly known as the Flame of Forest, is an important indigenous tree species of India recognized for its nutritional, medicinal, ecological, and cultural significance. Although Palash flowers have traditionally been used in folk medicine and various cultural practices, their potential as a functional food ingredient remains largely unexplored. The present theoretical study examines the sustainable utilization of Palash petals in herbal tea preparation and evaluates their nutritional significance, health-promoting properties, and contribution to climate-smart food systems. Available literature indicates that Palash petals contain valuable nutrients and bioactive compounds, including carbohydrates, proteins, dietary fibre, calcium, iron, flavonoids, and antioxidants, which may contribute to overall health and well-being. The development of Palash-based herbal tea represents an innovative approach to value addition of indigenous plant resources while reducing biological waste and promoting sustainable resource utilization. Furthermore, the utilization of Palash petals can support biodiversity conservation, encourage the preservation of traditional knowledge, and create livelihood opportunities for rural communities through small-scale processing and marketing. As a caffeine-free functional beverage, Palash herbal tea has the potential to meet the growing consumer demand for natural and health-promoting products. The findings suggest that Palash herbal tea can serve as a sustainable, nutritious, and climate-resilient beverage, contributing to nutritional security, environmental sustainability, and the broader objectives of climate-smart agriculture and sustainable food systems.

Keywords: Palash, Butea monosperma, Herbal Tea, Functional Beverage, Sustainable Agriculture.

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Behavioural, Emotional Feelings and Well Being of Human Psychology: Impact of Ornamental Horticulture and Tree Scaping- A Mini Review

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Abstract

Ornamental horticulture and tree scaping, the intentional design, cultivation and management of plants and trees exert profound, science-backed behavioural and emotional impacts on human psychology. These landscapes, ranging from home gardens to urban green spaces, operate as restorative environments that reduce psychological distress, foster emotional stability, and encourage positive social interaction. Engaging in horticultural activities like planting, pruning, or watering lowers cortisol levels, the primary stress hormone. Regular interaction with green spaces reduces mental fatigue and improves concentration, attention span, and memory. Caring for plants encourages mindfulness and provides a constructive outlet for emotional release and self-expression, often serving as a non-medication alternative for depression and anxiety. Well-maintained ornamental gardens in urban areas foster social interactions, reducing social isolation and encouraging community participation. In work settings, interior plants and views of green landscapes are linked to increased creativity and productivity by up to 15%. Even brief exposure to trees, such as a 20-30 minute walk or sitting near green foliage, can reduce feelings of depression and anxiety by 58% and decrease anger and hostility by 44%. Cultivating plants provides a sense of accomplishment and purpose, enhancing self-worth. Ornamental landscapes help build emotional stability and resilience, especially in teenagers and those dealing with trauma. The presence of nature has been shown to reduce blood pressure and stabilize nervous system activity. Multiple canopy shapes and colours of trees and flowers contrast with rigid, geometric urban environments, creating a calming visual environment that helps the brain recover from cognitive load. Studies have shown that individuals living near trees experience a third less psychological stress and a lower rate of antidepressant prescriptions. Trees provide essential shade, which reduces high surface temperatures that can lead to increased feelings of anger and aggression. Physical contact with trees, such as touching bark, helps people feel more cantered, grounded, and connected to the present moment. Gardens with high plant biodiversity have a stronger stress-relieving impact on individuals. Spending at least 120 minutes a week in green environments is linked to significant gains in health and wellbeing. Even bare trees in winter have a positive psychological impact compared to purely urban environments.

Keywords: Profound stress relief, Emotional resilience, Restoration and mindfulness, Tree Scaping, Sensory restoration, Lowered psychiatric risks, Thermal comfort and temperament.

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Living BandAid: A Sustainable Bacterial Cellulose-Based Smart Wound Dressing Platform for Green Biomedical Applications

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Abstract

Chronic wounds, burn injuries, and microbial infections continue to represent major healthcare challenges worldwide. Conventional wound dressings are commonly composed of synthetic materials that may exhibit poor biodegradability, limited biological activity, and inadequate healing support. The present study proposes "Living BandAid," a smart bacterial cellulosebased bioactive wound healing platform integrating microbial biotechnology, biomaterials engineering, bio sensing systems, and regenerative healthcare concepts.

Bacterial cellulose synthesized by Komagataeibacter xylinus is utilized as the primary scaffold material due to its nanofibrillar structure, high water retention capacity, mechanical strength, flexibility, purity, and biocompatibility. The proposed platform incorporates antimicrobial compounds, pH-responsive sensing components, and controlled therapeutic release functionality for enhanced wound management.

The methodology involves microbial cellulose biosynthesis under static aerobic conditions, purification of cellulose pellicles, fabrication of flexible wound dressing scaffolds, incorporation of antimicrobial and biosensing agents, and characterization of physical and biological properties. The system is additionally designed to monitor infection-associated pH variations through visible colorimetric response mechanisms.

Expected outcomes include development of a biodegradable multifunctional wound dressing capable of supporting tissue regeneration, reducing microbial contamination, maintaining optimal wound hydration, and providing real-time visual wound monitoring. The proposed platform aims to serve as a sustainable alternative to conventional wound care systems while contributing to advancements in smart regenerative biomaterials and green biomedical technology.

Keywords: Bacterial cellulose, Smart wound dressing, Regenerative medicine, Biosensor, Sustainable biomaterials

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Next-Generation Floriculture: Harnessing Hydroponics for Sustainable Ornamental Horticulture

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Abstract

Hydroponics, a soilless cultivation technique that utilizes nutrient-enriched water solutions for plant growth, has emerged as an innovative practice in floriculture and landscape design. With increasing concerns over land scarcity, water limitations, soil degradation and the demand for high-quality ornamental crops, hydroponic systems offer a sustainable and efficient alternative to conventional cultivation methods. The technology enables precise control of nutrients, water, pH and environmental conditions, resulting in improved growth, higher flower quality and enhanced resource-use efficiency. In floriculture, hydroponic cultivation has been successfully adopted for the production of cut flowers, potted plants and ornamental foliage species. Crops such as rose, gerbera, carnation, chrysanthemum, lily, orchid and anthurium have demonstrated superior performance under hydroponic systems compared to traditional soil-based cultivation. Advanced systems including Nutrient Film Technique (NFT), Deep Water Culture (DWC), ebb-and-flow systems and drip hydroponics facilitate optimal root-zone conditions, promoting vigorous growth, uniform flowering and increased yield. Studies have reported substantial reductions in water consumption and fertilizer losses, making hydroponics an environmentally sustainable production strategy. The integration of hydroponics into landscape design has opened new opportunities for urban greening and space-efficient ornamental displays. Hydroponic installations are increasingly utilized in indoor landscapes, vertical gardens, rooftop gardens, green walls and public spaces where soil availability is limited. The technology supports year-round production and allows designers to create aesthetically appealing, low-maintenance landscapes with reduced pest and disease incidence. Furthermore, hydroponically grown ornamental plants contribute to improved indoor air quality and enhanced visual environments. Recent innovations, including automated nutrient delivery systems, smart sensors, Internet of Things (IoT)-based monitoring and artificial intelligence-assisted management, have further increase the efficiency and scalability of hydroponic floriculture. As urbanization continues to expand, hydroponics represents a promising approach for sustainable ornamental plant production and modern landscape development. Its ability to conserve resources, improve plant quality and support innovative design solutions makes hydroponics a key component of future horticultural and landscape systems.

Keywords: Hydroponics, Floriculture, Soilless Cultivation, Sustainable Landscape Design, Urban Horticulture.

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Luminescent Polyolefin Photonic Films for Solar Spectrum Re-Engineering: Toward Next-Generation Smart Greenhouse Materials

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Abstract

The spectral mismatch between incident solar radiation and the Photosynthetically Active Radiation (PAR) requirements of crops represents a fundamental limitation in greenhouse productivity. Conventional polyolefin-based cladding materials, particularly Linear Low-Density Polyethylene (LLDPE), exhibit high optical transparency but lack the ability to selectively manipulate the solar spectrum. Herein, we report the development of luminescent polyolefin photonic films capable of solar spectrum re-engineering through fluorescence-mediated spectral down-conversion. LLDPE (melt index ~1.0 g/10 min; density ~0.920 g cm^{-3}) was compounded via twin screw extrusion with a multifunctional additive system comprising tetrakis[methylene(3,5-di-tert-butyl-4-hydroxyhydrocinnamate)]methane (primary antioxidant), tris(2,4-di-tert-butylphenyl) phosphite (secondary antioxidant), Hindered Amine Light Stabilizers (HALS), and zinc stearate as a processing aid and dispersant. A synthetic, cationic xanthene dye fluorescent chromophore (Rhodamine B) was incorporated as the active spectral conversion agent. The processing strategy enabled uniform micro-dispersion of the chromophore within the non-polar polymer matrix without compromising melt processability or film integrity. Optical characterization (200–1100 nm) revealed efficient absorption in the UV–blue region and re-emission in the near red spectral domain (560-590nm), aligning with the absorption bands of chlorophyll a and b. The modified films exhibited enhanced red photon flux and favorable spectral redistribution while maintaining high visible light transmittance. Rheological analysis indicated a reduction in zero-shear viscosity, suggesting improved chain mobility and effective dispersion of the dye phase, while differential scanning calorimetry confirmed minimal disruption to the semicrystalline morphology of LLDPE. Although thermodynamic solubility of the chromophore in the polyolefin matrix is inherently limited, the presence of zinc stearate species and optimized processing conditions facilitated stable dispersion, mitigating aggregation-induced quenching at low concentrations. Additionally, controlled attenuation of UV radiation is expected to reduce insect activity by interfering with UV-mediated host recognition pathways. Biological validation using Arthrospira platensis (Spirulina) demonstrated enhanced biomass productivity under modified films relative to control conditions, indicating improved photosynthetic efficiency due to spectral optimization. This work establishes a scalable materials engineering approach for integrating luminescent functionality

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into commodity polyolefin films. The developed photonic films provide a pathway toward next-generation smart greenhouse materials with tunable spectral properties, enhanced crop productivity, and reduced environmental impact.

Keywords: Polyolefin films, Spectral down-conversion, Cationic Xanthine Chromophore, LLDPE, Photonic greenhouse materials, Arthrospira platensis

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A Comprehensive Study and Literature Review of Mechanical Properties in Agave Americana Fiber

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Abstract

Found in the century plant, Agave americana delivers a tough natural fiber. Extracted from lengthy leaves through retting or mechanical means, its makeup includes cellulose, hemicellulose, along with lignin. Strength comes from rich cellulose levels; rigidity arises due to lignin presence. These strands show notable resistance when stretched, display firmness, carry shine, and extend into long forms. Light yet resilient, they serve well within composite materials, cloth production, cordage, plus ground cover systems that favor nature. Though rigid by nature, the material breaks down over time, regenerates easily. From harvest method to end form, structure remains consistent - dense bundles formed deep inside fleshy foliage.

Fibers labeled AAL occur naturally, sourced sustainably, showing notable resistance under tension, flexibility, a lightweight nature. Their performance during stretching until failure relies closely upon how much cellulose they contain - about sixty-two percent - and structural order reaching fifty-one percent, along with techniques used to isolate them. Research indicates increased bending capacity, ability to withstand squeezing forces within construction substances, especially if older fibers undergo correct preparation steps.

Keywords: AAL, AAF, Natural Fibers, Reinforcement, Composite, Geotextiles Crystallinity, Biodegradable.

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Smart Remote-control and Electronic Safety System for Vision-Assisted Four-Wheel Paddy Transplanter

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Abstract

A remote-controlled system for four-wheel rice transplanter has been developed with electronic control systems to enable an operator to control the transplanter while sitting in a safe and comfortable location outside the puddled field. A developed system consists of remote-controlled system to remotely-control the on/off of vehicle, steering, direction, speed, brake control, transplanting function (transplanting tray raising/lowering and planting arm engage/disengage) and emergency stop of the machine with the help of programmed Electronic Control Unit (ECU). Electronic control unit consists of ten channel remote-controller with transmitter module to transmit the signal from the remote to the receiver, receiver module in the machine to transfer the channel signal to the controller and motor drive modules. Motor drive modules was used to actuate the actuator (wiper motor and linear actuator) to perform different driving control during operation, micro-controller unit included (Arduino Nano) in the system to remote-start the machine at a distance of 500 m. An emergency stop system was developed using Arduino Nano to stop the vehicle while detecting the obstacle in front of the vehicle with the help of ultrasonic sensor and relay. Developed remote-controlled system was easily attachable / detachable to a commercially available ride-on-type rice transplanter. The developed remote-controlled system to ride-on-rice transplanter was evaluated in puddled paddy field at Paddy Breeding Station, TNAU, Coimbatore. The developed system was remotely operated by operator standing out of field at a distance of 200 m. The mean deviation from the travel path was observed as 0.13 ± 0.05 m for the developed remote-controlled ride-on-type transplanter, which was observed almost near to manually operated ride-on-type transplanter (0.11 ± 0.03 m). The field capacity, field efficiency and fuel consumption of developed remote-controlled system attachment to ride-on-rice transplanter found as 0.24 ha/h, 71 % and 3.1 l/ha respectively at forward speed of 1.61 km/h and slip rate of 12 %. This will improve working efficiency, attract the rural youth through entrepreneurship and it also help to overcome the problem of labour shortages during the peak season.

Keywords: Remotely-controlled system, Anti-collision system, Vision sytem, Paddy transplanter, Precision agriculture

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Conducting Polymer Polypyrrole-Fly Ash/ Co_2O_3 Composite with Carboxymethyl Cellulose Binder as Enzymatic Biofuel Cell Anode

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Abstract

The present study illustrates the electropolymerizing method of Co_2O_3-coated fly ash is decorated on a conducting polymer polypyrrole's backbone to create a new nanocomposite on the working electrode platinum by doping it with 5-sulphosalicylic acid (SSA) and by using carboxymethyl cellulose (CMC) as a binder, which plays a crucial role in the binding of the nanocomposite. The PPY/FA-Co_2O_3/CMC is used as a supporting framework to develop a flexible, porous, and large-surface-area bioanode for the effective immobilization of the methylene blue mediator and glucose oxidase (GOx) enzyme for the enzymatic biofuel. The bioanode's performance can be greatly enhanced by optimizing the interactions between the composite materials, opening the door for cutting-edge uses in renewable energy technologies. The electrobiocatalytic activity was characterized by using cyclic voltammetry (CV), linear sweep voltammetry (LSV), and electrochemical impedance spectroscopy (EIS). The morphological characterization was carried out by scanning electron microscopy (SEM). The structural analyses were analysed by Fourier transform spectroscopy (FTIR). These analyses show that FA-Co_2O_3 was successfully integrated into the PPY matrix and offer important insights into the material properties. To assess the bioanode's performance in real-world applications. The synthesized bioanode PPY/FA-Co_2O_3/CMC/MB/GOx provides support for the biomedical applications derived from coal combustion waste. This innovative approach highlights the potential of using waste materials and opens doors for sustainable energy solutions in the field of bioelectronics also.

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Techno-Nutritional Evaluation of Biofortified Carrot Powder for Micronutrient-Dense Functional Food Development

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Abstract

The development of nutrient-dense functional foods using biofortified crops represents a promising strategy for improving dietary quality and promoting sustainable food systems. The present study aimed to evaluate the techno-nutritional potential of biofortified yellow (PCY-2) and purple (PCP-2) carrot powders as functional ingredients in bakery products. Fresh carrots were dried using convective tray drying and processed into powders, followed by comprehensive physicochemical and phytochemical characterization. Both powders exhibited appreciable nutritional quality with elevated crude fibre, protein, and mineral content. Purple carrot powder showed significantly higher total phenolics (25.90 mg GAE/100 g), anthocyanins (1214.82 mg CGE/100 g), and antioxidant activity (87.18% DPPH inhibition), whereas yellow carrot powder was particularly rich in lutein (3610.01 µg/100 g). Fourier Transform Infrared Spectroscopy (FTIR) confirmed the retention of major bioactive functional groups after processing. The developed powders were incorporated into wheat-based cookies and muffins at varying substitution levels and subjected to sensory, physicochemical, and phytochemical evaluation to determine their suitability for functional food development. Sensory evaluation identified 20% incorporation in cookies and 30% incorporation in muffins as the optimum levels, achieving desirable acceptability while enhancing nutritional quality. Cookies and muffins enriched with purple carrot powder exhibited higher levels of total phenolics (17.21 and 12.40 mg GAE/100 g), anthocyanins (78.94 and 33.49 mg CGE/100 g), and antioxidant activity (47.21% and 38.78% DPPH inhibition), while those enriched with yellow carrot powder provided elevated lutein concentrations (36.08 and 12.03 µg/100 g), respectively, compared to their control counterparts. The findings highlight the potential of biofortified carrot powders as clean-label, phytonutrient-rich ingredients for development of value-added bakery products. Their incorporation offers an effective food-based approach to enhance the nutritional and functional value of commonly consumed foods, while supporting sustainable utilization of biofortified horticultural crops and development of health-promoting food systems.

Keywords: Biofortification, Functional foods, Anthocyanins, Lutein, FTIR

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Isolation, Characterization and Enzymatic Profiling of Antibiotic-Resistant Bacteria from Traditional Freshwater Sources of Himachal Pradesh

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Abstract

The emergence and dissemination of antibiotic-resistant bacteria (ARB) in environmental settings have become a critical concern for global public health. Aquatic ecosystems, in particular, serve as dynamic reservoirs facilitating the persistence and spread of resistant microorganisms. In the present study, six environmental water samples were collected and subjected to microbiological analysis to isolate and characterize potential ARB. Bacterial colonies were recovered by spread plate technique at three different concentrations. Morphologically distinct colonies were selected and purified using streak plate method, resulting in a total of 42 bacterial isolates. Phenotypic characterization was performed based on colony morphology. Gram staining, virulence assay and a series of biochemical assays including catalase, oxidase, citrate utilization, urease activity and indole production tests were performed. The isolates exhibited considerable diversity in colony characteristics such as size, pigmentation, margin, and elevation. Biochemical profiling further demonstrated significant metabolic variability among the isolates. Preliminary screening on antibiotic-supplemented media indicated the presence of potential antibiotic-resistant bacteria within these environmental samples. Although detailed quantitative susceptibility testing was not conducted, the observed growth patterns suggest that aquatic environments may act as reservoirs of resistance traits. Overall, this study provides a foundational phenotypic insight into environmental bacterial diversity and highlights the potential role of water sources in harbouring antibiotic-resistant bacteria. These findings establish a basis for future molecular characterization and in-silico analysis of antibiotic resistance genes (ARGs) to better understand resistance dissemination in environmental systems.

Keywords: Fresh Water, Antibiotics, Antibiotic Resistance, Antibiotic Resistance Genes

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Deep Learning-Based Honey Adulteration Detection Using 1D-CNN and Bidirectional LSTM : A Comparative Study with Optuna Hyperparameter Optimization and SHAP Explainability

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Abstract

Honey adulteration poses a significant global issue in food safety and authentication, with the fraudulent inclusion of sugar syrups and other adulterants causing extensive consumer harm, thereby requiring effective deep learning solutions for automated detection. This research conducts a comparative study of two deep learning models, namely the 1D-Convolutional Neural Network and Bidirectional LSTM (Bi-LSTM), assessed using physicochemical parameters (such as Color Score, Density, pH, Electrical Conductivity, Fructose, Glucose, Viscosity, Water Content) and NIR spectroscopy datasets. The study employs Optuna-based Bayesian hyperparameter optimization with Tree-structured Parzen Estimator sampling for fine-tuning specific to each dataset. The physicochemical dataset included 247,903 samples, while the NIR hyperspectral dataset comprised 8,675 measurements across 128 wavelength bands. Anti-overfitting techniques like L2 regularization, Dropout, Batch Normalization, and EarlyStopping were systematically implemented during training. The 1D-CNN demonstrated superior results, achieving an F1-Score of 0.9881, 98.49% accuracy, and an AUC-ROC of 0.9994 on physicochemical data. In contrast, NIR-based classification attained 99.08% accuracy, with SHAP-driven explainable AI analysis identifying pH and Color Score as the most distinguishing features. This confirms that 1D-CNN models consistently outperform Bi-LSTM networks and that combining transfer learning principles with Optuna optimization produces robust and generalizable models for detecting honey adulteration.

Keywords: Honey adulteration, Deep learning, 1D-convolutional neural network, Bidirectional LSTM, NIR spectroscopy, Physicochemical parameters.

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Constraints Expressed by Farmers in Managing the Resources in Different Farming Situations

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Abstract

Agriculture enterprise is a way of life of Indian farmers. In an increasing crowded world, conservation and management of resources is vital to sustain life support system on earth. The farmers always need new knowledge, new skills and more modern concept than their traditionalism. Indian agriculture is seen with diversified farming situations with wide physiographic, geological and climatic features and influenced by varied socio-economic characteristics of farm families. The present study on constraints expressed by farmers in managing the resources in different farming situations was undertaken in three districts (Mandya, Chikkaballapura and Tumkuru) of Karnataka state. With sample size of 180 respondents from different farming situations (Assured, Protected and Rainfed). Ex-post facto research design was used in the present investigation. The major constraints faced by farmers in resource management in all the farming situations are increase in cost of inputs, farming is not profitable, non-availability of agricultural implements suitable for small and marginal farmers, erratic rainfall, lack of suitable markets for agricultural products, difficulty in getting credit to agricultural activities from nationalized banks, declining water table, lack of information to farmers on marketing of agricultural produce and lack of technical guidance to farmers. And major suggestions are minimum support price to agricultural produce, assured and remunerative price to agricultural produce, development of agricultural equipments/implements suitable for small and marginal farmers, loan at lower interest rate and promotion of labour saving technologies.

Keywords: Resource management, Constraints, Suggestions and Farming situation

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Microplastics as Reservoirs of Antimicrobial Resistance Genes: Emerging Challenges for Public Health and One Health

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Abstract

Background: Antimicrobial resistance (AMR) is one of the biggest threats to global health. At the same time, microplastic pollution has become a major environmental problem. Recent studies show that microplastics provide a surface for microorganisms to attach and form biofilms, known as the plastisphere. These biofilms can carry antimicrobial-resistant bacteria, antimicrobial resistance genes (ARGs), and mobile genetic elements, which may help spread resistance in the environment.

Objective: To review the role of microplastics as reservoirs of antimicrobial resistance genes and discuss their impact on public health from a One Health perspective.

Methods: A narrative review was carried out using peer-reviewed articles published between 2020 and 2025. Literature was collected from PubMed, Scopus, Web of Science, and Google Scholar. Studies from journals such as Nature Reviews Microbiology, Environmental Science & Technology, Science of the Total Environment, npj Biofilms and Microbiomes, and Frontiers in Microbiology were reviewed.

Results: Studies show that microplastics provide a suitable surface for bacterial attachment and biofilm formation. These biofilms increase bacterial survival and promote the transfer of ARGs through plasmids, integrons, and transposons. Important resistance genes such as blaNDM, blaKPC, mecA, vanA, and tet genes have been detected on microplastics. Wastewater, rivers, soil, oceans, and even food can act as sources for the spread of these resistant bacteria and genes, increasing the risk of human and animal exposure.

Conclusion: Microplastics are emerging as important environmental reservoirs of antimicrobial resistance genes and may contribute to the spread of AMR. Reducing plastic pollution, improving environmental surveillance, and adopting a One Health approach are important steps to control this growing public health problem. More research is needed to understand the long-term health effects and develop effective prevention strategies.

Keywords: Microplastics; Antimicrobial Resistance; Antimicrobial Resistance Genes; Plastisphere; Biofilms; One Health

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Biofilm Formation in Candida Species: An Emerging Challenge in Clinical Mycology

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Abstract

Background: Candida species are important opportunistic fungal pathogens responsible for a wide range of infections, particularly in immunocompromised and hospitalized patients. Their ability to form biofilms on host tissues and indwelling medical devices significantly contributes to disease persistence and treatment failure.

Objective: To review the role of biofilm formation in Candida species and its impact on virulence, antifungal resistance, and clinical outcomes.

Methods: A narrative review of published literature from the past decade was conducted using major biomedical databases. Studies focusing on biofilm development, pathogenicity, antifungal susceptibility, and emerging therapeutic approaches were analyzed

Results: Biofilm formation is a multistep process involving adhesion, proliferation, maturation, extracellular matrix production, and dispersal. The biofilm matrix protects fungal cells from host immune responses and limits antifungal penetration, resulting in reduced drug susceptibility. Differences in biofilm-forming capacity have been reported among various Candida species, including Candida albicans, Candida tropicalis, Candida parapsilosis, Candida glabrata, and Candida auris. Recent advances in anti-biofilm strategies, such as combination therapy, nanoparticles, and biofilm-disrupting agents, have shown promising results

Conclusion: Biofilm formation plays a pivotal role in the pathogenesis and persistence of Candida infections. Improved understanding of biofilm biology may facilitate the development of effective therapeutic interventions and enhance patient outcomes.

Keywords: Candida Species, Biofilm, Antifungal Resistance, Virulence, Clinical Mycology.

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Microbial Biostimulants: A Sustainable Strategy for Enhancing Medicinal Plant Productivity and Secondary Metabolite Production

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Abstract

The growing global demand for medicinal plants and their bioactive compounds has intensified the need for sustainable cultivation practices that ensure both productivity and quality. Medicinal plants serve as important sources of pharmaceuticals, nutraceuticals, cosmetics, and other value-added products owing to their diverse secondary metabolites. However, conventional agricultural practices often rely on excessive chemical inputs, raising concerns regarding environmental sustainability and soil health. In this regard, biostimulants have emerged as promising tools for improving crop performance through eco-friendly approaches. Among the various categories of biostimulants, microbial biostimulants have gained considerable attention due to their ability to enhance plant growth, nutrient acquisition, stress tolerance, and rhizosphere functioning through beneficial plant–microbe interactions.

Plant growth-promoting rhizobacteria (PGPR) represent an important group of microbial biostimulants capable of stimulating plant development while reducing dependence on synthetic agrochemicals. The application of PGPR-based bioformulations offers significant potential for improving medicinal plant cultivation by enhancing biomass production and promoting the accumulation of valuable secondary metabolites. The present study highlights the potential of microbial biostimulants as a sustainable and future-oriented approach for medicinal plant production, contributing to environmentally responsible agriculture and meeting the increasing industrial demand for high-quality medicinal plant resources.

Keywords: Microbial biostimulants; Plant Growth-Promoting Rhizobacteria (PGPR); Medicinal plants; Secondary metabolites; Bioformulation; Sustainable agriculture; Rhizosphere interactions; Plant productivity.

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Fabrication of Protein-based Edible Film For Sustainable Active Packaging

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Abstract

All over the globe, the concern regarding solid waste management is prevalent. The major percentage of waste comes from the packaging industry. Food Packaging is one of the biggest industries, and most of the packaging materials are non-biodegradable petroleum-based polymer based which leads to environmental pollution and various other health hazards. Also, these polymers undergo photo-oxidation and release free radicals, which in turn enter food materials, thereby exerting a detrimental influence on the food quality. Thus, to limit these problems, an attempt is made to fabricate biodegradable packaging, thereby reducing the solid waste disposal. Food-grade polymers like proteins, polysaccharides, and lipids have been extensively studied for packaging purposes as they are biodegradable, biocompatible, and the by-products released during their degradation pose no harm to health and the environment. In the present investigation, zein protein s used for preparing the edible films. Zein is a natural protein isolated from corn. It has a high hydrophobic character due to its high content of non-polar amino acids. Zein is generally recognized as a safe (GRAS) biomaterial and has promising properties such as low toxicity, biodegradability, and biocompatibility. This study aims to fabricate biodegradable films of zein using glycerol and essential oils (cinnamon oil and clove oil) and to determine their microstructures and functional properties. Traditional packaging like HDPE, PP etc have a poor resistance to UV. Long-wave UV passes easily through plastic and glass. Protein-based zein packaging has an inherent character of UV absorption and prevents its transmittance to the packaged material. They have been characterised through UV-Visible spectrum and proved to be UV stable. No UV stabilizers, absorbers, or blockers are needed, unlike conventional packaging materials. In general, these edible films will have a promising effect on conventional packaging and be a boon to the environment, along with their nutritive values.

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Bioactive Compounds in Fruits and Their Role in Human Health

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Abstract

Fruits are important part of the human diet and provide not only essential nutrients but also numerous bioactive compounds which play a very important role in health promotion and disease prevention. The main types of bioactive compounds in fruits are phenolic compounds, flavonoids, carotenoids, alkaloids, and terpenoids. These phytochemicals possess different pharmacological effects such as antioxidant, anti-inflammatory, antimicrobial, anticancer, and antidiabetic activity that help to reduce the risk of the development of chronic diseases such as cardiovascular disorders, diabetes, cancer, and neurodegenerative disorders. Moreover, the mechanisms of action of these compounds are discussed, including free radical scavenging, modulation of cellular signalling pathways, and regulation of metabolic processes. The possible applications of bioactive compounds from fruits such as functional foods, nutraceuticals, pharmaceuticals, cosmetics, and natural preservatives. Nevertheless, the main limitations include the low bioavailability, instability, and lack of clinical data.

Keywords: Antioxidant, Bioactive compounds, Functional foods, Phytochemicals, Nutraceuticals

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Development of a High Strength, All-climate Biodegradable Bamboo Plastic for Universal Plastic Replacement and 5G Application

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Abstract

The massive use of petroleum plastic material has become a major environmental challenge due to their non-biodegradable nature and it is harmful to ecosystem. This research proposes development of bamboo plastic (bamplast), of a high strength, all-climate biodegradable bamboo plastic for universal plastic designed as a sustainable alternative to conventional plastic bamboo is a primary raw material because of its rapid growth, high cellulose content, renewability, and low environmental. Bamboo plastic by extracting cellulose from bamboo plant and mixing or combining it with biodegradable binders and natural reinforcing agent to make a durable bio composite plastic and this research is used for packaging applications and electronic device and 5G application things. Aim of bamboo plastic products a wide range of plastic products like carry bags, agricultural products, household items disposable goods and some industrial components. This research promotes the use of renewable bamboo resource, to reduce the dependence of fossil -fuel-plastics, minimizes plastic waste, and supports sustainable development by providing an eco-friendly solution for future plastic replacement and this research aims to contribute to the reduction of electronic waste and encourage the adoption of sustainable materials in emerging technologies.

Keywords: Environmental, Biodegradable, Reinforcing, Electronic, Eco-friendly, Plastic, Petroleum, Biocomposite.

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Automated Monitoring of Cattle Behaviour and Welfare Using Computer Vision Technology

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Abstract

Animal welfare and behaviour monitoring are essential components of efficient livestock management, influencing animal health, productivity, and farm sustainability. Conventional methods of monitoring cattle behaviour primarily depend on manual observation, which is labour-intensive, time-consuming, and susceptible to observer bias. The need for continuous and objective assessment has encouraged the development of automated monitoring approaches based on computer vision technology. The objective of this study is to investigate the use of computer vision techniques for the automated monitoring of cattle behaviour and welfare under farm conditions. Video data collected through strategically positioned cameras are analysed to identify and track cattle and to recognize key behavioural activities such as feeding, drinking, walking, standing, lying, and social interactions. Variations in these behavioural patterns are used as indicators of potential welfare concerns, including stress, injury, illness, or environmental discomfort. By continuously monitoring cattle behaviour in real time, the proposed system provides an objective method for welfare assessment while reducing the dependence on manual labour. Early identification of abnormal behavioural changes can support timely management interventions, improve animal well-being, and minimize production losses associated with health-related issues. Furthermore, the system contributes to precision livestock farming by providing reliable behavioural information for informed decision-making. The study demonstrates the potential of computer vision technology as an effective, non-invasive tool for enhancing cattle welfare assessment and promoting sustainable livestock production systems through continuous behavioural monitoring and data-driven management practices.

Keywords: Cattle behaviour, Animal Welfare, Computer Vision Technology, Automated Monitoring, Precision Livestock Farming, Behavioural Assessment, Livestock Management.

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5G Enabled Smart System for Sustainable Air and Water Purification

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Abstract

The main problem discussed is the increasing level of environmental pollution, especially the rise in carbon dioxide (CO_2) in the atmosphere and the contamination of water resources. To address this problem I focus on edible algae for best performs . For air purification, these micro algae perform photosynthesis, where it absorbs CO_2 from the atmosphere and releases oxygen. This helps reduce greenhouse gases and improves air quality . For water purification, the microalga can remove excess nutrients, organic pollutants, and certain contaminants from water. As a result, it helps improve water quality and supports a healthier environment . To improve system efficiency and monitoring 5G technology is integrated for real time monitoring and management. An additional advantage is that the algae biomass produced during the purification process is not wasted. It is rich in proteins, vitamins, minerals, and bioactive compounds, making it useful for food products, dietary supplements, animal feed, and biotechnology applications. These algae offers a multifunctional approach by combining air purification, water treatment, and biomass production in a single system. Because it is renewable, environmentally friendly, and cost-effective, it has strong potential as a sustainable technology for addressing current environmental challenges and supporting future sustainable development.

Keywords: Algae, Water purification, Air purification, Biomass production, 5G technology

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Advanced Precision Agriculture Using IoT Sensing, AI Analytics, and Digital Twin Technology

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Abstract

Achieving precision in the agricultural framework is important for improving agricultural productivity, optimal resource utilization, and sustainability. This study proposes an intelligent tillage monitoring system that integrates the Internet of Things (IoT), Artificial Intelligence (AI), Digital Twin technology, and next-generation 5G/6G communication technology. Multiple sensors continuously collect real-time environmental and soil data, including soil moisture, temperature, humidity, nutrient levels, light intensity, and rainfall. The collected data is analysed using AI techniques to monitor crop health and crop stress. A Digital Twin of tillage provides a virtual representation of the field, enabling farmers to visualize and monitor agricultural parameters in real time through cloud-based dashboards and mobile applications. The use of high-speed 5G/6G networks ensures secure, low-latency communication among field devices, cloud platforms, and end-users. The proposed system also supports automated irrigation based on sensor data, optimizing water usage and reducing manual intervention. In addition, an intelligent fire detection and prevention module continuously monitors abnormal conditions and instantly alerts the farmers via mobile notifications. By combining IoT sensing, AI-driven analytics, Digital Twin technology, automation, and advanced 5G/6G connectivity, this framework enables efficient farm management for next-generation precision agriculture.

Keywords: IoT, Precision Agriculture, Artificial Intelligence, Digital Twin, 5G Communication, Automated Irrigation, Crop Health Monitoring, Sustainable Agriculture.

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Artificial Intelligence, Bioinformatics, Genomic Technologies, and 5G-enabled Smart Agriculture for Developing Climate-resilient Crops: A Comprehensive Review

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Abstract

Climate changes pose a significant threat to crop yield due to environmental stresses such as drought, high temperature, salinity, and flood. It becomes critical to develop stress-tolerant varieties that can cope with climate alterations. Therefore, this paper discusses how genomic approaches, bioinformatics, artificial intelligence, and 5G communication can help to improve the crops. Firstly, genomic methods assist in studying and identifying crucial genes that determines stress-tolerance and bioinformatics contributes by storing large datasets in one place. Furthermore, artificial intelligence allows predicting and monitoring the crop and plant performance by providing accurate data. Secondly, 5G network ensures efficient communication between different sensors, electronic devices, and applications. In general, combining these approaches may significantly increase the effectiveness of breeding procedures. However, despite recent advancements, several challenges remain. Specifically, it is essential to consider the possible negative effects on the environment. Moreover, it is necessary to develop innovative ideas of integrating and analysing various datasets. Overall, the use of interdisciplinary technologies is crucial when addressing climate-related agricultural issues.

Keywords: Climate, Genome, Bioinformatics, Artificial Intelligence, 5G Technology.

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Biochar from Locally Available Biomass as a Sustainable Strategy for Enhancing Soil Moisture Retention in Arid Rainfed Systems

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Abstract

Increasing climate variability and declining rainfall pose serious threat to food security and the livelihoods of farming communities in arid and rainfed regions. Developing sustainable soil management strategies that enhance water use efficiency and crop resilience has therefore become a priority for climate-adaptive agriculture. Biochar, produced through slow pyrolysis of organic biomass, has emerged as a promising nature-based intervention for enhancing soil moisture retention and improving resilience of cropping systems under variable rainfall conditions. Owing to its high surface area and porosity, biochar enhances plant-available water in soil profile, while also improving soil physical properties, promoting stable carbon sequestration, enhancing nutrient use efficiency, and stimulating microbial activity - collectively contributing to more resilient and sustainable agricultural systems. Conversion of locally available underutilized biomass – including invasive Prosopis juliflora, castor stalks, and cotton residues into biochar also offers a sustainable pathway for waste biomass management in arid regions. Preliminary biochar production using a muffle furnace across three temperatures with a residence time of one hour indicated that lower pyrolysis temperature (350°C) resulted in higher biochar recovery (>30% for all substrates), along with comparatively lower pH and electrical conductivity, properties favorable for soil application. For scalable low-cost production, a biochar kiln was designed using a 200 L oil barrel thermally insulated with a ceramic blanket. The sealed barrel, filled with feedstock, was externally heated while internal temperature was monitored using digital probes. Once the temperature reached 350°C, it was maintained for 30 minutes before stopping external heating to ensure uniform carbonization. After two hours, the system was quenched with water. This low-cost kiln achieved biochar yields of 42–55% across feedstocks. Characterization of the produced biochars revealed high water holding capacity at −0.33 bar, ranging from 197.4% to 247.2%, demonstrating strong potential for enhancing soil moisture retention in rainfed soils. These findings underscore the potential of locally sourced biochar as a scalable, climate-smart soil amendment for stabilizing crop production, improving water use efficiency, and building agricultural resilience to increasingly erratic rainfall in arid environments.

Keywords: Low-Cost Kiln, Biochar, Rainfed Agriculture, Dry Soils.

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Integrating NDVI-Based Regression and Support Vector Machine Classification for Rice Yield Estimation in Samastipur District, Bihar, India

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Abstract

Timely and accurate Yield estimation is key to setting solid agricultural policies, providing food security at regional levels, and developing accurate precision management of crops in agriculture. To address it, this study develops a district-level rice (Oryza sativa L.) yield forecasting framework within the Indo-Gangetic Plains of Bihar, India, focusing specifically on the Samastipur district. Utilizing multi-temporal Landsat-8/9 satellite imagery alongside the Normalized Difference Vegetation Index (NDVI) and Support Vector Machine (SVM) classification, it estimates the yield of Kharif rice 2023-24. Rice-growing areas were first delineated using SVM classification of Landsat-8/9 data, validated against rice paddy extent data obtained from the Water Resources Information System (WRIS) portal. A logarithmic regression model ($Y = 207.37e^{\wedge}(6.6786*NDVI)$; $R^2 = 0.82$) was then fitted to relate peak-season NDVI values to ground-referenced rice yield data. The estimated total rice-cultivated area was 117,256 ha (observed) against an actual area of 86,534 ha (73.8% accuracy), while the mean estimated yield was 3,062 kg ha^{-1} compared to the actual district average of 2,587 kg ha^{-1} (84.5% accuracy). Spatial yield maps reveal significant within-district variability, with high-productivity zones (2,800-5,900 kg ha^{-1}) concentrated in the northern and north-eastern blocks and low-yield zones (240-1,200 kg ha^{-1}) occurring in the flood-prone southern and western portions. This study demonstrates the operational feasibility of integrating freely available Landsat data with machine learning classification and non-linear regression for district-level crop yield monitoring, with implications for scaling such approaches across the Bihar plains.

Keywords: Rice yield estimation; NDVI; Landsat-8/9; SVM classification; Samastipur; Bihar; Remote Sensing; Logarithmic regression; Crop mapping.

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Arcopilus aureus (Chivers) Wang & Samson - A New Report from Eastern India, Growing in Soil of Chalsa Tea Garden (West Bengal)

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Abstract

Background: Soil fungi are essential components of soil ecosystems. Through decomposition, nutrient recycling, symbiotic interactions, and soil stabilization, they support plant growth, maintain soil fertility, and contribute to the overall functioning of terrestrial environments.

Objective: The present study was undertaken with the objective to record soil fungi occurring in different tea gardens in Eastern India, which can be beneficial economic crop like tea and importance for human health.

Method: The fungi was isolated from the soil of Chalsa tea garden situated in district of Jalpaiguri, West Bengal. Fungi was inoculated on Malt extract agar (MEA) medium, Potato dextrose agar (PDA) medium to see whether the fungi observed by microscope and molecular analysis.

Results: Isolated cultural identification was confirmed based on its cultural characteristics and molecular studies. There were observed mycelia, perithecia, asci, ascospores and molecular analysis confirmed as *Arcopilus aureus* (Chivers) Wang & Samson (=*Chaetomium aureum Chivers).*

Conclusion: The present investigation reports, *Arcopilus aureus* for the first time from Eastern India. Identification of *Arcopilus aureus* was confirmed by its cultural characteristics and DNA sequencing data. Hence, the collections of Arcopilus aureus assistance to successful management of economic crop like tea.

Keywords: *Arcopilus aureus*, Cultural characteristic, Molecular analysis, Tea soil.

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El Niño–Southern Oscillation Impacts on Crop Productivity in Rajasthan, India

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Abstract

Rajasthan's agriculture is uniquely exposed to monsoon failure. With the summer monsoon accounting for over 90 per cent of annual rainfall across most of the state and the Kharif season almost entirely rainfed, any large-scale suppression of the Indian Summer Monsoon (ISM) translates quickly into crop loss. El Niño events are the single strongest predictor of such suppression at the interannual scale, yet their district-to-district impacts across this climatically diverse state and their downstream consequences for individual crop categories have not been systematically quantified. The present research address this using 52 years (1966–2017) of IMD gridded daily rainfall records for 33 districts and ICRISAT district-level crop data for 26 districts.

The present analysis shows that strong El Niño events (Oceanic Niño Index≥1.5) reduce state-average June–September rainfall by roughly 22–25% relative to the long-term mean. Crucially this suppression operates through amplitude reduction, not through any detectable shift in monsoon onset or withdrawal. The causal pathway runs directly from Pacific sea-surface temperature anomalies to monsoon rainfall deficits and then to Kharif crop yield losses; Rabi crops, being largely irrigated, are substantially more resilient. Pearl millet grown on about 5 million ha under rainfed conditions emerges as the highest-risk staple crop in the state, with area, production and yield all contracting simultaneously in strong El Niño years. These findings have direct operational relevance: April-June ENSO outlooks can serve as quantitative triggers for district-level agricultural contingency planning in Rajasthan.

Keywords: El Niño–Southern Oscillation, Indian Summer Monsoon, Rajasthan, Kharif crops, Rabi crops, crop yield anomaly, Pearl Millet, food security, ONI, drought

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Identifying the Potential Link Between Drought and Submergence Tolerance in Rice

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Abstract

Due to changes in climatic conditions crops face a combination of abiotic stresses that affect their growth and development which ultimately leads to a huge decline in their yield. An alarming population increase around the world which is expected to reach 1 billion by the year 2050, is demanding a boost in food production particularly in developing countries like India which leads the global population. Rice a major cereal crop that feeds more than a billion people in the world is affected by various biotic and abiotic stresses. Among the abiotic stresses drought and submergence represent contrasting regimes which can occur during the same cropping season causing huge losses to the farmers growing rice particularly in the rainfed regions of eastern India. Rice plants have developed various physical, physiological, morphological and biochemical adaptations to cope with these stresses. Among the physical adaptations the cuticular wax represents an important trait that helps plants to mitigate drought stress. Under drought stress the cuticular wax biosynthetic genes are upregulated, resulting in an increased biosynthesis of wax. Cuticular wax forms a hydrophobic barrier above the surface of the leaves which prevents non-stomatal water loss and controls cuticular transpiration thus aiding in the drought tolerant ability of rice. Similarly, submergence- a type of flooding stress is the third most significant form of abiotic stress affecting rice growth particularly in eastern India where the flood prone deepwater ecologies are found common. Submergence stress restricts gaseous exchange between plant and environment, diminishes photosynthetic capacity and if the stress lasts for more than 5 days then plant mortality may occur. To adapt to submergence stress rice plants have developed a hydrophobic surface underwater which is called the leaf gas film or plant plastrons. These plastrons maintain underwater gaseous exchange and performs the process of photosynthesis in the absence of light and help the plant to survive under anaerobic conditions. Many researchers have proved that the maintenance of the leaf gas film is related to the abundance of cuticular wax deposition in the surface of the leaves. Hence cuticular wax also helps in submergence tolerance in rice. So an attempt has been made to establish a potential link between drought and submergence tolerance in rice by keeping in fact that the cuticular wax might contribute to tolerance to the contradictory stresses. The work was carried out in by screening a set of traditional landraces of rice which are found to be tolerant for both drought and submergence stress, analyzing their morpho-physiological and biochemical traits for both the stresses individually and characterizing the wax profile for the selected panel of rice genotypes. Developing rice varieties with multiple abiotic stress tolerance will be crucial for addressing the challenge of growing global population in the context of global climatic change.

Keywords: Climate change, Abiotic stress, Drought, Submergence, Cuticular wax

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Effect of Climate Change on Abiotic Stress and Their Mitigation Strategies in Major Spice Crops

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Abstract

Climate change is increasingly recognized as a major challenge to the sustainable production of spice crops due to the intensification of abiotic stresses such as heat, drought, waterlogging, salinity and altered radiation regimes. Changes in temperature patterns, erratic rainfall and rising atmospheric CO_2 levels significantly affect the growth, phenology, yield and quality of important spice crops including black pepper (*Piper nigrum L.*), cardamom (*Elettaria cardamomum* Maton), chili (*Capsicum spp.*), turmeric (*Curcuma longa L.*) and coriander (*Coriandrum sativum L.*). Abiotic stresses disrupt vital physiological and biochemical processes such as photosynthesis, transpiration, nutrient uptake and hormonal regulation, while inducing oxidative stress through excessive accumulation of reactive oxygen species. These effects result in reduced productivity and undesirable changes in the synthesis of essential oils and other secondary metabolites that determine spice quality. Mitigation of climate change–induced abiotic stress in spice crops requires an integrated strategy combining climate-resilient agronomic practices, improved water and soil management, microclimate modification and optimized crop calendars. This review synthesizes current knowledge on climate change–driven abiotic stresses in spice crops and highlights effective mitigation strategies to support sustainable spice production under changing climatic conditions.

Keywords: Sustainable, Abiotic stresses, Black pepper

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Climate-Smart Agronomic Practices in Millet Systems: A Review of Productivity, Adaptation and Resource- Use Efficiency

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Abstract

Millet-based farming systems are central to food and livelihood security in semi-arid regions facing increasing climate variability. Climate-smart Agriculture (CSA) has gained prominence as a strategic approach to enhance productivity, strengthen adaptive capacity and improve environmental sustainability in these systems. This review synthesizes evidence from 80 peer-reviewed studies (2015–2025), including 58 works cited directly to support key findings. A systematic review was conducted following PRISMA guidelines, supported by bibliometric and thematic analyses. The findings show that CSA interventions—particularly soil–water conservation, nutrient management, improved varieties and crop diversification—consistently enhance yield stability, water-use efficiency and drought resilience. Integrated CSA approaches demonstrate more robust and consistent outcomes than single interventions. Nonetheless, mitigation effects remain insufficiently quantified across the literature. Adoption of CSA practices is shaped by access to inputs, extension services, market linkages and institutional support, which continue to constrain large-scale implementation. The results indicate that while agronomic technologies are effective, their broader impact is limited by systemic barriers related to institutions and value chains. The study underscores the need for integrated strategies that combine technological, institutional and market interventions to improve the sustainability and scalability of millet-based CSA systems. Overall, this review provides a comprehensive synthesis of existing evidence and identifies key research and policy priorities for advancing climate-resilient millet agriculture.

Keywords: Adaptation; Climate-Smart Agriculture; Millets; Productivity; Smallholder Adoption; Resource-Use Efficiency

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Driving Operational Excellence through Enhanced Supply Chain Responsiveness: An Empirical Study of HOPCOMS

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Abstract

The growth of economy of a State relies on a centralized structure that supports and protects the state's overabundance of manufactured goods. As an agriculturally-based economy, India should have prioritized products that are produced in large quantities and have the potential to export both domestically and internationally. The present study, conducted in Bangalore, India, shows how removing intermediaries and providing direct rewards to member-farmers might increase the operating efficiency of HOPCOMS, a cooperative society. The study used a quantitative approach with convenient sampling and a structured questionnaire distributed to frequent HOPCOMS cooperative society consumers. The response rate was 70.22 percent, sufficient to produce reliable results. The five variables evaluated were commodity stocked, agile logistics, lean techniques, supply chain responsiveness, and supply chain efficiency, and they all exhibited positive benefits in achieving excellence in supply chain management. The cooperative society will benefit its member-farmers, and the HOPCOMS' operational excellence will be raised to new heights. The study's goals were achieved, with commodities stocked, agile logistics, and lean techniques all having a direct and beneficial impact on supply chain responsiveness and the importance of supply chain responsiveness to supply chain efficiency. As a result of the HOPCOMS's effective operation, not only will the member-farmer benefit but the quality and services will also improve.

Keywords: Supply chain responsiveness, Supply chain efficiency, HOPCOMS, Agile logistics, lean techniques, Commodities stocked, Farmers, Intermediaries

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Tourism, Food Provisioning and Behavioural Adaptation in Bonnet Macaques (Macaca radiata) at Suruli Falls, Meghamalai Forest Landscape, Southern Western Ghats, India

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Abstract

Although tourist feeding and human–primate interactions have been documented across several wildlife tourism destinations, relatively few studies have explored how seasonal changes in visitor density may influence behavioural responses in provisioned primate populations. In the context of Suruli Falls, where tourist numbers fluctuate considerably across seasons, bonnet macaques (Macaca radiata) may experience varying access to anthropogenic food resources. Understanding how these seasonal changes influence food-seeking behaviour, human dependence, and conflict-related interactions remains an underexplored area of research.

This paper presents a field-based observational perspective based on repeated visits, direct observations, and photographic documentation collected between 2022 and 2025 within the Meghamalai Forest Landscape, southern Western Ghats, India. We outline a conceptual framework— the "Behavioral Slippery Slope"—to explain the progression from natural foraging to human dependency under seasonal tourism regimes. Based on our observations, we document key behavioral shifts, such as infrastructure exploitation, risk-taking, and object manipulation, and present a standardized, non-invasive primatological monitoring protocol to guide future research.

Finally, we discuss the conservation implications of these behavioral changes, advocating for the integration of "behavioral integrity" as a core metric for regional wildlife management to protect the natural evolutionary behaviors of this endemic and declining primate.

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Elucidating the Impact of Postharvest Treatments on Shelf Life Extension in Guava (Psidium guajava L.)

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Abstract

Guava (Psidium guajava L.) is a climacteric fruit that is rich in nutrients but spoils quickly after harvest, which leads to big losses in storage and marketing. The current study aimed to assess the effectiveness of T1-2% Chitosan, T2- 2% Pectin, T3-1% Carboxy methyl cellulose, T4- 4% Beewax, T5- 0.1% Orange oil, T6- 2% Calcium Chloride, T7- 0.5mM Salicylic acid, T8- 0.2mM Methyl Jasmonate, T9- 0.1% Clove oil and T10- Control on Allahabad Safeda, Lucknow-49, Lalit and Arka Kiran varieties of guava under ambient storage conditions in prolonging the shelf life. Treated fruits were evaluated at regular intervals for physiological, physicochemical and biochemical parameters. Among the treatments evaluated, T1-2% chitosan was found to be the most effective treatment compared to other treatments. Among the four guava varieties evaluated Lucknow-49 demonstrated potential superior physiological stability, delayed ripening and enhanced biochemical retention. The combination of low PLW, high firmness retention and strong antioxidant defense indicates effective regulation of metabolic and stress-responsive pathways during storage. The study highlights the potential of postharvest treatments for improving storage life and market quality of guava under ambient conditions. Chitosan edible coating acts as a sustainable solution to mitigate the postharvest losses in guava.

Keywords: Guava, shelf life, Chitosan, Fruit quality.

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Physicochemical and Functional Properties of Cassava Sago Fortified with Beetroot Powder: A Comparative Analysis of Wet and Reconstituted Dry Cassava Starch

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Abstract

Cassava (*Manihot esculenta* Crantz) is an important tuber crop in India, known for its high energy yield per unit area and time. However, cassava harvesting and processing are seasonal, mainly occurring from October to March, which leads to storage problems and quality losses during the off-season. Traditional sago production from wet starch also requires large amounts of water, typically 20,000 to 30,000 liters per tonne of sago. To overcome these issues, this study explored a method of producing sago from reconstituted dry cassava starch, enabling off-season production from April to September. Although cassava sago is rich in carbohydrates, it is deficient in protein, fiber, minerals, and vitamins, necessitating fortification to enhance its nutritional and functional quality. Incorporation of beetroot powder provides natural color along with dietary fiber, minerals, and antioxidants such as betalains, thereby transforming cassava sago into a value-added functional food. In this study, beetroot powder was incorporated at 2, 4, and 6% (w/w) to improve the nutritional profile of starch rich cassava sago (sabudana). The physicochemical, functional, pasting, rheological, antioxidant, and mineral properties of beetroot powder (BRP) fortified cassava sago prepared from wet starch (WS) and reconstituted dry starch (RCS) were evaluated. Fortification significantly increased crude fiber, protein, fat, and total dietary fiber contents, with the highest total dietary fiber values of 0.88% and 0.92% observed in WS and RCS sago, respectively, at 6% BRP. Functional properties, including solubility, swelling volume, total phenolic content, and antioxidant activity, improved with increasing BRP levels. Pasting and rheological analyses showed reductions in peak viscosity, breakdown viscosity, and storage modulus, indicating restricted starch granule swelling due to starch-fiber interactions. Total phenolic content and antioxidant activity increased proportionally with BRP incorporation. Mineral analysis further revealed significant enrichment of calcium, iron, magnesium, and copper in fortified samples. Overall, the study demonstrates that beetroot powder effectively enhances the nutritional and functional quality of cassava sago, highlighting its potential for developing value added functional sago from both wet and reconstituted dry cassava starch.

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Organic Management of *Centella asiatica L.* against Major Leaf Blight Disease (s)

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Abstract

Centella asiatica (L.), commonly known as Indian Pennywort, Asiatic Pennywort, or Gotu Kola, is a herbaceous, perennial, tropical medicinal plant belonging to the Apiaceae family (formerly Umbelliferae). *C. asiatica* is a high-value medicinal crop extensively used in pharmaceuticals, nutraceuticals, and cosmeceuticals due to its therapeutic potential in neuroprotection, wound healing, anti-aging, and stress modulation. However, *C. asiatica* is highly susceptible to leaf blight disease, which significantly affects its yield, quality, and concentration of critical bioactive compounds such as asiaticoside and madecassoside and their respective aglycones, asiatic acid and madecassic acid. Furthermore, conventional reliance on chemical fungicides not only compromises the purity of the medicinal product due to residue accumulation but also poses environmental hazards and contradicts the core principles of organic farming. Therefore, to mitigate the adverse effects of chemical management, in this study, an attempt was made to evaluate an eco-friendly alternative for leaf blight disease(s) in *C. asiatica* by using some bioinputs viz., bio-agents (*Trichoderma harzianum, Bacillus subtilis)* and plant/animal derived inputs like Jeevamrit and Azadirachtin. At first, the pathogen associated with the *C. asiatica* leaf blight disease was first isolated and identified as *Curvularia lunata* on the basis of cultural, morphological and molecular characterisation. Then in vitro evaluation of different bioagents and organic products against *Curvularia lunata* was carried out using poisoned food and dual culture technique where among the considered bioinputs, the highest mycelial growth inhibition over control was exhibited by the bioagent viz., *Trichoderma harzianum.* In case of in vivo evaluation of bioagents and organic products against leaf blight disease of *C. asiatica L.,* disease incidence was recorded lowest (10.80 %) in the treatment where seedling root dip + Soil application + Foliar spray was done with bioagents taken into consideration (*Trichoderma harzianum* + *Bacillus subtilis*), which is almost at par with the chemical control (7.73 %). LC-MS/MS analysis confirmed that this treatment did not degrade the plant's key bioactive compounds (asiaticoside) Moreover, during screening of local land races of *C. asiatica*, three among eight tested land races (Karbi Anglong, Majuli and Jorhat) demonstrated strong resistance to leaf blight, while the rest showed moderate resistance. These resistant genotypes represent valuable genetic resources for future breeding programs aimed at developing disease-resistant *C. asiatica* cultivars.

Keywords: *Centella asiatica* L., *Curvularia lunata,* organic management, bioactive compounds, local land races

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Taxonomic Account of the Economically Important Genus Scirtothrips (Thysanoptera: Terebrantia) in India

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Abstract

Scirtothrips Shull is one of the largest genera in the Thripidae subfamily Thripinae, with 115 species known worldwide. Members are very small, mostly yellow or pale bodied thrips and are very active on the surface of young fleshy leaves, although adults are often seen on flowers. Even though thirteen species of *Scirtothrips* have been recorded from India, only S. dorsalis Hood is widely distributed in the country. The species recorded in India are *S. bispinosus* (Bagnall), *S. donumdei* Rachana et al., *S. dorsalis*, *S. fulleri* Faure, *S. hitam* Ng, Mound and Azidah, *S. kenyensis* Mound, *S. lami* Rachana et al., *S. machili* Masumoto and Okajima, *S. malayensis* Ng, Mound and Azidah, *S. mangiferae* Priesner, *S. oligochaetus* (Karny), *S. pteridicola* Ananthakrishnan, *S. quercus* Pal et al. and *Scirtothrips* sp. Species encountered during the study; *S. bispinosus, S. donumdei, S. dorsalis, S. machili, S. mangiferae, S. oligochaetus* and *Scirtothrips* sp. Many *Scirtothrips* species are economically important as pests of agricultural and horticultural crops. *Scirtothrips* dorsalis is a notorious pest of chilli as well as Tospovirus vector. *Scirtothrips kenyensis* is also recorded as pest of tea in Africa. Because of their high invasion potential and pestiferous nature, members of this genus such as *S. aurantii* Faure, *S. citri* (Moulton) and *S. dorsalis* are also of serious quarantine concern in several countries including India. Although they occur mainly in the warmer areas of the world, a few species have been dispersed extensively by the horticultural trade. Hence, accurate species identification is important for framing appropriate pest management policies and quarantine regulations.

Keywords: Pest, Thrips, Trade, Vector

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Balancing Productivity and Biodiversity: A One Health Perspective on Precision Agriculture

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Abstract

The growing demand for food production has accelerated agricultural intensification worldwide, often at the cost of agroecosystem biodiversity and ecosystem health. Although precision agriculture is widely recognized for improving productivity and resource-use efficiency, its potential contributions to biodiversity conservation and One Health outcomes remain insufficiently integrated within existing agricultural and environmental discourse. This study examines how precision agriculture technologies can be conceptualized as tools for balancing agricultural productivity with agroecosystem biodiversity conservation within a One Health framework.

Using a literature-based conceptual analysis, the study synthesizes evidence from technologies such as Geographic Information Systems (GIS), remote sensing, and Internet of Things (IoT)-enabled sensors. The proposed framework illustrates how site-specific management practices, including precision spraying, variable-rate fertilization, and sensorbased irrigation, can reduce pesticide drift, nutrient losses, and water wastage while optimizing agricultural inputs. These interventions contribute to improved soil and water quality, reduced ecological disturbance, and the conservation of agroecosystem biodiversity

Particular attention is given to pollinators as sentinel indicators of ecosystem health, representing one of the most extensively documented examples of biological responses to precision management practices. Evidence suggests that reducing non-target chemical exposure through precision technologies can support pollinator conservation while maintaining ecosystem services and agricultural productivity. The study further conceptualizes precision agriculture as a form of ecological intensification, whereby technological innovation enhances production while minimizing environmental pressures.

By integrating digital agriculture, biodiversity conservation, and One Health principles, the proposed framework highlights pathways toward more resilient and sustainable food systems. The framework also identifies priorities for future interdisciplinary research aimed at aligning agricultural productivity with long-term ecosystem health, though outcomes may vary with technological accessibility, management practices, and local ecological conditions.

Keywords: *Precision Agriculture, One Health, Agroecosystem Biodiversity, Pollinator Conservation, Ecological Intensification*

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Artificial Cultivation of Wild Edible Mushrooms using Agro-wastes for Waste Valorization

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Abstract

Mushroom production represents one of the most commercially important step towards diversification of agriculture based microbial technology for large-scale recycling of agro-wastes in an agricultural country like India. Thereby, an attempt was made to artificially cultivate *Auricularia* delicata and *Schizophyllum commune*, collected from different districts of Assam based on their frequency of occurrence. For artificial cultivation of *Auricularia delicata* and *Schizophyllum commune*, different available agro-based substrates for spawn production and fruiting body production were considered. For spawn production of *Auricularia delicata*, grain based basal substrates like paddy, wheat, maize and pearl millet were evaluated. Supplements like tea leaves, rice bran, rice straw and gram powder were further examined for their effect on enhancing mycelial running rate of *Auricularia delicata*. Effect of supplements did show significant enhancement on mycelial running rate. During the attempt for fruiting body production, only primordial initiation could be attained. Substrates like saw dust, sugarcane bagasse, rice straw and corn cobs were experimented as the fruiting substrates. All the substrates evaluated for fruiting body production exhibited primordial initiation except saw dust and highest no. of primordia was recorded in paddy straw (6.0) after 16 days of bagging. Similarly, for spawn production of *Schizophyllum commune,* basal substrates like paddy grain, wheat grain, paddy straw, saw dust, rice bran and wheat bran were evaluated based on their spawn run. For commercial spawn production of *Schizophyllum commune,* the best three amongst the considered substrates i.e., Paddy grain, Wheat grain and Paddy straw were prepared in every possible substrate combination and spawn run in each substrate combination were observed and recorded. Thereby, these basal substrate combination viz., Paddy grain + Wheat grain + Paddy straw where highest mycelial running rate was exhibited, was considered for the next part of fruiting body production. During the attempt for fruiting body production, two substrates were considered viz., paddy straw and sawdust. Days for spawn run in paddy straw showed faster growth (4.66 days) as compared to sawdust (10.00 days), and also primordial initiation was observed earlier in paddy straw fruiting media (8.66 days). Proximate nutritional composition analysis of cultivated *Schizophyllum commune* was also performed and found to be almost at par with the wild species except protein content.

Keywords: Agro-waste, wild mushroom, substrates, *Auricularia delicata, Schizophyllum commune,* spawn, fruiting body

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Evaluation of Suitable Forecasting Models for Potato Crop in India – A Statistical Approach

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Abstract

Accurate prediction of horticultural crop performance is critical for agricultural planning and policy. Potato (*Solanum tuberosum* L.) is strategically important for India's food security and export revenue. This study compares five forecasting approaches-ARIMA, Exponential Smoothing (ETS), Prophet, Structural Time Series (STS), and Support Vector Regression (SVR)—using annual data on potato area, production, and productivity in India from 1950–51 to 2023–24. Model performance was evaluated using RMSE, MAE, MAPE, and cross-validation with Ljung–Box residual diagnostics. ARIMA models achieved the lowest MAPE across all three variables: 1.79% (area), 4.31% (production), and 4.93% (productivity), outperforming all competing models. Five-year forecasts (2025–2029) project steady expansion in cultivated area and total production, but a declining productivity trend-a finding with significant policy implications for input-use efficiency and varietal improvement. ARIMA is identified as the most suitable model for agricultural planners and market regulators in India.

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Eco-Nanobiotechnology for Sustainable Pest Management: Fermented Polyherbal Mediated Copper Oxide Nanoparticles as Potent Antifeedants Against Spodoptera Species

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Abstract

Insect pests cause significant crop losses worldwide, while excessive use of chemical pesticides leads to environmental pollution, pest resistance and health hazards. This study presents an eco-friendly approach for synthesizing copper oxide nanoparticles (CuO NPs) using a 15 day fermented polyherbal extract prepared from *Azadirachta indica*, *Carica papaya* and *Ocimum tenuiflorum*, enriched with cow dung and cow urine. The fermented extract acted as both a reducing and stabilizing agent during nanoparticle synthesis. The synthesized CuO nanoparticles were characterized using UV–Visible spectroscopy, FTIR, SEM, EDX and GC–MS analyses. Results confirmed successful nanoparticle formation with characteristic absorption at ~300 nm, flake-like morphology, high-purity copper and oxygen composition and the presence of several bioactive compounds with insecticidal properties. The antifeedant activity of CuO nanoparticles was evaluated against two major agricultural pests, *Spodoptera frugiperda* and *Spodoptera litura*. The nanoparticles exhibited strong concentration dependent antifeedant activity, with maximum inhibition of feeding reaching 89.38% in *S. frugiperda* and 94.41% in *S. litura* at 150 µg/mL. Statistical analysis confirmed the significance of the results ($p<0.001$). The findings demonstrate that fermented polyherbal-mediated CuO nanoparticles are an effective, low cost and environmentally sustainable nano-biopesticide with promising applications in integrated pest management and sustainable agriculture.

Keywords: CuO nanoparticles, Fermented polyherbal extract, Antifeedant activity, *Spodoptera* pest management

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Evaluation of Direct Seeded Rice Technology as a Climate-Smart Approach for Water Saving, Labour Reduction and Sustainable Rice Production in the Mullaiperiyar River Basin

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Abstract

Rice (Oryza sativa L.) cultivation in Tamil Nadu is increasingly constrained by water scarcity, labour shortages and climate variability, necessitating the adoption of resource-efficient and climate-resilient technologies. An On-Farm Trial (OFT) was conducted during Kharif 2023–2025 in the irrigated lowland ecosystems of the Mullaiperiyar River Basin, Theni district, Tamil Nadu, to evaluate the performance of Direct Paddy Seeder technology as an alternative to conventional rice establishment methods. The experiment was laid out in a Randomized Block Design with three treatments: Improved Direct Paddy Seeder, Broadcasting and Conventional Transplanting by using rice variety CO 55. Improved Direct Paddy Seeder significantly improved crop establishment, yield attributes and grain yield. The technology recorded the highest productive tillers m^{-2} (1071), grains $panicle^{-1}$ (223.33) and grain yield (61.07 q ha^{-1}), registering yield advantages of 17.2 and 9.3 per cent over broadcasting and conventional transplanting respectively. Mechanized direct seeding reduced seed requirement to 20 kg ha^{-1}, achieving seed savings of 75 per cent over broadcasting and 66.7 per cent over transplanting. Elimination of puddling, nursery raising and transplanting operations reduced irrigation water use by 33.3 per cent and enhanced water productivity to 6.96 kg ha^{-1} mm^{-1} compared with 4.36 kg ha^{-1} mm^{-1} under conventional transplanting. Labour requirement was reduced by 50.8 per cent through mechanized sowing and mechanical weed management, substantially lowering drudgery and dependence on scarce agricultural labour. Economic analysis indicated the highest net return (Rs.93,067 ha^{-1}) and benefit-cost ratio (3.25) under the Direct Paddy Seeder treatment. The study demonstrates that Direct Paddy Seeder technology is a scalable climate-smart intervention that conserves water, saves seed, reduces labour drudgery and enhances productivity and profitability. Its adoption can significantly strengthen the resilience and sustainability of rice-based farming systems in water-limited irrigated ecosystems.

Keywords: Climate-resilient agriculture, Direct Paddy Seeder, Water conservation, Labour-saving technology, Water productivity, Drudgery reduction, Sustainable rice production, Climate-smart agriculture.

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From Dust to Den: Decoding the Soil preference of Ground nesting bee, *Hoplonomia westwoodi* (Nomiinae: Halictidae)

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Abstract

The pearly-banded bee, Hoplonomia westwoodi (Nomiinae: Halictidae), is an efficient buzz pollinator of crops belonging to the family Solanaceae with unique 'poricidal anthers' in the flowers. Domiciliation of H. westwoodi is incredibly effective for pollination of polyhouse grown solanaceous vegetables. A study was conducted to investigate the nesting activity, soil preference and nest reuse by H. westwoodi. The nest-burrowing activity was highest in October (12.67 ± 1.15 burrowing events/month), and least in February (1.03 ± 0.11 burrowing events/month). The number of pollen flights was maximal between 10:00 and 12:00 p.m. in the active nesting period. The mean number of active turrets per nest was significantly higher in pots with plants (17.17 ± 2.63 active turrets/pot) compared to pots without any plants (8.01±1.54 active turrets/pot). A significantly higher rate of acceptance (63.2%) of sandy soil for nest construction by H. westwoodi was observed, with the highest number of brood cells/turret (13.25 ± 2.22 brood cells/turret) and adult emergence (95%). The present study shows that the pearly-banded bee H. westwoodi is amenable to nest construction in portable pots with sandy soils. The study indicated a possible scope for using portable pots with nests built by H. westwoodi for managed pollination of Solanaceous crops under protected cultivations.

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Elucidating the interactions of Viral protein genome-linked (VPg) of Cardamom mosaic virus with host Histones and SGS3

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Abstract

Interactions between viral proteins and host chromatin are increasingly recognized as important mechanisms of host manipulation during the plant virus infection. *Cardamom mosaic virus* (CdMV) is a major pathogen affecting small cardamom, with viral proteins modulating host cellular processes to facilitate the infection. Nuclear inclusion a (NIa) protein comprises an N-terminal VPg domain and a C-terminal protease domain. Viral protein genome-linked (VPg) of CdMV has previously been shown to interact with host histones H3 and H4 of *Elettaria cardamom*, suggesting a potential role in chromatin-associated regulation. In the present study, VPg was divided into three putative domains and analysed for interaction with histones H3 and H4 with *in-silico* and *in -vivo* yeast two-hybrid (Y2H) system to identify the regions involved in histone association. Individual VPg domains exhibited reduced interactions compared to full-length VPg, suggesting that structural integrity may be required for stable histone binding.

In addition, the NIa protease of CdMV contains a putative histone-binding motif resembling that of MYST histone acetyltransferases, suggesting a possible role in epigenetic regulation. Considering this, histone acetyltransferase (HAT) assays are also being conducted to explore the potential epigenetic implications of VPg/NIa-mediated host interactions.

Similarly, interaction between CdMV VPg and *Solanum lycopersicum* Suppressor of Gene Silencing 3 (SGS3), a key component of the RNA silencing pathway, has also been established through yeast two-hybrid (Y2H) analysis. Furthermore, domain-wise interaction analysis of *S. lycopersicum* SGS3 was undertaken to identify the specific region of SGS3 involved in VPg recognition.

Additionally, Bimolecular Fluorescence Complementation (BiFC) assays are being carried out to validate VPg interactions with these host proteins and to determine the site of their interactions. Overall, this study provides mechanistic insights into VPg-mediated host protein interactions and highlights the potential involvement of VPg in chromatin-associated and RNA silencing-related host regulatory processes during CdMV infection.

Keywords: *Cardamom mosaic virus* (CdMV), VPg, NIa protease, histone H3, histone H4, *Elettaria cardamomum,* SGS3, yeast two-hybrid, BiFC, histone acetyltransferase assay.

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Performance Evaluation of Sequential Batch Reactor (SBR) Based Sewage Treatment Plants with Chlorination Disinfection in Gujarat, India: A Review

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Abstract

Rapid urbanization demands automated municipal wastewater solutions like Sequential Batch Reactor (SBR) technology. This study evaluates the performance of five operational SBR-based Sewage Treatment Plants (STPs) in Gujarat, India, analyzing secondary treatment efficiency alongside chlorine disinfection dynamics. Following standard monitoring protocols, grab samples were collected across pre- and post-chlorination stages under variable chlorine dosages of 5.0 ppm and 6.0 ppm. Evaluation parameters included physico-chemical properties, organic carbon matrices, Total/Faecal Coliform log-reductions, and the formation of Trihalomethanes (THMs) as toxic disinfection byproducts. Results show that well-maintained STPs achieve robust organic and nutrient breakdown. Increasing chlorine dosing safely met regulatory pathogen targets without triggering detectable THM formation, remaining below detection limits across all facilities. However, operational bottlenecks like screen clogging and dosing pump failures significantly compromised nitrification and bacterial reduction at one site. This research highlights that while SBR technology is highly effective for safe water recycling and circular economy models, strict operational discipline and routine equipment maintenance are mandatory to prevent localized environmental discharge failures.

Keywords: Wastewater treatment, Sequential Batch Reactor (SBR), Chlorine disinfection, Coliform reduction, Trihalomethanes (THMs), Plant maintenance, Water reuse, Gujarat

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Smart Landscaping Transforms Urban Spaces, Paving the way for Greener Cities

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Abstract

Simultaneous pressures of demographic growth, accelerated urbanization and climate change present a critical global challenge: balancing food production, environmental conservation and sustainable urban development. Rapid urban expansion alters natural land-use patterns, fragments ecosystems, reduces green cover and diminishes urban biodiversity, resulting in increased temperatures, air pollution, stormwater runoff and declining environmental quality. In this context, a strategic transition toward green, climate-resilient cities has become essential. Achieving this transformation requires integrated and sustainable urban planning approaches that incorporate ecological principles into all stages of infrastructure development and governance. Smart landscaping has emerged as an effective and sustainable solution to address contemporary urban challenges by integrating horticultural innovations into city infrastructure. Modern green infrastructure practices such as vertical landscaping, rooftop gardens, terrace farming, rain gardens, xeriscaping, urban food gardens and Miyawaki forests contribute significantly to improving urban environmental health. These interventions enhance carbon sequestration, mitigate the urban heat island effect, improve air quality through pollutant filtration, reduce noise pollution, conserve water resources and support urban biodiversity. Furthermore, the use of diverse native and climate-adapted plant species strengthens ecosystem resilience while minimizing maintenance requirements and resource consumption. Beyond environmental benefits, smart landscaping also delivers social and economic advantages by improving public health, promoting recreational opportunities, enhancing aesthetic value and strengthening community engagement with nature. Green spaces contribute to mental well-being, increase property values and support sustainable livelihoods through urban horticulture initiatives. As cities continue to expand, integrating smart landscaping strategies into urban planning frameworks can bridge the gap between nature and urbanity while advancing climate adaptation and mitigation goals. Thus, smart landscaping represents a key pathway toward creating healthier, greener and more sustainable cities capable of meeting future environmental and societal challenges.

Keywords: Smart Landscaping, Green Infrastructure, Environmental Conservation, Vertical Landscaping, Green Spaces.

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Nutrition Insecurity, Dietary Behaviours and Sustainable Well-Being Strategies among Urban Adult Women: A Public Health Assessment in Coimbatore District

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Abstract

Urbanization and changing lifestyles have significantly transformed dietary behaviours among women, contributing to a growing burden of nutrition-related health challenges. Despite improved food availability, nutrition insecurity remains a major public health concern, characterized by inadequate access to safe, affordable, and nutrient-dense foods. This study assessed dietary patterns, nutritional challenges, and well-being strategies among urban adult women in Coimbatore District, Tamil Nadu. An ex-post facto research design was employed with 120 urban women selected through purposive and simple random sampling techniques. Data were collected using a structured interview schedule through personal interviews and online surveys.

The study examined food consumption patterns, meal-skipping behaviour, nutritional awareness, food accessibility, and health status. Qualitative data were analysed using NVivo to identify key nutritional challenges, while Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed to assess the influence of factors such as time constraints, work stress, nutrition behaviour, and well-being on health outcomes. Additionally, geospatial analysis was conducted to map the distribution of healthy and unhealthy food outlets surrounding the study area and understand the local food environment.

Findings revealed that irregular meal patterns, reliance on processed foods, work-related stress, nutritional deficiencies, and limited access to healthy food choices adversely affected women's

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health and well-being. The study proposes age-specific nutrition interventions, workplace wellness initiatives, food environment improvements, and policy-driven approaches to enhance nutritional security. Promoting sustainable dietary practices and equitable access to nutritious foods can contribute significantly to improved public health outcomes and women's well-being in rapidly urbanizing regions.

Keywords: Nutrition Insecurity; Urban Women; Dietary Behaviour; Public Health; Nutritional Well-Being ; Food Environment

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Challenges and Opportunities Faced by Seasonal Cane-Cutting Laborers in Maharashtra: A Pilot Study

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Abstract

This paper explores the structural deprivation and policy invisibility fueling the exploitation of seasonal cane-cutters, an army of nearly 500000 in Maharashtra, that experiences a complex web of economic exclusion, occupational health vulnerabilities, and legal anonymity perpetuating inter-generational poverty and forced migration. The multi-method research, combining the compilation of occupational health & safety incidents from journal archives & media reports, qualitative analysis of household livelihood realities, comparative review of policy provisions under Building & Other Construction Workers Act against the case of cane cutters, and analysis of 2011 Census and NSSO migration data demonstrated that the cane-cutters are an intensely deprived community: their existence on less than the national minimum wage- as a couple they earns Rs 200-250 per ton with 12-15 hour work days-coupled with widespread landlessness, usury and debt bondage makes them vulnerable to severe work related injury and illness including musculoskeletal injuries, heat stress and respiratory disease with no social insurance or compensation. Informal unwritten contracts on their cane cutting work denies them legal unionization & social security benefits like Provident Fund. The seasonal cane cutters are unrecognized in any central labour codes & their inability to form any formal association means there are neither formal avenues of dispute resolution nor are there any provisions for a labour welfare board. Hence labour codes protection and a labour welfare board is an urgent necessity.

Keywords: Cane-Cutting Laborers, Labor Rights, Sugar Cane, Migration Patterns, Socioeconomic Impact, Social Security, Worker Protection, Social Security, Maharashtra, Pilot Study

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Exploring the Potential of Thermophilic Proteases in Bioremediation of Protein based Wastes

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Abstract

Background: Proteases catalyze hydrolytic breakdown of peptide bonds within polypeptides, yielding smaller and soluble peptides and free α-amino acids. Thermophilic alkaline proteases, derived from extremophiles, show low viscosity, easy purification, higher substrate utilization efficiency, solvent tolerance and serve as promising tools in cosmetics, detergents, medical, tannery, food and agro related industries.

Objective: The primary objective of this study was to explore the industrial applicability of thermophilic alkaline protease derived from bacterial isolates found in hot water springs.

Methods: The alkaline protease was harvested by submerged fermentation. Optimal temperature and pH conditions for maximal enzyme production were ascertained, followed by purification of crude enzyme by ammonium sulphate precipitation and dialysis techniques. Enzyme stability was analyzed over variable ranges of thermal and pH conditions. Biodegradation capabilities of protease enzyme were assessed on three proteinaceous wastes, derived from three distinct sources, namely hair discards [human waste], chicken feathers [poultry waste] and deoiled groundnut oilcakes [agro-waste]. Keratinolytic efficiency of protease was sharply confirmed on human hair and chicken feather samples. Qualitative tests and paper chromatography further confirmed proteolytic degradation of these protein samples.

Results: Purified thermophilic alkaline protease showed an increase in enzyme activity after four consecutive days of dialysis. The purified enzyme exhibited ability to bio-degrade proteinaceous human hair discards, chicken feathers and deoiled groundnut oilcakes within 31, 21 and 12 days respectively of incubation at 37°C.

Conclusion: Experimentally verified results confirmed that the isolated protease enzyme exhibited caseinolytic, alkaliphilic and thermotolerant properties. The isolated enzyme can serve as a promising tool in biodegradation of protein and keratin- rich wastes, further finding usability in cosmetics, food- and agro-industrial sectors.

Keywords: Thermophilic, Alkaline Protease, Caseinolysis, Biodegradation, Keratinolysis

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Natural Polymer-Based Nanobiomaterials for Biomedical and Food Packaging Applications

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Abstract

The biodegradability, biocompatibility, renewability, and functional flexibility of natural polymer-based nanobiomaterials have made them attractive substitutes for traditional synthetic materials. Chitosan, gelatin, starch, cellulose, alginate, pectin, proteins, and plant-derived gums are examples of polymers that can be modified at the nanoscale to create films, coatings, hydrogels, nanofibers, and nanocomposites with enhanced mechanical, barrier, antimicrobial, antioxidant, and bioactive-delivery properties. Because these materials may safely interact with living tissues, they are rapidly being employed in biomedical applications for wound dressings, tissue-engineering scaffolds, controlled drug delivery systems, biosensors, and regenerative medicine. Natural polymer-based nanobiomaterials can improve food quality and shelf life in food packaging by strengthening defense against oxidation, moisture, oxygen, and microbial deterioration. The creation of active and intelligent packaging solutions is further made possible by the incorporation of nanoparticles, essential oils, plant extracts, and bioactive chemicals. Nanoparticle safety, migration, scalability, regulatory approval, cost, and long-term stability remain significant issues despite their potential. This study focuses on the latest advancements, uses, advantages, drawbacks, and potential applications of natural polymer-based nanobiomaterials in the food packaging and biomedical industries.

Keywords: Natural polymers, Biodegradable packaging, Biomedical applications, Nanocomposites, Sustainable materials.

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Precision Nutrition in the AI Era: Integrating Nutrigenomics, Metabolomics and Digital Health for Personalized Disease Prevention

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Abstract

Precision nutrition is becoming an effective approach to combat the growing prevalence of obesity, metabolic syndrome, diabetes type 2 and other non communicable diseases (NCDs). Precision nutrition is more customized than the “one size fits all” approach, and uses an individual's genetic, metabolic, physiological and lifestyle to customize their diet. Recent developments in nutrigenomics and metabolomics have improved our knowledge of the role of genes in the interactions with nutrients, and how metabolic markers can be used to measure disease risk. Meanwhile, digital health technologies and artificial intelligence (AI) have the potential to monitor health and respond with personalised nutrition recommendations in real time, using wearable devices, mobile health apps, continuous monitoring and AI-driven analytics. Integrating information across various 'omics' with health and lifestyle data can help AI make personalized predictions on metabolic health outcomes and guide evidence-informed interventions to prevent obesity, cardiovascular disease and type 2 diabetes. Among the exciting innovations that are progressing in the age of personalised healthcare are digital twins, predictive health modelling and adaptive nutrition platforms. From a sustainability perspective, precision nutrition also has a part to play in the prevention of disease, the efficient use of healthcare resources, reducing healthcare costs and improving health outcomes for the long term. But data privacy, ethical issues, algorithmic bias, accessibility, and clinical validation are some of the issues that need to be tackled for wider adoption.

Keywords: Precision Nutrition, Artificial Intelligence (AI), Nutrigenomics, Metabolomics, Digital Health, Personalized Nutrition

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From Food Waste to Fashion: Vegan Leather Production Using Tomato and Pumpkin By-Products

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Abstract

Agricultural waste generation, particularly from tomatoes (*Solanum lycopersicum*) and pumpkin, presents a growing environmental challenge and highlights the need for sustainable valorisation strategies. Market fluctuations often reduce produce prices, leading to the discarding of fresh crops either in the field or at commercial marketplaces due to their perishable nature and rapid spoilage. This study investigates the potential of tomato and pumpkin residues as a raw material for producing organic, vegan leather. The mechanical properties of the resulting bio-based leather were evaluated under different experimental treatments to assess its performance and competitiveness with conventional animal-derived leathers. Valorisation of tomato and pumpkin by-products not only mitigates environmental pollution but also addresses food waste, enabling the development of sustainable materials aligned with circular economy principles. Preliminary findings indicate that tomato and pumpkin waste-derived organic leather exhibits promising mechanical characteristics, supporting its potential as an eco-friendly alternative to traditional leather.

Keywords: Organic leather, Tomato and pumpkin residues, Mechanical properties, Sustainability, Agricultural waste valorisation, Food waste

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Synergistic Effect of NPK, Neem Cake and Fish Manure on Soil Fertility and Sustainability

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Abstract

A field investigation was carried out during the kharif seasons of 2023 and 2024 to examine the influence of integrated nutrient management practices on okra cultivation. The study evaluated the combined application of chemical fertilizers (NPK), neem cake, and fish manure with respect to soil characteristics, crop growth, productivity, nutrient absorption, and economic returns. The experiment was established using a factorial randomized block design comprising three levels of each nutrient source. The findings indicated that the sole application of NPK fertilizers produced only marginal changes in soil physical conditions. However, the incorporation of neem cake and fish manure along with mineral fertilizers markedly enhanced soil structural properties. The lowest bulk density value of 1.31 Mg m^{-3} was observed at the 15–30 cm soil depth under integrated nutrient treatments. Water retention capacity reached 46.39%, while the infiltration rate increased to 3.96 cm hr^{-1} with greater additions of organic amendments. Continuous application of the integrated nutrient sources resulted in a substantial buildup of soil organic carbon, which increased from 0.50% to 0.69% in the 0–15 cm soil layer over the two-year period. Corresponding improvements were also recorded in soil organic matter content and cation exchange capacity, the latter attaining a maximum value of 22.33 Cmol (p+) kg^{-1}. Furthermore, the availability of essential nutrients, including nitrogen, phosphorus, potassium, sulphur, and zinc, was considerably higher during the second year, demonstrating the cumulative benefits of combining organic manures with inorganic fertilizers. In conclusion that integrated nutrient management through the combined application of NPK, neem cake and fish manure significantly improved soil health over two consecutive years.

Keywords: Soil health, Neem cake, Fish manure, Quality, Fertility.

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Economics of Chinese Potato Production and Marketing in Kerala: Evidence from Farm Level Analysis

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Abstract

Chinese potato (Plectranthus rotundifolius (Poir.) Spreng) is an important tropical tuber crop cultivated in Kerala, contributing significantly to farm income and livelihood security of the households. Despite its importance, information on production economics and marketing performance remains limited. The present study was undertaken to evaluate the economics of Chinese potato production and analyze the prevailing marketing practices in Kerala. Primary data were collected from 80 Chinese potato growers in the Palakkad and Idukki districts of Kerala through a well structured survey. Descriptive statistics and economic analysis were employed to assess production costs, returns and marketing characteristics. The results revealed that the average area under Chinese potato cultivation was 0.54 ha per farmer, with an average yield of 9.84 t/ha. The farmers had an average operational holding of less than one hectare. Chinese potato cultivation was found to be economically viable, with a benefit–cost ratio of 1.77:1 and an average net return of Rs. 1.60 lakh/ha. About 98% of the produce was marketed immediately after harvest, reflecting limited storage opportunities and the liquidity requirements of farmers. Marketing was largely channelized through wholesalers (50%), aggregators (38.75%) and other intermediaries (11.25%). Market access was facilitated mainly by the Vegetable and Fruit Promotion Council Keralam (VFPCK) and the Marayoor Forest Station, although these channels influenced price realization. Farmers identified price fluctuations, rising input costs and inadequate post-harvest infrastructure as the major constraints affecting production and marketing. The study confirms the economic potential of Chinese potato cultivation and emphasizes the need for improved market linkages, storage facilities and institutional support to enhance farmers' income and strengthen the sustainability of the sector.

Keywords: Chinese potato, production economics, marketing channels, profitability, farm level analysis, Kerala.

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Smart Wetlands: Integrating AI/ML for Gov ernance, Monitoring, and Pollutant Detection

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Abstract

Wetlands are vital ecosystems that support biodiversity, regulate climate, improve water quality, and provide essential ecosystem services. However, increasing anthropogenic pressures, including pollution, urbanization, habitat fragmentation, and climate change, have led to the degradation of wetland ecosystems worldwide. This explores the emerging concept of "Smart Wetlands," focusing on the integration of Artificial Intelligence (AI) and Machine Learning (ML) in wetland governance, environmental monitoring, and pollutant detection.AI-driven approaches such as remote sensing, predictive modeling, geospatial analysis, and real-time sensor data processing enable efficient assessment of wetland health and facilitate the early detection of environmental threats. Furthermore, the integration of microbial indicators with ML algorithms enhances the accuracy of pollutant identification and ecological risk assessment. These technologies support evidence-based decision-making and promote sustainable wetland management through continuous environmental surveillance. A novel framework proposed in the development of a neural network-based Smart Wetland Monitoring System that connects multiple wetlands through a centralized computerized network. In this system, real-time sensors deployed across various wetland sites continuously monitor critical environmental parameters, including pH, temperature, dissolved oxygen, turbidity, nutrient levels, conductivity, and pollutant concentrations. The collected data are transmitted to a central platform where AI and neural network models analyze, visualize, compare, and predict changes in wetland conditions. Such an interconnected monitoring network would enable comparative assessment of multiple wetlands, rapid detection of pollution events, spatial mapping of ecosystem health, and data-driven governance at regional scales. This highlights the importance of interdisciplinary collaboration among ecology, microbiology, environmental science, data science, and artificial intelligence to develop intelligent, scalable, and sustainable wetland management systems. The Smart Wetland framework offers a promising approach for future conservation efforts, supporting real-time monitoring, informed decision-making, and long-term ecosystem resilience.

Keywords: Smart Wetlands; Artificial Intelligence (AI); Neural Networks; Real-Time Environmental Monitoring; Wetland Conservation

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Sustainable Valorization of Red Ochre Mine Waste into High-Strength Iron Ore Pellets for Blast Furnace Applications: An Innovative Approach Toward Circular Mining

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Abstract

The increasing demand for iron ore resources highlights the need for sustainable technologies that can utilize low-grade iron-bearing materials. Red ochre, an iron-rich by-product generated during iron ore mining, remains largely underutilized despite its significant resource potential. This study investigates the conversion of red ochre fines from the Daitari Iron Ore Deposit, Odisha, into blast furnace-grade pellets through an optimized pelletization process. Mineralogical and microstructural analyses revealed hematite and goethite as the dominant iron-bearing minerals. Green pellets were prepared using varying bentonite contents with fixed additions of limestone and coke fines, followed by induration at temperatures between 1100 and 1300 °C. Thermal treatment transformed goethite into hematite and promoted the formation of calcium ferrite and fayalite bonding phases, resulting in improved pellet strength. Pellets containing 1.0 wt.% bentonite and indurated at 1300 °C achieved the highest cold compressive strength (≈258 kg/pellet) and the lowest porosity (≈25%), meeting blast furnace quality requirements. The findings demonstrate an effective strategy for converting mine waste into a value-added ironmaking feedstock, supporting resource efficiency, circular mining, waste minimization, and sustainable steel production.

Keywords: Red ochre; Sustainable pelletization; Circular mining; Iron ore beneficiation; Green steel.

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Assessment of Farmers' Awareness and Adoption of Improved Horticultural Varieties in Different Agro-Climatic Regions

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Abstract

Fruit quality plays a significant role in influencing consumer purchasing behavior and market demand. Consumers generally prefer fruits based on attributes such as taste, sweetness, color, aroma, texture, size, nutritional value, and shelf life. Understanding these preferences is essential for plant breeders to develop improved fruit varieties that meet consumer expectations. The present survey-based study aims to assess consumer preferences for different fruit quality traits through questionnaires and interviews conducted among consumers of different age groups.The survey findings help identify the most desirable characteristics in fruits and provide valuable information for breeding programs. The study also examines the influence of factors such as age, income, education, and health awareness on consumer choices. Incorporating consumer preferences into breeding objectives can enhance market acceptance, increase profitability for farmers, and improve the quality of horticultural produce.The results of this study may assist plant breeders and researchers in developing consumeroriented fruit varieties, thereby contributing to sustainable horticultural production and improved food quality.

Keywords: Consumer preference, Fruit quality, Plant breeding, Horticultural crops, Quality traits, Market demand, Consumer survey, Fruit breeding.

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RNA-Seq Analysis Reveals Molecular Basis of Rice Resistance to Brown Planthopper, Nilaparva lugens (Stål)

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Abstract

The brown planthopper (*Nilaparvata lugens*, BPH) is a major rice pest, inflicting severe yield losses (30-70%) globally. Developing resistant rice varieties is crucial for sustainable management. Molecular basis of BPH resistance in rice is not well established. We investigated two resistant cultivars (Salkathi, CR Dhan 805) and one susceptible (Naveen) under BPH stress. Phenotypic evaluations confirmed robust antixenosis and antibiosis resistance mechanisms in resistant cultivars, evidenced by significantly lower honeydew excretion (e.g., Salkathi: 24.03 mm^2 vs. Naveen: 237.27 mm^2) and reduced nymph survival (e.g., Salkathi: 21.66% vs. Naveen: 83.33%). Transcriptome analysis identified 9,479 differentially expressed genes (DEGs), with 3,288 functionally annotated. These DEGs were significantly enriched in defense-related pathways, including the jasmonic acid (JA)/ethylene-dependent pathway, MAPK signaling, and secondary metabolite biosynthesis. Key transcription factors like WRKY, MYB, bHLH, and NAC families were identified as important regulators. Notably, Callose Synthase Gene-9 showed significant upregulation in resistant varieties, enhancing structural defenses. Three putative candidate genes (*LOC4339516, LOC4351819, LOC107275890*) were identified, shortlisted, and validated by qRT-PCR, showing significant downregulation in resistant varieties, suggesting their role in resistance through transcriptional and metabolic adjustments. These findings provide critical insights into defense-related genes and pathways, offering key targets for breeding and genetic engineering to enhance BPH resistance and contribute to global food security.

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Phytoremediation as a Sustainable Strategy for Indoor Air Quality Management

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Abstract

Indoor air quality has become an important environmental and public health issue because people spend nearly 80–90% of their time indoors. Rapid urbanization, inadequate ventilation, and the widespread use of synthetic building materials and household products have increased the concentration of indoor air pollutants. Common contaminants such as volatile organic compounds (VOCs), particulate matter (PM), formaldehyde, benzene, and carbon dioxide (CO_2) can adversely affect human health, resulting in respiratory illnesses, allergies, cardiovascular problems, and reduced cognitive performance (Matheson et al., 2023; Mushahary et al., 2024).

Among the various approaches available for indoor air purification, phytoremediation has gained considerable attention as a sustainable and environmentally friendly technology. Phytoremediation utilizes plants and their associated rhizospheric microorganisms to absorb, degrade, or transform airborne pollutants into less harmful substances (Gawrońska et al., 2024). In addition to pollutant removal, indoor plants contribute to humidity regulation, oxygen enrichment, and the improvement of indoor aesthetics. Several ornamental plant species, including Chlorophytum comosum (spider plant), Spathiphyllum wallisii (peace lily), Epipremnum aureum (golden pothos), and Sansevieria trifasciata (snake plant), have demonstrated the ability to remove VOCs and other indoor contaminants effectively (Wolverton et al., 1989; Dela Cruz et al., 2014).

This review summarizes the major sources of indoor air pollution, associated health risks, and the mechanisms involved in plant-mediated air purification. It further evaluates the effectiveness of different indoor plant species in pollutant removal and discusses recent advances in phytoremediation-based technologies (Peterson et al., 2023; Matheson et al., 2023). In addition, the challenges and future prospects of integrating plant-based biofiltration systems into modern indoor environments are examined. Overall, indoor plants represent a cost-effective, sustainable, and aesthetically attractive strategy for improving indoor air quality and supporting healthier living conditions.

Keywords: Indoor air pollution; phytoremediation; indoor plants; air quality management; volatile organic compounds; biofiltration; sustainable environmental management.

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Assessment of Genetic Variability, Heritabili ty and Genetic Advance in Induced M tants of Moringa (Moringa oleifera Lam.) Var. PKM 1

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Abstract

Moringa oleifera is renowned as a miracle tree due to its diverse applications in nutrition, medicine, agriculture, and biotechnology. Despite its immense potential, Moringa with improved leaf yield is not yet developed, necessitating the development of improved genotypes through mutation breeding. The research was carried out at Department of Vegetable Science, Horticultural College and Research Institute, Periyakulam during 2023-2024. To generate genetic variability and identify superior genotypes, seeds were treated with gamma rays (100, 200, and 300 Gy) and ethyl methane sulphonate (EMS) at concentrations of 0.15%, 0.20%, and 0.25%. Following continuous evaluation from the M_1 to M_3 generations, fifteen mutants from the selected mutant family 15-1-09 (derivative of gamma ray induced mutation) of M4 generation were assessed along with the control variety PKM 1. Among all the assessed characters related to leaf yield, high genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were recorded for internodal length (28.86% and 29.03%), number of rachis per tree (28.80% and 28.90%), leaf breadth (21.38% and 21.52%), number of secondary branches (27.94% and 28.13%), protein content (21.10% and 21.17%), crude fibre content (26.23% and 26.38%) and fresh leaf yield (25.00% and 25.12%) indicating substantial genetic variability. Broad-sense heritability was high (>60%) for all the traits studied, including growth, yield and nutritional parameters. Genetic advance as percent of mean (GAM) exceeded 20% for all traits except plant height at first harvest (18.45%) suggesting the predominance of additive gene action. The high variability, heritability and genetic advance observed among the mutants indicate significant scope for selection and improvement. The study demonstrates the effectiveness of induced mutagenesis in developing high-yielding and nutritionally superior moringa genotypes for future breeding programmes.

Keywords: Induced Mutagenesis, Gamma Rays, Heritability, Genetic Advance.

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Comparative Ethnobotanical Assessment of Plant Resources Use among the Bodo and Rabha Communities of Udalguri District, Assam

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Abstract

Traditional medical knowledge is an important part of the cultural history of indigenous people and is still widely practiced in fundamental healthcare, especially in rural and tribal areas. The present study was undertaken to document and compare the ethnobotanical knowledge and use of medicinal plants by the Bodo and Rabha communities of Purani Hapagaon and Batabari villages, respectively, in Udalguri District, Assam, India. Ethnobotanical information was collected from 20 households in each village through field surveys using semi-structured questionnaires, individual interviews, and discussions with knowledgeable informants. Households were selected using the snowball technique. Information regarding medicinal plant diversity, traditional uses, and their cultural, nutritional, and economic significance was systematically documented. Quantitative ethnobotanical analyses included Frequency of Citation (FC), Relative Frequency of Citation (RFC), Use Value (UV), Informant Agreement Ratio (IAR), and Informant Consensus Factor (ICF/Fic).

Ethnobotanical survey recorded 144 plant species in Rabha community and 99 species in Bodo community, reflecting rich ethnobotanical diversity and extensive indigenous knowledge. The survey also showed that 74 species were common to both communities and Rabha and Bodo communities had 70 and 25 unique species, respectively, implying variation in traditional knowledge and plant use. The species *Mangifera indica* L. and *Areca catechu* L. showed the highest FC, RFC, and UV values, indicating their extensive application and cultural importance. On the other hand, the ethnobotanical indices of *Acmella grandiflora* (Turcz.) R.K. Jansen and *Citrus limetta* Risso were comparatively low, indicating limited use.

The Rabha community showed higher species richness and broader medicinal plant utility than the Bodo community, suggesting stronger preservation of traditional ethnobotanical knowledge. The study also highlights the necessity of documentation and conservation of indigenous knowledge systems and medicinal plant diversity for sustainable resource management, biodiversity conservation, and future phytochemical and pharmacological research.

Keywords: Ethnobotany; Plant Resources; Indigenous Communities; Traditional Knowledge; Biodiversity Conservation.

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Antifungal Efficacy of Plant Extracts against Common Bean Anthracnose caused by *Colle totrichum lindemuthianum* Sacc and Magn

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Abstract

French bean (*Phaseolus vulgaris* L.) is an important leguminous vegetable crop, grown throughout the world for its green pods as well as dry beans. During cultivation the crop is infected with several fungal, bacterial and viral diseases which not only reduces the yield but also impair its quality. Among fungal diseases anthracnose caused by *Colletotrichum lindemuthianum* is widespread problem limiting the profitable cultivation and seed production of French bean. The pathogen causes extensive damage to the pods and seeds since the lesions on them considerably reduce the market value. Limited availableness of the resistant cultivars makes the farmers to rely on fungicides for disease management. So, the present research was carried out with an objective to develop some sustainable and eco-friendly control measures. The aim of this study is to assess the antifungal efficacy of some plant extract in suppressing the proliferation of *Colletotrichum lindemuthianum*. Nine plant extracts *viz*. Ginger (*Zingiber officinale*), Heena (*Lawsonia inermis*), Tulsi (*Ocimum tenuiflorum*), Eucalyptus (*Eucalyptus occidentalis*), Black pepper (*Piper nigrum*), Onion (*Allium cepa*), Bougainvillea (*Bougainvillea glabra*), Datura (*Datura stramonium*) and Marigold (*Tagetes* sp.) were evaluated by poisoned food technique at two different concentrations (10 and 15 %). At 10%, Ginger extract showed maximum inhibition of the pathogen *i.e*., 74.4 % followed by Datura (70.92%) and Black pepper (68.02%) extracts. At 15%, Black pepper extract was found most effective and recorded significantly highest growth inhibition (86.81%) followed by Ginger (83.89%) and Datura (77.43%) extracts. At both the concentrations, Black pepper, Ginger and Datura extracts were found most fungitoxic, remarkable and promising substitute for the synthetic fungicides against the pathogen.

Keywords: Antifungal activity, *Colletotrichum lindemuthianum,* Eco-friendly, Plant extract

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Physico-Chemical Assessment and IDW-Based Spatial Interpolation of Water and Sed iment Parameters in the Lagoon Ecosystem of Kavaratti Island, Lakshadweep, India

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Abstract

Coral reef lagoons of Lakshadweep are among the most productive and ecologically significant marine ecosystems, supporting high biodiversity and providing essential ecosystem services. However, these fragile ecosystems are increasingly vulnerable to climate variability and anthropogenic pressures. The present study evaluated the physicochemical parameters of water and sediment in the coral reef lagoon ecosystem of Kavaratti Island, Lakshadweep, and examined their spatial distribution using the Inverse Distance Weighting (IDW) interpolation method. Water and sediment samples were collected from four sampling locations and analyzed for temperature, pH, conductivity, salinity, Total Dissolved Solids (TDS), hardness, alkalinity, chloride, nitrate, phosphate, calcium, magnesium, organic carbon, and Chemical Oxygen Demand (COD). The results revealed noticeable spatial variations in water and sediment quality. Water and sediment pH remained alkaline, ranging from 8.31–8.61 and 7.51–8.37, respectively. Conductivity varied from 19.6–41.2 mS/cm in water and 28.3–49.6 mS/cm in sediments. Salinity (32.2–34.0 ppt), TDS (43.26–43.93 mg/L), and alkalinity (146.66–162 mg/L) showed relatively minor fluctuations across sampling sites. Hardness ranged from 1600–4000 mg/L, while nitrate concentrations varied between 3.53 and 6.00 µg/mL. Phosphate concentrations remained low in both water and sediment samples. Sediment calcium, magnesium, and organic carbon exhibited spatial variability, indicating differences in sediment composition and nutrient status. IDW-based spatial interpolation highlighted distinct distribution patterns of the measured parameters within the lagoon ecosystem. Biodiversity assessment recorded diverse coral, fish, invertebrate, algal, and coastal plant species, emphasizing the ecological significance of the Kavaratti coral reef lagoon.

Keywords: Coral reef lagoon, Kavaratti Island, Lakshadweep, Physico-chemical parameters, Water quality, Sediment quality, IDW interpolation, Biodiversity.

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Sustainable Cultivation of *Hericium erinaceus* and *Pleurotus djamor* Using Agricultural Residues

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Abstract

Mushroom cultivation offers an effective approach for converting agricultural residues into nutritious food and value-added products. The present study compares the cultivation behaviour and morphological characteristics of *Hericium erinaceus* and *Pleurotus djamor* with reference to their potential for large-scale production and utilization. Both mushrooms were cultivated on lignocellulosic substrates under controlled growing conditions. Differences were observed in growth rate, fruit body development and production cycle. *Pleurotus djamor* completed the cultivation cycle within a shorter period and produced attractive fruiting bodies suitable for fresh market sales. In contrast, *Hericium erinaceus* required a longer cultivation period but possesses growing demand as a medicinal mushroom because of its reported association with cognitive health and neuroprotective properties. The use of agricultural wastes as cultivation substrates reduces residue accumulation while generating an additional source of income for growers. The findings indicate that both mushroom species can contribute to resource-efficient farming systems, although their cultivation strategies and market opportunities differ. *Pleurotus djamor* appears suitable for rapid commercial production, whereas *Hericium erinaceus* offers opportunities in the functional food and nutraceutical sectors. The study supports the wider adoption of mushroom cultivation as a practical component of sustainable agriculture and rural enterprise development.

Keywords: *Hericium erinaceus, Pleurotus djamor,* Mushroom Cultivation, Agricultural Residues and Industrial Potential

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In vitro Assessment of Indigenous Probiotic Strains isolated from Gut Microbiota of Red-bellied Pacu (Piaractus brachypomus)

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Abstract

The Red-bellied Pacu (*Piaractus brachypomus*) is an economically important freshwater fish species widely cultured in tropical and subtropical regions worldwide. The species is well adopted because of its rapid growth, seed availability, high consumer demand and suitability for diversified aquaculture systems. However, the intensification of culture practices may increase the occurrence of bacterial diseases in near future. Further, the growing concern over antimicrobial resistance has necessitated the development of eco-friendly disease management strategies. Indigenous probiotics have emerged as promising alternatives to antibiotics owing to their superior ability to colonize inside the gut, compete with pathogens, improve nutrient utilization and enhance host health. The present study aimed to isolate and characterize indigenous probiotic bacteria from the intestine of healthy red-bellied Pacu. Bacterial isolates were evaluated for probiotic potential through *in vitro* assays i.e., antagonistic activity against fish pathogens, tolerance to acidic pH and bile salts, auto-aggregation, cell surface hydrophobicity, extracellular enzyme production and antibiotic susceptibility. A total of 30 bacterial isolates were identified, among which *Enterococcus faecalis, Enterobacter homarchei, Bacillus cereus* and *E. casselifalvus* exhibited desirable probiotic characteristics and were identified as potential probiotic candidates for freshwater aquaculture. These isolates demonstrated tolerance to pH 3 and bile 0.3% and was positive to the enzymes amylase, esculin hydrolyase, lipase and negative to gelatinase. The auto-aggregation values ranged from 0.41% to 76.32% after 4 hours of incubation. All the isolates were negative to haemolytic activity. The probiotic isolates also exhibited antagonistic activity against fish bacterial pathogens. The findings highlight the potential of host-associated probiotic bacteria for developing species-specific probiotic formulations and contribute to sustainable health management practices.

Keywords: Red-bellied Pacu (*Piaractus brachypomus*); Indigenous probiotics, Gut microbiota, *In vitro* characterization and Sustainable aquaculture

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A Dynamic Interplay of Innate Immune Path ways During Bacterial Invasion in the Kidney Tissue of Freshwater Farmed Asian Seabass

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Abstract

Bacterial infections trigger complex host immune responses in fish, but understanding these responses require analysis at the pathway level where coordinated gene networks reveal the mechanisms of immune activation and disease progression. The present study reveals the transcriptomics of kidney tissue infected with *Pseudomonas putida* in freshwater farmed Asian seabass (*Lates calcarifer*). The experiment was conducted to identify important infection-responsive signalling pathways and their associated candidate genes. High-quality RNA sequencing data from control and infected fish showed efficient read alignment and clear separation between experimental groups by Principal Component Analysis, confirming robust transcriptional responses. Differential expression analysis identified 944 significant genes, with 679 upregulated and 265 downregulated Differentially Expressed Genes (DEGs). Gene Ontology Enrichment revealed strong activation of immune, inflammatory, stress-response, coagulation and tissue-repair processes, while genes related to neuronal signalling were downregulated. Two major pathways dominated the host response ie. cytokine-cytokine receptor interaction and NOD-like receptor signalling pathways. The cytokine pathway involved TNFα, IL-1β, IL-8, CCL25a, IL17A/F1, IL17c, IL10, TNFRSF6B, IL1R2 and IL2RG, reflecting inflammatory amplification, immune cell recruitment, mucosal defence and cytokine regulation. The NOD-like receptor pathway included ANTXR1, ANTXR2A, PANX1, CTSB and CASR, indicating host sensing, DAMP signalling, inflammasome activation and lysosomal stress responses. These findings identify pathway-linked candidate genes that connect cytokine signalling with NOD-like receptor-mediated innate immunity in Asian seabass. Understanding this molecular mechanism paves a way to design treatments that unmask the bacteria and expose them to therapeutics for effective controlling of prevalent bacterial pathogens of Asian seabass.

Keywords: Asian seabass, Kidney, Transcriptomics, Immune signalling Pathway, Differentially Expressed Genes, Gene ontology

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Decoding Crown Root Initiation in Rice at Single-Cell Resolution

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Abstract

Root architecture is a key determinant of nutrient and water uptake, yet the cell-type-specific gene expression programs that drive root development remain poorly resolved, particularly for adventitious (crown) roots in monocots. We used single-cell RNA sequencing (scRNA-seq) to dissect the transcriptional landscape of crown root initiation in the rice cultivar IR64. Profiling crown root emergence over 8 days post-germination identified day 6 as the optimal developmental stage, with the ~1 mm stem base tissue selected as the site of crown root primordia formation. Protoplasts isolated from this tissue were profiled on the 10x Genomics Chromium platform across two biological replicates, yielding 3,995 and 6,385 high-quality cells after ambient RNA removal, mitochondrial filtering, and doublet detection. Integration of replicates using Harmony followed by Louvain clustering resolved 12 transcriptionally distinct cell clusters. Differential expression and Gene Ontology enrichment analysis identified candidate marker genes for each cluster, and comparison with existing datasets helped validate cluster identities, including confirmation of a xylem cell population based on known marker genes. This dataset provides the first single-cell transcriptomic resource for crown root initiation in rice and a foundation for identifying regulators of non-embryonic root development. We are investigating the annotation of the remaining unidentified clusters using comparative marker analysis and pseudotime/trajectory inference to reconstruct the differentiation path from ground meristem to specialized root cell types, with planned validation of key candidate genes through in-situ hybridization

Keywords: scRNA-seq, crown root, rice, root architecture, marker genes

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Exploring the Methylation-driven Regulatory Mechanisms of Drought Response in Rice

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Abstract

Drought limits the production of rice and other water-intensive crops. Over half of the world's population relies on rice, the third most important of the major food crops. The scarcity of water resources for rice could raise concerns for food insecurity among the growing population. Various adaptive strategies have evolved in plants to withstand drought stress. In particular, DNA methylation has emerged as a key regulatory layer, affecting stress-responsive transcriptional programs by modifying gene activity without altering the DNA sequence. In this study, we analyzed genome-wide DNA methylation patterns in five drought-tolerant and two drought-sensitive rice cultivars subjected to drought stress. Comparative analyses revealed extensive drought-induced methylation changes across cultivars; however, methylation signatures among the studied cultivars showed varied responses to drought stress. These findings suggest that stress-induced DNA methylation may not be the dominant determinant of drought adaptation and instead may act in concert with additional regulatory layers. Based on this hypothesis, we are investigating the role of small RNAs in maintaining methylation and expression patterns in drought response. We are also examining how different cultivars regulate drought-specific transcriptomic responses despite exhibiting similar methylation landscapes. Integrative analyses of methylome, transcriptome, and small RNA datasets across the seven cultivars will provide deeper insights into the regulatory networks underlying drought response in rice.

Keywords: DNA Methylation, Epigenetics, Rice, Drought Stress, Small RNAs, Transcriptomics

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Deciphering Physio-Morphological and Biochemical Traits Conferring Resistance to *Maruca vitrata* (Geyer) in Pigeonpea Genotypes for Sustainable Agriculture and Climate Resilience

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Abstract

Host plant resistance is a key component of Integrated Pest Management and sustainable agriculture, providing an environmentally safe and cost-effective strategy for managing insect pests. The spotted pod borer, *Maruca vitrata* (Geyer), is one of the most destructive pests of pigeonpea, causing considerable losses in grain yield and quality. The present investigation was undertaken during Kharif 2017 and 2018 at MPKV, Rahuri, to identify physio-morphological and biochemical traits associated with resistance or susceptibility to *M. vitrata* in 34 pigeonpea genotypes. ICP-8863, BDN-711, and BDN-716 were identified as resistant, recording the lowest larval population, pod damage, and seed damage. Resistance was associated with lower crude protein (<9.82%), moisture (<82.75%), total soluble sugar (5.90–6.29%), and chlorophyll content (1.63 mg g^{-1}), whereas higher total phenol (1.62–1.98 mg g^{-1}) and tannin (0.31–0.37 mg g^{-1}) contents were negatively correlated with pest infestation. Morphological traits such as higher trichome density, greater pod wall thickness, pod breadth, seed breadth, and favourable flowering and maturity duration also contributed to resistance. The identified resistant genotypes and associated resistance traits can be effectively utilized in breeding programmes and climate-resilient IPM strategies for sustainable pigeonpea production.

Keywords: Spotted pod borer, pigeonpea, genotype, resistant

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Deciphering the Population Expansion and Dispersal Dynamics of Frankliniella schultzei Through Global mtCOI Haplotype Analysis

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Abstract

The common blossom thrips (*Frankliniella schultzei* (Trybom)), is a cosmopolitan sap feeder and sole vector of orthotospoviruses causing major economic constraint in several agricultural and horticultural crops globally. Although they are universal, the taxonomic position, diversity and genetic composition studies are still lacking and yet needed for the understanding of their population structure, genetic diversity which is essential to study their dispersal pathways and to predict their invasion dynamics. The current study focuses on utilizing mitochondrial cytochrome oxidase I (mtCOI) sequences for investigating the global haplotype diversity of *F. schultzei*. An agro-climatic zone wise field survey for the collection of *F. schultzei* from different field and horticultural crops throughout Tamil Nadu followed by their characterization through chaetotaxy, and further quantitative morphometry for the collected species from different agro – climatic zones for a comparative analysis.

Further molecular characterization for genetic identity was done followed by submission of the sequences in National GenBank. For a comparative genetic analysis, the submitted sequences and a set of mtCOI sequences representing populations from Australia, Canada, South Africa, Brazil, Japan, the United Kingdom, the United States and India collected from National GenBank were analyzed to determine their genetic lineage and haplotype diversity. A median-joining network created to illustrate haplotype associations, and assessment of haplotype diversity, nucleotide diversity, and demographic characteristics were also done. The results indicated the presence of 14 different haplotypes due to 113 total mutations in the dataset. The most common haplotype (Hap_1) was shared among the populations from India, Canada, and Australia while populations from current study were in close association reflecting regional genetic variation within a globally connected population. Moderate Haplotype diversity, low nucleotide diversity revealed rare mutations, supporting recent population expansion and substantial global genetic similarity in *F. schultzei* which paves path for potential invasion.

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Root Organ Culture: A Sustainable Platform for the *In Vitro* Multiplication of Arbuscular Mycorrhizal Fungi

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Abstract

Arbuscular mycorrhizal fungi (AMF) are among the most important beneficial soil microorganisms owing to their ability to improve plant nutrient acquisition, stress tolerance, and overall crop productivity. However, their commercial exploitation is constrained by their obligate biotrophic nature, requiring a living host for growth and multiplication. Conventionally, AMF inoculum is produced in pot culture using host plants such as maize or sorghum grown in sterile substrates. Although widely practiced, this method is labor-intensive, time-consuming, susceptible to contamination, and often yields inconsistent quantities of infective propagules. To overcome these limitations, several in vitro propagation techniques, including hydroponic, aeroponic, bioreactor-based systems, and root organ culture (ROC), have been explored. Among these, root organ culture has emerged as the most efficient and reliable approach for the large-scale, contamination-free multiplication of AMF under controlled conditions. In this monoxenic culture system, AMF are propagated in association with *Rhizobium rhizogenes*-induced transformed hairy roots, enabling continuous fungal growth and spore production without the requirement of an intact host plant. The successful establishment of an efficient ROC system depends on the production of vigorous, stable, and contamination-free hairy roots. Therefore, standardization of the root organ culture protocol is essential to achieve reproducible hairy root induction and sustained root growth suitable for long-term AMF multiplication. The present study focused on developing an efficient root organ culture system by evaluating key factors influencing hairy root induction and culture establishment. A reproducible protocol was established for generating healthy transformed root cultures that can be maintained through successive subcultures for continuous in vitro propagation. The standardized ROC system developed in this study provides a robust platform for large-scale AMF inoculum production and offers significant potential for applications in biofertilizer production, plant–microbe interaction studies, microbial biotechnology, and sustainable agricultural systems.

Keywords: Arbuscular mycorrhizal fungi – ROC - Hairy root production – *in vitro* technique

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Effect of Fertigation Levels and Intervals on Growth and Yield of Bittergourd

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Abstract

Traditional fertilizers commonly available in the market are not completely water-soluble and contain insoluble impurities, making them unsuitable for application through drip irrigation systems. When applied conventionally, a considerable portion of nutrients is lost through leaching, evaporation, and soil fixation, resulting in low fertilizer use efficiency. In many cases, plants utilize less than 50% of the applied nutrients. Fertigation, the application of water-soluble fertilizers through irrigation systems, offers an efficient method of supplying nutrients and water according to crop requirements, thereby improving nutrient use efficiency, maintaining optimum soil fertility, and enhancing crop productivity. A field experiment was conducted during *Kharif* (2018–19) and Summer (2019–20) at the Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, to standardize fertigation levels and intervals for bitter gourd. The treatment F_2 (120% RDF through water-soluble fertilizers) and fertigation interval S_1 (4-day interval) significantly improved growth parameters, yield attributes, and fruit yield. The highest pooled fruit yield of 177.37 q ha^{-1} under F_2 and 163.91 q ha^{-1} under S_1 was recorded. Thus, fertigation with 120% RDF at 4-day intervals was found to be the most effective schedule for maximizing growth and yield of bitter gourd.

Keywords: Ferigation, Bittergourd, Interval, Growth, Yield

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Evaluating the Probiotic Potential of Indigenous *Lactobacillus delbrueckii* 3A for the Development of a Functional Mango-Carrot Blended Beverage

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Abstract

The growing global interest in functional foods has accelerated the development of probiotic beverages as health-promoting alternatives to conventional dairy products. Fruit and vegetable based probiotic beverages are gaining increasing attention due to their rich nutritional profile, consumer acceptability, and suitability for lactose-intolerant and vegan populations. In this context, the present study aimed to explore the probiotic potential of an indigenous *Lactobacillus delbrueckii* 3A strain for the development of a functional mango-carrot blended beverage with enhanced nutritional and health prom1oting properties. Lactic acid bacteria (LAB) were isolated from homemade curd using de Man, Rogosa and Sharpe (MRS) agar, purified and screened for desirable probiotic attributes. Based on morphological, biochemical and molecular characterization, the most promising isolate was identified as *Lactobacillus delbrueckii* 3A through 16S rRNA gene sequencing. A pre-inoculum (10^{11}-10^{12} CFU mL^{-1}) was incorporated into a mango and carrot blend (4:2 ratio) supplemented with 40% water for fermentation. Process parameters were optimized using Central Composite Design (CCD) under Response Surface Methodology (RSM), which revealed that fermentation at 25 °C for 24 h with 0.75% inoculum yielded the best product quality. The optimized beverage exhibited significantly enhanced antioxidant activity, ascorbic acid, carotenoid and total phenolic contents, along with excellent sensory acceptability in terms of taste, flavour, colour and overall acceptability. FTIR analysis revealed characteristic functional groups associated with bioactive compounds, while GC–MS profiling identified volatile constituents responsible for the desirable aroma and flavour of the beverage. Shelf-life studies demonstrated that the probiotic beverage retained desirable physicochemical and nutritional characteristics for up to 60 days under refrigerated storage, particularly in glass bottles. Moreover, probiotic viability remained above 7 log CFU mL^{-1} throughout storage, satisfying the recommended standards for probiotic foods. The absence of coliforms, yeasts and moulds during storage confirmed the microbiological safety of the product. These findings highlight the potential of indigenous *L. delbrueckii* 3A as a promising probiotic starter culture for the development of novel non-dairy functional beverages with enhanced nutritional quality and commercial potential.

Keywords: Functional food; *Lactobacillus delbrueckii* 3A; probiotic beverage; non-dairy probiotic; mango-carrot blend; bioactive compounds; shelf life.

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Scientific Advances in Alternative Protein Sources for Sustainable Protein Production

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Abstract

The increasing global demand for dietary protein, coupled with the environmental burden of conventional livestock production, has intensified the need for sustainable protein production systems. Alternative protein sources have emerged as promising approaches to address challenges related to greenhouse gas emissions, resource utilization, food security and nutritional sustainability. However, these technologies are often considered independently despite their shared objective of supporting resilient and sustainable food systems. The present review provides a comprehensive overview of recent scientific advances in four major alternative protein sources, namely, plant-based proteins, cultivated meat, insect-derived proteins and fermentation-enabled proteins, with emphasis on the technological innovations underpinning their development, nutritional attributes, environmental implications and challenges to large-scale adoption. Recent developments in protein texturization, high-moisture extrusion, cellular agriculture and precision fermentation have significantly improved the nutritional, functional and sensory characteristics of alternative protein products. Researches have demonstrated the feasibility of developing high-protein meat analogues and nutritionally enhanced alternative protein products, while consumer research indicates that acceptance remains technology-dependent despite increasing awareness of sustainability benefits. Collectively, current evidence indicates that no single alternative protein technology independently satisfies all nutritional, environmental, technological and societal requirements for future protein production. The complementary development of plant-based, cultivated, insect-derived and fermentation-enabled proteins offers the greatest potential for advancing sustainable protein production. Continued advances in food science, biotechnology, regulatory frameworks and consumer acceptance will be essential to facilitate their large-scale adoption and contribute to sustainable food systems capable of meeting future global protein demands.

Keywords: Alternative protein, Nutritional sustainability, Plant based protein, Cultivated meat, Insect-derived proteins, Precision fermentation

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The Peri-Urban Horticultural Nexus: Integrating Food Security, Water Sustainability, Human Health and Climate Resilience for Sustainable Development

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Abstract

Rapid urbanization, climate change and increasing resource scarcity are placing unprecedented pressure on food systems, water resources, public health and land use, particularly in peri-urban regions where urban and rural landscapes converge. Peri-urban horticulture has emerged as a promising strategy to address these interconnected challenges by enhancing local food production, improving nutritional security, generating livelihoods and promoting environmental sustainability. This review examines peri-urban horticultural systems through a Food-Water-Health-Land Nexus framework, emphasizing the interdependence of food production, water management, human well-being and ecosystem health. Drawing on recent research and global case studies, the review synthesizes evidence on the contributions of peri-urban horticulture to food security, resource-use efficiency, climate adaptation, biodiversity conservation and socio-economic resilience. Innovative approaches such as protected cultivation, climate-smart horticulture, agroforestry, circular resource management and emerging digital technologies are highlighted for their potential to enhance productivity while minimizing environmental impacts. At the same time, the review critically assesses major challenges, including land-use competition, water scarcity and contamination, urban expansion, policy fragmentation and unequal access to resources and technology, which may constrain the sustainable development of peri-urban agricultural systems. The findings underscore the need for integrated governance, participatory planning and context-specific innovations to balance agricultural productivity with environmental protection and public health objectives. By explicitly aligning peri-urban horticulture with the United Nations Sustainable Development Goals, particularly SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-Being), SDG 6 (Clean Water and Sanitation), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action) and SDG 15 (Life on Land), this review highlights its potential to support healthier, greener and more resilient communities and provides a science-based foundation for sustainable urban development in a rapidly changing world.

Keywords: Peri-urban horticulture; Food-Water-Health-Land Nexus; Food security; Climate resilience; Sustainable Development Goals (SDGs).

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Protection and Restoration of Water Bodies in Tamilnadu : Challenges and Solutions

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Abstract

Water is essential for the survival of all living organisms. Water bodies such as lakes, ponds, tanks, rivers, and canals play a crucial role in ensuring water security, groundwater recharge, agricultural productivity, and ecological balance in Tamil Nadu. However, rapid urbanization, encroachments, pollution, inadequate maintenance, and climate change have led to the continuous degradation of these valuable water resources. Consequently, water scarcity, declining groundwater levels, loss of biodiversity, and environmental degradation have become serious concerns. Against this background, the present study examines the challenges associated with the protection and restoration of water bodies in Tamil Nadu and explores sustainable solutions for their long-term conservation.

The primary objective of this study is to identify the major factors responsible for the deterioration of water bodies and to propose effective measures for their protection and restoration. The study adopts a qualitative research approach based on secondary data collected from government reports, research articles, books, and relevant documents.

The findings reveal that encroachments, pollution, climate change, and inadequate maintenance are the major threats to water bodies in Tamil Nadu. Furthermore, the study highlights that rainwater harvesting, desilting, community participation, technological interventions, and integrated water resource management are essential for sustainable restoration. The study emphasizes the need for coordinated efforts among government agencies, local communities, and stakeholders to ensure water security and environmental sustainability for future generations.

Keywords: Water Bodies of Tamilnadu, Protection, Restoration, Groundwater Recharge, Encroachment, Pollution, Climate Change, Rainwater Harvesting, Sustainable Water Management, Community Participation

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Valorization of Fruit and Vegetable Wastes and its Importance

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Abstract

A significant yet underutilized source of important nutrients and bioactive compounds is fruit and vegetable waste (FVW), which includes peels, seeds, pomace, and other processing by-products. The valorization of FVW has become an essential strategy for turning discarded biomass into high-value goods while improving resource efficiency, given the worrisome quantities of food waste occurring worldwide. In addition to reducing waste, FVW is high in proteins, dietary fibers, vitamins, minerals, polyphenols, carotenoids, anthocyanins, and other phytochemicals with important nutritional and functional qualities. FVW is a viable raw material for the creation of functional foods, nutraceuticals, and natural food additives because these compounds have been linked to antioxidant, anti-inflammatory, antibacterial, and disease-preventive activities. To recover these important components, a number of valorization strategies have been investigated. While advanced extraction technologies like ultrasoundassisted extraction, microwave-assisted extraction, supercritical fluid extraction, and enzymeassisted extraction offer higher recovery efficiencies with less environmental impact, conventional methods like composting, anaerobic digestion, and animal feeding are still widely used. By preserving heat-sensitive nutrients and bioactive substances, these green approaches enhance the quality of recovered ingredients. Additionally, residual biomass can be transformed into value-added products including single-cell proteins, exopolysaccharides, biodegradable packaging materials, and edible coatings using integrated zero-waste valorization systems. By recovering nutrients that would otherwise be lost and integrating them into the food supply chain, the nutritional valorization of FVW promotes food security. By producing high-value bio-based products, it also generates economic prospects. As a result, FVW valorization is a novel and sustainable strategy that improves human nutrition, advances the ideas of the circular bioeconomy, and raises the general effectiveness and sustainability of contemporary food systems.

Keywords: Valorization, Nutritional Importance, Non-Thermal Processing, Biomass

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Experimental Assessment of Runoff and Soil Loss under Varying Rainfall and Land Surface Conditions in Sandy Loam Soil

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Abstract

Water-induced soil erosion is one of the most serious environmental challenges threatening agricultural productivity, soil health, and sustainable land management worldwide, particularly in developing countries such as India. Rapid urbanization, infrastructure development, and changing land-use practices have accelerated soil erosion beyond natural soil formation rates. Runoff generation and soil loss are strongly influenced by rainfall characteristics, soil properties, land use/land cover, land slope, and antecedent soil moisture conditions. Understanding the combined effects of these factors is essential for developing effective soil and water conservation strategies. The present study aimed to evaluate the effects of rainfall intensity, rainfall duration, land use/land cover, and land slope on Direct Surface Runoff (DSRO) and soil loss in sandy loam soil using a Mini Rainfall Simulator (Eijkelkamp™). The rainfall simulator enabled controlled experimentation by allowing precise manipulation of rainfall intensity and duration under both laboratory and field conditions. Experimental observations demonstrated that increasing land slope reduced infiltration opportunity time, resulting in higher runoff generation. Significant variations in runoff and soil loss were observed among different land use/land cover conditions. Cultivated land exhibited lower runoff because crop root systems enhanced soil porosity and infiltration capacity. However, cultivated plots exhibited comparatively higher soil loss than barren land because tillage disturbed and loosened the surface soil, making soil particles more susceptible to detachment under simulated rainfall. The average annual runoff and soil loss obtained from the experimental plots under selected rainfall intensities and durations were approximately 8039.12 $m^3\ ha^{-1}$ and 178.27 $t\ ha^{-1}$, respectively. The estimated average annual soil loss for the ICAR–IARI campus, New Delhi, was 46.05 $t\ ha^{-1}\ yr^{-1}$, while the annual rainfall erosivity factor (R) was estimated at 14,452.24 $MJ\ mm\ ha^{-1}\ h^{-1}\ yr^{-1}$. These findings enhance the understanding of runoff generation and soil erosion processes and provide valuable insights for designing effective soil and water conservation strategies to promote sustainable land management in erosion-prone regions.

Keywords: Water-induced soil erosion, rainfall simulator, rainfall erosivity, land use/land cover, Direct Surface Runoff (DSRO), sandy loam soil.

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Predictive Assessment of Soybean Kunitz Trypsin Inhibitor Levels from Calcium, Magnesium, Iron, and Zinc Concentrations

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Abstract

Soybean is a rich source of proteins, oils and minerals. But, it is also contains many anti-nutritional factors. The present study investigated relationships between these two contrasting features, specifically Kunitz Trypsin Inhibitor and mineral composition. A dataset comprising 54 soybean genotypes was analyzed, with calcium (Ca), magnesium (Mg), iron (Fe), and zinc (Zn), quantified using Atomic absorption spectroscopy, as predictor variables and KTI as response factor. Seed Ca, Mg, Zn, and Fe, ranged from 1.31–3.71 g kg^{-1}, 1.06–3.07 g kg^{-1}, 21–55 mg kg^{-1} and 44–106 mg kg^{-1} resp. KTI estimate ranged from 2.07 to 7.49 TIU/mg protein. Correlation study indicated negative relationships of KTI with Ca ($r = -0.69$) and Mg ($r = -0.57$), whereas positive correlations were observed with Zn ($r = 0.39$) and Fe ($r = 0.48$). Multiple linear regression (MLR), random forest (RFST) and partial least squares regression (PLR) techniques were applied. RFST expressed high accuracy ($R^2 = 0.82$; RMSE = 0.51), PLR ($R^2 = 0.78$; RMSE = 0.64) and MLR ($R^2 = 0.75$; RMSE = 0.70). These findings emphasize the implementation of mineral profiles to predict KTI levels facilitating screening of soybean varieties.

Keywords: Soybean, Kunitz trypsin inhibitor, AAS, calcium, magnesium, iron, zinc, predictive modelling.

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Paddy Farming Practices and their Impact on Water Management in Cauvery Delta Region: An Investigation

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Abstract

Paddy is one of the most important food crops in Tamil Nadu, providing substantial employment opportunities and playing a vital role in ensuring food security. The Cauvery Delta Region, popularly known as the "Rice Bowl of Tamil Nadu," contributes significantly to the state's paddy production. However, paddy cultivation in recent years has been facing several challenges, including crop holidays, crop diversification, frequent crop failures, encroachment of irrigation canals and water channels, rapid urbanization, and the conversion of agricultural land into residential and commercial areas. These issues have adversely affected agricultural productivity and the livelihoods of farming communities. Paddy cultivation has a direct relationship with water availability and efficient irrigation management, as both are essential determinants of agricultural productivity. Despite the importance of irrigation, farmers—particularly marginal, small, and medium landholders—continue to experience severe water-related challenges. The irregular release of Cauvery water, poor maintenance of irrigation canals and distributaries, encroachment of water channels, excessive extraction of groundwater through borewells, and inadequate hydrological irrigation management have significantly constrained sustainable paddy farming in the region. These factors have reduced farm productivity, increased cultivation costs, and threatened the long-term sustainability of agriculture in the Cauvery Delta. The present study has the following specific objectives: (i) to examine the paddy farming practices adopted by different categories of farmers in the Cauvery Delta Region; (ii) to analyse the relationship between paddy farming practices and the existing water management system in the Cauvery Delta; and (iii) to suggest appropriate policy measures for strengthening sustainable paddy farming practices and improving water resource management for sustainable agricultural development. The study is based on both quantitative and qualitative research methods. Primary data will be collected through a structured questionnaire administered to different categories of farmers across the Cauvery Delta Region. Secondary data will be obtained from government reports, official publications, research articles, and other published sources. The collected data will be analysed using appropriate statistical techniques, including descriptive statistics, regression analysis, and Analysis of Variance (ANOVA), to examine the relationships between farming practices, irrigation management, and agricultural productivity. The findings of the study reveal that the majority of farmers depend heavily on the timely release of Cauvery water for paddy cultivation. However, water often fails to reach the tail-end regions because of inadequate irrigation infrastructure, poor canal maintenance, encroachment of water channels, and inefficient water distribution systems. Consequently, farmers experience reduced

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crop productivity and increased vulnerability to agricultural risks. The study concludes that strengthening irrigation infrastructure, ensuring equitable water distribution, restoring irrigation canals, promoting efficient water management practices, and enhancing coordination between the Central and State Governments are essential for protecting paddy farming and achieving sustainable agricultural development in the Cauvery Delta Region.

Keywords: Paddy farming, Water management Cauvery water, Livelihoods and Sustainable agriculture development

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Cross-Cohort Identification of WDFY3-AS2 as a Potential Prognostic lncRNA Biomarker in Renal Cell Carcinoma Using TCGA Transcriptomic Data

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Abstract

Renal cell carcinoma (RCC), predominantly comprising Kidney Renal Clear Cell Carcinoma (KIRC) and Kidney Renal Papillary Cell Carcinoma (KIRP), remains a significant clinical challenge due to the lack of reliable molecular biomarkers capable of predicting disease progression. Long non-coding RNAs (lncRNAs) have emerged as promising regulators of tumor biology and potential prognostic biomarkers. This study aimed to identify consistently downregulated lncRNAs across independent RCC cohorts and evaluate their clinical relevance.

RNA-sequencing expression data and clinical information for KIRC and KIRP were obtained from The Cancer Genome Atlas (TCGA). Differential expression analysis was performed following transcript filtering, using Welch's two-sample t-test with Benjamini-Hochberg false discovery rate (FDR) correction. Common downregulated lncRNAs were identified through cross-cohort intersection and further validated using the ENCORI database. Spearman's rank correlation analysis was employed to examine associations between candidate lncRNA expression and clinicopathological parameters.

A total of 122 and 99 significantly downregulated lncRNAs were identified in KIRC and KIRP, respectively, with 63 transcripts shared between both cohorts. ENCORI validation reduced these candidates to a single common lncRNA, WDFY3-AS2, demonstrating robust and reproducible downregulation across both RCC subtypes. In KIRC, decreased WDFY3-AS2 expression showed significant negative correlations with AJCC stage, T stage, nodal involvement, metastatic status, and male gender, indicating progressive loss of expression with increasing disease severity. The crosscohort validation strategy substantially minimized false-positive candidate selection and highlighted WDFY3-AS2 as a biologically relevant transcript associated with renal cancer progression.

These findings suggest that WDFY3-AS2 is a promising candidate prognostic biomarker for RCC and provide a strong computational foundation for future functional validation and clinical investigation. The study further demonstrates the effectiveness of integrating differential expression analysis with cross-cohort validation to identify robust biomarker candidates in cancer transcriptomics.

Keywords: Renal Cell Carcinoma, Long Non-coding RNA, WDFY3-AS2, TCGA, Bioinformatics, Differential Gene Expression, Biomarker Discovery, ENCORI.

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Radiation induced mutation for resistance against races/ pathotypes of Fusarium oxysporum f.sp ciceris in chickpea (*Cicer arietinum L.*)

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Abstract

Present investigation was aimed at identification of suitable mutant or a combination of mutants influencing race specific resistance to wilt in chickpea. Experimental material was consisted of the population of three selected varieties of chickpea (JG63, JG74, and JG130) grown in the Seed Breeding Farm, Dept. of Plant Breeding and Genetics, College of Agriculture, Jabalpur (M.P.) under AICRP on chickpea during Rabi 2014-15. Dry seeds (10-12% moisture) of these varieties were irradiated with different doses of gamma rays (150, 200 and 400GY). Another set of pre-soaked seeds in distilled water (12hrs.) was treated with Ethyl Methane Sulphonate (EMS) at different concentration (0.3, 0.4 and 0.5%). Some portion of seeds irradiated at 150 and 200GY Gamma-ray doses were also treated with 0.3% and 0.4% EMS independently. Efficacy of Gamma rays, EMS and their combination treatment screened for resistance in M2 progeny mutant chickpea against race2 and race4 of Fusarium oxysporum f. sp. ciceris by using root dip inoculation technique. 400GY treatment of physical mutagen and combination treatment of 200GY + 0.3% EMS exhibited resistance against both the races of Fusarium in all the three-selected genotypes whereas, 0.4% EMS showed resistance against both the races of Fusarium for two genotypes i.e., JG63, JG130.

Keywords: *Fusarium oxysporum f.sp ciceris* (FOC), Ethyl Methane Sulphonate, races/pathotypes and genotypes etc.

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CRISPR/Cas9-mediated editing of LBD20 (Lateral Organ Boundaries Domain) enhances Fusarium wilt resistance in banana cv. Grand Nain (AAA)

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Abstract

Banana (Musa spp.) is a vital fruit crop of peninsular India, contributing significantly to food security and rural livelihoods. However, its production is severely threatened by Fusarium wilt, caused by Fusarium oxysporum f. sp. cubense (Foc), particularly Tropical Race 4 (TR4). The lack of resistant cultivars, coupled with limitations in conventional breeding due to sterility and polyploidy, necessitates the development of alternative strategies such as genome editing for enhancing disease resistance.

In the present study, CRISPR/Cas9-mediated genome editing was employed to target the Lateral Organ Boundaries Domain 20 (LBD20) transcription factor, a putative negative regulator of jasmonate-mediated defense responses. A CRISPR/Cas9 construct (pRGEB32-MaLBD20) carrying a gene-specific guide RNA was introduced into embryogenic cell suspensions via Agrobacterium-mediated transformation. As a proof-of-concept, editing of the phytoene desaturase (PDS) gene resulted in a high frequency of albino phenotype (~91%), with sequencing confirming tri-allelic mutations, thereby validating the efficiency of the editing system.

Subsequently, transformation targeting LBD20 generated 44 putative lines, of which 33 were confirmed positive for the Cas9 transgene. Edited plantlets were regenerated and evaluated for disease response following pathogen inoculation (Fusarium oxysporum f. sp. cubense Tropical Race 4). LBD20 knockout lines exhibited enhanced resistance, as evidenced by reduced vascular discoloration and lower disease severity compared to wild-type plants.

The regenerated edited plants are currently maintained in the transgenic net house for further evaluation of growth and agronomic parameters. These findings demonstrate that targeted knockout of host susceptibility gene such as LBD20 for developing Fusarium wilt-resistant banana lines using genome editing approach.

Keywords: Banana, Genome editing, CRISPR/Cas9, LBD20, Fusarium wilt

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Assessment of Varietal Susceptibility to Major Insect Pests of Mango across Major Growing Districts of Tamil Nadu

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Abstract

An extensive survey was carried out to assess the incidence of major insect pests of mango across mango growing locations of Tamil Nadu. The survey covered Palamedu and Vadipatti of Madurai district; Sankari, Kakkapalayam and Panamarthupatti of Salem district; Narikudi of Virudhunagar district; and Nallampalli, Thadangam and Karimangalam of Dharmapuri district. Insect pests viz., leaf hoppers, fruit flies, scales, leaf twisting weevil, thrips, gall midge, leaf webber and flower webber were recorded using standard observation units. Across the pooled dataset, fruit flies recorded the highest mean infestation of 65.32%, followed by gall midge with 62.25%. Among count-based pests, leaf hoppers recorded the highest pooled incidence of 21.58 nos./twig, followed by leaf twisting weevil with 11.55 no. of leaf twists/tree and thrips with 9.00 nos./twig. Comparatively lower pooled incidence was observed with regard to leaf webber, scales and flower webber. The highest leaf hopper incidence was observed in Alphonso at Kakkapalayam (38.3 nos./twig) of Salem district, while fruit fly (92.0%) and gall midge (90.92%) infestation were highest in Totapuri, particularly at Panamarthupatti, Thadangam and specified locations. Senthura recorded higher incidence of scales and leaf twisting weevil, whereas Gudhadath mango variety at Karimangalam of Dharmapuri district showed comparatively lower incidence of the mentioned insects. This study highlighted that clear varietal and location-specific differences existed in pest incidence and provided baseline information for developing localized pest surveillance and integrated pest management strategies.

Keywords: Mango, insect pest survey, fruit fly, gall midge, leaf hopper, varietal susceptibility and integrated pest management.

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Assessment of Nutritional Status and Dietary intakes Among Children Aged 3–5 Years in Urban Preschools of Vadodara

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Abstract

Background: Diets that fail to meet the macro and micronutrient demands of preschool children ultimately undermine their nutritional status, leaving them vulnerable to long-term growth and cognitive deficits. This gap is due to a combination of picky eating habits, high processed foods intake, and lack of dietary variety.

Methods: The present study was conducted to assess the nutritional status and dietary intakes of 103 preschool children aged 36-59 months in urban Vadodara. The height (cm) and weight (Kg) was measured to assess the nutritional status using WHO Growth Standard 2006. A 24-hour dietary recall for three consecutive days was used to assess children's food consumption where data was obtained from their mothers to assess nutrient adequacy of their diets. Dietary Diversity Score (DDS) was calculated by counting consumption of 7 food groups the previous day and classified as poor DDS (≤3 food groups) and good DDS (≥4 food groups) as per FANTA 2016. The institute's Ethical clearance committee approved the present study.

Result: Mean age of the children was 49±7.38 months. The prevalence for stunting, underweight and wasting was 20.1%, 10.7% and 17.4% respectively. Mean nutrient intakes were within the recommended levels with protein consumption around twice the recommended limits. Calcium intakes were the most varied among the population. The mean dietary diversity scores for the population were 4.38±0.73 with good dietary diversity among majority of subjects (90.3%) of the population. Younger children demonstrated significantly better nutrient intake profiles compared with older age groups. This study revealed that though majority subjects had good DDS, yet the malnutrition prevalence existed.

Conclusion: Thus, dietary diversity alone may not serve as a good indicator for adequate intake. There is a strong need to conduct in-depth analysis of diets in terms of the quality of diets to get meaningful associations with the nutritional status.

Keywords: Nutritional Status, Dietary Intakes, Dietary Diversity, Preschool children, Malnutrition

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Associations Between Malnutrition and Early Childhood Development Outcomes Among Urban Preschoolers

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Abstract

Background: Childhood malnutrition constitutes one of the most pressing global public health challenges of the present era. It is not merely a manifestation of insufficient food intake, but a profound biological and developmental disruptor that alters a child's life trajectory at its earliest stage. These early disruptions stand in the way of Sustainable Development Goal 4 and its Target 4.2, which envisions every child developmentally on track by school age.

Methods: This cross-sectional study examined the prevalence of malnutrition and its associations with ECD outcomes among 270 children aged 3 to 5 years attending preschools in Urban Vadodara, Gujarat. Anthropometric measurements were interpreted using WHO growth reference Z-scores, and developmental status was assessed using UNICEF's ECDI2030, the tool employed to monitor SDG 4.2.1.

Results: Malnutrition was alarmingly prevalent, with stunting and wasting each affecting 38.1% of children and underweight recorded at 46.2%, exceeding national and Gujarat state estimates. Approximately 6% of children were developmentally not on track. Stunting (Low Height-for-Age) was significantly associated with delayed walking, illustrating how chronic undernutrition translates into motor developmental setbacks. Children with better Weight-for-Age z-scores performed better on ECD assessments and prosocial behaviour, establishing a clear and measurable link between anthropometric status and holistic early childhood development in an urban preschool setting.

Conclusion: A deeper understanding of how nutrients shape ECD can help governmental and nongovernmental organizations design effective interventions and improve developmental outcomes for children.

Keywords: Malnutrition, SDG, Early childhood development, Anthropometric status, Stunting, Urban preschoolers

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Whole-Genome and Phylogenetic Insights into Mangrove-Derived Cellulosimicrobium aquatile Promoting Pearl Millet Growth

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Abstract

Mangrove ecosystems are highly dynamic coastal habitats subjected to salinity stress, tidal fluctuations, waterlogging, and limited nutrient availability, supporting microbial communities with unique adaptive and metabolic capabilities. This study investigates a mangrove-derived plant growth-promoting rhizobacterium (PGPR) isolated from a rhizosphere-associated mangrove ecosystem for its ability to enhance the growth of pearl millet (*Pennisetum glaucum L.*), a highly nutritious and drought-resistant cereal aligned with SDG 2: Zero Hunger. A total of 12 bacterial isolates were obtained from rhizosphere-associated mangrove sediments and screened for PGPR traits using standard biochemical and plate-based assays. Among these, one strain, designated TM1, was selected for detailed phylogenetic analysis and whole genome sequencing. Combined 16S rRNA-based phylogeny and genome-scale comparisons revealed that TM1 belongs to *Cellulosimicrobium aquatile*, with high sequence similarity and robust bootstrap support. The TM1 genome was sequenced using Illumina with a read length of 151 and assembled using QUAST for evaluating quality of de novo genomic assemblies and BUSCO for assessing the completeness of genome assembles. The genome annotation is understood by KEGG pathway and revealing gene repertoires associated with nutrient acquisition (phosphate solubilization pathways, siderophore biosynthesis), phytohormone modulation, stress response, and biocontrol mechanisms. These genomic features provide a mechanistic basis for the observed PGPR traits and indicate that TM1 is metabolically versatile and ecologically fit for rhizosphere colonization. Greenhouse pot experiments demonstrated that TM1 inoculation enhanced root and shoot growth, increased leaf number, improved biomass, and elevated chlorophyll content in pearl millet compared with uninoculated controls, with particularly pronounced responses in coir pith-based systems. Altogether, the isolation and screening of mangrove rhizobacteria, combined with phylogenetic and genomic characterization and functional validation, identify *Cellulosimicrobium aquatile* (TM1) as a strong PGPR candidate for sustainable pearl millet production and highlight the potential of mangrove-derived microbes as resilient inoculants in climate-smart agriculture aligned with SDG 2: Zero Hunger.

Keywords: PGPR, Mangrove ecosystem, *Cellulosimicrobium starin,* Pearl millet.

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NMDAR-Mediated Calcium Signalling: A Critical Neuroendocrine Regulator of Reproduction in *Bemisia tabaci*

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Abstract

N-methyl-D-aspartate receptors (NMDARs) are ionotropic glutamate receptors that regulate neuronal calcium signalling and intracellular secondary messenger pathways, playing pivotal roles in synaptic plasticity, neuronal development, and neurological disorders in vertebrates. Despite their evolutionary conservation, the molecular characteristics and physiological functions of NMDARs remain largely unexplored in insects. Here, we characterised and functionally validated two NMDAR subunits, *Btab* N1 and *Btab* N2, in the agricultural pest *Bemisia tabaci (B. tabaci*), presenting innovative coupling of neuronal calcium signalling with juvenile hormone biosynthesis and the reproductive regulatory network. Spatial and temporal expression analyses revealed predominant expression in the head and thorax and elevated transcript abundance during later developmental stages. Structural modelling predicted a conserved hetero-tetrameric receptor architecture, while molecular docking demonstrated favourable binding of the non-competitive antagonist MK-801 within the predicted channel pore. Pharmacological inhibition and RNA interference consistently suppressed NMDAR expression and disrupted downstream calcium signalling components, including calmodulin (CaM), calcium/calmodulin-dependent protein kinase II (CaMKII), cAMP response element-binding protein (CREB), protein kinase C (PKC), and nitric oxide synthase (NOS). This suppression was accompanied by significant downregulation of Juvenile Hormone Acid O-methyltransferase (JHAMT) and Vitellogenin, resulting in reduced oviposition, egg hatchability and nymphal establishment. Collectively, our findings establish NMDAR-mediated calcium signalling as a neuroendocrine regulator linking neuronal activity to juvenile hormone biosynthesis and reproductive fitness in *B. tabaci,* highlighting NMDARs as promising molecular targets for next-generation whitefly management.

Keywords: Ionotropic glutamate receptor; Pharmacological inhibition; MK-801; Juvenile hormone biosynthesis; Reproductive fitness; Pest management.

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Assessment of Farmers Preference on Traits of Moth Bean and Production Constraints in Villupuram District, TamilNadu, India

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Abstract

Moth bean *(Vigna aconitifolia*), locally known as Nari Payiru, serves as a critical pulse crop for the resource-poor farmers of the Villupuram district. Cultivated primarily during the winter (*Karthigai pattam*), its extreme tolerance to drought and high temperatures makes it a cornerstone of climate-resilient agriculture in rainfed arid regions.

The project focused on four pillars: identifying trait preferences, examining yield dynamics/economics, analyzing marketing behavior, and understanding production constraints. Data was gathered via focus group discussions across the high-production blocks of Vikravandi, Mailam, Vallam, and Marakkanam. Yield data and cost metrics were validated through front-line demonstrations at KVK Villupuram, with results analyzed using descriptive statistics and Garret's Ranking Technique.

The project focused on four pillars: identifying trait preferences, examining yield dynamics/economics, analyzing marketing behavior, and understanding production constraints. Data was gathered via focus group discussions across the high-production blocks of Vikravandi, Mailam, Vallam, and Marakkanam. Yield data and cost metrics were validated through front-line demonstrations at KVK Villupuram, with results analyzed using descriptive statistics and Garret's Ranking Technique.

Moth bean cultivation in Villupuram is characterized by low-input traditional methods. Seeds are typically broadcasted with minimal fertilizer or weed management. Average yields range from 1500 to1600 kg/ha, though climate-induced fluctuations can drop yields to as low as 200kg/ha. With a total cultivation cost of ₹46,400 per hectare and an average sales price of ₹80/kg, the crop generates a gross income of roughly ₹1,27,600. This results in a highly favorable Benefit-Cost (BC) Ratio of 2.75, confirming moth bean as a high-return crop relative to its input requirements. Marketing is primarily handled through regulated markets in Tindivanam and neighboring Pondicherry, with the latter being the preferred destination due to higher price realizations. However, the sector faces several systemic hurdles: Abnormal heavy winter rains and severe cold snaps are the leading causes of yield vagaries. Prices fluctuate between ₹40 and ₹130 per kg, often dictated by traders transporting produce to Northern India. Yellow Mosaic Virus (YMV) remains a major threat. Additionally, a new threat—Cuscuta (dodder)—has emerged, frequently introduced via contaminated Indigo seeds used in crop rotations. The project highlights that while moth bean is economically lucrative and climate-resilient, its growth is stifled by seed quality issues and climatic sensitivity. To sustain its cultivation, there

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is an urgent need for Seed Purification. Strategies to combat YMV and the emerging Cuscuta infestation and Market Information Systems to help farmers navigate price fluctuations between regional regulated markets.

Keywords: Moth bean, Constraints, Economics

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Host Plant-driven differences in behavioural responses and life-history performance of fruit fly, *Zeugodacus cucurbitae*

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Abstract

Host selection in polyphagous tephritids such as *Zeugodacus cucurbitae*, is intricately mediated by plant-derived volatile organic compounds (VOCs), which function as critical determinant for reproductive success and fitness. This study investigated the olfactory orientation, ovipositional preference, and demographic fitness of *Z. cucurbitae* across three major cucurbit hosts: sponge gourd (*Luffa aegyptiaca*), bottle gourd (*Luffa siceraria*), and bitter gourd (*Momordica charantia*), utilizing fruits at distinct developmental stages. Gravid females displayed strong and stage-specific olfactory preferences, with maximum attraction toward 3-day-old sponge gourd and bottle gourd fruits and 5-day-old bitter gourd for oviposition. In contrast, virgin females showed non- significant attraction, underscoring the influence of reproductive status on host-seeking behaviour. When responses were compared among host species, gravid females exhibited a clear hierarchy of preference. Sponge gourd emerged as the most attractive host, followed by bottle gourd, whereas bitter gourd consistently showed the lowest attractiveness. Oviposition assays further demonstrated host discrimination, with sponge gourd receiving the highest egg deposition under both choice (554 ± 20.39 eggs/female) and no-choice bioassay (519 ± 12.59 eggs/female). Population reared on sponge gourd yielded highest intrinsic rate of increase r (0.102), finite rate of increase λ (1.108), and net reproductive rateR0 (62.29), confirming its suitability for offspring development and population establishment. By establishing a direct linkage between VOCs-mediated host selection and offspring performance, these findings provide a critical foundation for isolating stage-specific semiochemicals to advance behavioural manipulation strategies.

Keywords: Semiochemicals, Cucurbits, *Zeugodacus cucurbitae,* Pest management, volatile organic compounds (VOCs)

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Bioefficacy of Seaweed-Based Biostimulant (KDALPASI Gel) in Enhancing Paddy Growth and Yield

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Abstract

The rising need for sustainable agricultural methods to ensure global food security and mitigate environmental degradation has heightened interest in natural, environmentally friendly alternatives to synthetic agrochemicals. Seaweeds, also known as macroalgae, are a diverse group of multicellular, predominantly photosynthetic algae that inhabit marine environments. Extracts from seaweeds contain endogenous plant hormones such as auxins, cytokinins, and gibberellins, which directly promote cellular division and growth. When applied to soil as biostimulants, seaweed extracts enhance microbial activity, increase soil fertility, and improve soil structure, thereby facilitating better nutrient availability and stimulating root development. The field experiments conducted using a randomized block design with three replications and 11 treatment combinations on the paddy variety ADT 58 at ICAR-Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Vellore (12.93°N, 79.14°E) during 2023-2024 to evaluate the bioefficacy of seaweed-based biostimulant (KDALPASI Gel) in paddy cultivation. The study found that the highest grain yield (6855.8 kg/ha) was achieved with 100% RDF+ kdalpasi gel @ 18.75 kg/ha at basal, 30, 45 and 60 days after transplanting, significantly outperforming other treatments. The lowest yield was in the control (3666.3 kg/ha). The combined use of bio-stimulants and fertilizers increased grain yield by 49.44% compared to the control. The highest net return and benefit-cost ratio (3.37) were observed in 100% RDF + soil application of KDALPASI Gel @ 18.75 Kg/ha at all intervals), reflecting its superior productivity. The proximate composition of rice for the best treatment showed 73.32 g/100g of carbohydrates, 12.93 g/100g of protein, 0.92 g/100g of fat, 0.49 g/100g of total ash, and 0.60 g/100g of crude fiber.These findings suggest that integrating seaweed-based biostimulants with inorganic fertilizers can significantly improve rice yield and economic returns, offering a sustainable and cost-effective strategy for rice cultivation.

Keywords: Paddy, Seaweed, Biostimulant, Bioeeficacy, Proximate

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Impact of *Rhizobium nepotum* strain on Soil Microbial, Enzyme Activities and Plant Growth of Blackgram (*Vigna mungo* L. Hepper) VBN 11 in Madurai District

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Abstract

The present study aimed to isolate, characterize and evaluate the efficiency of indigenous *Rhizobium nepotum* (Rn) strains associated with blackgram (*Vigna mungo* L. Hepper), cultivated in the Madurai District of Tamil Nadu. Fifteen Rhizobial isolates were obtained from root nodules and confirmed through morphological, biochemical and molecular characterization as well as congo red and hofer's alkaline tests. Blackgram a widely grown pulse crop with an average productivity of 598 kg ha^{-1}, depends on symbiotic nitrogen fixation rather than urea fertilization; therefore, the effectiveness of native Rhizobia is critical for nodule formation and yield improvement. Root exudate profiling by GC-MS revealed the presence of diverse bioactive compounds including flavonoids, phenolics, lectins, tocopherols, organic acids, essential minerals, 3-O-methyl-D-glucose and n-hexadecanoic acid. These phytochemicals exhibit antimicrobial, antioxidant and signaling functions that attract native microflora, enhance rhizobacterial colonization and support efficient nitrogen fixation. Among the isolates, *R. nepotum* (Rn) and *Rhizobium pongamiae* (Rp) were selected for further evaluation through roll towel assays, pot culture and field experiments. Pot culture results showed that treatment T4 (Rn) produced the highest root length (19.8 cm plant^{-1}), shoot length (46.5 cm plant^{-1}), nodule number (14 plant^{-1}) and nodule weight (1.2 g plant^{-1}). Field experiments confirmed that treatment T3 (Rn) recorded superior nodulation (12 nodules plant^{-1}), nodule weight (1.4 g plant^{-1}) and yield (596 kg ha^{-1}). The findings demonstrate that the indigenous *R. nepotum* strain exhibits strong ecological compatibility with blackgram and significantly enhances growth, nodulation, soil enzyme activity and yield. Therefore, *R. nepotum* is recommended as an effective indigenous bioinoculant with multilocation trials needed to validate its wider applicability.

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AI-Assisted Multi-Omics Biomarker Discovery Platform for Breast Cancer Prognosis Using Ensemble Machine Learning

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Abstract

Breast cancer is the most prevalent malignancy among women globally, with over 2.3 million new cases diagnosed annually, yet the lack of robust multi dimensional prognostic biomarkers continues to limit personalised therapeutic decision making and early stage risk stratification. Conventional single omics approaches fail to capture the full molecular heterogeneity of tumour biology, necessitating integrative computational frameworks that operate across multiple biological dimensions simultaneously. AI assisted, interactive web based research platform developed in Python (Streamlit) that systematically integrates five molecular omics layers genomics, transcriptomics, epigenomics, proteomics and metabolomics to identify clinically relevant breast cancer biomarkers through ensemble machine learning and multivariate survival modelling. The platform was applied to The Cancer Genome Atlas Breast Invasive Carcinoma (TCGA-BRCA) cohort comprising 1,211 samples. Data harmonisation incorporated ComBat-Seq batch correction followed by $\log_2(\text{CPM}+1)$ normalisation to eliminate inter-batch technical variation and biomarker discovery was performed using an ensemble voting strategy that integrates Least Absolute Shrinkage and Selection Operator (LASSO) regression, Random Forest importance ranking and Support Vector Machine with Recursive Feature Elimination (SVM-RFE), thereby ensuring only features consistently selected across all three methodologies were retained. The ensemble pipeline identified a consensus ten gene prognostic signature like *TOP2A, CDK1, BUB1B, CCNB1, KIF20A, CDC20, DLGAP5, CCNA2, AURKB and MKI67* — primarily associated with cell cycle regulation and chromosomal segregation. The signature achieved a diagnostic area under the receiver operating characteristic curve (AUC) of 0.941 (95% CI: 0.927–0.955), with sensitivity of 89.2% and specificity of 91.5% at the Youden-optimal threshold. Kaplan–Meier stratification revealed a hazard ratio of 2.91 ($p = 1.1\times10^{-15}$; 95% CI: 2.21–3.83), while external validation across the METABRIC cohort (n = 1,980; HR = 2.04) and a six-dataset GEO meta-analysis (pooled HR = 1.87; $I^2 = 34\%$) confirmed robust cross-platform generalisability. SHAP-based model interpretability further elucidated the biological contributions of each biomarker to overall risk prediction. These findings conclusively demonstrate that AI driven multiomics integration substantially outperforms single layer approaches and that the identified ten gene signature holds significant translational potential as a cost effective prognostic panel for breast cancer subtype stratification and targeted therapeutic guidance, thereby advancing precision oncology within the life sciences domain.

Keywords: Multiomics integration, Biomarkers, Ensemble machine learning, LASSO; Random Forest, Precision oncology

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Sustainable Agri-Entrepreneurship: A Comprehensive Review of its Theoretical Foundations, Business Model Innovation and Emerging Trends

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Abstract

Sustainable entrepreneurship has emerged as a vital approach to addressing the interconnected economic, social, and environmental challenges faced by modern societies. By combining entrepreneurial innovation with the principles of sustainable development, it promotes business practices that generate economic value while simultaneously contributing to social well-being and environmental protection. In this context, entrepreneurs act as catalysts for change by developing innovative solutions that transform traditional business models and encourage sustainable economic progress. The Triple Bottom Line (TBL) framework serves as a key conceptual foundation, emphasizing the balanced integration of economic performance, social responsibility, and environmental sustainability. This review provides a comprehensive synthesis of the existing body of knowledge on sustainable entrepreneurship by examining major thematic areas, including Sustainable Business Model Innovation (SBMI), circular economy strategies, sustainable agrifood systems, innovation during crises, inclusive cooperative enterprises, and entrepreneurial contributions toward achieving the Sustainable Development Goals (SDGs). The literature indicates that innovation-oriented entrepreneurial initiatives have the potential to create economic opportunities while addressing pressing sustainability concerns. Nevertheless, significant research gaps remain regarding the mechanisms through which such innovations generate measurable economic, social, and environmental outcomes. The review highlights the importance of developing integrated analytical frameworks that capture the dynamic relationship between innovation and sustainability. It further emphasizes the need for supportive institutional ecosystems, effective collaboration among multiple stakeholders, and entrepreneurial capacity-building to facilitate the successful adoption of sustainable business practices. By identifying key challenges and proposing directions for future research, this review demonstrates that sustainable entrepreneurship can play a transformative role in fostering resilient, inclusive, and environmentally sustainable economic systems, thereby contributing to the advancement of a more sustainable global economy.

Keywords: Sustainable Agri-entrepreneurship, Triple Bottom Line, Circular economy

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Improving Tomato (*Solanum lycopersicum* L.). Productivity and Soil Health using Bio char under Reduced NPK Fertilizer Regimes

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Abstract

Excessive reliance on synthetic fertilizers degrades soil health, reduces microbial activity, and poses significant environmental challenges. The present study was conducted to evaluate the potential of biochar to mitigate the adverse effects of reduced Nitrogen-Phosphorus-Potassium (NPK) fertilizer application on the growth, yield, fruit quality, and soil health of tomato *(Solanum lycopersicum* L.). The experiment consisted of seven treatments: T1 – 100% recommended dose of fertilizers (RDF) of NPK (control); T2 – 75% RDF + biochar; T3 – 75% RDF + vermicompost; T4 – 50% RDF + biochar; T5 – 50% RDF + vermicompost; T6 – 50% RDF + vermicompost + biochar; and T7 – 75% RDF + vermicompost + biochar. Among the treatments, T4 (50% RDF + biochar) significantly enhanced vegetative growth, yield attributes, fruit quality, soil fertility, and microbial populations compared with the control. Tomato yield increased by 11.33% over the control despite a 50% reduction in NPK fertilizer application. Fruit quality parameters, including total soluble solids, ascorbic acid, lycopene, β-carotene, and mineral content, were significantly improved under T4. Furthermore, this treatment increased soil organic matter, available nitrogen, phosphorus, and potassium, as well as the populations of rhizosphere bacteria and fungi. These findings demonstrate that biochar can effectively compensate for a 50% reduction in NPK fertilizer application while enhancing tomato productivity, fruit nutritional quality, soil fertility, and microbial activity, thereby providing a sustainable strategy for reducing dependence on synthetic fertilizers.

Keywords: Biochar, Nutrient Dynamics, Soil Health, Tomato growth and yield

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RNA Purification using the Nanotechnology for RNA Sequencing

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Abstract

One efficient technique of getting quality RNA for RNA-sequencing (RNA- seq) is RNA purification based on nanotechnology, especially when isolating RNAfrom complicated biological materials consisting of hard cell wall, polysaccharides, polyphenols and other impurities which often affect the efficiency of standardcolumn-based extraction techniques. It is possible to isolate both total RNAandproposed RNA with enhanced selectivity and efficiency due to the specific properties of nanomaterials, including the high ratio of surface area to volume and controllablesurface chemistry. Cell lysis and removal of proteins using chaotropic salts are oftenused to disrupt cells and inactivate RNAses during RNA purification process. Thesubsequent step of the process is RNA capture using nanoparticles throughelectrostatic attraction or sequence-specific hybridization. In the presence of anexternal magnetic field, magnetic nanoparticles facilitate fast separation of RNA- nanoparticle complex, completely eliminating proteins, DNA, and secondarymetabolite inhibitors. Elution in low ionic strength solutions will provide purifiedRNA suitable for library preparation and sequencing purposes, while additional washing steps will help to get rid of any contaminants. Various nanomaterials havebeen studied as a means of RNA purification including magnetic iron oxidenanoparticles coated with silica or carboxyl groups for high-throughput total RNAisolation, gold nanoparticles modified by thiol group for selective enrichment of predicted RNA sequences, and graphene oxide nanoparticles coated with cationicpolymers for effective RNA binding and RNases protection. Nanoparticle-basedpurification technique allows for obtaining more pure RNA, better recovery of raresequences, reduced co-purification of inhibitors, RNase protection, and is compatiblewith automation. Nanotechnology-based purification technique is an excellent tool for transcriptome profiling, discovery of novel RNAs, and accurate quantification of gene expression in various biological systems due to their advantages, which provide better preservation and sequencing of RNA molecules.

Keywords: Nanotechnology, RNA purification, RNA sequencing (RNA-seq), Nanoparticles, Transcriptome analysis.

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Bio-fabricated Selenium Nanoparticles as a Sustainable Seed Nanopriming Agent for Enhancing Germination and Seedling Vigour in Rice

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Abstract

Global climate change and burgeoning population pressures necessitate the adoption of sustainable agricultural practices to ensure future food security. This study investigates the efficacy of green-synthesized selenium nanoparticles (SeNPs) as a seed nanopriming agent to enhance the germination and seedling establishment of rice (*Oryza sativa L.*). Utilizing an eco-friendly approach, SeNPs were bio-fabricated using raisin (*Vitis vinifera L.*) extract as a reducing and stabilizing agent. The synthesized nanoparticles, characterized via UV-Vis, XRD, and FE-SEM, exhibited a crystalline nature with an average size of approximately 40 nm. These SeNPs were applied to prime rice seeds of the HUR-105 genotype at concentrations of 20 µM and 25 µM. The experimental results demonstrated that nanopriming with SeNPs significantly accelerated germination, achieving approximately 95% within 48 hours and reaching full germination two days earlier than hydroprimed controls. This improvement is largely attributed to a stimulation of water imbibition by over 50% and the potential creation of nanopores by the particles, facilitating rapid moisture entry. Furthermore, SeNP-primed seeds exhibited a remarkable ~65% escalation in α-amylase activity, triggering efficient starch mobilization and elevating total soluble sugar content to support early embryo growth. Histochemical analysis and enzyme assays revealed that SeNPs precisely modulated reactive oxygen species (ROS) levels—including hydrogen peroxide and superoxide radicals—within the "oxidative window" necessary for physiological signaling. This was accompanied by the significant upregulation of antioxidant enzymes, specifically superoxide dismutase (SOD) and catalase (CAT), to maintain cellular redox homeostasis. This study concludes that bio-fabricated SeNPs offer a cost-effective, sustainable tool for improving seedling vigour and nutrient status in modern rice cultivation.

Keywords: Nanopriming, Selenium Nanoparticles, Rice Germination, Sustainable Agriculture, Seedling Vigour

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Emotional Intelligence Training Programme on Perception, Personality, and Quality of Work Life among Urban and Rural Staff Nurses: A Pilot Experimental Study

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Abstract

Background: Staff nurses experience considerable occupational stress due to demanding clinical responsibilities, emotional labour, rotating shifts, and challenges in balancing professional and personal commitments. These stressors adversely influence emotional well-being, personality development, perception towards work, and Quality Of Work Life (QWL), ultimately affecting patient care and organizational outcomes. Although emotional intelligence (EI) has been recognized as a protective factor against occupational stress, structured EI training programmes specifically designed for hospital staff nurses remain limited in the Indian healthcare context. The novelty of this study lies in integrating a structured Emotional Intelligence Programme addressing self-awareness, self-management, social awareness, empathy, social skills, motivation, and work-life balance into nursing practice while simultaneously evaluating its effects on perception, personality traits, and quality of work life using standardized assessment tools.

Methods: A quantitative true experimental pre-test–post-test control group design was adopted following an exploratory phase. Forty staff nurses were selected using simple random sampling and allocated equally to intervention (n=20) and control (n=20) groups. The intervention comprised a structured Emotional Intelligence Programme delivered over multiple sessions through lectures, PowerPoint presentations, experiential learning, role plays, mindfulness exercises, SWOT analysis, emotional regulation activities, communication training, and motivation exercises. Data were collected using a structured Perception Questionnaire, the Ten Item Personality Inventory (TIPI), and the Quality of Nursing Work Life Survey. Descriptive statistics summarized participant characteristics, while paired t-test, Pearson correlation, and Chi-square tests were employed to determine intervention effectiveness, relationships among study variables, and associations with selected demographic characteristics at a significance level of $p<0.05$.

Results: Baseline findings indicated moderate perception towards professional and personal life, moderate personality trait scores, and moderate quality of work life among participants. Following the intervention, the experimental group demonstrated significant improvement in perception, personality, and QWL compared with the control group. Rural nurses demonstrated significantly higher perception ($t=-2.44$, $p=0.025$) and personality scores ($t=-6.39$, $p=0.0001$) than urban nurses, whereas urban nurses reported significantly better quality of work life ($t=10.08$, $p<0.0001$).

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Following EI training, rural nurses showed significant improvement in managing work-related deadlines affecting family relationships (t=2.62, p=0.028), while urban nurses demonstrated a significant reduction in critical behaviour (t=-2.52, p=0.033). Although most correlations were non-significant because of the pilot sample, personality showed a moderate positive association with quality of work life among rural nurses (r=0.620, p=0.056), indicating a clinically meaningful trend.

Conclusion: The Emotional Intelligence Programme was feasible, acceptable, and effective in enhancing perception, positive personality characteristics, and quality of work life among staff nurses. Integrating structured EI training into continuing nursing education may strengthen emotional resilience, improve interpersonal relationships, reduce occupational stress, and promote healthier work environments, thereby enhancing patient care quality and staff retention. The pilot findings support progression to a larger multicentre randomized controlled trial. The relatively small sample size, short follow-up period, and single geographical setting limit generalizability, nevertheless, the study provides valuable preliminary evidence supporting the implementation of emotional intelligence interventions within nursing practice.

Keywords: Emotional Intelligence, Staff Nurses, Quality of Work Life, Perception of Work-Life, Psychological Well-being, Nursing Education.

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Harnessing Ultrasonication for Sustainable Valorisation of Mangosteen (*Garcinia mangostana* L.) Pericarp Waste to Bakery Product

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Abstract

Mangosteen (Garcinia mangostana L.), widely known as the "Queen of tropical fruits," is a highly valued fruit, admired for its unique flavour. Its pericarp constitutes a major portion of the fruit and is often discarded as waste, despite being rich in bioactive compounds such as phenolics, tannins, and xanthones. The present study aimed to standardise ultrasonication parameters for detanninization of mangosteen pericarp and to evaluate its potential as a functional ingredient in muffin preparation. The ultrasonication experiment consisted of ten treatments, including a control (T0) and combinations of treatment time (30, 40, and 50 min) and temperature (40, 50, and 60°C), all at a constant frequency of 40 kHz. Among the treatments, T4 (40 min, 40°C) showed higher phenolic retention, while T5 (40 min, 50°C) was effective in improving antioxidant and crude fibre content. The optimised peel powder, T5 (40 min, 50°C), was further utilised in muffin preparation with six treatments comprising different proportions of breadfruit flour (BFF) and mangosteen peel flour (MPF): T0 (100% wheat flour), T1 (100% BFF), T2 (75% BFF + 25% MPF), T3 (50% BFF + 50% MPF), T4 (25% BFF + 75% MPF), and T5 (100% MPF). Results revealed that incorporation of mangosteen peel powder enhanced the physical and nutritional attributes of muffins, including phenolic content and antioxidant activity. The L, a, and b colour values of muffins prepared from T5 were superior both inside and outside, exhibiting a chocolate-like tinge compared to the lighter wheat flour muffins (T0). This darker colour was found to be more appealing and acceptable to consumers. Puffiness and bite resistance also improved with increasing levels of mangosteen peel flour. Muffins prepared from 100% mangosteen peel flour showed the highest dietary fibre, antioxidant, phenol, and flavonoid contents. The study highlights the potential of mangosteen pericarp as a value-added functional ingredient, promoting waste utilisation, nutritionally enriched bakery products, and sustainable food processing practices.

Keywords: Non-thermal processing, Detanninization, Waste utilisation, Puffiness, Antinutritional

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Microbial Carbon Farming: Harnessing Endophytic Methylotrophs for Climate-Resilient Cropping Systems

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Abstract

Climate change poses significant challenges to global agriculture by reducing crop productivity, increasing greenhouse gas emissions, and accelerating soil carbon loss. Sustainable microbial interventions have emerged as promising strategies to enhance crop resilience while contributing to carbon sequestration. Among beneficial plant-associated microorganisms, endophytic methylotrophs have gained considerable attention due to their ability to utilize one-carbon compounds, colonize internal plant tissues, promote plant growth, and improve stress tolerance. Their unique metabolic pathways facilitate carbon assimilation, enhance photosynthetic efficiency, and support plant carbon fixation through improved physiological performance. Microbial carbon farming integrates such beneficial microorganisms into agricultural systems to increase carbon capture while sustaining crop productivity under changing climatic conditions. Endophytic methylotrophs produce phytohormones, solubilize nutrients, synthesize ACC deaminase and stimulate antioxidant defense mechanisms, thereby improving plant growth under drought, salinity, and temperature stress. In addition, these microbes contribute to soil health by enhancing microbial diversity, promoting nutrient cycling, and increasing carbon retention within the rhizosphere and plant biomass. Emerging advances in microbial formulation technologies, synthetic microbial consortia and precision agriculture further expand their potential for large-scale field applications. This study highlights the physiological, biochemical, and ecological roles of endophytic methylotrophs in climate-resilient cropping systems and discusses their contribution to microbial carbon farming. It also examines recent advances, current limitations, and future research directions for integrating these microorganisms into sustainable agricultural practices. Harnessing endophytic methylotrophs represents a promising nature-based solution for developing carbon-smart agriculture capable of simultaneously enhancing crop productivity, improving environmental sustainability and mitigating climate change.

Keywords: Endophytic methylotrophs, Microbial carbon farming, Carbon sequestration, Climate-resilient agriculture, Sustainable cropping systems, Carbon-smart agriculture

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Nanobubble Technology for Soil Microbiome Engineering: Innovations, Applications, and Future Perspectives

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Abstract

Global agriculture is facing unprecedented environmental challenges driven by climate change, soil degradation, declining microbial diversity, and excessive agrochemical use, necessitating innovative, sustainable solutions to ensure global food security. Soil microbiomes play indispensable roles in nutrient cycling, organic matter decomposition, soil fertility, plant growth promotion, and disease suppression, making them fundamental to resilient agricultural systems. Therefore, preserving and engineering beneficial microbial communities has become a priority for achieving sustainable and climate-resilient agriculture. Despite their considerable potential, conventional microbial inoculants often exhibit poor survival in field conditions, limited rhizosphere colonisation, and inconsistent performance due to environmental variability and competition with indigenous microorganisms. These limitations underscore the need for innovative technologies that enhance microbial establishment, persistence, and functional efficiency. Nanobubble technology has recently emerged as a promising approach for soil microbiome engineering owing to its nanoscale size, high specific surface area, prolonged stability, and exceptional oxygen transfer efficiency. By improving microbial functionality and nutrient utilization, nanobubble technology has the potential to reduce dependence on synthetic agrochemicals while minimizing environmental impacts. Its unique physicochemical properties enhance root-zone oxygenation, create favourable microbial habitats, stimulate beneficial microbial interactions, promote microbial metabolic activity, and facilitate biofilm formation, thereby improving the establishment and functional performance of beneficial microorganisms in agricultural soils. Furthermore, nanobubble technology offers diverse applications by enhancing the survival and activity of plant growth-promoting rhizobacteria (PGPR), improving biofertilizer efficacy, increasing nutrient use efficiency, suppressing soilborne pathogens, and strengthening soil health and resilience. Its integration with rhizosphere engineering, precision agriculture, and synthetic microbial consortia presents a transformative strategy for optimizing plant–microbe interactions and improving crop productivity. Future research should focus on elucidating nanobubble-microbe-plant interactions, optimizing application protocols across diverse agroecosystems, and conducting large-scale field validations. Overall, nanobubble technology represents a next-generation strategy for sustainable soil microbiome engineering, advancing science-driven innovations that promote resilient agriculture, environmental sustainability, and a better planet.

Keywords: Nanobubble technology, Soil microbiome engineering, Rhizosphere engineering, Precision agriculture

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Biosorption Of Cr (VI) By *Trichoderma harizianum* A Novel Biosorbent

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Abstract

Industrial effluents containing heavy metals may consider a major source of contamination causes serious environmental problems. Decontamination of heavy metals from wastewater has been a challenged for a long time. A number of methods have been developed for removal of toxic metal ions from wastewaters such as precipitation, evaporation, electroplating, ion exchange, membrane processes, etc. However, these conventional technologies are providing expensive due to non- regenerable materials used, high cost and generation of toxic sludge. Biosorption is a process which represents a biotechnological innovation as well as a cost effective excellent tool for removing heavy metals from aqueous solutions. It represents a typical technique for using economical alternate biological materials for the purpose. Today, biosorption is one of the main components of environmental and bioresource technology. Application of microorganisms (specifically bacteria, algae, yeasts and fungi) as biosorbents for heavy metal removal have received growing interest due to high surface to volume ratio; large availability, rapid kinetics of adsorption and desorption and low cost. In this work, Dried biomass of *Trichoderma harizianum* powder was taken as a low cost biosorbent for the sorption of Chromium(VI). The various parameters like Initial metal ion concentration, Initial pH, Temperature and Biosorbent dosage were studied in a batch reactor. Equilibrium was reached after 24 h of contact time. The optimum values of initial Chromium concentration, initial pH, temperature and biomass loading are found to be 50mg/l, 2,30°C and 5g/l . Under this optimised condition a maximum percentage removal of 95% and specific uptake of 11mg/g was obtained for Cr(VI) sorption.

Keywords: Biosorption, Trichoderma harizianum, Initial concentration, Biomass load and Equilibrium model.

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Effect of Foliar and Bunch Spray Nutrition on Yield of Banana CV. Ney Poovan Under Sodic Soils

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Abstract

A field study as carried out during 2023-2024 at the horticultural college and research institute for women, Tamil Nadu Agricultural university, Tiruchirappali, India to evaluate the influence of foliar and bunch spray nutrition on finger characteristics and yield of banana cv. Ney poovan under sodic soil. A Randomized Block Design (RBD) was employed for the experiment, featuring ten distinct treatment combinations replicated thrice. Among the treatments tested,T7 (application of 1 % SOP +1% urea at 6,7 and 8 month after planting, followed by bunch spraying after denavelling and again one month later) produced the best results. This treatment significantly enhanced several yield attributes including bunch weight (18kg), bunch length (90cm), bunch breadth (33cm), number of hands per buch (13), hand weight (1.24 kg), number of fingers per hand (18), hand length (17cm), hand breadth (12cm), finger length (14cm), finger breadth (6cm), and finger weight (96 g). Consequently, the highest yield of 40.81t ha-1 was recorded under this treatment compared with the control (T10).

Keywords: Banana, sodic soil, foliar spray, bunch spray, Ney poovan, SOP, Urea, Banana sakthi

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Molecular Diagnosis and Botanical Management of Sacbrood Virus Disease: A Sustainable Approach to Apiculture

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Abstract

Honey bees (*Apis cerana indica)* are indispensable pollinators that sustain agricultural productivity and ecosystem health. However, viral brood diseases, particularly Sacbrood virus (SBV), pose a major threat to colony survival and beekeeping. The present study aimed to molecularly diagnose SBV associated with brood disease and evaluate an eco-friendly management strategy for infected colonies in Kerala, India. Symptomatic brood samples collected from apiaries across Kerala were subjected to RT-PCR using SBV-specific primers, followed by sequencing and phylogenetic analysis. Subsequently, selected botanical extracts were evaluated under field conditions for the management of virus-infected colonies.

Among the samples analysed, one viral isolate (CTPM01) produced the expected SBV-specific amplicon (≈450–480 bp). Sequence analysis revealed 97.69% similarity with the Indian Sacbrood virus isolate II10 infecting *A. cerana indica*, while phylogenetic analysis confirmed its clustering within the SBV lineage, providing molecular confirmation of Sacbrood virus associated with brood disease in Kerala. Field evaluation demonstrated that *Phyllanthus niruri* (5%) was the most effective botanical treatment, significantly reducing virus-infected brood cells and improving colony recovery and foraging activity compared with untreated colonies. The treatment offered a safe and environmentally sustainable alternative to conventional chemical-based disease management.

The integration of molecular diagnostics with botanical-based disease management provides an effective strategy for early detection and sustainable control of viral brood diseases in Indian honey bee colonies. The findings contribute to pollinator health, sustainable apiculture, and environmentally responsible agricultural practices, supporting the development of eco-friendly disease management strategies for honey bee conservation.

Keywords: *Apis cerana indica,* Sacbrood virus, molecular diagnosis, *Phyllanthus niruri,* sustainable apiculture.

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Soil Physico-Chemical Properties, Productivity and Economics of Wheat Under STCR -Based Nutrients Application

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Abstract

A field experiment was conducted for two consecutive years during the Rabi seasons of 2020-21 and 2021-22, at Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, District of Uttar Pradesh (25°24'30" N latitude and 81°51'10" E longitude, with an elevation of approximately 98.0 meters above sea level) to study the Soil Physico-Chemical Properties, and Economics of Wheat. STCR approach reach out to farmer through saving of fertilizers nutrient and a desired yield can be achieved as per economic condition of farmers The experiment was carried out in Randomized Block Design and replicated thrice with 9 treatments. The best treatment combination was (T3) GRD+ FYM 5 tha-1 (120:60:40 NPK kg ha-1) + FYM 5 t ha-1, which displayed grain yield of 6.34 t ha-1 and straw yield 7.61 t ha-1 on a pooled basis, respectively. From the economic point of view, the treatment (T3) combination gave the maximum net return of ₹ 109945.00 ha-1 with B:C ratio of (3.06) during the experimental year 2020-21.

Keywords: Soil Physico-Chemical Properties, Productivity, Economics, Wheat and STCR

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Evaluation of Complete Extruder Pellet Feed, Integrated and Grazing-Based Feeding Sys tems on Growth Performance and Economics of Production in Thanjavur Black Goats

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Abstract

Goats are important small ruminants that contribute to the livelihoods and nutritional security of small and marginal farmers. Yet, traditional grazing-based feeding systems are often nutritionally inconsistent and insufficient to support optimal growth. This study evaluated the effect of complete extruder fodder pellet feed, integrated feeding, and grazing-based feeding systems on the growth performance and economics of production in Thanjavur Black goats. A 28-day feeding trial was conducted at the Livestock Farm Complex, VCRI, Orathanadu, using 18 goats (6–8 months old) randomly divided into three treatment groups (n=6 each): T_1, fed 100% pellet feed (500 g/animal/day); T_2, fed 50% pellet feed (250 g/animal/day) with green fodder (3.0 kg) and tree fodder (1.5 kg); and T_3, maintained on grazing supplemented with tree fodder (150 g) and concentrate cake (100 g). Body weights were recorded weekly, and monthly weight gain served as the primary performance indicator. Goats on T_1 recorded the highest and most uniform monthly body weight gain (mean 1.67 kg, CV lowest), followed by T2 (1.34 kg) and T3 (1.03 kg), establishing a clear performance ranking of T1 > T2 > T3. A cost–benefit analysis using prevailing Tamil Nadu market prices showed that T_1 generated the highest net profit per goat per month and the most favourable benefit-cost ratio, attributable to superior weight gain despite comparable feed costs, while T_3 incurred the lowest feed cost but reduced profitability due to higher grazing supervision requirements. These findings indicate that complete pelleted feeding significantly enhances growth performance and profitability in Thanjavur Black goats compared to integrated or grazing-based systems, and may be recommended for intensive small ruminant production, while grazing-based systems remain a viable low-input alternative for resource-constrained smallholder farmers.

Keywords: Thanjavur Black goat, extruder pellet feed, growth performance, feed efficiency, cost-benefit analysis.

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Categorization of Rice Genotypes for Total Phosphorus Uptake in Critical Stages Under Different Phosphorus Levels in Low Phosphorus Soil Ecosystem

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Abstract

A field experiment was conducted at paddy breeding station, TamilNadu Agricultural University which was located at Coimbatore district. The field was laid out in split plotdesign with replicated thrice. The characteristics of the experimental soil was clay in texture and belongs to Noyyal Soil series (*Vertic Ustochrept*). The soil was non-saline and alkaline in nature. Theavailable nutrient content of the soil was low in available nitrogen (210 kgha-^{1}), low in available phosphorus (7.0 kg ha-^{1}) and high in available potassium (350 kgha-^{1}). The treatments comprised of Factor A: twenty two rice genotypes viz., CB06732, TNRH180, AS06034, CB08536, CB08513,CB08504, CB08509, CB06535, TP08010, AD07038, TM07333, AS06035, AD0801, TM07278,ACM07001, AS6016, CORH-3, ADT-47, ADT43, ASD16, CO47 and ADT45 and Factor B: 0 & 50 kgha-^{1}. Nitrogen was applied as four equal splits at rice critical stages and full dose of phosphorus and potassium was applied as basal application as per the fertilizer schedule (RDF-150:50:50 kg NPK ha-^{1}). The results revealed that rice genotypes viz., CB06732 recorded higher mean total phosphorus uptake at active tillering (10.1 kg/ha), panicle initiation (25.0 kg ha-^{1}) and flowering stage (44.0 kg ha-^{1}) and it was followed by AS06034, TP08010 and CB06732. Even at phosphorus omitted condition rice genotypes viz., CB06732 (8.8 kgha-1), CB08513 (37.6 kgha-^{1}) and AS06035 (37.3 kgha-^{1}) performed well under low phosphorus soil ecosystem. The lowest phosphorus uptake was found in AD07038.

Keywords: Rice genotypes, Total phosphorus uptake, Phosphorus levels, Noyyal Soil series and Critical stages.

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Assessment of Foliar and Soil Applied Silicon in Supressing Sucking Insect Pests of Guava (cv. Lucknow-49)

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Abstract

Guava (*Psidium guajava L.*) is one of the most important fruit crops cultivated in tropical and subtropical regions. However, its productivity is limited by several sucking insect pests that reduce plant vigour and fruit quality. Overusing chemical insecticides has led to serious problems like resistance development, residue accumulation and environmental contamination and residue accumulation, making it essential to develop sustainable pest control. Silicon has emerged as a promising plant defence enhancer capable of improving both physical and biochemical resistance against insect herbivores. The present investigation was undertaken to evaluate the efficacy of soil and foliar application of silicon in suppressing sucking insect pests through the induction of phenolic defence in guava cv. Lucknow-49. A field experiment was conducted during the 2025–26 cropping season in Achampatti village of Madurai district using a Randomized Block Design comprising ten treatments with three replications. The treatments included different combinations of basal application and foliar sprays of different silicon sources, along with suitable controls. Observations on the population of major sucking insect pests, namely aphids, jassids, whiteflies, thrips and mealybugs, were recorded at periodic intervals following treatment application. Among the treatments, T_2 (basal application of calcium silicate + 1% potassium silicate foliar spray) consistently recorded the lowest mean pest population, with striped mealybug (2.55/15 cm shoot), pink mealybug (2.02/15 cm shoot), wooly whitefly (0.95/2.5 sq cm/three leaves), spiralling whitefly (0.85/3 leaves), green schield scale (1.40/15 cm twig) and wax scale (1.04/15 cm twig), representing reductions of 51.96%, 44.54%, 57.98%, 53.03%, 55.98% and 55.03%, respectively, over the untreated control. The same treatment also recorded the highest total phenol content (1.98 mg g^{-1}), compared with 1.3 mg g^{-1} in the untreated control, indicating enhanced biochemical defence following silicon application. The reduction in pest incidence was positively associated with increased phenol accumulation, suggesting that silicon-mediated induced resistance contributed to improved protection against sucking insect pests in guava.

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Characterization of a Copy of BjWRI1 via Overexpression and Knock-down in Indian Mustard (Brassica juncea subsp. juncea) for Unravelling its Role in Increasing Oil Content

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Abstract

India imports large amounts of vegetable oils since the domestic production is limited. This necessitates increase in oil seeds production domestically with higher oil content. *Brassica juncea* (Indian mustard) is one of the most important oil seeds grown in India. Increasing oil content further in *B. juncea* is limited by available genetic variations thus requires understanding of oil biosynthesis. Identifying and modifying key genes involved in the oil biosynthesis will accelerate the oil content improvement. One such key gene is *WRI1* (WRInkled1). In this study, we attempted to elucidate function of this gene by knockdown using RNAi and overexpression using seed specific *oleosin1* promoter. One *WRI1* copy present on A7 chromosome selected. Transgenic plants developed using Agrobacterium mediated transformation using tissue culture of hypocotyls and confirmed by PCR (Polymerase Chain Reaction) based screening. Expression levels of this gene detected by qRT-PCR (quantitative Real Time – PCR) using cDNA. The effect of knockdown and overexpression was detected in leaf tissue of RNAi plants and overexpression plants, respectively. But in seeds (20 Days After Anthesis) we did find only overexpression in both RNAi and overexpression plants. The RNAi plants exhibited observable reduction in plant height, number of siliques per plant, number of seeds per silique, whole plant dry mass, harvest index, 100 seed weight, seed yield per plant, oil content, oil yield per plant and total glucosinolates content when compared to Non-transgenic plants. Overexpression plants exhibited observable increase in number of primary branches, number of siliques per plant, number of seeds per silique, whole plant dry mass, harvest index, seed yield per plant while reduction in 100 seed weight without any change in oil content or total glucosinolates content in comparison with non-transgenic plants. This suggests that, this copy of *WRI1* gene improves seed yield (up to 55%) and supports oil biosynthesis.

Keywords: *Brassica juncea*, *WRI1,* transformation, RNAi and seed specific overexpression

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Evaluating the Impact of Combined Application of Fermented Organic Manure and Chemical Fertilizer on Growth and Yield of Rice

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Abstract

Fertilizer management practices is essential for sustainable rice cultivation, as prolonged chemical fertilizer use can lead to nitrogen loss and environmental harm, whereas incorporating organic fertilizers offers a viable alternative to provide nutrients, enhance soil health, and support eco-friendly rice production. The present field experiment was carried out to know the combined effect of fermented organic manure and chemical fertilizer. The experiment was conducted during *kharif* and *rabi* season of 2025- 26 at KVK. Virinjipuram, Vellore. The experiment was laid out in randomized block design with seven treatments and three replication. The treatments were maintained in rice field to determine the growth and yield of rice are T1 - 100% Fertilizer, T2 - 100% Fertilizer +100% FOM, T3 - 100% Fertilizer +125% FOM, T4 - 100% Fertilizer +75% FOM; T5 - 75% Fertilizer , T6 - 75% Fertilizer +100% FOM; T7 - 75% Fertilizer +125% FOM.. The result revealed that the effect of combined application of FOM and chemical fertilizer significant effect on growth and yield of rice. The grain and straw yield was recorded maximum with 100% Fertilizer +125% FOM of 6235 Kg ha-1 and straw yield of 8813 Kg ha-1 which was on par with 100% Fertilizer +100% FOM. The lowest grain and straw yield was observed in - 75% Fertilizer. Application of 100% Fertilizer +125% FOM with chemical fertilizer were produced more yield compare to 100% RDF with an increase of 7 percent.

Keywords: FOM, Fertilizer, Yield

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Unsupervised Classification of Sentinel-2 Imagery for Seasonal Land-Cover Dynamics in Ladakh: Implications for Climate Change Adaptation and Agricultural Resilience in High-Altitude Cold Deserts

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Abstract

The Union Territory of Ladakh, a high-altitude cold desert in the Trans-Himalayas, is experiencing rapid climate-induced changes in vegetation phenology, glacial meltwater availability, and agricultural viability. Accurate monitoring of seasonal land-cover dynamics is critical for building climate resilience in this fragile ecosystem. This study presents a reproducible unsupervised classification workflow using Sentinel-2 Level-2A imagery (April–September 2025) to map vegetation versus barren land across the growing season in the Leh region. Multi-temporal Sentinel-2 scenes were preprocessed with band resampling, cloud/snow masking using the Scene Classification Layer (SCL), and computation of spectral indices (NDVI, NDWI, MNDWI, NBR, NDSI). A K-Means clustering algorithm (k=6) was applied on stacked spectral bands and indices, followed by post-classification aggregation into vegetation and barren land classes. Classified maps and area statistics were generated using a modular Python workflow (rasterio, scikit-learn, pandas) for full reproducibility. Results revealed strong seasonality: vegetation area increased dramatically from 3.11 km2 in April to a peak of 4712.85 km2 in August (+151,317% relative to April), then declined sharply in September as fields were harvested. Barren land exhibited an inverse trend, reaching its lowest extent in August. These patterns confirm the short growing season and heavy dependence of Ladakh's agriculture on glacial meltwater and irrigation. The study demonstrates that unsupervised classification combined with spectral indices provides a robust, low-cost, and scalable tool for monitoring climate-sensitive land-cover changes in data-scarce high-altitude regions. Findings offer actionable insights for irrigation planning, food security, and climate adaptation strategies in the Himalayan cold deserts.

Keywords: Sentinel-2, unsupervised classification, K-Means, seasonal land-cover change, Ladakh, climate change adaptation, high-altitude agriculture, cryosphere

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Value-Added Products from Malt-Based Composite Flour: A Food-Based Approach to Combat Hidden Hunger

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Abstract

Hidden hunger, caused by deficiencies of essential micronutrients such as iron, zinc, calcium, and vitamin A, affects over 2 billion people worldwide and remains a major public health challenge, particularly among children, adolescents, pregnant women, and low-income populations. Developing affordable, nutrient-dense foods from locally available crops is a sustainable strategy to improve nutritional security. Malt-based composite flour, formulated from malted cereals, millets, pulses, soybean, and other functional ingredients, offers a promising food-based intervention while promoting value addition to agricultural produce. Malting is an economical bioprocessing technique that enhances nutrient bioavailability by reducing anti-nutritional factors, improving protein and starch digestibility, increasing enzymatic activity, and enhancing functional properties for product development. Composite flour formulations incorporating finger millet, sorghum, legumes, and soybean were optimized through standardized malting and roasting temperature and time to achieve desirable flavour, colour, texture, and nutritional quality. The optimized flour was successfully utilized to develop value-added products, including complementary foods, bakery products, health mixes, and ready-to-cook formulations. Sensory evaluation indicated that up to 30% incorporation of maltbased composite flour was highly acceptable without compromising product quality. Promotion of malt-based composite flour aligns with food and nutrition security initiatives by encouraging the utilization of climate-resilient crops, reducing post-harvest losses through value addition, and improving access to nutrient-rich foods for community-based nutrition interventions. It also supports rural entrepreneurship, and offers a practical, sustainable foodbased approach to combating hidden hunger and improving nutritional security.

Keywords: Hidden hunger, malt-based composite flour, value-added products, nutritional security

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Functional Foods from Agricultural Waste: A Sustainable Approach for Value Addition and Nutritional Security

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Abstract

Globally, a significant proportion of fruits and vegetables is lost during harvesting, processing, transportation, and marketing, resulting in the generation of large quantities of agricultural waste. Common by-products such as fruit peels, seeds, pomace, stems, leaves, and husks are often discarded despite being rich sources of dietary fibre, polyphenols, flavonoids, carotenoids, vitamins, minerals, and other bioactive compounds. The improper disposal of these residues contributes to environmental pollution while also representing a loss of valuable nutritional resources. Converting agricultural waste into functional food ingredients offers a sustainable strategy to reduce food waste, improve resource utilization, and create high-value products that support human health.

Recent advances in green extraction technologies, including ultrasound-assisted extraction, enzyme-assisted extraction, microwave-assisted extraction, and supercritical fluid extraction, have improved the efficient recovery of bioactive compounds from agricultural residues. In addition, drying technologies such as freeze drying, spray drying, and solar drying facilitate the production of stable functional ingredients with minimal loss of nutritional quality. The integration of food processing technologies with sustainable waste management supports the principles of the circular economy by transforming waste into marketable products with economic and environmental benefits.

Future research should focus on identifying novel bioactive compounds from locally available agricultural residues, developing cost-effective processing technologies, evaluating the health benefits of functional ingredients through clinical studies, and designing eco-friendly packaging systems for value-added products. The adoption of agricultural waste valorization not only supports environmental sustainability but also aligns with global goals for responsible consumption, waste reduction, and improved public health. Therefore, transforming agricultural waste into functional foods represents an innovative and sustainable approach for achieving nutritional security, economic growth, and circular bioeconomy development.

Keywords: Functional foods, Agricultural waste, Value addition, Bioactive compounds, Dietary fibre, Fruit and vegetable by-products, Nutraceuticals, Circular bioeconomy, Sustainable food processing, Postharvest management.

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Chlorantraniliprole-induced Lethal and Sublethal Effects on Toxicity, Life-History Traits, and Demographic Fitness of Spodoptera frugiperda (J.E. Smith, 1797)

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Abstract

The invasive fall armyworm, *Spodoptera frugiperda* (J.E. Smith), is a major constraint to global maize production because of its high reproductive capacity and rapid development of insecticide resistance. Although chlorantraniliprole is extensively used for its control, its lethal and sublethal impacts on population fitness remain inadequately understood. This study investigated the toxicological effects of chlorantraniliprole on the life history, reproductive performance, demographic parameters, and population growth of *S. frugiperda* using the age-stage, two-sex life table approach. Leaf-dip bioassays with third-instar larvae estimated LC_{10}, LC_{25}, and LC_{50} values of 0.0048, 0.0354, and 0.3274 mg L^{-1}, respectively. Exposure to chlorantraniliprole significantly prolonged larval development while reducing pupal duration, adult longevity, and female fecundity in a concentration-dependent manner. Mean fecundity declined from 593.95 eggs per female in the control to 150.25 eggs per female at LC_{50}, with only a modest reduction at LC_{10} (519.30 eggs per female). Life table analyses showed significant decreases in the intrinsic rate of increase (r), finite rate of increase (λ), net reproductive rate (R_0), and gross reproductive rate (GRR), accompanied by increased mean generation time (T) and doubling time (DT). Age-stage survival (Sxj), life expectancy (exj), reproductive value (vxj), and age-specific maternity (lxmx) were consistently reduced in treated populations. Population projections further demonstrated substantial suppression of long-term population growth, particularly at LC_{25} and LC_{50}. These findings demonstrate that chlorantraniliprole imposes significant toxicological and demographic constraints on *S. frugiperda,* providing valuable evidence for insecticide risk assessment, resistance management, and sustainable integrated pest management.

Keywords: *Spodoptera frugiperda*; chlorantraniliprole; two-sex life table; sublethal toxicity; demographic trait; fitness cost

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Vegetative Anatomy and Mycotrophy of Epiphytic Endemic Orchid Coelogyne nervosa Rich

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Abstract

The family Orchidaceae is one of the largest plant families on earth encompassing around 10% of flowering plant species. It consists of over 700 genera and 25,000 species. In orchidaceae, to solve the taxonomic problems, anatomical examination is important. However, in recent years this discipline has lost and went out of the fashion (Balachandar et al., 2019). But recent decade's anatomy is rejuvenating because of its application in many fields of plant biology. The elucidation of significant anatomical characters is still necessary to support the classification based on recent phylogenies. So, the present study was aimed to elucidate the significant anatomical character which is useful for species delimitation. Anatomical characteristics of epiphytic orchid *Coelogyne nervosa* were observed. Leaves Narrowly elliptic, acute, slightly undulate, plicate leaves and amphistomatic. Cuticle is arranged on the epidermal cells and absence of hypodermis. Vascular bundles are arranged in concentric rings, which are collateral. The large vascular bundles distributed in central region and smaller bundles are distributed on peripheral region. Sclerenchymatous patch of cells capped the both sides of vascular bundles. In addition, the starch grains were distributed near the vascular bundles. In large vascular bundles meta xylem observed in central and phloem was arranged next to xylem. The pseudobulb is fleshy and epidermis is uniseriate with compactly arranged thin-walled rectangular cells. Air chambers are present in the ground tissue. In addition, idioblasts containing raphides and abundant cruciate starch grains also occur in the ground tissue. The outline of the root is wavy and velamen is made up of layer of 3-4 cells layers. Water storage cells were observed in velamen regions which contains reticulate or banded thickenings. The objective of the study is: To compare vegetative anatomical traits and mycorrhizal colonization patterns in *Coelogyne nervosa*. To evaluate and identify anatomical characters useful for species delimitation and ecological interpretation.

Keywords: Orchid, Mycorrhizal colonization, Ecological adaptation, Anatomy of root.

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Development of Vitamin C Enriched Tomato Through CRISPR/Cas9-Based Genome Editing

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Abstract

Vitamin C (ascorbic acid) is an essential antioxidant that plays a critical role in human nutrition and plant stress tolerance. Tomato (Solanum lycopersicum L.) is one of the most widely consumed vegetable crops worldwide and serves as an important dietary source of vitamin C. However, the natural vitamin C content in commercial tomato cultivars remains insufficient to meet increasing nutritional demands. Genome editing technologies, particularly the CRISPR/Cas9 system, provide a precise and efficient approach for improving nutritional traits in crop plants. The present study aims to develop vitamin C-enriched tomato lines through CRISPR/Cas9- mediated targeted mutagenesis of the Ascorbate Peroxidase gene. APX is involved in the ascorbate-glutathione pathway and catalyzes the utilization of ascorbate during reactive oxygen species detoxification. It is hypothesized that disruption of APX activity may reduce ascorbate consumption, thereby increasing the accumulation of vitamin C in tomato fruits. Specific guide RNAs targeting conserved regions of the APX gene were designed and assembled into a CRISPR/Cas9 expression construct. The construct was introduced into tomato through Agrobacterium-mediated transformation, followed by regeneration and molecular screening of edited plants. Putative mutants are being characterized through PCR-based analysis, sequencing of target loci, and assessment of vitamin C content in edited lines. The successful generation of APX-edited tomato plants is expected to provide insights into the role of APX in ascorbate metabolism and contribute to the development of nutritionally enhanced tomato cultivars. This study demonstrates the potential of CRISPR/Cas9 genome editing as a powerful tool for crop biofortification and sustainable improvement of human nutrition.

The present study aims to develop vitamin C-enriched tomato through CRISPR/Cas9-mediated genome editing of the APX gene. Guide RNAs (gRNAs) targeting conserved regions of APX were designed using bioinformatic tools based on target specificity, predicted editing efficiency, and minimal off-target potential. Selected gRNA sequences were synthesized and cloned into a CRISPR/Cas9 plant expression vector using standard molecular cloning techniques. Successful insertion of gRNA cassettes was confirmed through colony PCR and restriction analysis.

Keywords: Tomato, Vitamin C, Ascorbic Acid, CRISPR/Cas9, APX, Genome Editing, Biofortification.

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Water Budgeting for Fodder Crops and Live stock Population in Different Agro-Climatic Zones of Tamil Nadu

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Abstract

Water is a critical yet finite resource that governs both fodder crop productivity and livestock performance in Tamil Nadu. This study presents a comprehensive water budget analysis for the seven agro-climatic zones of Tamil Nadu, integrating data from the 2019 Livestock Census with zone-specific fodder crop water requirement estimates. The total livestock population of 15.63 crore (including 12.07 crore poultry) demands approximately 113.33 crore litres of water per day. An additional 5.84 lakh litres per day is required for fodder crop irrigation, bringing the aggregate daily water demand to approximately 113.38 crore litres. Significant inter-zonal variation was observed: the Cauvery Delta records a water surplus due to high rainfall (900–1300 mm) and perennial irrigation, while the southern and northwestern zones face critical deficits with rainfall below 700 mm. Statistical analysis (ANOVA, coefficient of variation) confirmed highly significant differences ($p < 0.01$) in the water requirements across zones and species. Zone-specific water management strategies, including deficit-tolerant fodder cultivation, rainwater harvesting and integrated crop-livestock water planning, are recommended.

Keywords: Water budget, Agro-climate zones of Tamil Nadu, Effective Rainfall, Water requirement and deficit for livestock's, crop-livestock water planning.

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Plant-derivatives Enhance Host Defence and Suppress Postharvest Anthracnose in Mango (Mangifera indica L.)

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Abstract

Mango anthracnose caused by *Colletotrichum gloeosporioides* severely reduces fruit quality, shelf life, and marketability, highlighting the need for sustainable alternatives to synthetic fungicides. This study evaluated the antifungal efficacy of six medicinal plants *(Anethum graveolens, Ferula asafoetida, Justicia adhatoda, Macrotyloma uniflorum, Nyctanthes arbor-tristis, and Vitex negundo)* using five solvent extracts and essential oils (EOs) through in vitro and in vivo assays. Antifungal activity was assessed by mycelial growth and spore inhibition, while GC-MS and SEM were used to identify bioactive compounds and examine fungal ultrastructural changes. Essential oils exhibited significantly greater antifungal activity than solvent extracts, with *A. graveolens* EO showing the highest efficacy, followed by *F. asafoetida* and *N. arbor-tristis*. GC-MS revealed the presence of fatty acids, terpenoids, sulphides, and sesquiterpenes, whereas SEM confirmed severe hyphal and conidial damage after EO treatment. In vivo, *A. graveolens* and *N. arbor-tristis* EOs significantly reduced disease incidence, lesion development, respiration rate, and weight loss while maintaining fruit firmness, colour, titratable acidity, sensory quality, and TSS/TA ratio during 15 days of ambient storage. Enhanced antioxidant enzyme activities (SOD, POD, CAT, and PPO) and increased phenolic, flavonoid, and antioxidant contents indicated induced host defence responses. These findings demonstrate the potential of *A. graveolens* and *N. arbor-tristis* EOs as eco-friendly alternatives for sustainable postharvest management of mango anthracnose.

Keywords: *Colletotrichum gloeosporioides*, Postharvest, Botanical formulation, Essential oil, Phytoextracts.

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Changing Pest Scenario in Sapota Growing Regions of Tamil Nadu, India

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Abstract

Sapota, Manilkara achras (Mill) Fosberg of family Sapotaceae, is a hardy fruit crop,. Climate changes in Tamil Nadu exacerbates insect pest infestations in sapota due to shifting temperature, humidity, and rainfall. In India, as many as 25 insect pests have been reported in sapota trees and 12 in Tamil Nadu. Roving survey was carried out at randomly selected locations in various sapota orchards of Theni, Dindigul, Pudukottai, Erode, Salem, Krishnagiri and Coimbatore districts of Tamil Nadu from 2024 to 2025. In each orchard, ten trees were randomly selected. On each tree, three twigs were selected, thus thirty twigs were observed for recording the incidence on buds and leaves due to various pests. The incidence of mite, mealybug and fruit fly on fruit was observed from total number of fruits per 5 twigs of 1 m length and infested fruits per tree were recorded. For seed borer randomly selected 100 fruits will be observed at fortnightly intervals and damaged fruits will be noted down to calculate damage percentage. The status of sapota pests under the roving survey conducted in sapota growing regions of Tamil Nadu indicated that all the major and minor pest were observed throughout the year (Table 1). During flowering season, there was slight decrease of bud damage due to bud borer in Theni, Dindigul, Pudukottai, Erode, Salem, Krishnagiri and Coimbatore districts (1.50-9.85%) with maximum infestation was observed during May-August months. Similarly, there was slight decrease incidence of chiku moth (6.70%) bud damage and maximum bud infestation was recorded during May-July and November- January. But increasing trend was observed for fruit flies (6.25%) fruit fly damage during April- June. The seed borer was slight increase in incidence (4.24%) during April-May and December-January in Theni and Dindigul districts. .The incidence of mid rib folder was minimum compared to previous incidence (1.15%) leaf damage and was peak during November- December and March-June months. . There was less incidence of fruit mite (0.45%) , leaf miner damage (1.05%) and leaf twisting weevil (1.20%). The mealy bug incidence was not observed during this suvery period. There were no minor pest became major and incidence of new insect pests in surveyed area of 2024-2025. Also, there was no major change in incidence pattern of the pests from previous year in Tamil Nadu.

Keywords: Sapota, Insect Pests, Monitoring, Management

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Effect of Intercropping on Growth and Yield of Sugarcane Under SSI

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Abstract

An experiment was conducted in Sugarcane research station at Sirugamani, TNAU to study the Effect of intercropping on growth and yield of sugarcane under SSI. A strip plot design was utilized with three replicates, four main plots and four subplots. The intercrops were raised in three rows with a spacing of 150 cm and four rows with a spacing of 180 cm. RDF of drip fertigation for SSI was followed using a surface drip irrigation system. Observation on growth parameters, yields were recorded and crop equivalent yield and economic returns were worked out. Wide row planting was adopted using long duration high tillering cultivar, irrigation, fertile soil and biotic stress management. Intercropping, sugarcane top integration and drip irrigation can form a requisite of wide row planting techniques. The results revealed that a significantly increased growth attributes are plant height, tillers and shoot population, Number of millable canes and cane yield were recorded at 150 cm two-row planting with sunnhemp (M2S4). Higher cane yield, Sugar yield and economic returns were also recorded under 150 cm two row planting of sugarcane with sunnhemp (M2S4).

Keywords: Sustainable Sugarcane Initiative, Number of millable canes

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Carbon Sequestration Potential of Grasses for Restoration of Degraded Wastelands and Permanent Pastures in Tamil Nadu: A District-Wise Assessment

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Abstract

Permanent pastures and culturable wastelands constitute underutilized land resources with considerable potential for climate change mitigation through grassland-based carbon sequestration. This study assessed the extent and trend of degraded pasture and culturable wasteland across Tamil Nadu using five-year district-level land-use records (2020–21 to 2024–25) and compiled the reported carbon sequestration potential of 19 grass species suitable for wasteland restoration. Species were grouped into three functional categories: native drought-tolerant grasses, improved fodder grasses and high-biomass grasses. One-way analysis of variance (ANOVA) was performed to test whether the mean carbon sequestration potential differed significantly among the three groups. The analysis revealed a highly significant effect of functional group on carbon sequestration potential ($F(2,92) = 45.15$, $p < 0.0001$), with high-biomass grasses such as Vetiver (Chrysopogon zizanioides) and Cumbu Napier and Cenchrus sp. grass (*Cenchrus sp.*) sequestering substantially more carbon (mean 3.72 t C ha^{-1} yr^{-1}) than native drought-tolerant species such as Buffel and Bermuda grass (mean 1.98 t C ha^{-1} yr^{-1}). Tukey's post-hoc test confirmed significant pairwise differences among the three groups. These findings support prioritizing high-biomass grass species in large-scale wasteland restoration programs where soil moisture and management inputs permit, while native drought-tolerant grasses remain essential for restoring the most degraded, low-input rangelands typified by districts such as Ariyalur and Thanjavur.

Keywords: carbon sequestration of grazeland grass, grassland restoration, wasteland, permanent pasture

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Design Optimization of Agrivoltaic Systems for Sustainable Production of *Philodendron* 'Red Congo': Integrating Microclimate, Plant Physiology and Renewable Energy

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Abstract

Agrivoltaic systems have emerged as a promising approach to simultaneously generate renewable energy and cultivate crops, thereby enhancing land-use efficiency and promoting climate-smart agriculture. However, the productivity of shade-loving ornamental foliage crops under different agrivoltaic configurations remains inadequately explored. The present study investigated the influencem of photovoltaic panel tilt angle and mounting height on the microclimate, physiological responses, vegetative growth, and energy generation of *Philodendron* 'Red Congo' under an agrivoltaic system. A two-year field experiment (2024-25 and 2025-26) was conducted at ICAR-Indian Institute of Horticultural Research, Bengaluru, using a Factorial Completely Randomized Block Design comprising four panel tilt angles (0°, 20°, 40°, and 60°) and two mounting heights (6 ft and 8 ft) with three replications. Microclimatic parameters, including photosynthetically active radiation, light intensity and canopy temperature, along with vegetative growth traits and physiological attributes, were evaluated. Agrivoltaic configuration significantly influenced the growing environment and crop performance. The 6 ft mounting height combined with a 60° panel tilt created a favourable microclimate that improved better pot plant growth (44.86 cm height) and plant spread (38.77 cm) over pooled seasons. Physiological parameters like chlorophyll content and photosynthetic efficiency (5.25 µmol CO_2 m^{-2} s^{-1} and 52.71 SPAD, respectively) also improved in this treatment compared with other treatments. In contrast, the 8 ft mounting height exposed plants to greater irradiance and canopy temperature, resulting in reduced growth and increased leaf scorching (32.25 % - 33.63 %). However, the 20° panel tilt recorded the highest cumulative electrical energy generation of 635.80 and 582.00 kWh, respectively for two seasons, resulting in an estimated reduction of 871.94 kg (0.87 t) of CO_2 emissions over the twoyear study period, thereby demonstrating its potential to enhance environmental sustainability alongside ornamental crop production. Land Equivalent Ratio exceeded unity (1.81 and 1.67 for two cropping seasons for agrivoltaics with 6ft height and 60° tilt angle, respectively) across agrivoltaic treatments, confirming its advantage of dual land use and energy generation. These findings indicate that optimizing panel geometry can effectively enhance the performance of shade-tolerant ornamental crops while

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maintaining efficient energy generation, supporting the adoption of agrivoltaic systems for sustainable horticultural production.

Keywords: Agrivoltaics, *Philodendron* 'Red Congo', panel tilt angle, mounting height, microclimate, renewable energy.

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Comparative Evaluation of Spawn Production, Substrate Suitability and Antimicrobial Activity of Ganoderma lucidum

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Abstract

*Ganoderma lucidum i*s a medicinal mushroom well known for its therapeutic properties and potential as a biological control agent against several plant pathogens. The present study was conducted to identify a suitable grain substrate for spawn production, standardize an appropriate sawdust substrate for its mass cultivation and to evaluate the antimicrobial activity of *G. lucidum*. Five different grain substrates (wheat, sorghum, rice, mungbean and nagli) were evaluated to identify the most suitable medium for spawn production of *G. lucidum*. Among them, wheat grains performed the best, showing complete colonization with dense, thick white mycelial strands and the shortest spawn run period (9.87 days). Different sawdust–rice bran combinations were also evaluated for mass cultivation, revealing significant differences in pinhead initiation and cultivation performance and identifying the most suitable substrate combinations for efficient cultivation of *G. lucidum*. *G. lucidum* exhibited varying degrees of antifungal activity against all the tested pathogens *(Colletotrichum falcatum, Sclerotium rolfsii, Fusarium moniliforme, Aspergillus niger and Trichoderma viride)* with the effectiveness differing among the fungal species and solvent extracts. The maximum mycelial growth inhibition was recorded against *Fusarium moniliforme* (74.99%). The study demonstrated that *G. lucidum* possesses significant antifungal potential and can serve as an eco-friendly biocontrol agent, offering a sustainable alternative to chemical fungicides for effective plant disease management and enhanced agricultural productivity.

Keywords: *Ganoderma lucidum*, antimicrobial activity, spawn production

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Synthesis, Characterization and Adsorptive Performance of Sericin-Polypyrrole-Magnetite Hybrid Composite for Carbaryl Removal from aqueous solution

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Abstract

The widespread use of pesticides in agriculture has led to the contamination of water resources, posing significant risks to environmental sustainability, and human well-being. Carbaryl, a toxic carbamate pesticide, is frequently detected in agricultural runoff and wastewater, necessitating the development of efficient and sustainable remediation strategies. In this study, a novel **sericin-polypyrrolemagnetite (Ser-PPy-Mag) biohybrid adsorbent** was synthesized using sericin, a protein-rich byproduct of the silk industry, thereby **promoting waste valorization and circular economy principles.** The synthesized composite was characterized using FTIR, FESEM–EDAX, and UV–Visible spectroscopy to investigate its structural and surface properties. Batch adsorption experiments were performed to evaluate the influence of adsorbent dosage, initial pesticide concentration, contact time, pH, and temperature on carbaryl removal. Under optimized conditions, the Ser-PPy-Mag composite achieved a **maximum carbaryl removal efficiency of 94.8%**, demonstrating its excellent adsorption capability and potential for practical wastewater treatment applications. The present study provides an environmentally friendly method for the dual purpose of reducing pesticide pollution and environmental loads from the waste of the silk industry. The findings contribute to the advancement of green water treatment technologies and support the United Nations Sustainable Development Goals, particularly SDG 6 (Clean Water and Sanitation), SDG 12 (Responsible Consumption and Production) and SDG 3 (Good Health and Well-being).

Keywords: Carbaryl, Pesticide removal, Silk industry waste valorization, Sustainable wastewater treatment, Circular economy

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Comprehensive Assessment of Morphological Attributes, Biochemical Parameters, Phytochemical Constituents, and Antioxidant Activities of the Endangered Citrus macrop tera Mont. (Hatkora) from Northeast India

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Abstract

Citrus macroptera Mont locally known as *Hatkora* is grown in wild or semi-wild state in north eastern part of India. The main objective of the study was to examine the morphological characters and biochemical variations within 30 accessions from five different districts of Mizoram. The investigation indicate the wide range of variability in terms of morphological and biochemical parameters of *Hatkora*. Significant differences exists in polymorphic qualitative features such as leaf lamina shape, leaf lamina margin, leaf apex shape, petiole wing shape, fruit shape, fruit apex shape, fruit base shape, seed shape, and colour. Fruit biochemical characteristics, such as TSS, juice pH, ascorbic acid, titratable acidity, total, reducing and non-reducing sugars, phenolics, flavonoids, DPPH, and ABTS activities and fruit quantitative characteristics, such as fruit weight, fruit volume, fruit length, fruit diameter, rind thickness, juice volume, juice percentage, and number of seeds per fruit showed significant differences. To protect these endangered species and guarantee their availability for future usage, breeding programs can benefit from the thorough findings by improving the cultivar and implementing conservation measures. However, further research on molecular variation is suggested for selection of elite genotypes for crop improvement programme.

Keywords: *Citrus macroptera, Hatkora*, morphological variation, biochemical variation, seeding pattern, Mizoram

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Recent Trends in Stage-Specific Microbial Functional Dynamics of Nitrogen Transformation in Intensive Shrimp Farming: A Precision Bioremediation Framework for Sustainable Aquaculture

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Abstract

Intensive culture of Pacific white shrimp (Litopenaeus vannamei) is associated with progressive increases in biomass, feed input, organic loading, and nitrogenous waste generation. Accumulation of ammonia and nitrite remains a major constraint to water quality stability, shrimp health, and sustainable production. Recent trends highlight a paradigm shift toward precision bioremediation in intensive shrimp aquaculture moving from broad-spectrum treatments to targeted microbiome management tailored to specific shrimp growth stages. Although probiotic-based bioremediation is increasingly applied in commercial aquaculture, interventions are commonly based on fixed schedules or general dosage recommendations with limited consideration of culture stage and the functional state of nitrogen-transforming microbial communities. Microbial dynamics can naturally shift from ammonia assimilation in early-stage water columns to highly active nitrification. Stage-specific precision bioremediation framework based on the temporal dynamics of microbial nitrogen transformation useful in intensive shrimp ponds. It will integrate longitudinal monitoring of ammonia, nitrite, nitrate, water quality, sediment characteristics, feed load, and shrimp biomass with microbial community profiling and targeted analysis of nitrogen-cycle functional markers. Stable, ammonia-accumulating, nitrite-accumulating, and recovery states will be characterized to identify microbial functional signatures associated with nitrogen instability. Functionally selected probiotic strains and consortia will subsequently be evaluated under culture-stagespecific environmental and nitrogen-load conditions. The proposed framework aims to shift probiotic management from conventional schedule-based application towards biologically informed intervention based on culture stage, nitrogen load, and microbial functional state. Identification of stage-specific nitrogen transformation patterns may improve the timing and functional selection of probiotic interventions for ammonia and nitrite bioremediation. The study is expected to contribute to precision biological management of intensive shrimp ponds, reduce nitrogen-related production risks, and support environmentally sustainable aquaculture through microbial ecology-based decision strategies.

Keywords: Pacific white shrimp (Litopenaeus vannamei); Nitrogen bioremediation; Microbial functional dynamics; Precision probiotics; Sustainable aquaculture

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Development of Multifunctional Zinc- and Iron-solubilizing Microbial Consortia-based Novel Biostimulants for Enhancing Micronu trient Biofortification, Productivity, and Soil Health in Lentil (*Lens culinaris L.*)

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Abstract

Micronutrient deficiencies, particularly zinc (Zn) and iron (Fe), are major constraints limiting lentil productivity and grain nutritional quality. The present study aimed to develop microbial consortium-based liquid biostimulants to improve Zn and Fe nutrition, crop growth, yield, grain quality, and soil health in lentil (Lens culinaris L.). A total of 127 Zn-solubilizing rhizospheric bacterial isolates, 123 Fe-solubilizing rhizospheric bacterial isolates, and 30 nodule-associated bacterial isolates were isolated and screened for multifunctional plant growth-promoting (PGP) traits. Among the isolates, Rh-ZnSB 38 exhibited the highest Zn-solubilization efficiency, Nd-Isolate 1 was the most efficient nodule-associated Zn solubilizer, and Rh-FeSB 18 showed the highest Fe-solubilization efficiency. Selected isolates, namely Rh-ZnSB 38, Rh-ZnSB 90, Nd-Isolate 1, Rh-FeSB 18, and Rh-FeSB 80, exhibited multiple PGP attributes, including ammonia production, indole-3-acetic acid (IAA) production, gibberellic acid (GA_3) production, and biofilm formation. Based on 16S rRNA gene sequencing, these isolates were identified as *Brevundimonas diminuta* (Rh-ZnSB 38; PX796471), *Paenibacillus populi* (Rh-ZnSB 90; PX796469), *Brevundimonas sp.* (Nd-Isolate 1; PX796470), *Cellulosimicrobium cellulans* (Rh-FeSB 18; OL589187), and *Bacillus pumilus* (Rh-FeSB 80; KY807996). Based on compatibility and functional performance, Zn-solubilizing, Fe-solubilizing, and combined Zn + Fe microbial consortia were developed and formulated as liquid biostimulants using humic acid (0.5–1.0%) and seaweed extract (5–10%) as additives. The formulations were evaluated under pot and field conditions in combination with 50% and 100% recommended doses of fertilizers (RDF). Among the treatments, T22 (10% seaweed extract + Zn- and Fe-solubilizing microbial consortium + 50% recommended NPK + 50% $ZnSO_4$ + 50% $FeSO_4$) exhibited the best overall performance, significantly enhancing plant growth, grain yield, nutrient uptake, and Zn–Fe biofortification compared with the recommended dose of fertilizers (RDF) and other treatments. These findings demonstrate that integrated microbial consortium-based biostimulants, coupled with a 50% reduction in chemical fertilizers and micronutrient inputs, represent a sustainable and effective strategy for enhancing lentil productivity, grain nutritional quality, and soil health.

Keywords: Lentil, microbial consortium, zinc-solubilizing bacteria, siderophore-producing bacteria, seaweed extract, humic acid

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Multi-variate Analysis of Kaempferia galanga L., an Important Medicinal and Aromatic Plant Collected from Western Ghats of India for Rhizome Yield

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Abstract

Kaempferia galanga L., is a glabrous, perennial herb originated from India with potential of medicinal and aromatic properties. Twenty-eight *K. galanga* accessions including 2 checks (Rajani and Kasturi) with 3 replications were subjected to morphological characterization through basic statistics, anova, components of variance and multivariate analysis using 13 important rhizome yield related traits observed during rabi season of two years, 2024-25 and 2025-26 at ICAR-NBPGR RS, Thrissur (using R software). Basic statistical analysis revealed the presence of considerable genetic variation as higher co-efficient of variation (%) for traits viz., total weight of rhizome without nodule (53.78), total weight of rhizome with nodule (51.59), weight of secondary rhizome (45.47), number of leaves plant-1 (40.44) and weight of primary rhizome (37.31). High PCV and GCV values were obtained for total rhizome weight without root-tubers (27.24), weight of secondary rhizome (26.87), total rhizome weight with root-tubers (26.46), weight of primary rhizome (25.25). These traits had also showed high heritability along with high genetic advance as per cent of mean along with number of leaves per plant. Cluster analysis of morphological data based on Euclidean's distance using UPGMA method formed 3 major clusters (I, II and III). Clustering pattern mainly based on six rhizome yield related characters named as weight of secondary rhizome, total rhizome weight without root-tubers, weight of primary rhizome, total rhizome weight with root-tubers, width of primary and secondary rhizome. Two-dimensional scatter plot of principal components analysis revealed the presence of 84.6% of cumulative genetic variation from first three PCs as 64.7, 12.4 and 7.5, respectively. Genotypes with comparable total rhizome weight without root-tubers plant-1 against best check, Kasturi (211.17g) identified as follows: IC582824 (240.56g); IC582790 (240.34g); IC373593 (222.92g); IC550152 (221.99g). Hence, there is urgent need to augment the genetic resources of *K. galanga* by more collections and to know their utilization through biochemical and molecular approaches.

Keywords: *Kaempferia galanga,* Cluster and PCA analysis, Genetic diversity, Rhizome, Medicinal and aromatic plant

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Formulation and Standardization of Pennisetum glaucum (Pearl Millet) based Ready-to-Cook Breakfast Premix

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Abstract

Background & Objectives: The demand for convenient and nutrient-rich foods has increased considerably with changing dietary habits and lifestyles. Pearl millet (Pennisetum glaucum) is a nutrient-dense cereal possessing significant nutritional and functional attributes; however, its utilization in ready-to-cook convenience foods remains limited. This study aimed to formulate and standardize a ready-to-cook breakfast premix using Pennisetum glaucum (pearl millet), evaluate its storage stability, and analyse the nutritional composition of the selected standardized product.
Materials & Methods: Pearl millet grains were processed adequately to reduce phytate content and enhance flavour and shelf stability. Five ready-to-cook breakfast recipes were formulated using premix done by blending roasted pearl millet with selected food ingredients and traditional spice mixes. The premix was standardized and assessed for shelf-life under ambient storage conditions. Sensory assessment was performed by 25 semi-trained panel members using 9-point hedonic scale. The product with the highest overall acceptability was selected for nutritional analysis. Proximate composition was determined according to AOAC methods, and zinc and selenium contents were quantified using AAS.
Results: The standardized breakfast premix exhibited desirable storage stability and was used to prepare different traditional breakfast recipes. Among the prepared recipes, Adai received the highest sensory acceptability scores. The standardized premix provided 18.1% of the daily energy requirement for a moderately active adult female, 28.3% of protein, 44.9% of carbohydrates, 21.6% of fat, 48.9% of dietary fibre, 44.3% of zinc, and 68.4% of selenium requirements per 100 g.
Conclusion: The study highlights the potential of pearl millet as a key ingredient of the nutritious ready to cook food. It becomes an evidence-based support for the wider utilization through value addition and offering consumers healthier instant breakfast options.

Keywords: Pearl millet (Pennisetum glaucum), ready-to-cook breakfast premix, value addition, sensory evaluation, storage stability, nutritional composition.

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Collection and Evaluation of Athalakkai (Momordica cymbalaria Hook F.) Genotypes for Higher Yield and Productivity

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Abstract

Athalakkai (*Momordica cymbalaria* Hook F.) is a perennial herbaceous climber found in parts of Southern India. It resembles bitter gourd in morphology and belongs to the family Cucurbitaceae. Athalakkai classified as an underutilized vegetable and it is widely distributed in the tropical regions of Africa and India. It is distributed across several Indian states, including Tamil Nadu (Virudhunagar, Madurai, Theni, Dindigul, Tuticorin, Ramanathapuram), Andhra Pradesh, Karnataka, West Bengal, Maharashtra and Madhya Pradesh. The vegetables are available in the market during November and December (on season) and off-season fruits are available during June-July every year. The present study entitled "Collection and evaluation of athalakka (*Momordica cymbalaria*) genotypes for higher yield and productivity was carried out at College Orchard, Department of Horticulture, Agricultural College and Research Institute, Madurai during 2025 with the aim of identifying high yielding athalakkai genotypes suitable for commercial cultivation in Southern districts of Tamil Nadu. The study was laid out in a Randomized Block Design (RBD) with 30 genotypes and replicated twice. The datas analysed statistically. Results showed significant variations in the mean performance of 30 athalakkai genotypes for various traits, indicating substantial genetic diversity and high breeding potential within the germplasm. The present study results revealed that among the genotypes MC2 recorded the highest values in growth, yield and quality characters. MC registered the highest values in days to first flowering (18.5 days), vine length (125.67 cm), number of vines per plant (867), number of fruits per vine (12.3), fruit length (4.91 cm), fruit girth (3.76 cm), fruit weight (0.93 g), number of fruits per plant (71.67), fruit yield per plant (57.1 g/plant) followed by Vilathikulam local (MC 28). However, Chittur local (MC 14) registered the lowest values in all the traits. Regarding quality traits, Pudupatti local (MC 2) exhibited the highest values in vitamin C (289.00 mg/100 g), protein (2/15 mg/100 g) and crude fibre content (6.4 g) whereas Chittur local (MC 14) observed the lowest values. The present study it was concluded that MC 2 performing better under Madurai condition and need further evaluation.

Keywords: Athalakkai, *Momordica cymbalaria,* genotypes, evaluation, yield and quality.

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Marine-Derived Multi-Target Inhibitors Against Drug-Resistant Mycobacterium tuberculosis: An Integrated in silico Screening and Molecular Docking Approach

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Abstract

Tuberculosis (TB), caused by *Mycobacterium tuberculosis,* remains a major global health threat, with the emergence of drug-resistant strains highlighting the need for novel antitubercular agents. Marine natural products, known for their structural diversity and unique bioactivities, offer a promising yet underexplored source for drug discovery. This study used an in-silico approach to screen marine-derived compounds as potential inhibitors of three key *M. tuberculosis* targets — KasA, InhA, and EmbB — including their drug-resistant mutant forms. A library of 127 marine compounds was evaluated for drug-likeness and predicted toxicity, and molecular docking was performed using AutoDock Vina to assess binding affinities and interactions with both wild-type and mutated targets. Several compounds showed strong binding affinities (≤ −7 kcal/mol): Luffariellin and Isobatzelline E for KasA, Xanalteric acid II for EmbB, and Isobatzelline E and Callystatin A for InhA. Fiscpropionate F exhibited the highest binding affinity toward KasA (−12.14 kcal/mol), EmbB (−11.08 kcal/mol), and InhA (−8.62 kcal/mol). Key interactions were largely retained in mutated proteins, suggesting potential efficacy against resistant strains. These findings suggest that marine-derived natural products, particularly Fiscpropionate F, are promising multi-target candidates for combating drug-resistant tuberculosis and warrant further validation through molecular dynamics simulations and experimental studies.

Keywords: Tuberculosis, *Mycobacterium tuberculosis*, Marine natural products, Molecular docking, Drug discovery

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Valorization of Underutilized Cowpea through Sprouting for Functional Aquafaba Production

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Abstract

Aquafaba, the liquid obtained after cooking legumes, has emerged as a multifunctional plant-based egg substitute because of its unique functional properties. This study investigates the impact of sprouting on the extraction yield, biochemical, and techno-functional properties of aquafaba derived from sprouted legumes. Response surface methodology (RSM-BBD) was used to determine the optimal extraction ratio, including 36 hours of sprouting, a 1:2.5 seed-to-water ratio, and a 10-minute cooking time. These optimized conditions were used for the comparative analysis between two cooking methods, such as stove-top boiling (ST) and pressure-cooking (PC) of sprouted (ST-S, PC-S) and unsprouted (ST-US, PC-US) cowpea AQ, assessing its physical and optical properties. The study also measured foaming, emulsifying, biochemical, and anti-nutritional properties to evaluate techno-functional characteristics. Results showed that sprouting significantly enhanced protein content (1.68±0.04 mg/mL), total phenolic content (5.29±0.2 mg GAE/mL), and exhibited an antioxidant capacity of 89.76 ± 0.03%. Similarly, Foaming capacity and stability increased by 9.9% and 13%, respectively, and lowered foam density (0.218±0.07). It also maintained a lower foam drainage volume of 9.3%. Emulsion activity improved for PC-S (88.1 ±0.02%), along with reduced turbidity (84.8±0.01%) compared with ST-S. Additionally, anti-nutritional factors are likely altered by the synergistic effects of pressure-cooking and the sprouting process, as reported for saponin (2.945 ± 0.002 mg DE/g), Tannin content (0.821 ± 0.005 mg TAE/g), and phytic acid content (7.95 ±0.004 mg/g). These findings collectively confirm the potential of pressure-cooked sprouted cowpea AQ in vegan food applications.

Keywords: Egg-alternative, Food waste valorization, Functional properties, Legume cooking water, Vegan.

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Atmospheric Cold Plasma as a Sustainable Approach for Enhancing the Quality of Palmyra Sprout (Borassus flabellifer) Flour

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Abstract

Palmyra sprout (*Borassus flabellifer*) flour is a nutrient-rich underutilized food material whose utilization is limited by the presence of antinutritional factors and poor functional properties. This study investigated the effect of atmospheric cold plasma treatment on the nutritional, functional, bioactive, antinutritional, and structural properties of palmyra sprout flour. Flour samples were treated at 10, 20, and 30 kV for 10, 15, and 20 min, while untreated and treated samples were analyzed for proximate composition, functional properties, total phenolic content, total flavonoid content, antioxidant activity, tannin and saponin contents, and structural characteristics using FTIR, XRD, and SEM. Cold plasma treatment caused only minor changes in proximate composition, indicating that the nutritional quality of the flour was largely preserved. Significant improvements were observed in water absorption capacity, foaming capacity, and foaming stability due to plasma-induced structural modifications. Tannin and saponin contents were reduced from 260.00 to 114.05 mg/g and 3.229 to 1.207 mg/g, respectively. However, prolonged plasma exposure resulted in a decline in total phenolic content, total flavonoid content, and antioxidant activity. Structural analyses confirmed disruption of hydrogen bonding, increased surface porosity, and a reduction in relative crystallinity from 46.13% to 35.96%. Among the treatments, 30 kV for 15 min was identified as the optimum condition, providing the best balance between improved functional properties, reduced antinutritional factors, and preservation of nutritional quality. The results demonstrate that atmospheric cold plasma is a promising non-thermal technology for enhancing the quality and application potential of palmyra sprout flour in functional food formulations.

Keywords: Atmospheric cold plasma; Borassus flabellifer; Functional properties; Antinutritional factors; Structural characterization

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Antidiabetic and Hematinic Potential of Millet-Based Rice Analogue in Streptozotocin-Induced Diabetic Rats

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Abstract

The present study investigated the antidiabetic and hematinic potential of a millet-based rice analogue (MBRA) in streptozotocin (STZ)-induced diabetic Wistar albino rats. Diabetes was induced using STZ (50 mg/kg body weight), and animals were divided into five groups, namely normal control (G1), diabetic control (G2), STZ + white rice (G3), STZ + metformin (G4), and STZ + MBRA (G5). MBRA was supplemented at 20 g/day, and its effects on body weight, urinary glucose, serum biochemical parameters, haematological indices, and pancreatic histopathology were evaluated. MBRA feeding significantly improved metabolic and haematological status compared to the diabetic control group ($p < 0.05$). The MBRA-treated group exhibited the highest body weight gain (130.76 ± 5.81 g), indicating improved nutrient utilization and metabolic recovery. Urinary reducing sugar levels were reduced in G5 (0.43 ± 0.03 mg/dL) compared with the diabetic control (3.06 ± 0.07 mg/dL), demonstrating effective glycemic regulation. Similarly, serum reducing sugar levels decreased substantially, while serum iron content increased to 321.73 ± 1.23 µg/dL, suggesting significant hematinic benefits. Haematological analysis revealed that MBRA maintained red blood cell count, haemoglobin, and haematocrit levels comparable to the standard treatment group and improved platelet counts toward normal values. Histopathological examination of pancreatic tissues showed preservation of pancreatic architecture, reduced degeneration of islets of Langerhans, minimal vascular congestion, and lower inflammatory cell infiltration in MBRA-treated rats. Overall, MBRA demonstrated significant antidiabetic, hematopoietic, and pancreatic protective effects, yielding superior outcomes relative to the white rice control and showing efficacy comparable to or greater than metformin in several parameters. These findings suggest that MBRA has strong potential as a functional food for the dietary management of diabetes and associated iron-deficiency anaemia.

Keywords: Millet-based rice analogue; Diabetes mellitus; Iron-deficiency anemia; Functional food; Haematological parameters; Streptozotocin; Pancreatic histopathology.

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Drying-Induced Changes in Texture, Color, and Nutritional Quality of Winged Bean Seeds Using Experimental Modeling and ANN-GA

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Abstract

Winged bean (*Psophocarpus tetragonolobus)* is a protein-rich, climate-resilient legume with potential as a sustainable alternative to soybean. This study evaluated the effects of hot-air drying (40°C to 60°C) on winged bean (WB) seeds' drying kinetics, nutritional composition, and functional quality, supported by thin-layer modeling and ANN-GA prediction. Moisture removal followed the falling-rate period, best described by the Logarithmic and Page models, with an activation energy of 31.6 kJ/mol. Increasing temperature reduced drying time and residual moisture (<6%) without major losses in protein (33%), fat (21%), or carbohydrate (36%) content. Total phenolic content, total flavonoid content, and antioxidant activity found to be increased with increase in temperature. On the other hand, tannins, saponins, and phytic acid decreased significantly. The ANN-GA model achieved high predictive accuracy (R2 > 0.99). Overall, drying at 50 °C found to have balanced efficiency, bioactive enhancement, and color stability. These findings highlight potential of WB seed as a functional, nutrient-rich, and sustainable legume for plant-based food applications.

Keywords: Winged Bean, Drying Kinetics, Legume, Texture Profile, ANN-GA, Modeling

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Harnessing Zinc Solubilizing Bacteria for Sustainable Zinc Nutrition in Blackgram

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Abstract

Zinc (Zn) is an essential micronutrient involved in enzymatic activities, protein synthesis, and several physiological and metabolic processes that regulate plant growth and development. Zinc deficiency affects nearly 50% of the world's arable soils, resulting in reduced crop productivity and poor nutritional quality of food crops (Gangadhar Sethi *et al.*, 2025). This deficiency also contributes to human malnutrition, particularly in populations dependent on plant-based diets. Therefore, sustainable approaches to improve zinc availability and uptake are essential. Zinc Solubilizing Bacteria (ZSB) offer an eco-friendly solution by converting insoluble forms of zinc into plant-available forms through biological processes, thereby enhancing nutrient availability, soil fertility, and zinc use efficiency while reducing dependence on chemical fertilizers (Haroon *et al.* 2022). A field experiment was conducted during rabi 2025 at Kuppepalayam village, Coimbatore district, to evaluate the effect of Zinc Solubilizing Bacteria with and without zinc sulphate on the growth, productivity, and zinc uptake of blackgram. The experiment consisted of five treatments: absolute control, recommended dose of fertilizers (RDF), RDF + 25 kg $ZnSO_4$ ha^{-1}, RDF + 12.5 kg $ZnSO_4$ ha^{-1} + Zinc Solubilizing Bacteria (2 kg ha^{-1}), and RDF + Zinc Solubilizing Bacteria (2 kg ha^{-1}). The growth and yield attributes of blackgram were recorded at harvest stage and results revealed that application of 12.5 kg of zinc sulphate along with recommended NPK fertilizer dose and zinc solubilising bacteria @ 2 kg ha-1 significantly improved the growth and yield attributes of blackgram over control. Plant height increased substantially with treatment levels and ranged from 21.6 to 38.6 cm. The yield attributes such as number of pods per plant, number of seeds per pod and 100 seed weight varied from 31.1 to 95.3, 4.01 to 7.63 and 4.8 to 6.2 g, respectively. Higher grain yield of 1112 kg ha-1 and total zinc uptake of 77.1 g ha-1 was recorded with RDF + 12.5 kg $ZnSO_4$ ha-1 + soil application of Zinc Solubilising Bacteria @ 2 kg ha-1, which was significantly superior to all other treatments. Hence, this study demonstrates that integrating Zinc Solubilizing Bacteria with a reduced dose of zinc sulphate enhances zinc uptake and crop productivity, providing a sustainable strategy for blackgram cultivation while reducing the requirement for inorganic zinc fertilizers.

Keywords: Zinc, Zinc Sulphate (ZnSO4), Zinc Solubilizing Bacteria (ZSB), Zinc uptake and Blackgram.

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Germination Led Enhancement in Nutritional Properties of Proso Millet

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Abstract

Proso millet (PM), one of the millets is known to possess a high protein and bioactive content. However, it also does hold a good amount of anti-nutrient content (ANC) like tannin, saponin, and phytic acid. Which along with impeding the digestibility of protein, starch and minerals, add bitter tastes to the food. Germination, a traditional bioprocess technique aids in decreasing the ANC. Germination of PM was carried out at different times (24, 48, 72 h) and temperatures (20, 25, 30°C). The total polyphenol and flavonoids content was found to range from 1.2 ± 0.11 to 2.84 ± 0.03 mg GAE/g DW and 183.04 ± 35.6 to 388.66 ± 6.96 µg QE/g DW, respectively. In a similar fashion DPPH radical scavenging and FRAP activity ranged between 0.35 ± 0.012 to 0.46 ± 0.012% and 570 ± 53.90 and 3025 ± 75.78 µg AAE/g DW. There was a rise in protein and free amino acid content with increasing germination period and temperature from 19.99 ± 0.19 to 35.08 ± 2.17 mg BSAE/g DW and 3.25 ± 1.74 to 12.81 ± 13.1 mg LE/g DW, respectively. Owing to a decrease in the ANCs like tannin, saponin and phytic acid from 715.66 ± 66.59 to 503.84 ± 33.29 mg TAE/g DW, from 147.78 ± 7.75 to 88.69 ± 4.09 µg DE/g DW, and from 7.51 ± 0.10 to 6.05 ± 0.06 mg/g DW. Besides the decrease in ANCs, there was a decrease in starch content from 73.33 ± 2.5 to 57.83 ± 3.14 mg/g DW and a simultaneous increase in reducing sugar from 17.03 ± 0.66 to 139.28 ± 22.84 µg GE/g DW due to increased enzyme activity during germination. The rise in bioactive compounds led to increased antidiabetic potential by increasing % α-amylase inhibition capacity from 86.27 ± 19.41 to 134.91 ± 58.39.

Keywords: Germination; Proso Millet; Antidiabetic Potential; Bioactive Compounds; Antinutrient; Bioprocessing

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Assessing the Contribution of Indigenous Cattle to Livelihood Security of Farmers in Karnataka

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Abstract

Indigenous cattle are playing important role in nutritional security due to presence A2 allele of beta casein as compared to exotic cattle reducing the chances of metabolic disorders like diabetes, heart diseases etc. To analyze the contribution of indigenous vs. crossbred cattle in the nutritional security of farmers including soil nutrients, the study was carried out in three districts of southern Karnataka based on higher population of indigenous cattle i.e. Hallikar, Malnad Gidda and Amritmahal. From each district, two taluks and from each taluk, a cluster of three villages were selected based on indigenous cattle population. From each cluster of villages, 20 households owning indigenous and crossbred cattle were randomly selected, making the total sample size of 120 farm households. Data was collected through semi-structured interview schedule. The study revealed that the sample households had less number of milking indigenous cattle (1.56) as compared to crossbred cattle (1.98). In all the cases, indigenous cattle were producing less milk (2.76 L/day/anim.) as compared to crossbred cattle (7.33 L/day/anim.). Net return/anim./day was Rs.11.29 in case of indigenous cattle as compared to Rs. 64.81 in case of crossbred cattle. Without considering cost of fodder, Net return/anim./day was Rs.54.59 in case of indigenous cattle as compared to Rs. 118 in case of crossbred cattle. However, milk nourishment to the family (L/day) was more in case of indigenous cattle as compared to crossbred cattle. Protein, fat and calcium nourishment per animal to the family gm/day was less in case of crossbred cattle (3.07, 3.93 & 0.11, resp.) as compared to indigenous cattle (52.56, 67.34 & 1.97, resp.). Dung production (Kg/day/anim.) was less in case of indigenous cattle as compared to crossbred cattle. Nutrients to farm i.e. NPK kg/year/animal was more in case of crossbred cattle (73.58, 36.79 & 147.17, resp.) as compared to indigenous cattle (54.39, 27.19 & 108.77, resp.). The indigenous breed wise contribution also calculated.

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Valorisation of Peanut-Based Milk Analogue By-Products for Sustainable Food Product Development

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Abstract

The valorisation of by-products generated during peanut (Arachis hypogaea L.) plant-based milk processing represents a sustainable strategy for enhancing resource efficiency and advancing nutrition security. Peanut milk is a nutrient-rich plant based milk analogue owing to its high-quality proteins, unsaturated fatty acids, vitamins, and bioactive compounds. However, its processing generates substantial quantities of by-products, including peanut okara and liquid residue, which remain largely underutilized despite their significant nutritional and functional potential.

This study explores the utilization of peanut milk processing by-products as value-added ingredients for the development of sustainable food products. Comprehensive characterization revealed that peanut okara is a rich source of dietary fibre, protein, and bioactive phytochemicals, while the liquid residue contains considerable levels of protein. These by-products show promising nutritional properties, making them suitable for incorporation into a range of food formulations to enhance their nutritional quality and functional performance.

Furthermore, peanut milk by-products can serve as sources of functional food ingredients, including dietary fibre and protein concentrates, thereby contributing to the development of nutritious, plant-based food products. Their incorporation into human diets offers an effective approach to improving protein and healthy fat intake while simultaneously reducing food processing waste.

The valorisation of peanut milk processing by-products aligns with the principles of the circular bioeconomy by promoting waste minimization, resource recovery, and sustainable food production. This approach not only addresses environmental concerns associated with agro-industrial by-products but also supports the development of innovative, nutrient-dense, plant-based foods. Overall, the study demonstrates that the efficient utilization of peanut milk processing by-products represents a viable strategy for sustainable food product development, improved nutrition security, and enhanced environmental sustainability.

Keywords: by-product utilization, plant based milk analogue, sustainable food product.

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Artificial Intelligence and Sustainable Consumer Behaviour for Reducing House hold Food Waste

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Abstract

Household food waste has become a critical global sustainability challenge, with theUnited-Nations Food Waste Index estimating that over 1 billion tonnes of food are wastedannually-at the retail, food service, and household levels. Households account for the largest share-ofthis waste, leading to substantial economic losses, unnecessary consumption of water, energy, and land resources, and increased greenhouse gas emissions that accelerateclimate change. Recent research indicates that consumer behaviour—includingimpulsivepurchas-ing, inadequate meal planning, improper food storage, and misunderstandingoffood date labels—is a major driver of avoidable household food waste. Artificial Intelligence(AI) has emerged as a promising tool for addressing these challenges through smart foodinvento-ry management, expiry-date prediction, personalized shopping recommendations, demand forecasting, waste tracking, and intelligent recipe suggestions usingavailableingredients. This review synthesizes recent evidence on integrating AI-enabledtechnologies with sustain-able consumer practices, including responsible purchasing, portion planning, effective food storage, leftover utilization, and consumer awareness, toimprove household resource man-agement. It also discusses implementation challengessuch as digital accessibility, affordabil-ity, user acceptance, and data privacywhilehighlighting opportunities for interdisciplinary research and policy support. Integrating AI with sustainable consumer behaviour can sub-stantially reduce household foodwaste, enhance resource efficiency, strengthen food securi-ty, and contribute to achievingtheSustainable Development Goals, particularly SDG 2 (Zero Hunger), SDG12 (ResponsibleConsumption and Production), and SDG 13 (Climate Action).

Nearly one-third of food produced worldwide is lost or wasted, contributing to green-housegas emissions, inefficient resource utilization and food insecurity. The study con-cludesthatintegrating Artificial Intelligence with sustainable consumer behaviour can sig-nificantly reduce household food waste, enhance resource efficiency, strengthen food securityandcontribute to climate-resilient and environmentally sustainable communities.

Keywords: Artificial Intelligence; Household Food Waste; Sustainable Consumer Behaviour; ResourceManagement; Food Security

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Deep Learning-Based Detection and Classification of Mango Leaf Diseases Using AlexNet for Precision Agriculture

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Abstract

Mango (Mangifera indica L.), widely known as the "King of Fruits," is one of the most economically important fruit crops cultivated across tropical and subtropical regions. However, the productivity and quality of mango are severely affected by various foliar diseases, including anthracnose, bacterial canker, powdery mildew, sooty mould, and dieback. Early and accurate identification of these diseases is essential to minimize crop losses, improve fruit quality, and reduce indiscriminate pesticide application. Conventional disease diagnosis based on visual inspection is often time-consuming, subjective, and dependent on expert knowledge, making it unsuitable for large-scale field applications. Recent advances in artificial intelligence, particularly deep learning, provide an effective solution for automated disease diagnosis through image-based classification.The present study proposes a deep learning-based framework using the AlexNet convolutional neural network (CNN) architecture for automatic detection and classification of mango leaf diseases. A publicly available Kaggle MangoleafBD dataset consisting of 1,500 images representing six classes, namely healthy leaves, anthracnose, bacterial canker, powdery mildew, sooty mould, and dieback, was utilized for model development. Each class contained 250 images, and the dataset was randomly divided into 70% training images and 30% testing images. Prior to model training, image preprocessing was performed using adaptive histogram equalization to enhance image contrast and improve feature visibility. The images were resized to match the AlexNet input dimension (227 × 227 × 3 pixels), and data augmentation techniques, including rotation and zooming, were applied to improve model generalization. Transfer learning was employed using the pre-trained AlexNet model to extract discriminative features from mango leaf images. Feature extraction was investigated using two different network layers, namely the conv1 layer and the pool5 layer, to evaluate their influence on classification performance. The extracted deep features were subsequently used to train the classifier, and model performance was evaluated using testing images and confusion matrix analysis. Comparative analysis demonstrated that the model utilizing features extracted from the conv1 layer achieved an overall classification accuracy of 72.9%, whereas the pool5 layer significantly improved classification accuracy to 98.4%. The superior performance of the pool5 layer is attributed to its ability to capture more abstract and discriminative image features through deeper convolutional representations. The developed model substantially outperformed conventional machine learning techniques reported in previous studies, including Artificial Neural Networks (62%) and K-Nearest Neighbour (66%) classifiers.

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The high classification accuracy achieved by the proposed AlexNet-based model demonstrates the effectiveness of deep convolutional neural networks for automated mango disease diagnosis. The system provides rapid, reliable, and non-destructive identification of major mango leaf diseases, thereby supporting timely disease management decisions and reducing dependence on manual diagnosis. The proposed framework has considerable potential for integration into mobile applications, smart farming systems, and precision agriculture platforms to assist farmers, extension personnel, and researchers in real-time disease monitoring. Such automated disease detection systems can facilitate early intervention, reduce unnecessary pesticide applications, lower production costs, and enhance sustainable mango cultivation. Future research may focus on expanding the dataset with field-acquired images, incorporating additional disease classes under varying environmental conditions, and deploying lightweight deep learning architectures for real-time mobile and edge computing applications. The study demonstrates that transfer learning using AlexNet offers an efficient and practical solution for intelligent mango disease detection, contributing to sustainable crop production and improved agricultural productivity.

Keywords: Mango leaf disease; Deep learning; AlexNet; Convolutional Neural Network (CNN); Transfer learning; Precision agriculture; Plant disease detection; Computer vision; Image classification; Artificial intelligence.

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Genetics Analysis of Drought Tolerance in Rice (Oryza sativa)

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Abstract

A study involving 81 rice genotypes was conducted to assess genetic variability, yield performance, and drought tolerance. Significant variation was observed for all morphological, seedling, and root traits, indicating the presence of substantial genetic diversity. Genotypes KRG 47, KRG 29, and KRG 51 exhibited superior performance for yield and yield-contributing traits, while KRG 2, KRG 45, and KRG 51 showed promising drought tolerance through enhanced root growth and seedling vigour under 15% PEG-induced stress. High heritability coupled with high genetic advance for all traits suggested the predominance of additive gene action and the effectiveness of selection. Correlation analysis identified productive tillers, 100-seed weight, flag leaf width, grains per panicle, and panicle length as important traits influencing yield. Mahalanobis D^2 analysis grouped the genotypes into seven clusters, with KRG 7, KRG 61, and KRG 63 identified as genetically diverse parents suitable for hybridization. The study identified valuable genotypes for use in breeding programmes aimed at developing high-yielding and drought-resilient rice varieties.

Keywords: Rice genotypes, Genetic variability, Grain yield, Yield-contributing traits, Drought tolerance, PEG-6000 stress, Seedling vigour, Root traits, Heritability, Genetic advance, Correlation analysis, Mahalanobis D^2 analysis, Genetic divergence, Cluster analysis, Rice breeding, Drought-resilient varieties.

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In vitro Screening and Biochemical Profiling of Green and Red Chilli Fruits Challenged by *Colletotrichum capsici*

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Abstract

Anthracnose, caused by *Colletotrichum capsici*, remains a formidable constraint on chilli (*Capsicum annum L.*) production and the most economically significant damage is observed on mature fruits during the pre- and post-harvest stages, directly impacting marketability and yield. In this study, thirty green and red chilli genotypes were systematically evaluated under controlled conditions using an *in vitro* detached fruit assay to decipher resistance responses against the pathogen. Disease severity was assessed across multiple time points, revealing notable genotypic variation. Green chilli genotypes such as Bhavigva-F1 and ARD-5533-F1 showed heightened susceptibility, characterized by rapid lesion expansion and elevated Percent Disease Index (PDI), while entries like Akhanda-23-F1, SVHA 1049 and SVHA 2222 exhibited delayed symptom progression and comparatively lower PDIs. In red fruits, Bhavigva-F1, ARD-5533-F1, Meenakshi-F1 and ARD-2343 showed highly susceptibility (HS), characterized by rapid lesion expansion and elevated Percent Disease Index (PDI). Multivariate analysis, including Principal Compound Analysis (PCA) further highlighted the distinct pathological profiling of tested genotypes. Complementary biochemical profiling at four days post-inoculation identified significant difference in the accumulation of total phenols, soluble sugars, reducing sugars and proteins. Notably, Biochemical profiling showed that Moderately susceptible genotypes maintained higher TSS, TRS, phenols and proteins, supporting stronger defensive metabolism, whereas HS genotypes exhibited rapid depletion. Together, these insights not only affirm the existence of valuable genetic variability for anthracnose resistance in chilli but also emphasize the utility of integrating biochemical markers with phenotypic screening. The development and deployment of resistant cultivars is widely regarded as the most economically viable and environmentally sustainable approach.

Keywords: Anthracnose; chilli genotypes; PDI; Disease severity; Biochemical

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Development of Cowpea (*Vigna unguiculata*) Cookies as a Prebiotic Food Product for Gut Health

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Abstract

Background: Increasing awareness about gut health has led to a rise in demand for functional foods containing natural prebiotic content. Cowpea (*Vigna unguiculata*), which is an underutilized climate-resilient legume with high amounts of fibre, resistant starch, galacto-oligosaccharides, and polyphenolic compounds, will selectively stimulate the growth of beneficial species in the gut. The production of prebiotic food products from cowpea is a sustainable approach that will help improve gut health.

Objective: To develop and formulate cowpea-based prebiotic cookies and assess the nutritional value, sensory properties, and functional characteristics of the developed product.

Methodology: Cowpea flour was used to prepare cookies using standardized processing techniques. The cookies produced were then analyzed in terms of their nutritive value and sensory acceptability through trained and semi-trained panel members. For product preparation, the formulation was designed to retain the inherent prebiotic potential of cowpea while preserving its desired organoleptic and physicochemical qualities.

Results: The developed Cowpea Cookies exhibited high sensory acceptance with taste, texture, and overall acceptability. 100g of Cowpea cookies provides 22% of the energy, 39% of the protein, 20% of the carbohydrate, 18% of the fat, and 49% of the fiber requirement of the RDA for the reference adult.

Conclusion: Cowpea Cookies are not commonly available in the local market and offer a convenient source of prebiotics for daily consumption that strengthens gut-barrier function, enhances immune function, reduces inflammation, and improves overall well-being.

Keywords: Gut dysbiosis; Prebiotic; Short Chain Fatty Acids; Resistant starch; Galacto-oligosaccharides

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Calibration and Validation of CERES-Maize Model for Hybrid Maize under Varied Irrigation and Nitrogen Levels

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Abstract

A field experiment was conducted at ZARS, V. C. Farm, Mandya during Rabi-2024 on "Calibration and validation of CERES-maize model for hybrid maize under varied irrigation and nitrogen levels". The experiment was laid out in split plot design with two irrigation levels as main plot and five nitrogen levels as sub plot, replicated thrice. Among irrigation levels, IW/CPE = 1.0 (I2) recorded higher plant height (159.07 cm), Leaf area index (LAI) (2.41), Total dry matter production (TDM) (285.51 g plant-1), kernel (5845 kg ha-1) and stover yield (8984 kg ha-1), but was at par with IW/CPE = 0.8 (I1). Among nitrogen levels, plant height (200.41 cm), LAI (3.56), TDM (357.36 g plant-1), kernel (8102 kg ha-1) and stover yield (11,180 kg ha-1) were significantly higher in 125% (N5), and was at par with 100% RDN (N4). CERES-Maize model was calibrated and validated by using data collected from the field experiments. The model satisfactorily predicted the TDM, LAI, number of kernels cob-1, 100 seed weight, cob length, kernel and stover yield with RMSE of 40.52 g plant-1, 0.65, 52.90, 2.03 g, 1.11 cm, 508.46 and 1150.80 kg ha-1, respectively. The higher net returns (Rs. 1,49,806 ha-1) and B:C ratio (3.44) was recorded in I1N5 and I1N4, respectively. Hence, it is inferred that the CERES-Maize model was successfully validated for irrigation and nitrogen levels in Cauvery Command Area of Karnataka with model efficiency of 96% and hence, model can be used as a tool for strategic decisions.

Keywords: CERES-maize model, IW/CPE, nitrogen level, hybrid maize, Model calibration and validation

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Diversity in Immune Response between Avian Species following Newcastle Disease Virus Infection

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Abstract

Newcastle disease virus (NDV) is a major avian pathogen responsible for significant economic losses in the global poultry industry. Differences in disease susceptibility between chicken and Japanese quail suggest the existence of species-specific immune regulatory mechanisms. The present study employed a network-based transcriptomic re-analysis to identify oppositely regulated immune genes between the two species following NDV infection. Publicly available RNA-Seq datasets representing mock-infected and NDV-infected (2K3 velogenic and LaSota lentogenic strains) chicken and Japanese quail samples were analyzed using the Galaxy Europe platform. Following sequence alignment using HISAT2 and gene quantification using featureCounts, a total of 121 genes exhibiting opposite expression patterns between the two species were identified. Of these, 89 genes were successfully annotated and subjected to Gene Ontology (GO), Kyoto Encyclopedia of Genes and Genomes (KEGG), and protein–protein interaction (PPI) network analyses using ShinyGO and STRING databases. GO enrichment analysis revealed significant enrichment of defense response (FDR = 2.10×10^{-7}), immune response (FDR = 3.51×10^{-5}), inflammatory response (FDR = 7.47×10^{-5}) and cytokine-related biological processes. KEGG analysis identified the cytokine–cytokine receptor interaction, Influenza A, phagosome and Salmonella infection pathways as significantly enriched. PPI network analysis revealed IL6, IL8L1, ACOD1, SOCS1, SOCS3, CCL19, IFNG, IL18, IL4I1 and IL22RA2 as major hub genes, These hub genes were consistently upregulated in chicken but downregulated in Japanese quail following NDV infection. These findings suggest species-specific regulation of immune signaling pathways that may underlie differences in NDV susceptibility.

Keywords: Newcastle disease virus, Chicken, Japanese quail, STRING, Hub genes, Cytokine signaling.

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Harnessing Halophyte-Associated Endophytic Bacteria for Developing Stress-Resilient Microbial Consortia

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Abstract

Endophytic bacteria isolated from halophytes of the Tuticorin Salt Pan represent a valuable source of stress-resilient Plant Growth-Promoting Rhizobacteria (PGPR) for sustainable agriculture. In this study, 25 endophytic bacterial isolates were screened for abiotic stress tolerance, plant growth-promoting traits, antimicrobial activity, extracellular enzyme production, and compatibility for microbial consortium development. Several isolates exhibited high tolerance to salinity (up to 10% NaCl), a broad pH range (5–9), and moderate osmotic stress (5–10% PEG). The isolates also demonstrated multiple PGP attributes, including indole-3-acetic acid, acetoin and ammonia production, nitrogen fixation, phosphate and zinc solubilization, siderophore production, and ACC deaminase activity. Selected isolates exhibited antagonistic activity against the phytopathogen *Pseudomonas syringae* and produced extracellular hydrolytic enzymes, including amylase, lipase, and protease. Based on their complementary functional traits, compatible isolates were assembled into a microbial consortium. Seed bioassays using *Vigna mungo L.* (black gram) demonstrated enhanced germination and seedling vigor following treatment with a 0.5% consortium inoculum, highlighting its potential as a sustainable bioinoculant for improving crop performance under stress conditions.

Keywords: Endophytic bacteria, Halophytes, Abiotic stress tolerance, Bioinoculant

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Assessment of fodder preference in Mecheri Lambs offered different forms of Sesbania aculeata and Crotalaria juncea Using a Cafeteria Feeding System

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Abstract

The present study evaluated the fodder preference and feeding behaviour of Mecheri lambs offered different physical forms of Dhaincha (Sesbania aculeata) and Sunnhemp (Crotalaria juncea) under a cafeteria feeding system. Twenty weaned Mecheri lambs were randomly assigned to two treatment groups: T1 (Dhaincha) and T2 (Sunnhemp). A 22 day cafeteria trial, including a 7 days adaptation period, was conducted at the Livestock Farm Complex, Veterinary College and Research Institute, Namakkal, during February to March 2025. Lambs were simultaneously offered fresh, wilted and dried forms of the respective fodders and feeding behaviour was recorded during the first 30 minutes after feeding. Wilted Dhaincha received significantly ($P < 0.01$) more feeding attempts (6.77 ± 0.31) than the dried form (0.10 ± 0.07), whereas fresh Sunnhemp recorded the highest feeding attempts (5.80 ± 0.44). Bite rate was highest for fresh fodder (57.50 ± 0.12 and 57.27 ± 0.18 bites/min for Dhaincha and Sunnhemp, respectively) and lowest for dried fodder. Feeding bout duration was longest for wilted Dhaincha (28.77 ± 0.62 min) and fresh Sunnhemp (27.27 ± 1.27 min). Fresh fodder also resulted in the highest voluntary intake (6.51 and 6.27 kg/day for Dhaincha and Sunnhemp, respectively) and greater body weight gain compared with dried fodder. The findings demonstrate that the cafeteria feeding system effectively identifies fodder preference in Mecheri lambs. Fresh and wilted forms of Sesbania aculeata and Crotalaria juncea were consistently preferred over dried forms, leading to higher voluntary intake, favourable feeding behaviour and improved growth performance. These non conventional protein rich legumes have considerable potential as sustainable forage resources for sheep production.

Keywords: Fodder preference, Feeding behaviour, Non conventional fodder, Growth performance

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Geospatial Intelligence for Predicting Water borne Pesticide Toxicity in Orathanadu: A One Health Approach

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Abstract

Intensive organophosphate (OP) pesticide use in the paddy-based agroecosystems of the Cauvery Delta has increased the risk of environmental contamination through irrigation water, agricultural runoff, and associated food chains. Although acute OP poisoning has been documented in livestock, companion animals, wildlife, and humans, spatial assessment of environmental exposure has remained limited. Building upon our previous veterinary investigation, which documented 1,023 neurological cases including 32 confirmed cases of delayed organophosphate-induced neuropathy, this study integrated veterinary toxicology with geospatial intelligence to characterize environmental risk under a One Health framework.

Georeferenced veterinary poisoning records were integrated with land-use and landcover patterns, paddy cultivation intensity, pesticide-use practices, irrigation canal networks, rainfall, soil characteristics, and satellite-derived environmental variables using Geographic Information Systems (GIS). A **Veterinary Waterborne Toxicity Risk Index (VWTRI)** was developed using multi-criteria spatial analysis to delineate areas vulnerable to waterborne organophosphate contamination.

Spatial analysis identified environmentally vulnerable zones where intensive agricultural activity, hydrological connectivity, and veterinary poisoning events converged, demonstrating the potential pathways for environmental dissemination of organophosphate residues. The generated GIS-based risk maps provided a practical framework for prioritizing environmental surveillance, residue monitoring in water and food-producing systems, and targeted interventions in high-risk locations. This study demonstrates that integrating veterinary clinical evidence with environmental and geospatial datasets provides an effective One Health decision-support model for predicting pesticide toxicity hotspots. The proposed framework offers a scalable approach for environmental risk assessment, sustainable pesticide management, and protection of livestock, wildlife, ecosystem integrity, and public health in intensively cultivated delta regions.

Keywords: Organophosphate pesticides; One Health; Geospatial Intelligence; Geographic Information Systems (GIS); Environmental surveillance; Agricultural runoff; Water quality; Cauvery Delta.

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Development and Preliminary Evaluation of a Phytoestrogen-Enriched Functional Pseudocereal Savoury Mix for Menopausal Women

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Abstract

Background: Menopause is characterized by declining endogenous estrogen levels, resulting in vasomotor symptoms such as hot flashes and night sweats, along with reduced quality of life and heightened risk of osteoporosis and cardiovascular disease. While hormone replacement therapy remains effective, associated safety concerns have increased interest in food-based interventions. Phytoestrogen-rich functional foods present a promising dietary strategy, yet few available products integrate adequate phytoestrogen content with a complete nutritional profile addressing protein and micronutrient needs specific to this population. **Aim:** To develop and conduct a preliminary evaluation of a phytoestrogen-enriched functional pseudocereal savoury mix intended to support the nutritional needs of menopausal women. **Methods:** A phytoestrogen-enriched functional pseudocereal savoury mix was developed using a -raw materials were cleaned, graded, adequately processed, and blended with the ancillary ingredients before being ground into a coarse powder and packaged under hygienic conditions. The developed product was initially evaluated for sensory acceptability by a semi-trained panel of 20 participants based on appearance, colour, taste, flavour, texture, and overall acceptability using a 9-point hedonic scale. The optimized formulation was subsequently subjected to proximate nutrient analysis using standard analytical methods to determine its nutritional composition. **Results:** Sensory evaluation showed good acceptability of the developed phytoestrogen-enriched functional pseudocereal savoury mix, with taste, flavour, and overall acceptability receiving the highest mean scores on the 9-point hedonic scale. Nutritional evaluation revealed that per 100g of the developed product contributed approximately 17.5% of daily energy, 35.2% of protein, 37.5% of dietary fibre, 21.2% of calcium, 79.2% of magnesium, and 32.0% of iron requirements for moderately active adult women aged 40–60 years. **Conclusion:** The developed phytoestrogen-enriched functional pseudocereal savoury mix demonstrated good sensory acceptability and favourable nutritional potential. Its contribution to protein, dietary fibre, and essential minerals suggests its suitability as a nutrient-dense functional food option for supporting the dietary requirements of menopausal women.

Keywords: Menopause; Phytoestrogen; Functional Food; Pseudocereal.

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Evaluation of Antimicrobial Potential of Nisin Encapsulated Polymeric Nanoparticle Against *Listeria monocytogenes* and *Staphylococcus aureus*

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Abstract

Nisin, an antimicrobial peptide produced by Lactococcus lactis, is a prominent food biopreservative. Still, its use in therapeutic applications is limited by its poor stability and rapid proteolytic degradation in physiological conditions. To address this limitation, this study optimised a biopolymeric nanocarrier system utilising a matrix of sodium alginate and gum arabic and evaluated it for antimicrobial activity, antibiofilm activity, pH-responsive release and its stability under gastrointestinal conditions. The encapsulated nisin retained antimicrobial activity against Listeria monocytogenes and Staphylococcus aureus. The nanoparticle formulation, through sustained release, was shown to have antibiofilm activity when compared to free nisin, which was found to promote adaptive biofilm formation after prolonged incubation. The nanoparticles also demonstrated pH-responsive release and protected the nisin from proteolytic degradation in simulated gastric and intestinal fluids. These findings thus demonstrate that the sodium alginate gum arabic polymeric nanoparticles loaded with nisin provide an effective platform for improved stability, controlled release and improving the therapeutic potential of nisin for clinical as well as food safety applications.

Keywords: Nisin, nanoencapsulation, antimicrobial peptides, biofilm, drug delivery, food safety

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Mainstreaming Teasel Gourd (*Momordica subangulata* subsp. *renigera* (Wall. ex G.Don) W.J.de Wilde) Cultivation in Humid Peninsular India

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Abstract

Crop diversification aims to increase production, improve nutritional intake and security, lower the risk of crop loss, and guarantees economic viability, diversity in the food basket and climate resilience. The semi-domesticated teasel gourd, also known as "Kantola" or Assam Kakrol (*Momordica subangulata* subsp. *renigera* (G.Don) de Wilde), is indigenous to the Assam-Myanmar region. It is grown commercially in the eastern and northeastern states of India, primarily in Odisha, West Bengal, Assam, Tripura, and to a lesser extent in the Andaman Islands. It has great export potential and the top producer and exporter is Bangladesh. Being bitterless, highly nutritious (Fe - 119.80 ppm, Mn – 33.90 ppm, Cu – 10.80 ppm, Zn – 32.30 ppm) and with unique flavour and taste, it can be a good choice for diversifying the vegetable basket in West Coast. Its tender leaf clippings can also be used as a vegetable. Owing to its wider climatic adaptability (tolerant to heavy rainfall and low sunshine hours), the crop is now being popularised and getting momentum for homestead cultivation (two seasons) in humid Peninsular tract. Over hundred farmers in West coast were supplied the sprouted male and female tubers for cultivation in their homesteads. Being a dioecious crop, it faces the problem of non-synchrony in availability of male and female flowers and lack of pollinator visit. Thus, requirement of hand pollination outside its home range is also a constraint for wider adoption in commercial scale. To overcome this, efforts are underway through interspecific hybridization between teasel gourd (2n = 56) and spine gourd (*M. dioica*) (2n=28) to develop amphidiploids through polyploidization to combine high vegetative propagation efficiency, bigger fruit size, prolificacy and extended harvest period of teasel gourd and entomophily of spine gourd. Synergy between KVKs, State Agricultural Departments and various extension agencies can further strengthen the percolation of this crop to non-traditional areas. Our studies on different accessions collected from Assam, Mizoram, Nagaland, Odisha and Tripura states showed that IC641667, an accession from Tripura, was found to be a promising one, with maximum value for weight (93.00 g), width (4.94 cm), circumference (16.76 cm) and flesh thickness (0.54 cm) of the fruit. IC641684 was found to give fruit weight up to 130 g, when grown in fertile soil under optimum field conditions.

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Keywords: Teasel gourd, *M. subangulata* subsp. *renigera*, Genetic diversity, Under-utilized vegetable, Popularisation

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Development of Sustainable Glucosinolate-Enriched Functional Tablets from Moringa oleifera Seed Extract for Nutraceutical Applications

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Abstract

Moringa oleifera is an important medicinal tree recognized for its rich nutritional profile and diverse bioactive phytochemicals, particularly glucosinolates, which exhibit promising therapeutic and antioxidant properties. The present study aimed to develop a sustainable nutraceutical formulation using glucosinolate-rich seed extracts of *Moringa oleifera* (PKM-1) for potential antidiabetic applications. Mature seeds were cleaned and glucosinolates are extracted using a hydroalcoholic solvent (1:1 ethanol-water) by maceration. The concentrated extract was evaluated for major phytochemicals including alkaloids, flavonoids, glycosides, phenolics, and saponins. The biological efficacy of the extract was assessed through in vitro α-amylase and α-glucosidase inhibition assays, demonstrating significant enzyme inhibition of approximately 78% and 77%, respectively, indicating strong antidiabetic potential. The extract was subsequently formulated into tablets using wet granulation with different natural and synthetic binders. Pre-compression and post-compression quality parameters, including flowability, hardness, friability, weight variation, and disintegration time, satisfied with pharmacopeial specifications, confirming the suitability of the formulation for nutraceutical applications. An economic assessment revealed a production cost of approximately ₹7.88 per tablet with a benefit-cost ratio of 1.30, highlighting its commercial viability. The study demonstrates that Moringa oleifera seed extract can be effectively transformed into a value-added functional nutraceutical through sustainable processing technologies. Such products offer considerable potential for promoting human health, supporting agricultural value addition, and enhancing the utilization of underexploited plant resources. These findings contribute to the growing scope of eco-friendly functional food development aligned with sustainable agriculture and life science innovations.

Keywords: *Moringa oleifera*, glucosinolates, functional nutraceuticals, sustainable agriculture, antidiabetic activity, value addition, herbal tablets.

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Influence of Maturity and Geographical Origin on the Popping Quality Characteristics of Fox Nut (*Euryale ferox*) Seeds from Bihar and Manipur

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Abstract

Euryale ferox Salisb. (fox nut) is an important aquatic crop cultivated in the stagnant water bodies of northeastern India, particularly in Bihar, Manipur, West Bengal, Assam, Uttar Pradesh, and Madhya Pradesh. Bihar contributes nearly 80% of global fox nut production; however, exploring the popping potential of seeds from other regions is essential for expanding sustainable production. This study investigated the influence of seed maturity on the popping quality characteristics of fox nut seeds collected from Bihar and Manipur. Seeds were harvested at five developmental stages: 10, 20, 30, and 40 days after flowering, along with naturally abscised mature seeds. The quality attributes associated with popping were evaluated through engineering properties, proximate composition, scanning electron microscopy (SEM), X-ray diffraction (XRD), differential scanning calorimetry (DSC), pasting properties, rheological behavior, dynamic light scattering (DLS), and textural analysis. The results revealed that the carbohydrate content increased progressively with seed maturity, rising from 17.84% to 48.03% in Bihar seeds and from 22.90% to 51.10% in Manipur seeds. SEM observations revealed that maturation promoted the development of a dense and compact starch–protein matrix in Bihar seeds, which is expected to improve the retention of internal steam pressure during roasting and thereby enhance popping performance. In contrast, mature Manipur seeds exhibited a comparatively less compact starch matrix, suggesting lower structural integrity for pressure retention during popping. Furthermore, water absorption capacity increased with maturity in both seed origins, corresponding to the progressive accumulation of starch during seed development. Overall, the findings demonstrate that seed maturity significantly influences the structural and physicochemical characteristics governing popping quality, with mature Bihar seeds exhibiting superior microstructural features favourable for efficient popping. These results provide valuable insights for determining the optimum harvest stage and evaluating the commercial potential of fox nut cultivation beyond Bihar.

Keywords: *Euryale ferox,* Functional properties, Microstructure, Popping quality, Seed maturity

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Development of a Carotenoid-Enriched Dissolving Soup Stick for Sustainable Functional Nutrition

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Abstract

Background: Carotenoids are naturally occurring plant pigments that contribute to normal eye function and overall health as part of a balanced diet. The increasing demand for sustainable food products has encouraged the development of innovative functional foods that also minimize environmental impact. **Aim:** To develop and evaluate a carotenoid-enriched edible dissolving soup stick using yellow maize flour, roasted Bengal gram flour, and curry leaf powder as a sustainable functional food product. **Methodology:** The edible dissolving soup stick was formulated using yellow maize flour (approximately 65–70%) as the primary ingredient, roasted Bengal gram flour (15–20%) to improve protein content, nutritional quality, and structural integrity, and curry leaf powder (2–5%) as a natural source of carotenoids and antioxidant phytochemicals, along with natural binders and seasonings. The formulated soup sticks were moulded, dried, and evaluated for proximate composition, total carotenoid content, texture, mechanical strength, dissolution characteristics, and storage stability. Sensory evaluation was conducted using a semi-trained panel with a 9-point hedonic scale to assess appearance, colour, aroma, taste, texture, dissolution characteristics, and overall acceptability. **Results:** The developed edible dissolving soup stick exhibited satisfactory structural strength for handling, gradual dissolution in hot soup, and good sensory acceptability among the semi-trained panellists. The formulation retained appreciable levels of natural carotenoids and demonstrated desirable nutritional quality and storage stability, indicating its suitability as a functional and environmentally sustainable alternative to conventional single-use plastic stirrers and disposable utensils. **Conclusion:** The carotenoid-enriched edible dissolving soup stick represents an innovative approach to combining functional nutrition with sustainable food design. The product has the potential to enhance dietary carotenoid intake, reduce dependence on single-use plastic utensils, and promote the utilization of indigenous agricultural resources. This concept aligns with Sustainable Development Goals (SDGs) 3 (Good Health and Well-being), 12 (Responsible Consumption and Production), and 13 (Climate Action).

Keywords: Dissolving soup spoon, Carotenoids, Yellow maize flour, Betel leaf extract, Sustainable packaging, Millets.

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Exploring the Wheat Rhizosphere Core Microbiome and its Ecological Distribution Pattern Across Indo Gangetic Plain

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Abstract

The Indo-Gangetic Plain (IGP) is one of India's largest wheat producing regions, but the microbiome associated with wheat rhizosphere across IGP remains poorly explored. In this context, the present study investigates the wheat rhizosphere microbiome from 43 locations spanning the Lower (8 locations), Middle (15 locations), Upper (12 locations), and Trans IGP (8 locations). We analysed the microbial assemblages of wheat rhizosphere from these locations using a shotgun metagenomics approach to determine core microbial genera and, as a result, 177 PAN-IGP core microbial genera were identified and categorized into 45 inner-core, 87 outer-core, and 45 peripheral-core genera based on their mean relative abundance and coefficient of variation. While the inner core contained highly abundant and ecologically stable genera *(Streptomyces, Nocardioides, Sphingomonas, Pseudomonas, Bradyrhizobium, Methylobacterium,* etc.), the outer core comprised moderately abundant and stable genera (*Geobacter, Gemmata, Frankia, Nitrospira, etc.*). In contrast, the peripheral core showed increased ecological specialization by containing low-abundance and highly variable genera like *Rhodopirellula, Salinispora, Thermomicrobium, Roseiflexus, Nitrosococcus,* etc. Regional abundance profiling showed Streptomyces as the most abundant conserved genus across IGPs, whereas *Pseudomonas, Sphingomonas, Bradyrhizobium, Frankia,* and *Rhodococcus* registered marked differences in regional abundance. Indicator species, spatial centroid, and SSI analyses together indicated that the wheat rhizosphere microbiome associates a stable but widely distributed core genera and region-specific specialists. These findings provided an ecological basis for selecting both broadly adaptable and region-specific microbial candidates for microbiome-based wheat improvement.

Keywords: Indo Gangetic Plain; Wheat Rhizosphere; Shotgun Metagenomics; Core Microbiome; Spatial Distribution

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Adoption Level of Improved Dairy Farming Practices among Dairy Farmers in Tamil Nadu

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Abstract

The present study was conducted in Dharmapuri district of Tamil Nadu from April to May 2025 to assess the adoption pattern of improved dairy farming practices among dairy farmers. A total of 60 dairy farmers from five villages of Harur Block were selected using a structured and pre-tested interview schedule for data collection. The findings indicated that the majority of the respondents were elderly farmers with considerable farming experience and medium-sized livestock holdings. The overall adoption pattern revealed that 63.33 per cent of the respondents exhibited a medium level of adoption of improved dairy farming practices, while 20.00 per cent and 16.67 per cent demonstrated high and low levels of adoption, respectively. Among breeding practices, artificial insemination and proper drying-off of animals before calving recorded the highest adoption. In feeding management, timely colostrum feeding and green fodder cultivation were widely adopted, whereas the use of mineral mixtures showed comparatively lower adoption. With respect to health care management, vaccination and isolation of diseased animals were among the most frequently adopted practices. In contrast, adoption of marketing and general management practices, such as cattle insurance, utilisation of institutional credit, and awareness of government support schemes, remained relatively low. The study highlights a clear gap between the adoption of production-oriented practices and market-related management practices among dairy farmers. The findings provide valuable evidence for designing need-based extension programmes and policy interventions to promote the wider adoption of improved dairy farming practices. Strengthening extension services, enhancing farmers' awareness, and improving institutional support are essential for increasing the adoption of marketing and general management practices, thereby improving dairy productivity and the socio-economic well-being of dairy farmers in the study area.

Keywords: Adoption, Dairy farmers, Tamil Nadu, Improved dairy farming practices

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Pangenome Analysis of Bacillus altitudinis Exploring the Codon Bias and Plant Growth Promotion Traits

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Abstract

The bacterium *Bacillus altitudinis* is one of the important species of *Bacillus* genus popularly used as biocontrol agents against multiple diseases. Despite the fact that core genome of a species is more or less constant, still the multiple strains of the same species showed overall variations in genome size, gene content, preference for specific habitat or host. With the availability of multiple strains of the *B. altitudinis*, analysis of strain-specific functions, their phylogenetic relationship and codon usage preference are also gaining significant interests. In this study, we conducted a comprehensive pangenome analysis on the 71 strains of *B. altitudinis* isolated from different habitats. Our analysis identified that an open pangenome structure, with 2,858 core and 7596 accessory gene clusters. A total of 47 CAZy and 3687 plant growth promoting genes were found in the pangenome. Interestingly, all the nitrogen fixing genes were found only in the core genome suggested that nitrogen fixation is a major core function. Furthermore, a total of 60, and 126 genes related to siderophore biosynthesis, and biotic stress were found in the pangenome. The pangenome analysis indicates the enrichment of A/T nucleotide at the third position of codon. A significant correlation of value 0.39 and 0.55 between GC3 and GC12 was observed in the shell and cloud genomes. The outcome of the present study indicates the metabolic potential of *Bacillus altitudinis* as a biocontrol agent.

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Post-Waterlogging Recovery of Oxidative Stress and Antioxidant Defense in Tomato (*Solanum lycopersicum* L.)

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Abstract

Waterlogging poses a significant abiotic challenge that restricts tomato productivity by causing root hypoxia, overproduction of reactive oxygen species (ROS), and subsequent oxidative damage. Although the immediate impacts of waterlogging are well studied, the recovery response after stress withdrawal remain largely unclear. This study examined how tomato genotypes recover following short-term waterlogging. Thirty genotypes were first evaluated under four conditions: control (T0), and 1-day (T1), 2-day (T2), and 3-day (T3) waterlogging treatments applied during flowering. Based on tolerance scores, yellowing of leaf, adventitious root, and yield, twelve genotypes with contrasting responses were chosen for in-depth recovery assessment at 2, 12, and 22 days after waterlogging (DAW). Oxidative damage was measured via hydrogen peroxide (H2O2), malondialdehyde (MDA), and electrolyte leakage, while antioxidant defense capacity was analyzed through activities of superoxide dismutase, catalase, peroxidase, ascorbate peroxidase, and glutathione reductase. Tolerant genotypes showed quicker induction of antioxidant enzymes, reduced oxidative damage, better preservation of photosynthetic pigments and membrane stability, and more effective recovery than susceptible ones. The results indicate that the ability to reestablish cellular redox balance via robust antioxidant systems is a key factor determining recovery and tolerance after waterlogging in tomatoes. These insights enhance understanding of post-stress recovery mechanisms and highlight promising traits for breeding waterlogging-tolerant varieties.

Keywords: Waterlogging, Recovery, Oxidative damage, Antioxidant defense, Tomato

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Synthesis and Characterization of Cellulose Nanocrystals from Cottonseed Hulls Using Acid Hydrolysis and Ultrasonication

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Abstract

Cottonseed hulls are abundant byproducts of the cottonseed oil industry and are rich in cellulose fibers (30-50 %). In this research, cellulose nanocrystals were synthesized from cottonseed hulls via acid hydrolysis followed by ultrasonication. We investigated two acid concentrations (50 % and 60 % (v/v)) and ultrasound amplitudes (30 % and 50 %) in the synthesis of cellulose nanocrystals. The effects of treatment conditions on the physical, thermal, and structural properties were assessed using Fourier Transform Infrared Spectroscopy, X-ray diffraction spectroscopy, Differential Scanning Calorimetry, and Field Emission Scanning Electron Microscopy. The FESEM results showed fiber-like structures in the range of 100- 200 nm. The results revealed that the synthesis conditions significantly ($p<0.05$) affected particle size and structural properties, and that the ultrasound treatment helped reduce the acid concentration and obtain uniform cellulose nanofibers. The obtained nanofibers found diverse applications in food packaging, biomedical, waste-water purification, and textiles industries, etc.

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Evaluation of Sowing Methods for Improving Crop Establishment and Grain Yield of Direct-Seeded Rice under Drip Irrigation

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Abstract

Direct-seeded rice (DSR) is gaining importance as a resource-efficient alternative to conventional transplanted rice because of its potential to reduce water and labour requirements. However, successful crop establishment under drip irrigation largely depends on the selection of an appropriate sowing method. The present study was conducted to evaluate the performance of different sowing methods under drip irrigation in direct-seeded rice. A field experiment was carried out at the Wetland Farm, Tamil Nadu Agricultural University, Coimbatore, using a strip plot design comprising six sowing methods and two fertigation levels. Crop establishment and productivity were assessed through plant population and grain yield. Among the drip-irrigated treatments, tractor-drawn seed drill sowing with fertigation produced superior crop establishment and recorded the highest grain yield, while broadcast sowing resulted in the poorest performance. Fertigation improved grain yield across all sowing methods compared with non-fertigated treatments. The results indicate that tractor-drawn seed drill sowing combined with fertigation is an efficient mechanized crop establishment technique capable of achieving productivity comparable to the conventional manual line sowing method under surface irrigation, while offering the advantages of improved resource-use efficiency. The study highlights the potential of mechanized sowing and fertigation for promoting sustainable and efficient direct-seeded rice production under drip irrigation.

Keywords: Direct-seeded rice, drip irrigation, sowing methods, fertigation, crop establishment, grain yield

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Microfluidized Ant Egg Protein for Sustainable Food Emulsions

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Abstract

The growing demand for sustainable and functional protein ingredients has intensified the search for alternative food biopolymers capable of replacing conventional animal-derived emulsifiers. Edible insect proteins offer a promising solution owing to their high nutritional value and low environmental footprint; however, limited knowledge of their techno-functional properties restricts their commercial utilization. Aligned with the United Nations Sustainable Development Goals (SDGs 9, and 12), this study investigated the influence of microfluidization under varying pressures and processing cycles on the structural, physicochemical properties of red weaver ant (*Oecophylla smaragdina*) egg protein and pH , thermal stability, particle size and surface charge studied for the emulsion prepared from ant egg protein.

Microfluidization significantly improved protein functionality by increasing protein solubility to approximately 83%, increased water and oil holding capacities (4.58 ± 0.9) and (2.28 ± 0.1), enhanced emulsifying activity and stability index (60.34 ± 0.2 and 68.8 ± 0.97, respectively), pH stability, and centrifugal stability compared with the untreated control ($p < 0.05$). SDS–PAGE analysis indicated partial fragmentation of high-molecular-weight protein aggregates, suggesting structural modification that contributed to improved interfacial activity. Increasing microfluidization pressure and processing cycles significantly reduced the mean particle size from 836 to 238 nm ($p < 0.05$), producing finer and more uniformly dispersed emulsions. Emulsions processed at pressures exceeding 70 MPa exhibited minimal cream layer formation, demonstrating enhanced physical stability during storage. Although the surface charge decreased slightly with increasing protein concentration, the emulsions remained highly stable over a broad pH range, with expected flocculation occurring only near the isoelectric point ($pH \approx 4$). Rheological evaluation further revealed that highly pressurized samples exhibited near-Newtonian flow behaviour with reduced apparent viscosity, indicating improved flowability without compromising emulsion stability.

These findings demonstrate that microfluidization is an effective green processing technology for tailoring the functionality of ant egg protein into a highly stable, fine-particle emulsion with enhanced physicochemical properties. The study highlights the potential of red weaver ant egg protein as a sustainable, clean-label food emulsifier and supports its application as an innovative alternative protein ingredient, thereby contributing to resilient food systems, responsible production, and sustainable food innovation.

Keywords: Insect protein; Microfluidization; Alternative protein; Ant egg protein; Protein emulsion.

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Botanical Seed Treatment and Insecticidal Potential of Moringa oleifera and Syzygium cumini Extract-Based Formulations

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Abstract

The increasing demand for sustainable crop protection has accelerated interest in plant-derived formulations as eco-friendly alternatives to synthetic agrochemicals. In the present study, botanical formulations developed from Moringa oleifera seed extract and Syzygium cumini stem bark extract were evaluated for their seed treatment efficacy and insecticidal activity. Formulations at concentrations of 0.5%, 1.0%, 1.5%, and 2.0% were assessed for their effects on maize seed germination, seedling growth and seedling vigor under controlled laboratory conditions. Insecticidal efficacy was determined against two economically important storedgrain insect pests, Sitophilus oryzae (rice weevil) and Callosobruchus chinensis (pulse beetle), using the residual exposure bioassay. The results demonstrated a concentration-dependent response, with the 2.0% formulation producing the highest seed germination (100%), significantly improved seedling growth and enhanced vigor compared with the untreated control. Similarly, insecticidal activity increased with formulation concentration, with the 2.0% treatment causing 80% mortality of S. oryzae after 12 days of exposure and complete (100%) mortality of C. chinensis after 8 days under laboratory conditions. The findings demonstrate that the combined M. oleifera – S. cumini botanical formulation possesses dual functionality as an effective seed treatment agent and botanical insecticide. These results highlight its potential as an environmentally sustainable alternative to conventional synthetic agrochemicals for improving crop establishment and managing stored-grain insect pests within integrated crop protection systems.

Keywords: Moringa oleifera; Syzygium cumini; botanical formulation; seed treatment; seed germination; botanical insecticide; Sitophilus oryzae; Callosobruchus chinensis; sustainable agriculture.

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Influence of Milk Source and Reheating on the Texture Profile of Paneer Gravy Prepared from Osmotically Dehydrated Paneer prepared from Cow, Buffalo, and Full Cream Milk

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Abstract

Retort processing is an effective thermal sterilization technique for developing commercially sterile ready-to-eat products. However, high-temperature processing can significantly influence the texture of paneer, with hardness being the primary determinant of consumer acceptability. This study investigated the effect of retort processing under different temperature–time combinations (115–131°C) on the texture profile of paneer gravy prepared using paneer from three milk sources (cow milk, buffalo milk, and full cream milk) subjected to different pretreatments: fresh paneer, hot air oven-dried paneer (control), 21% (w/w) osmotic treated, and surface salt-treated paneer Texture profile analysis was performed before and after reheating by measuring hardness, adhesiveness, cohesiveness, springiness, chewiness, gumminess, and resilience. Hardness was the most responsive textural attribute and exhibited highly significant ($P \leq 0.01$) differences among processing treatments, indicating that retort temperature, holding time, milk source, and dehydration method collectively influenced the structural integrity of paneer. Paneer prepared from buffalo milk generally exhibited greater hardness than cow milk and full cream milk paneer, reflecting its higher total solids and casein content, whereas osmotic dehydration and surface salt treatment modified the protein network, thereby affecting the mechanical properties after retort processing. Significant ($P \leq 0.01$) changes were also observed in adhesiveness, chewiness, and gumminess, while cohesiveness, springiness, and resilience remained comparatively stable across most treatments ($P \geq 0.05$), demonstrating the retention of the internal elastic structure despite thermal sterilization. The findings highlight hardness as the most reliable indicator for optimizing retort processing conditions and paneer pretreatment to achieve desirable texture without compromising commercial sterility. This study provides valuable insights for developing high-quality, shelf-stable ready-to-eat paneer gravy with enhanced textural characteristics and consumer acceptability.

Keywords: Hardness, Osmotic dehydration, Paneer gravy, Retort processing, Texture profile analysis.

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Identification of Promising Elite Rice Lines through Integrated Phenotypic and Molecular Approaches for Constitution of an Elite Breeding Panel

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Abstract

Enhancing rice productivity while integrating resistance to major biotic stresses and improving grain nutritional quality is a major goal in climate-resilient breeding. In this study, a systematic strategy was adopted to identify elite genotypes for the development of a multi-trait breeding panel in rice. A total of 1,488 genotypes were initially screened, and 121 promising lines were selected based on high grain yield, resistance to leaf blast, neck blast, and sheath blight, and tolerance to brown planthopper infestation. These genotypes were further evaluated at Mandya and Gangavathi for yield and related agronomic traits, while resistance to diseases and pests was assessed under field conditions at Mandya. Grain zinc and iron concentrations were also estimated in dehusked grains to assess nutritional quality. Significant genotypic variation was observed across environments for most traits. Based on phenotypic performance, 41 genotypes were shortlisted for molecular analysis and genotyped using SSR markers linked to 53 genes governing 15 economically important traits. Integration of phenotypic and marker data led to the identification of eight elite genotypes, which were selected for inclusion in the elite breeding panel. These genotypes represent valuable genetic resources for pyramiding yield, resistance, and nutritional traits in rice breeding programs.

Keywords: Rice, elite breeding panel, climate resilience, grain zinc, grain iron and stress tolerance

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AI-Based Detection of Cotton Mirid Bug, Creontiades biseratense Distant Using YOLO Object Detection Models for Precision Pest Monitoring and Sustainable Crop Protection

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Abstract

The cotton mirid bug, *Creontiades biseratense* Distant, has emerged as a major sucking pest of *Bt* cotton, causing black scarring, square and boll shedding, parrot-beaked bolls and substantial yield losses. Conventional pest scouting relies on manual inspection of reproductive structures, which is labour-intensive, time-consuming and prone to sampling errors while potentially causing damage to plant parts. To overcome these limitations, the present study developed an artificial intelligence (AI)-based automated detection system for cotton mirid bugs using state-of-the-art deep learning object detection models. A dataset comprising 1468 images of mirid bug nymphs and adults was collected from cotton fields and coloured sticky traps using a smartphone camera. The images were annotated with bounding boxes and randomly divided into training (70%) and validation (30%) datasets. Ten YOLO architectures, including YOLOv5n, YOLOv5s, YOLOv8n, YOLOv8s, YOLOv10n, YOLOv10s, YOLO11n, YOLO11s, YOLO26n and YOLO26s were trained and evaluated on the Kaggle cloud platform. Among the evaluated models, YOLO11n achieved the highest mAP@50 (89.7%), whereas YOLOv8s recorded the best mAP@50-95 (45.4%). YOLOv5n delivered comparable detection accuracy (mAP@50-95: 45.2%) with only 2.503 million parameters and an inference time of 2.7 ms, while YOLOv8n achieved the fastest inference speed (1.9 ms) using 3.006 million parameters, making it highly suitable for real-time deployment. The developed AI framework enables rapid, accurate and non-destructive detection of cotton mirid bugs, providing a practical tool for precision pest surveillance and informed crop protection decisions. By facilitating timely intervention and reducing reliance on indiscriminate pesticide applications, this approach supports sustainable cotton production and contributes to the objectives of Sustainable Development Goal 12 (Responsible Consumption and Production).

Keywords: *Creontiades biseratense*, deep learning, YOLO, object detection, artificial intelligence.

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Breaking Seed Dormancy in Guinea Grass ((*Panicum maximum Jacq*): Insights into Mechanisms and Management

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Abstract

Seed dormancy in guinea grass (*Panicum maximum* Jacq.) is a critical barrier to successful seed production and crop establishment, limiting both germination efficiency and seedling vigour. The present investigation was undertaken to determine the dormancy duration in different genotypes, evaluate cost-effective dormancy breaking treatments, and elucidate physio-morphological mechanisms underlying dormancy. Germination studies revealed that varieties CO 2 and CO (GG) 3 exhibited dormancy periods of 180 and 135 days, respectively, with maximum germination of 24% and 20% recorded at the end of these intervals. To overcome dormancy, a series of treatments including thermal exposure, chemical soaking, and pre-chilling were imposed. Among these, soaking seeds in concentrated H_2SO_4 (98%, 36 N) for 5 minutes followed by KNO_3 (0.2%) for 5 minutes proved most effective, achieving 58% germination compared to 2% in untreated controls. Physiological and biochemical parameters such as vigour index, seedling dry weight, electrical conductivity, α-amylase activity, and dehydrogenase enzyme activity showed significant positive correlations with germination, confirming the efficacy of these treatments. Morphological studies using X-radiography demonstrated that intact seeds with lemma and palea inhibited germination due to physiological inhibiting mechanisms (PIMs) and mechanical barriers, while naked seeds harvested at 20 days after panicle emergence possessed fully developed embryos and recorded maximum germination. Seeds harvested at premature stages exhibited underdeveloped embryos, further contributing to dormancy. These findings establish that guinea grass seeds possess combined dormancy, involving immature embryo development, impermeable seed coat, and inhibitory structures. The study provides practical strategies for breaking dormancy, thereby enhancing seed quality and production efficiency. The results are of direct relevance to seed producers, farmers, and seed industries aiming to improve the establishment and productivity of guinea grass.

Keywords: Guinea grass, Seed dormancy, Dormancy breaking treatments

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Gamification in Agricultural Extension Training Programs for Sustainable Agriculture and Rural Development

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Abstract

The traditional archetype and effectiveness of agricultural extension in India is progressively constrained by low farmer participation, limited knowledge retention, information asymmetry, and the expanding complexity of climate-resilient and resource-efficient farming technologies. This requires a transformative shift to effectively bridge the gap between laboratory research and field-level adoption. Conventional training methods often fail to sustain learner engagement, particularly among marginal and smallholder farmers who constitute over 85 percent of India's farming community. Gamification, defined as the strategic integration of game-design elements such as points, badges, leaderboards, simulations, and narrative-driven challenges within non-formal education, trainings and behavioural interventions. This has emerged as a positive pedagogical innovation to enhance participatory learning and re-designing traditional training paradigm. This study examines the scope of gamification in strengthening extension training programmes for sustainable agriculture and rural development reshaped to the cultural and linguistic diversity of the Indian agrarian landscape the Indian context. It discusses the application of game mechanics, including adaptive quizzes, digital badges, leaderboards, mission-based learning, progress dashboards, simulation-based decision exercises, and reward systems, integrated with Information and Communication Technologies (ICTs), mobile-based advisory services, Krishi Vigyan Kendras (KVKs), Farmer Producer Organizations (FPOs), and digital extension platforms. Preliminary findings indicate that gamification facilitates higher cognitive engagement, reduces the generalized barrier of complex sustainable technologies, and fosters social learning through competitive yet collaborative structures. Gamification's success depends on digital infrastructure, multilingual content, literacy, and policy support. Blending it with India's Digital Agriculture Mission can enhance technology transfer, behavioural change, and extension system effectiveness. A context-specific, evidence-based gamification framework has promisable potential to accelerate sustainable agricultural intensification, strengthen rural livelihoods, and contribute towards achieving national agricultural development and Sustainable Development Goals.

Keywords: Agricultural Extension; Gamification; Sustainable Agriculture; Digital Agriculture; Climate-Smart Agriculture; ICT; Krishi Vigyan Kendra (KVK); Farmer Producer Organizations (FPOs); Rural Development; Technology Adoption.

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Vulnerability Assessment and Effectiveness of Climate Change Adaptation Strategies among Farmers in the Cauvery Delta Region of Tamil Nadu

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Abstract

Climate change has emerged as a significant challenge to agricultural sustainability, specifically in the Cauvery Delta Region of Tamil Nadu, where farming systems are increasingly affected by erratic rainfall, rising temperatures, prolonged dry spells and extreme weather events. Assessing farmers' vulnerability and the effectiveness of adaptation strategies is vital for improving climate resilience and ensuring sustainable agricultural production. The present study evaluates the vulnerability of farmers using a composite Vulnerability Index and exmines the effectiveness of both indigenous and scientific climate change adaptation strategies. The study was conducted among 200 farmers selected from the Cauvery Delta Region using an ex-post facto research design. Data were collected through a structured interview schedule, supported by field observations and focus group discussions. Vulnerability was estimated using indicators constituting exposure, sensitivity and adaptive capacity, while adaptation strategies were assessed using a composite effectiveness index based on economic, technical, environmental, and social dimensions. Preliminary findings confirms that majority of the respondents were moderately vulnerable to climate change, while comparatively fewer farmers represent high and low vulnerability categories. Farmers adopting a combination of scientific and indigenous adaptation strategies exhibited substantially lower vulnerability and higher effectiveness scores than those relying on individual practices. Scientific interventions such as climate-resilient crop varieties, water-saving technologies, and weather-based advisories, when integrated with indigenous knowledge, displayed greater effectiveness in improving adaptive capacity and farm resilience. The findings emphasize the need to strengthen integrated climate adaptation approaches for establishing resilient farming systems in the Cauvery Delta Region.

Keywords: Climate change, Vulnerability Index, Adaptation strategies, Effectiveness, Climate resilience, Sensitivity.

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Digital Agriculture and Smart Value Chains

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Abstract

Digital agriculture is transforming conventional farming systems into intelligent, data-driven, and sustainable production systems by integrating advanced information and communication technologies across the agricultural value chain. The rapid growth of global food demand, climate variability, labour shortages, and increasing pressure on natural resources have accelerated the adoption of digital technologies to improve agricultural productivity, resource-use efficiency, and market competitiveness. Smart value chains extend the concept of digital agriculture beyond farm production by integrating digital technologies into harvesting, postharvest handling, storage, processing, transportation, marketing, and retailing, thereby creating transparent, efficient, and resilient agrifood systems.

The integration of digital technologies with sustainable agricultural practices contributes significantly to climate-smart agriculture by enhancing resource-use efficiency, reducing greenhouse gas emissions, optimizing input utilization, and minimizing food losses throughout the supply chain. Emerging innovations such as digital twins, autonomous farm machinery, edge computing, 5G-enabled agricultural communication networks, and generative artificial intelligence are expected to further strengthen precision farming and smart value chain management. However, challenges including inadequate digital infrastructure, limited internet connectivity, high investment costs, data privacy concerns, insufficient technical skills, and unequal access to technology continue to hinder widespread adoption, especially in developing countries.

Future research should focus on developing affordable, scalable, and user-friendly digital solutions tailored to the needs of small and marginal farmers. Strengthening rural digital infrastructure, promoting public–private partnerships, improving digital literacy, and establishing supportive policies will be essential for accelerating digital transformation in agriculture. Overall, digital agriculture and smart value chains provide a comprehensive framework for improving productivity, reducing postharvest losses, enhancing food safety, increasing farmer incomes, and building resilient agrifood systems capable of supporting global food and nutrition security while contributing to sustainable development.

Keywords: Digital agriculture; Smart value chains; Artificial Intelligence (AI); Internet of Things (IoT); Precision agriculture; Blockchain; Big data analytics.

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Effectiveness of Agri-clinic Interventions in Crop Health Management and Farmer Awareness: Evidence from Manjapra Village, Kerala

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Abstract

The present study evaluated the effectiveness of a Agri-Clinic programme conducted at Manjapra village, Kerala, to improve crop health management and farmer awareness. The programme, organized by the M. S. Swaminathan Research Foundation in collaboration with Kerala Agricultural University, included field visits, farmer consultations, problem diagnosis, and method demonstrations. Major crop health constraints identified were pseudostem weevil in banana (16%), rhinoceros beetle in coconut (14%), red spider mite in arecanut (12%), Sigatoka leaf spot in banana (12%), wilt diseases in chilli (12%), rhizome rot in ginger (10%), Mahali disease in arecanut (8%), bud rot in coconut (8%), and dieback with abnormal leaf fall in nutmeg (8%). Scientific recommendations and demonstrations on pseudostem traps, Bordeaux mixture, Trichoderma enrichment, yellow sticky traps, and neem-based sprays were provided. Farmers' awareness regarding scientific crop management increased from 38% before the programme to 82% after participation, while 76% expressed willingness to adopt the demonstrated technologies. Participant feedback showed that 88% rated the programme as highly useful. The findings confirm that participatory Agri-Clinic interventions are an effective extension strategy for solving field-level crop problems, improving technology adoption, and promoting sustainable agriculture.

Keywords: Agri-Clinic, Crop health management, Farmer awareness, Sustainable agriculture, Farmer satisfaction

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Evaluation of Slow-Growth Culture Techniques for *In Vitro* Conservation of *Centella asiatica*

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Abstract

Centella asiatica (L.) Urban, commonly known as Vallarai, is an important medicinal herb valued for its pharmacological properties and widely used in traditional and modern medicine. However, increasing commercial demand, habitat degradation, and indiscriminate harvesting have accelerated the depletion of its natural populations, necessitating the development of efficient conservation strategies. The present study was conducted at Vanavarayar Institute of Agriculture, Pollachi to standardize a slow-growth culture protocol for the *in vitro* conservation of *C. asiatica*. Initially, ten combinations of plant growth regulators were evaluated to optimize embryogenic callus induction and shoot regeneration. Among the treatments, MS medium supplemented with 2.5 mg L-1 2,4-D-1 + 0.10 mg L BAP-1 recorded the highest embryogenic callus induction (63.67%) and callus fresh weight (82.67%), whereas the maximum shoot regeneration frequency (43.33%) was obtained on MS medium containing 2.0 mg L-1 kinetin + 0.100 mg L-1 NAA + 0.100 mg L-1 IBA. These optimized media were used as the control for evaluating four slow-growth treatments comprising different concentrations of mannitol and abscisic acid (ABA). Callus induction, callus survival, shoot regeneration frequency, shoot length, and the number of effective roots were assessed at 3, 6, and 9 months after culture initiation. Growth responses gradually declined under slow-growth conditions, confirming effective growth suppression while maintaining culture viability. Among the treatments, 3% mannitol combined with 0.5 mg L-1 ABA produced the highest callus survival (58.74%) and shoot regeneration frequency (31.62%) after nine months of storage, demonstrating its effectiveness for medium-term conservation. The optimized slow-growth protocol successfully prolonged the *in vitro* storage period, reduced the frequency of subculturing, and maintained the regenerative potential of cultures. This protocol offers a reliable, cost-effective, and practical approach for the conservation of valuable *C. asiatica* germplasm and can be utilized for long-term preservation, germplasm exchange, and sustainable utilization of this economically important medicinal plant.

Keywords: Conservation; germplasm; *in vitro;* slow growth

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Estimation of Fresh Cattle Dung Production and Farm Yard Manure Nutrient Equivalence from Cattle Population Dynamics: A Temporal Analysis (2007–2019) in Thanjavur District

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Abstract

Cattle dung is a valuable renewable resource that supports sustainable agriculture through nutrient recycling, soil fertility improvement, renewable energy generation and greenhouse gas mitigation. This study estimated fresh cattle dung production and farmyard manure (FYM) nutrient potential using livestock census data from 2007, 2012 and 2019 in Thanjavur District, Tamil Nadu. The cattle population declined from 4,46,750 in 2007 to 3,87,008 in 2012 and 3,50,527 in 2019. Fresh dung production was estimated for adults (60%; 22.5 kg/day), young stock (25%; 12.5 kg/day) and calves (15%; 6 kg/day). Average daily dung production decreased from 7,829.31 tonnes in 2007 to 6,142.98 tonnes in 2019, a decline of about 21.5%. Based on the nutrient composition of FYM (0.5% N, 0.2% P_2O_5, and 0.5% K_2O), the 2019 production could supply approximately 11,200 tonnes of nitrogen, 4,480 tonnes of phosphorus pentoxide, and 11,200 tonnes of potassium oxide annually. Efficient utilization of this resource can reduce dependence on synthetic fertilizers, lower production costs and decrease emissions associated with fertilizer manufacture. Composting and anaerobic digestion further reduce methane emissions while producing renewable energy and nutrient-rich manure. Regular FYM application improves soil organic carbon, soil structure, water-holding capacity, microbial activity and long-term productivity. The findings highlight the importance of integrated nutrient management and improved dung collection and processing systems to enhance environmental sustainability, climate-smart agriculture and the circular bioeconomy.

Keywords: Cattle dung, Farmyard manure, Nutrient recycling, Integrated nutrient management, Sustainable agriculture.

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Identifying Novel Microbes for the Management of Jasmine wilt Pathogen *Sclerotium rolfsii*

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Abstract

Jasmine is a major flowering crop of Tamil Nadu. Madurai region of Tamil Nadu is known to produce majorly 3 jasmine varieties namely: Gundumalli, Pitchi and Mullai, of which Gundumalli is the majorly cultivated variety of the crop. This flower crop, known for its fragrance is heavily infested by the wilt pathogen, Sclerotium rolfsii. Field survey in the areas of Alagichipatti, Melur and Ayanthekarai in Madurai reveal 30-70% infestation. In order to manage the pathogen, we have identified an endophytic Trichoderma strain, a rhizospheric bacterial strain and an actinomycete that have shown good biocontrol efficiency against the pathogen as compared to the available bioformulation. The identified bioagents were able to inhibit the pathogen by upto 70% as compared to the available commercial formulations that gave an inhibition percentage of only upto 50%.

Keywords: Gundumalli, *Sclerotium rolfsii*, wilt, Trichoderma, Bacteria, Actinomycete

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Evaluation of Suitable Forecasting Models for Major Vegetable Crops Price Prediction in Madurai District-A Statistical Approach

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Abstract

This study examines the growth trends and dispersion patterns of brinjal, bhendi, tomato, and onion prices in the Madurai district, while also evaluating the suitability of various price prediction models. Secondary price data for these selected crops were utilized for the analysis. The results reveal that prices for all four crops exhibited positive growth rates and high dispersion patterns during the study period. The forecasting performance of ARIMA, ANN, SVR, and LSTM models was evaluated using Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and Mean Absolute Percentage Error (MAPE). The evaluation indicates that the SVR model performed better for bhendi, brinjal, and onion, yielding lower error values across all three metrics. In contrast, the LSTM model demonstrated the best performance for tomato price prediction, registering the lowest MAE and RMSE values. Overall, SVR emerged as the most consistent model for forecasting vegetable prices, while LSTM proved superior specifically for tomato price prediction.

Keywords: Vegetables, Trend, Dispersion pattern, Forecast models

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Validation of Drip Irrigation Levels for Optimum Growth, Yield and Water Use Efficiency in Hybrid Castor (*Ricinus communis* L.)

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Abstract

Efficient irrigation management is essential for maximizing yield and water productivity in hybrid castor (Ricinus communis L. cv. YRCH–1), particularly in semi-arid regions where water scarcity is a major constraint. This study aimed to optimize drip irrigation scheduling for hybrid castor using USWB Class A open Pan Evaporation (PE) fractions and evaluate its impact on crop performance and economic returns. A field experiment was conducted during the 2025–2026 rabi season at Tapioca and Castor Research Station, Yethapur, Tamil Nadu, India, employing a Randomized block design (RBD) with eight irrigation treatments: seven drip irrigation schedules (0.4, 0.6, 0.8, and 1.0 PE, applied uniformly or split at flowering) and conventional surface irrigation as control. Results indicated that drip irrigation at 0.8 PE throughout the crop cycle produced the highest plant height (160.9 cm), seed yield (2280 kg ha^{-1}), oil yield (1112.64 kg/ha), and water-use efficiency (4.22 kg/ha/mm). This regime also resulted in the highest net return (Rs. 1,16,745 ha^{-1}) and benefit–cost ratio (3.72), while reducing overall cultivation costs. Seed yield exhibited strong positive correlations with capsules per plant (r = 0.96), dry matter (r = 0.95), and spikes per plant (r = 0.93). Water-use efficiency increased up to the 0.8 PE threshold but declined with further increments, confirming 0.8 PE as optimal. In conclusion, drip irrigation scheduled at 0.8 PE emerges as a water-saving, yield-enhancing, and economically viable strategy for hybrid castor cultivation in semi-arid environments. These findings provide robust, region-specific guidelines for precision irrigation and support the sustainable intensification of castor production.

Keywords: Hybrid castor, smart irrigation, pan evaporation, irrigation scheduling; water-use efficiency

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A Study on Importance of Solar Energy in Achieving the Sustainable Development in Agriculture

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Abstract

India has adopted around totally 17 Sustainable development goals from the United Nations to remove the poverty, people with prosperity, and protect the Earth. In the list of SDGs, most important that was clean energy access (SDG 7), sustainable economic growth (SDG 8), responsible consumption and production (SDG 12), and climate action (SDG 13). This study explains the importance and wide applications of solar energy especially in agriculture. In this study, analysis the economics of solar energy, and its environmental impact and from this transition of solar energy creates social benefits and individual benefits. The Social benefits were decrease the dependence on coals as source, reduce the emission of greenhouse gases, increase the energy security through solar energy and the individual benefits was generation of income to the farming community. At the same, this explains briefly the pros and cons in the installation, maintenance, which includes the high installation cost, lack of awareness among the farming community, lack of technical knowledge people on solar energy. It also discuss the benefits and problems of policy, which related to the solar energy by government. There was lot of studies related on solar energy; this study highlights the advantages in usage of solar energy particular in the agriculture that will help to achieve the sustainable development economy. It concludes by underscoring the necessity of collaborative activities from governments, international organizations, and the private sector to encourage and facilitate the integration of solar energy into agriculture, particularly in developing countries like India where the achievement of sustainable development in agriculture done through farming practices and clean energy is the most important for the realization of the SDGs.

Keywords: Solar Energy, SDG through agriculture, Income to Farming community.

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Bioactive and Safety Assessment of *Terminalia chebula* Extract for Functional Applications

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Abstract

Growing consumer preference for eco-friendly, safe, and naturally derived food ingredients has renewed interest in plant-based foods with added nutritional and functional benefits. *Terminalia chebula* is a medicinal plant grown in India and Southeast Asia and is a key component of triphala, a traditional Ayurvedic formulation. The fruits of *T. chebula* are included in the Indian pharmacopeia as an astringent and are reported to possess laxative, diuretic, cardiotonic, and hypoglycemic properties. The major phytoconstituents of the fruit are hydrolysable tannins, gallic acid, chebulic acid, chebulic ellagitannins, and gallate esters. In addition to its complex tannin profile, the fruit also yields a natural yellow dye that can be applied to textile substrates with or without the use of mordants. The present study aimed to evaluate the phytochemical composition, and preliminary safety of *T. chebula* fruit extract. The fruit extract was characterized for bioactive compounds using GC–MS and FTIR analysis. Safety assessment was carried out through brine shrimp lethality bioassay. GC–MS analysis revealed the presence of phytochemicals that are antioxidant, antibacterial, antifungal in nature, while FTIR spectra confirmed functional groups characteristic of polyphenols, tannins, terpenoids, flavonoids, carbohydrate and protein compounds in *T. chebula*. The brine shrimp assay indicated low cytotoxicity of the fruit extract. The results suggest that *T. chebula* extract is a safe, bioactive-rich natural product, highlighting its potential for use in food, nutritional, and functional product development.

Keywords: *Terminalia chebula,* phytochemicals, GC–MS, FTIR, brine shrimp bioassay

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Therapeutic Potential of Vanillin Against Metastasis in Oral Squamous Cell Carcinoma

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Abstract

Oral squamous cell carcinoma (OSCC) is a highly prevalent malignancy in which distant metastasis remains a major determinant of poor patient prognosis. Despite advances in treatment strategies, effective approaches to inhibit metastasis are still limited. Plant-derived bioactive compounds have emerged as promising candidates for targeted cancer therapy due to their safety and cost-effectiveness. Vanillin, a naturally occurring phenolic compound found in Vanilla and various millets, has demonstrated anticancer properties in multiple malignancies; however, its potential role in OSCC remains largely unexplored. This study aimed to evaluate the anti-metastatic potential of Vanillin by targeting epithelial–mesenchymal transition (EMT)-associated pathways. The cytotoxic and anti-migratory effects of Vanillin were investigated in vitro using non-metastatic (CAL-27) and metastatic (HSC3) oral cancer cell lines. Vanillin exhibited significant dose-dependent growth inhibition in both cell lines and markedly suppressed cell migration in metastatic HSC3 cells, indicating its potential to impede metastatic progression. To further elucidate the underlying molecular mechanisms, in silico analyses were performed to examine interactions with key EMT and metastasis-related markers, including Notch4, TBX3, E-cadherin, N-cadherin, and vimentin. Molecular docking studies demonstrated favourable binding affinity of vanillin towards E-cadherin, suggesting its role in maintaining epithelial integrity and inhibiting EMT. Furthermore, molecular dynamics simulations confirmed the stability of the vanillin–E-cadherin complex over time. Overall, these findings suggest that Vanillin exerts significant anti-proliferative and anti-migratory effects and may act as a potential inhibitor of EMT-mediated metastasis in OSCC. This study highlights Vanillin as a promising, safe, and cost-effective therapeutic candidate for further preclinical and clinical investigation.

Keywords: Oral squamous cell carcinoma (OSCC), Vanillin, Phytochemicals, Metastasis, Molecular docking

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Free-Living Soil Nematode Diversity as a Bioindicator of Soil Health: Implications for Food and Nutrition Security in the Pir Panjal Himalaya of Jammu and Kashmir, India

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Abstract

Biodiversity forms the foundation of food and nutrition security by sustaining ecosystem functions that maintain soil fertility, agricultural productivity, and ecosystem resilience. Among soil biota, free-living nematodes play critical roles in nutrient cycling, organic matter decomposition, microbial regulation, and soil food-web dynamics, making them valuable indicators of soil health and ecosystem functioning. Despite their ecological importance, knowledge of their diversity and community structure in the Himalayan region remains limited. This study investigates the diversity, trophic composition, and community structure of free-living soil nematodes across altitudinal gradients in the Pir Panjal Range, Jammu and Kashmir, India. Soil samples are being collected from representative forest and grassland ecosystems along an elevational gradient. Nematodes are extracted using the modified Baermann funnel technique, identified to the genus level using standard taxonomic keys, and classified into functional trophic groups. Community structure is assessed using the Shannon–Wiener, Simpson's, and Maturity indices in relation to soil physicochemical properties. Preliminary observations indicate that bacterivorous and fungivorous nematodes dominate nutrient-rich forest soils, promoting nutrient cycling and organic matter decomposition, while omnivorous and predatory nematodes enhance soil food-web stability. Altitudinal variation in nematode assemblages reflects changes in environmental conditions and ecosystem processes. By demonstrating how below-ground biodiversity supports soil functions essential for nutrient availability and sustainable plant productivity, this study highlights the significance of conserving soil biodiversity as a key component of food and nutrition security, providing a scientific basis for sustainable land management and biodiversity conservation in fragile mountain ecosystems.

Keywords: Biodiversity, Nematodes, Soil health, Ecosystem functioning, Pir Panjal.

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Farming in the Anthropocene: Carbon Credits Help Agriculture Heal the Planet Without Abandoning Farmers

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Abstract

The Anthropocene, the proposed geological epoch in which human activity has become a dominant force reshaping climate, soils, ecosystems, and biodiversity, places agriculture at a critical crossroads. It is both a major driver of greenhouse gas emissions and land degradation and a potential site of ecological restoration, carbon storage, and rural resilience.

The Anthropocene, defined by human-driven planetary change, places agriculture at a critical crossroads. Agriculture contributes to greenhouse gas emissions and land degradation, yet it can also support soil restoration, carbon storage, and rural resilience. This review assesses whether agricultural carbon-credit systems can provide credible climate benefits without shifting disproportionate financial and ecological risks onto farmers. It compares private platforms, including Indigo Ag and Nori, with public and compliance oriented approaches in California, Europe, and Australia. Carbon credits can encourage sustainable practices. Their climate value, however, is constrained by uncertainty in soil carbon measurement, contested baselines, additionality concerns, and the possibility that stored carbon may be released through drought, land use change, or altered management. Such uncertainties make it difficult to convert long-term and locally variable ecological processes into reliable, tradable credits. They also raise questions about who bears liability when promised carbon benefits do not persist. Program design strongly shapes farmer outcomes. California's Healthy Soils Program reduces transition risk for participating farmers by providing upfront public grants for beneficial practices and recognizes co-benefits, including water resilience and soil health. Australia's credit-based soil-carbon framework, by contrast, has been criticized for high transaction costs, complex verification requirements, uncertain returns, and limited accessibility for smaller farms. Across these models, credit payments may not fully cover equipment, labour, yield-risk, data, and advisory costs, while intermediaries can retain a portion of revenues. Effective reform requires rigorous carbon-integrity standards, transparent and farmer-friendly contracts, accessible technical assistance, public transition finance, and payments that reward biodiversity, water stewardship, and resilience alongside carbon.

Keywords: Anthropocene, Agricultural carbon credits, Regenerative agriculture, Farmer welfare, Sustainable practices, carbon-market integrity.

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Evaluation of High-Intensity Sequential Intercropping Systems in High-Density Planted Cotton

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Abstract

Field experiments were conducted at four research centres of Tamil Nadu Agricultural University under irrigated and rainfed conditions to evaluate the performance of two-row high-intensity sequential intercropping systems in high-density planted compact cotton variety VPT 2. The study aimed to assess the effects of different intercropping systems on seed cotton equivalent yield (SCY), resource-use efficiency and economic returns. The experiments were laid out in a Randomized Block Design with three replications. Ten treatments comprised sole cotton and various combinations of black gram, cluster bean, coriander and amaranthus as first and sequential intercrops. Cotton was planted at a spacing of 100 × 10 cm, while two rows of intercrops were sown between cotton rows at 30 × 10 cm. The second intercrop was sown one day after harvesting the first intercrop. The results showed that all intercropping systems recorded higher seed cotton equivalent yield than sole cotton, demonstrating the complementary effects of intercropping. Among the treatments, sequential intercropping of amaranthus followed by cluster bean or black gram consistently produced superior yields across both irrigated and rainfed environments. The cotton + amaranthus - cluster bean system recorded the highest total seed cotton equivalent yield. Short-duration intercrops performed better than the other intercrops evaluated. Resource-use efficiency was also enhanced under sequential intercropping. Higher Land Equivalent Ratio (LER) and Relative Production Efficiency (RPE) were observed in cotton intercropped with amaranthus followed by cluster bean or black gram, indicating more efficient utilization of land and available resources than sole cropping.

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Economic analysis revealed that these systems generated the highest gross income, net income and benefit–cost ratio. The study concludes that sequential intercropping of two rows of amaranthus followed by either cluster bean or black gram in high-density planted cotton is a technically viable and economically profitable production system. Adoption of these intercropping systems can improve productivity, resource-use efficiency and farm profitability under both irrigated and rainfed conditions.

Keywords: Cotton, High density planting, Intercropping, Yield, Economics

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Plant Genomics & Genomic Sequencing

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Abstract

In recent years, single-cell omics technologies have significantly advanced plant and agricultural research, providing transformative insights into plant development, cellular heterogeneity, and environmental response mechanisms. Traditional bulk-level analyses often obscure differences between individual cells, whereas single-cell RNA Sequencing (scRNA-seq) and single-nucleus RNA sequencing (snRNA-seq) now reveal unique expression profiles Across distinct cell populations, facilitating the identification of novel cell types and elucidation of gene regulatory Networks. Additionally, epigenomic approaches like single-nucleus ATAC sequencing (snATAC-seq) offer a deeper Understanding of chromatin accessibility and its complex relationship with gene regulation. These technologies have Seen widespread application in model plants such as Arabidopsis thaliana, as well as in major crops and horticultural Plants, providing essential data for crop improvement and breeding strategies. Moving forward, with the continued Development and integration of single-cell multi-omics technologies, there will be greater depth of insight into cell-Type-specific regulation and complex trait analysis, bringing new opportunities for sustainable agriculture and crop Improvement.

Keywords: Plant single-cell omics, Single-cell transcriptomics, Biology Findings, Plants, Crops, Horticultural plants.

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From Incubation to Commercialization: A Systematic Review of Agri-Life Science Startups

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Abstract

The growing emphasis on sustainable agricultural production, food security, biotechnological innovation, and climate-resilient farming has led to the proliferation of Agri-life science startups globally. These ventures play a critical role in transforming scientific research into commercially viable products and services and the institutional infrastructure needed for innovation, technology commercialization and entrepreneurial development is provided by incubation ecosystems. Their success is contingent. Despite, the existing literature is scattered in the fields of agriculture, biotechnology, life sciences, entrepreneurship and innovation management, limiting the coherent understanding of the role of incubation ecosystems for sustainable entrepreneurship. This paper conducts a systematic literature review of the literature on Agri-life science startups and incubation ecosystems to synthesize the literature, highlight key success factors and present an integrated conceptual framework. The PRISMA 2020 methodology was followed, and a structured search of peer-reviewed articles were obtained from the Scopus, Web of Science and google scholar (for capturing the grey area) databases between 2015 and 2026 The selected studies are analyzed by applying the Theory-Context-Characteristics-Methodology (TCCM) framework and bibliometric analysis is applied to map publication trends, influential authors, collaborative networks, and emerging thematic clusters. Results show that four main factors affect the successful establishment of startups: entrepreneurial competencies, mechanisms available in incubation, the innovation and commercialization process, and the ecosystem enablers, which include policy, financing, and institutional cooperation. These results suggest that an integrated framework between ecosystems for incubation and sustainable innovation outcomes is proposed. It further revealed an empirical imbalance in the literature with the prime focus on macrolevel ecosystem enablers and limited attention to micro level mechanisms for governing technologies and concentration efficiency. The study expands the entrepreneurship and innovation discourse and has implications for practice, the university, the incubator, policy makers, and investors.

Keywords: Agri-life science startups; Incubation ecosystems; Sustainable entrepreneurship; Innovation and technology commercialization; Systematic literature review; TCCM framework

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Advanced Bioconversion and Valorization of Spirulina Biomass for Sustainable Highperformance Aquafeed Production

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Abstract

The present study evaluated the effect of Spirulina supplementation as a sustainable protein source in fish feed on protein accumulation and growth performance in goldfish (Carassius auratus). A low-cost, self-designed bioreactor with a capacity of approximately 20 L was developed for Spirulina cultivation, reducing the cultivation period from nearly 30 to 15 days through optimized growth conditions. The harvested biomass contained approximately 95% Spirulina with minimal contamination, making it suitable for feed formulation. Experimental diets containing 0%, 25%, 50%, and 75% Spirulina were prepared by blending commercial fish feed with Spirulina biomass and administered to goldfish for 30 days. Protein estimation of fish muscle tissue was performed using the Bradford assay, with a standard calibration curve showing excellent linearity ($R2 \approx 0.98$). Results demonstrated a dose-dependent increase in muscle protein content, with the 75% Spirulina group exhibiting the highest protein concentration (361.58 µg/mL) compared to the control (349.46 µg/mL). Although no significant improvement in growth rate was observed, all experimental groups showed 100% survival, confirming the safety of Spirulina supplementation. These findings suggest that Spirulina is a sustainable, costeffective, and environmentally friendly feed supplement capable of enhancing protein accumulation, with promising applications in sustainable aquaculture and functional feed development.

Keywords: Spirulina; Carassius auratus; Aquaculture; Bradford Assay; Protein Estimation; Sustainable Aquaculture.

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Valorization of Lignocellulosic Biomass into Bio-Adhesives, High-Value Aromatics, and Platform Chemicals through Sustainable Bioprocess Approaches

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Abstract

The sustainable valorization of lignocellulosic biomass through an integrated biorefinery approach offers an efficient strategy for producing renewable platform chemicals and bio-based materials while minimizing agricultural waste. In this study, Sugarcane bagasse and Phragmites karka were utilized as lignocellulosic feedstocks to fractionate cellulose, hemicellulose, and lignin through sequential acid and alkaline pretreatment using H_2SO_4 and NaOH. The recovered lignin was characterized by Fourier Transform Infrared spectroscopy (FTIR) to confirm its structural characteristics. The cellulose-rich fraction obtained after pretreatment was hydrolysed to glucose, which was subsequently dehydrated under acidic conditions to produce 5-hydroxymethylfurfural (HMF), an important renewable platform chemical with applications in biofuels, polymers, and fine chemicals. In parallel, the extracted lignin was subjected to oxidative alkaline depolymerization using hydrogen peroxide (H_2O_4), which selectively cleaves β-O-4 ether linkages to generate high-value aromatic compounds, vanillin. Vanillin were extracted using ethyl acetate and characterized by FTIR indicating O-H, C-H, C=O, -O-CH3, -C-O through comparison with standard vanillin. Furthermore, the isolated lignin first demethylated by Na2SO3 Solution, then this demethylated lignin was incorporated with a natural polymer (Chitosan) and an appropriate cross-linking system (Citric Acid) to develop a sustainable lignin-based bio-adhesive as an eco-friendly alternative to petroleum-derived adhesives. Overall, this integrated biorefinery demonstrates the comprehensive utilization of sugarcane bagasse and Phragmites karka for the production of HMF, vanillin, and lignin-based bio-adhesives, thereby maximizing biomass utilization and supporting waste valorization, sustainable resource management, and the circular bioeconomy. The developed products have significant potential for applications in the chemical, packaging, and wood composite industries.

Keywords: Lignocellulosic Biomass; Sugarcane Bagasse; Phragmites karka; 5-Hydroxymethylfurfural (HMF); Vanillin; Lignin-derived Bio-Adhesive; Sustainable Biorprocess.

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Forecasting Area, Production, and Productivity of Banana in Tamil Nadu Using Linear and Non-Linear Growth Models

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Abstract

Banana (*Musa spp.*) is one of the most important fruit crops in India and contributes significantly to food security, rural livelihoods, and the horticultural economy of Tamil Nadu. Reliable forecasting of banana area, production, and productivity is essential for effective agricultural planning, policy formulation, market regulation and sustainable resource management. The present study aimed to identify the most appropriate linear and non-linear growth models for predicting the area, production and productivity of banana in Tamil Nadu and to forecast their future trends up to **2028**. Annual time-series data covering a period of **42 years (1982–83 to 2023–24)** were obtained from the *Season and Crop Reports of Tamil Nadu*. A series of linear and non-linear growth models including linear, logarithmic, inverse, quadratic, cubic, compound, exponential, growth, power and S-curve models were fitted separately for area, production and productivity. The best-fitting model was selected based on the highest coefficient of determination (R^2) and the lowest values of Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE).

The results revealed that the **cubic model** was the most suitable for forecasting the area, production, and productivity of banana in Tamil Nadu demonstrating superior predictive performance compared with the other models. During the study period, the average banana area, production and productivity were **93,892 ha, 3,747,100 MT** and **43.10 MT ha^{-1},** respectively. Forecasts generated using the selected model indicated an overall increasing trend in banana cultivation over the coming years. By **2028**, the cultivated area is projected to reach **59,465.2 ha**, while production and productivity are expected to attain **2,935,523 MT** and **22.92 MT ha^{-1}** respectively. These findings demonstrate that the cubic growth model provides reliable long-term forecasts and can serve as an effective decision-support tool for policymakers, researchers and planners in developing strategies for sustainable banana production, efficient resource allocation and future horticultural development in Tamil Nadu.

Keywords: Banana, Forecasting, Time-series analysis, Linear models, Non-linear models, Cubic model, Area, Production, Productivity, Tamil Nadu.

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Eco-Friendly Crop Protection: Comparative In Silico Screening of Phytochemicals Against Bacterial and Fungal Pathogens

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Abstract

Plant diseases caused by bacterial and fungal pathogens remain a critical challenge to global food security, with *Xanthomonas campestris* (black rot in crucifers) and *Verticillium dahliae* (vascular wilt in tomato and other crops) representing two of the most destructive agents. Conventional chemical controls are increasingly constrained by resistance development and ecological concerns, underscoring the urgent need for sustainable alternatives. This study presents a comparative computational pipeline designed to identify pathogen-specific molecular targets and evaluate plant-derived phytochemicals as eco-friendly crop-protective agents.

The originality of this work lies in its dual-pathogen framework, which integrates bacterial and fungal systems within a single analytical workflow. Using hub-gene prioritization, protein–protein interaction mapping, and structured target management in SQLite3, we identified key proteins including the LolA–LolB complex in *X. campestris* and the PevD1 effector in *V. dahliae*. Five phytochemicals—curcumin, gallic acid, isocarvacrol, kaempferol, and luteolin—were virtually screened against these targets using CB-Dock2 and AutoDock Vina. Docking simulations revealed strong binding affinities and stable ligand–protein interactions, while in silico toxicity profiling provided an additional safety filter.

Several compounds, notably curcumin and luteolin, demonstrated promising dual-pathogen activity with favorable predicted safety profiles. By systematically narrowing large datasets into experimentally testable candidates, this integrated pipeline accelerates the discovery of natural bio-pesticides. The comparative design further highlights cross-kingdom phytochemical efficacy, offering insights into compounds with broad-spectrum potential. Overall, this study contributes a scalable, reproducible, and environmentally responsible strategy for crop protection, bridging computational biology with sustainable agriculture.

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Comparison of Grain Yield Performance of Maize (*Zea mays* L.) Inbred Lines Under Uninoculated and Artificially Inoculated Conditions for Post-Flowering Stalk Rot Resistance

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Abstract

Post-flowering stalk rot (PFSR), predominantly caused by *Macrophomina phaseolina* in India, is a major disease of maize, particularly under prolonged dry conditions, leading to significant yield losses. Developing high-yielding and PFSR-resistant inbred lines is a sustainable and cost-effective strategy for disease management. In the present study, sixty-two maize inbred lines were evaluated for resistance to *M. phaseolina* and grain yield performance under artificially inoculated and uninoculated conditions during the *kharif* 2020 season at the Maize Research Centre, Hyderabad, using a randomized block design with three replications. The fungal isolates used for artificial inoculation were procured from the Plant Pathology Division, Agricultural Research Institute, Rajendranagar, Hyderabad and disease severity was assessed by stem-splitting using a 1-9 rating scale. Under uninoculated conditions, PFSR-95 (110 g) recorded the highest grain yield, reflecting its superior genetic potential. Under inoculated conditions, the mean grain yield of the inbred lines declined to 56.7 g per plant, ranging from 20 g (Z-63-45) to 95 g (PFSR-95), demonstrating the adverse impact of disease stress on productivity. Grain yield comparison under uninoculated conditions revealed that the inbred lines MGC-9, MGC-93, MGC-15, MGC-82, PFSR-151, PFSR-46, PFSR-95, and GP-265 outperformed the check hybrid DHM-117, whereas under inoculated conditions, only PFSR-95 (95g) and PFSR-90 (93g) produced higher grain yield than DHM-117(90g), indicating superior resilience under disease pressure. Overall, PFSR-90 and PFSR-95 combined strong resistance with superior grain yield under inoculated conditions, while PFSR-95 consistently exhibited outstanding performance across both environments. These inbred lines represent valuable genetic resources for developing high-yielding, PFSR-resistant maize hybrids and support sustainable maize production in stress-prone environments.

Keywords: Post-flowering stalk rot, yield, maize inbreds and disease resistance

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Effect of Micronutrients and Plant Growth Regulators on Growth, Yield and Quality of Acid Lime (Citrus aurantifolia Swingle) Var. PKM 1 in Tamil Nadu, India

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Abstract

The present investigation was conducted at Citrus Research Station, Tamil Nadu Agricultural University, Vannikonenthal, Sankarankovil, Manur Taluk, Tirunelveli District, Tamil Nadu. India during the year 2022-23 and 2023-24. The aim is to find out the suitable micronutrients and plant growth regulators to improve yield and quality of acid lime. The experiment was laid out in a Randomized Complete Block Design with three replications and ten treatments. Among the different treatments, the treatment (T10) Growth regulators and Micronutrients consortia (NAA 20ppm+Cycocel 0.2%+GA 3 @ 50 ppm+Znso4 @0.5% + FeSo4 @0.5%+Borax @0.2%+Ascorbic acid @ 30ppm + KNO3 @ 0.2%) recorded the maximum tree height (3.16 m), tree spread 4.53 m (East - West) and 5.03 m (North - South), Days to first flowering (102 days), Number of flower per shoot (6.10 Nos.), fruit set (57.40%), fruit retention (42.15%), fruit girth (5.42 cm), fruit weight (42.50 g), Fruit volume (cc) (40.10), No. of fruits per tree (482.20), yield per tree (21.10 kg), B:C ratio 2.13, TSS (6.310 Brix), juice content (32.50 ml) acidity (7.25 %) and ascorbic acid content (31.50 mg/100g) during 2022-23. The similar trend was noticed during 2023-24, T10 (Growth regulators and micronutrients consortia) recorded the maximum tree height (4.25 m), tree spread 5.80 m (East - West) and 5.95 m (North - South), Days to first flowering (105 days), Number of flower per shoot (11.25 Nos.), fruit set (61.25%), fruit retention (48.10%), fruit girth (5.40 cm), fruit weight (43.25 g), Fruit volume (cc) (41.15), No. of fruits per tree (580.80), yield per tree (23.70 kg), B:C ratio 2.50, TSS (6.320 Brix), juice content (35.50 ml) acidity (7.50 %) and ascorbic acid content (33.40 mg/100g). The treatment (T10) Growth regulators and Micronutrients consortia (NAA 20ppm+Cycocel 0.2%+GA 3 @ 50 ppm+Znso4 @0.5% + FeSo4 @0.5%+Borax @0.2%+Ascorbic acid @ 30ppm + KNO3 @ 0.2%) recorded maximum growth, yield and quality of acid lime during 2022-23 and 2023-24.

Keywords: Acid lime, micro nutrients, growth regulators, growth, yield, quality

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Effect of Plant Growth Regulators and Chemicals on Seed Germination in Periwinkle (*Catharanthus roseus* L.)

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Abstract

Seed germination experiments was undertaken to find out the "Effect of Plant growth regulators and chemicals on seed germination in Periwinkle" at College Orchard, AC&RI, Madurai during the year 2025. The experiment revealed that the seeds treated with gibberellic acid 50ppm (T2) recorded maximum seed germination percentage (93%), number of days taken for germination (4.3 days), Seedling height (13.7 cm), number of leaves per seedlings (9.7), root length (5.9 cm), root girth (0.53 cm) and weight of the seedling (16.6 gm) when compared to control

Keywords: Periwinkle, Gibberellic acid, Germination, Seedling height and Number of leaves.

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Climate Smart Agricultural Practices in India for Greenhouse Gas Mitigation

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Abstract

This paper explores Climate Smart Agriculture (CSA) as an important strategy for reducing greenhouse gas emissions from India's agricultural sector. It evaluates a range of CSA practices adopted across the country, with emphasis on their potential to lower emissions while improving food security and enhancing farmers' livelihoods. The discusses crop management practices, including the use of improved crop varieties, efficient nutrient management, and optimized water management, as well as soil management approaches such as conservation agriculture and agroforestry. System of Rice Intensification (SRI) is an effective climate-smart agricultural practice that reduces methane emissions by approximately 40%. In addition, it decreases water use by 25–50% while improving soil health. Integrated nutrient management reduces nitrous oxide emissions by about 20–30% through the efficient use of fertilizers. It also improves soil fertility and structure, leading to sustainable increases in crop productivity. Conservation agriculture can reduce carbon dioxide (CO_2) emissions by up to 50%. Furthermore, it enhances soil moisture retention, thereby improving soil quality and resilience. Agroforestry systems sequester approximately 2-4 tons of CO_2 ha-1 year-1 per hectare per year, making them an effective strategy for carbon storage. These systems also promote biodiversity and improve ecosystem health. Biogas production from animal manure captures up to 60% of potential methane emissions. This practice also reduces dependence on firewood and fossil fuels, contributing to cleaner energy use. Precision farming techniques reduce greenhouse gas emissions by 10-20% through the efficient use of agricultural inputs. They also minimize environmental contamination caused by excessive fertilizer and pesticide application. Alternate Wetting and Drying (AWD) is an effective irrigation practice that reduces methane emissions by 30-50% while saving up to 30% of irrigation water. The use of nitrification inhibitors lowers nitrous oxide emissions by approximately 30-40%. In addition, these inhibitors improve nitrogen-use efficiency and enhance crop yields. Crop diversification significantly increases the amount of carbon stored in the soil. It also reduces the incidence of pests and diseases while improving food and income security for farmers. These climate-smart agricultural practices are highly effective in reducing greenhouse gas emissions.

Keywords: Sustainable Agriculture, Climate-Smart Agriculture, Greenhouse Gas Emissions, Food Security

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Identification of Key Regulators of Metabolic and Immune Signaling in EBV-Associated Diffuse Large B-Cell Lymphoma

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Abstract

Epstein–Barr virus (EBV) is a well-established oncogenic virus associated with several lymphoid malignancies, including diffuse large B-cell lymphoma (DLBCL). However, the molecular mechanisms underlying EBV-driven DLBCL remain incompletely understood. This study aimed to identify shared molecular signatures and key regulatory genes linking EBV infection and DLBCL through integrated bioinformatics analyses. Three Gene Expression Omnibus (GEO) datasets comprising EBV-transformed B cells, DLBCL patients, and EBV-positive DLBCL samples were analyzed. A total of 487 differentially expressed genes (DEGs) were identified across all datasets. Functional enrichment analysis revealed significant involvement of p53, MAPK, cytokine–cytokine receptor interaction, viral response, and immune regulatory pathways. Protein–protein interaction network analysis identified ICAM1, CXCR4, FYN, IRF4, and PECAM1 as key hub genes. GeneMANIA analysis linked these genes to leukocyte migration, lymphocyte differentiation, interferon-γ response, and cell adhesion. Immune infiltration analysis demonstrated strong associations between key genes, diverse immune cell populations, and immune checkpoint molecules. GSEA further revealed activation of oxidative phosphorylation, TCA, proteasome, ubiquitin-mediated proteolysis, mTOR, TLR, and RIG-I-like receptor signaling pathways in EBV-positive DLBCL. Drug enrichment analysis identified dexamethasone, tretinoin, rosiglitazone, and mangiferin as potential therapeutic candidates. Collectively, these findings highlight novel biomarkers, therapeutic targets, and molecular mechanisms involved in EBV-associated DLBCL.

Keywords: ICAM1, CXCR4, IRF4, FYN, EBV Positive DLBCL

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Sustainable Food Systems Through Agroecology and Organic Farming

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Abstract

Agroecology and organic farming are now the main frameworks for ecological transformation due to the pressing need for a global shift toward sustainable food systems. Despite their frequent interchangeability, these two ideas present different approaches to sustainability. In order to elucidate the synergistic potential and distinctive contributions of agroecology and organic farming to agricultural science and policy, this review paper assesses the conceptual underpinnings, regulatory frameworks, production techniques, and socioeconomic aspects of these fields. A comprehensive analysis of recent literature (2020–2026) was conducted, focusing on comparative studies, policy assessments, and technical reports addressing system-level agricultural transitions. The analysis reveals that while both systems share core ecological goals such as soil health maintenance, biodiversity conservation, and chemical input reduction they differ significantly in scope and governance. Organic farming is primarily characterized as a production system governed by strict certification standards and market-driven policies (e.g., IFOAM, EU regulations). In contrast, Agroecology is defined as a transdisciplinary science that integrates ecological, social, and political dimensions, emphasizing farmer empowerment and social justice over standardized certification. Both systems face similar challenges, notably the "yield gap" compared to conventional agriculture, which requires scientific innovation in breeding, digitalization, and landscape redesign rather than simple input substitution. The findings suggest that future food security depends on a hybrid approach that leverages the regulatory rigor of organic farming with the socio-political transformative power of agroecology. Aligning both frameworks with the Sustainable Development Goals (SDGs) and prioritizing public policies that foster genuine farmer autonomy are critical for achieving a resilient and equitable global food system.

Keywords: Agroecology, Organic Farming, Sustainable Agriculture, Food Systems, Ecological Intensification, Agricultural Policy.

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Study of Impact of Crusher Site on Vegetation Growth and Development

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Abstract

Dust emitted from crusher units are one of the major source of air pollution. Plants around the crusher act as a sink for absorbing pollution, but they are considerably affected by it. This study was carried out to assess the impact of crusher site on vegetation growth and development around the crusher at Kangoli, Dharampura Jagdalpur. The vegetation was studied at different distances (0-10m, 10-20m, 20-30m) and at all four directions and also on the exposed and non-exposed sides of tree. A significant reduction in growth parameters was observed on plants which were near to crusher. Change in chlorophyll content was also investigated and a significant reduction in chlorophyll content was revealed on the exposed side of plant which was due to heavy deposition of dust fall from crusher. The present study clearly indicate that stone crushing dust adversely affect the growth and chlorophyll content of vegetation.

Keywords: Chlorophyll, Leaf, Air Pollution, Crusher, Dust

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BARX1-GATA4 Regulatory Crosstalk in Human Dental Pulp Stem Cells: An Integrative siRNA, Docking, and Network Pharmacology Study

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Abstract

Human dental pulp stem cells (DPSCs) are a highly accessible mesenchymal stem cell source with strong regenerative potential. In this study, we investigated the expression and functional relevance of the transcription factors BARX1 and GATA4 in DPSCs and explored their possible role in differentiation-associated signaling networks. DPSCs were isolated from third molar pulp tissue and characterized by morphology, qPCR, western blotting, and immunofluorescence. BARX1 was expressed at a higher level than GATA4 at both mRNA and protein levels, suggesting a prominent role in maintaining DPSC biology. To determine the functional importance of BARX1, transient siRNA-mediated knockdown was performed, which resulted in a significant reduction in DPSC proliferation and confirmed efficient gene silencing. In silico docking analysis suggested a favorable interaction between BARX1 and GATA4, indicating potential cooperative regulation. Furthermore, transcriptomic reanalysis of two public human DPSC RNA-seq datasets identified 662 differentially expressed genes, including 435 upregulated genes, with enrichment in pathways related to PI3K-Akt, MAPK, NF-kappa-β, TNF signaling, osteoblast development, and extracellular matrix organization. PPI analysis identified major hub genes associated with inflammatory, translational, and extracellular matrix-related regulation. Collectively, these findings support BARX1 as an important regulator of DPSC proliferation and suggest that BARX1-GATA4-associated networks may contribute to stem cell fate control and regenerative differentiation programs.

Keywords: DPSC, BARX1, GATA4, Network pharmacology

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Pharmacognostic Evaluation, Phytochemical Profiling, and Biological Activities of Crassula ovata: Bridging Ethnomedicine and Modern Therapeutics

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Abstract

Crassula ovata (Jade Plant), a succulent species belongs to the Crassulaceae family, possesses significant ethnomedicinal, environmental, and pharmacological importance. Beyond its global popularity as an ornamental indoor plant and air purifier utilizing Crassulacean Acid Metabolism (CAM) for carbon capture, C. ovata has a rich history in traditional medicine across Asia and Africa and also used in Chinese remedies for diabetes, Khoi and Maasai practices for gastrointestinal distress, and local African applications for treating warts, burns, epilepsy, and wound healing. Recent pharmacognostic and phytochemical screenings confirm the presence of bioactive constituents, including saponins, phenols, phytosterols, steroids, terpenoids, flavonoids, carbohydrates, and proteins. Pharmacological evaluations highlight its diverse biological potential, methanolic leaf extracts demonstrate strong antidiabetic efficacy via alpha amylase inhibition (up to 83% at 700 µg/mL), while aqueous extracts exhibit powerful antioxidant activity (85% scavenging at 200 µg/mL). The extracts show notable antimicrobial activity against *Escherichia coli, Pseudomonas*, and *Klebsiella species,* alongside emerging evidence supporting mucolytic, cytotoxic (anti-cancer), anti-inflammatory, and tissue-regenerative properties. These promising therapeutic attributes, current applications are constrained by potential veterinary toxicity, unstandardized extraction methods, and limited animal model validation. Fully unlocking the pharmaceutical value of *C. ovata* requires targeted future research focusing on isolating pure bioactive molecules, mapping genetic mechanisms, conducting detailed toxicological assessments, and executing rigorous in vivo clinical studies.

Keywords: Bioactive compounds; Phytochemical screening; Ethnomedicine; Antimicrobial activity; Pharmacognosy

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Climate-Smart Indigenous Plant-Factory System for Sustainable High-Value Crop Production

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Abstract

To meet the needs of a 9 billion population, while managing land, water use, and emissions for UN SDG 2030, agricultural productivity must increase by 70% by 2050. Per capita agricultural land has declined by 22% since 2000, making traditional farming insufficient to meet rising food demands. Plant factories with fully controlled environments offer consistent productivity, better produce quality and efficient resource use compared to greenhouses or open-field cultivation. The construction of low-cost plant factory offers a highly controlled environment, optimizing light, nutrition, and other climatic conditions to maximize crop productivity. The indigenous low-cost plant prototype (2.5 m length, 1.3 m width, and 2.6 m height) had four tiers. The indoor plant factory systems had higher productivity compared to outdoor soil-based cultivation methods. We compared both the systems having the same cultivation area (3.25 m^2), where the plant factory system accommodated 312 plants, which is 7 times more than the field-grown plants (43). Higher yield (41 kg) was recorded in the indigenously designed plant factory prototype, *i.e.* 11 times higher than the soil-based system (3.8 kg). This production system also enhanced the light, nutrient, and water use efficiencies optimizing the space and boosting yields. The B:C ratio for the proposed system was higher (2.68) compared to open-field cultivation (1.00). The energy efficiency and cost could be further optimized using solar photovoltaic panels. The tentative cost of the unit was worked out to be Rs.1,13,000/- with a breakeven point of 1 ½ years.

Keywords: Indigenous Plant Factory; Sustainable Farming; High-Density Cultivation; Resource Efficiency; Indoor Agriculture.

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Fructooligosaccharides Improve Glycemic and Inflammatory Outcomes in Gestational Diabetes Mellitus through the Gut-Metabolic Axis: A Randomized Controlled Trial

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Abstract

Background: Gestational Diabetes Mellitus (GDM) is a growing metabolic complication of pregnancy with significant maternal and neonatal risks. While conventional management focuses on diet and pharmacotherapy, targeting the gut microbiota represents a novel therapeutic frontier. Prebiotics such as fructooligosaccharides (FOS) have shown potential in modulating metabolic and inflammatory pathways; however, their role in GDM remains underexplored.

Objective: To evaluate the effect of FOS supplementation on glycemic parameters, inflammatory markers, and gut microbiota in women with GDM.

Methods: A total of 923 pregnant women from a tertiary care hospital in rural Vadodara were screened, identifying 76 (8%) with GDM. In a randomized controlled trial, 62 GDM women were allocated to control (n=30) and experimental (n=32) groups. The experimental group received 10 g/day FOS for 90 days. Glycemic indices (FBS, HbA1c), inflammatory markers (hs-CRP, IL-6), and gut microbiota (Bifidobacterium, Lactobacillus, *Escherichia coli*) were assessed pre- and post-intervention.

Results: FOS supplementation resulted in significant reductions in FBS by 2.8% and HbA1c by 4.3%. A significant decline in IL- 6 (3%, $p<0.01$) was observed, while hs-CRP showed a non-significant reduction. Notably, FOS induced a favourable microbiota shift, with a significant increase in Bifidobacterium (15%) and reduction in *E. coli* (22%), alongside a modest rise in Lactobacillus. IL-6 demonstrated a negative correlation with Bifidobacterium, whereas HbA1c positively correlated with *E. coli*.

Conclusion: This novel study demonstrates that FOS supplementation can beneficially modulate the gut-metabolic axis, improving glycemic control and reducing inflammation in GDM. FOS emerges as a promising, non-pharmacological adjunct in GDM management, warranting further large-scale validation.

Keywords: Prebiotics, Gestational Diabetes Mellitus, Gut microbiota, Inflammatory markers, Pregnant women.

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Integrated Phosphorus Management: A Sustainable Approach to Enhancing Groundnut Yield in Red Soils

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Abstract

The rising cost of soluble phosphate fertilizers has increased the need for economical and sustainable alternatives to conventional phosphorus (P) fertilizers for improving soil fertility and enhancing phosphorus use efficiency. Among the available options, rock phosphate has gained considerable attention due to its ability to increase phosphorus availability by enhancing its dissolution following soil application. Similarly, biochar has emerged as an environmentally friendly and cost-effective soil amendment with significant potential to improve soil quality and crop productivity.

In addition to increasing soil organic carbon and contributing to climate change mitigation, biochar plays an important role in improving the physical, chemical, and biological properties of soil. Its application enhances soil structure, porosity, and water-holding capacity while influencing soil pH, electrical conductivity (EC), cation exchange capacity (CEC), and organic carbon content. Furthermore, it enhances phosphorus availability from both mineral and organic sources and increases the use efficiency of nitrogen, phosphorus, and potassium. Earlier studies have demonstrated that the combined application of biochar with inorganic fertilizers improves soil fertility, root growth, crop development, and ultimately grain yield.

To evaluate the effectiveness of integrated phosphorus management, a field experiment was conducted in a randomized block design with three replications. The treatments comprised rock phosphate alone, rock phosphate combined with single superphosphate, phosphor bacteria, phosphor bacteria-enriched compost, biochar, and a control without phosphorus application. Among the treatments, the application of rock phosphate and biochar in a 75:25 ratio, incubated for 30 days before sowing (T_7), recorded significantly higher plant height, number of branches, leaf area index, and dry matter production. The same treatment also produced a significantly greater number of mature pods per plant and a higher harvest index. Consequently, the application of rock phosphate and biochar in a 75:25 ratio, incubated for 30 days before sowing recorded the 32.1 percent higher dry pod yield was recorded in the same treatment and 55 per cent higher net returns was realized over control, demonstrating that the integrated application of rock phosphate and biochar is an effective and economically viable strategy for maximizing groundnut productivity in red soils.

Keywords: Rock Phosphate, Bio char, Enriched FYM

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Influence of Integrated Nutrient Management on Enhances Soil Nutrient Status and Microbial Population in Pomegranate (*Punica granatum* l.) cv. Bhagwa

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Abstract

A study was carried out at farmer's field, Bagepalli taluk, Chikkaballapur district to determine the impact of integrated nutrient management on soil nutrient content and soil microbial population of pomegranate (*Punica granatum* L.) cv. Bhagwa. The experimental plot was laid out in a randomized complete block design with three replications and twelve treatments. The available soil nutrient content such as nitrogen, phosphorous, potassium, calcium, magnesium and micronutrient content were estimated during course of the experimental study. Along with that, soil microbial population count was also recorded. From the experimental study, the soil nutrients content after the fruit harvest indicated that, in a plants treated with 100 per cent RDF + vermicompost (5kg/plant) + neem cake (1kg/plant) + trichokawach (100g/plant) + darakshak (4ml/litre) foliar application + VAM (50g/plant) + *Penicillium pinophilum* (20g/plant) + seaweed extract (20g/plant) + chitosan (2g/litre) + salicylic acid (300ppm) + phosphoric acid (3ml/litre) + micronutrients through soil and foliar application + growth regulators (foliar application) (T_{12}) recorded the maximum uptake of nutrients and noticed minimum soil nitrogen (333.45 kg/ha), phosphorus (25.63 kg/ha), potassium (195.46 kg/ha), calcium (8.41 meq/100g), magnesium (2.62 meq/100g) and micronutrients content such as manganese (3.07 ppm), zinc (0.63 ppm), iron (4.09 ppm) and copper (0.37 ppm) respectively. The observations recorded on number of Pseudomonas and Trichoderma count in a soil sample revealed that, the maximum increase in soil Pseudomonas and Trichoderma count were observed in a plants treated with T_{10} and T_{12} (6.72 and 3.66 cfu/g/10^{-8}) respectively. Therefore, combined application of inorganic fertilizers, organic manures, bio-fertilizers, bio-stimulants and growth regulators (T_{12}) increased the availability and absorption of plant nutrients from the soil by enhancing the soil microbial activity.

Keywords: Bio-fertilizers, bio-stimulants, soil nutrients and microbial population

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Effect of Control Release Fertilizers on Vegetative, Gas Exchange attributes, and Nutrient Status of *Philodendron erubescens*

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Abstract

Philodendron erubescens, commonly known as the Philodendron pluto, is a popular ornamental plant species belonging to the family Araceae. Due to the bright green colour, this species is one of the leading indoor plants in commercial market. The current study investigated the efficacy of controlled-release fertilizers (CRFs) in accelerating the growth of tissue-cultured *Philodendron pluto* to commercial saleable size . Two CRF treatments - Basacote High K 6M +Hydrospeed CaB-Max and Organic CRF + Hydrospeed CaB-Max were compared against control using conventional water-soluble fertilizer. Forty-five-day-old tissue-cultured plantlets were evaluated over 60 days for morphological parameters, root development, physiological responses, and nutrient uptake. A CI-340 Handheld Photosynthesis Machine was employed to measure photosynthetic rate, transpiration rate, and stomatal conductance. Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) was used for precise quantification of foliar macro- and micronutrient concentrations. Results demonstrated that Basacote High K 6M + Hydrospeed CaB-Max significantly outperformed both Organic CRF + Hydrospeed CaB-Max and the control in accelerating plant growth to commercial standards. Basacote High K 6M + Hydrospeed CaB-Max treated plants reached a maximum mean height and spread after 60 days, approaching the target saleable size . Root morphology analysis using WinRHIZO software revealed enhanced root system development in Basacote High K 6M + Hydrospeed CaB-Max plants, indicating improved establishment. Physiological measurements showed higher photosynthetic rates , transpiration rates , and stomatal conductance in Basacote High K 6M + Hydrospeed CaB-Max plants. ICP-MS analysis indicated superior nutrient uptake and accumulation in T1-treated plants, particularly for calcium, potassium, magnesium, and iron. Strong positive correlations between physiological parameters and morphological traits suggest that enhanced nutrient availability from CRFs contributed to accelerated growth and improved plant quality. This study elucidates the potential of tailored CRF formulations to optimize the rapid establishment of tissue-cultured Philodendron Pluto into marketable plants, offering valuable insights for commercial nursery production practices.

Keywords: Stomatal conductance, transpiration rate, photosynthetic rate, root morphology, control release fertilize.

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Identification and Conservation of Elite Indigenous Seedling Mango (*Mangifera indi ca* L.) Germplasm for Sustainable Utilization in the Shivalik Region of Himachal Pradesh

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Abstract

The rapid replacement of indigenous seedling mango (*Mangifera indica* L.) populations with commercial cultivars has accelerated genetic erosion, threatening valuable plant genetic resources in the Shivalik region of Himachal Pradesh. Conserving elite seedling germplasm is essential for maintaining biodiversity, supporting climate-resilient breeding and promoting value-added processing. The present study aimed to identify superior indigenous seedling mango genotypes suitable for pickle processing while facilitating their conservation and sustainable utilization. Representative seedling mango populations were surveyed across six blocks of Hamirpur district during 2023–2024 and characterized using standardized physico-chemical descriptors. Superior genotypes were identified through a weight and score method, wherein key horticultural and pickle-quality traits were assigned weighted values according to their relative importance. Based on cumulative weighted scores, three elite genotypes (G26, G12 and G11) were selected. Genotype G26 exhibited superior fruit weight (165.81 g), peel thickness (2.93 mm), titratable acidity (2.63%) and total phenolic content (316.80 mg GAE 100 g^{-1}), whereas G12 recorded the highest fruit weight (168.05 g). Genotype G11 was characterized by the highest pulp-to-stone ratio (4.21) and crude fibre content (8.31%), indicating its suitability for pickle processing. Scion wood of the selected genotypes was collected and successfully propagated through veneer grafting in the nursery of the Department of Fruit Science, College of Horticulture and Forestry, H.P, to facilitate their ex situ conservation and future multiplication. These elite genotypes represent valuable indigenous germplasm for sustainable utilization and biodiversity conservation, thereby contributing to climate-resilient horticulture and enhanced livelihood opportunities through value-added processing.

Keywords: *Mangifera indica,* genotypes, conservation, sustainable utilization, pickling

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Assessment studies over the identification of anti microbial peptides (AMPs) from Chinese chestnut (*Castanea mollissima*)

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Abstract

Nut crops are the high value members of fruit crops. One of the main constraints in the augmentation of nut crop production is potential microbial diseases. Chemical method of microbial control reduces their quality and failed to meet the standards of international market. And the chemical method of management also has contributed to microbial resistance which is a major threat to plants, animals and human health, and over the time this condition becomes worse worldwide. Hence discovering novel antimicrobial agents gained significant importance. Here comes the relevance of Antimicrobial peptides. Antimicrobial peptides possess several advantages slower development of resistance, broad-spectrum antibiofilm activity, and the ability to favourably modulate the host immune response which are lacking in conventional antibiotics. The current study was performed to identify potential Anti Microbial Peptides (AMPs) present in one of the whole genome sequenced nut crops (*Chinese chestnut*). Potential AMPs were predicted using normal blast and Macrel AMP prediction tool. From the overall identified AMP sequences 10% of desirable AMPs that are of low e-value and high identity percentage were filtered out. Categorization of these potential AMPs based on physicochemical properties be would pay the easy and significant way for the retrieval of desired AMPs with desired parameters in future studies.

Keywords: Chinese chestnut, Nut crops, AMPs, Microbial resistance.

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Enhanced Bioavailability of Astaxanthin via Liposomal Encapsulation with Shatavari Extract for Management of PCOD

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Abstract

Astaxanthin, a marine-derived xanthophyll carotenoid, exhibits potent antioxidant and anti-inflammatory properties but suffers from poor aqueous solubility and low bioavailability, limiting its therapeutic application. This study aimed to enhance the bioavailability of astaxanthin through liposomal encapsulation combined with a plant-derived bioenhancer for potential application in Polycystic Ovary Syndrome (PCOD) management.

Astaxanthin was extracted from shrimp exoskeleton using ultrasound-assisted extraction with acetone, a sustainable and solvent-efficient technique. The extract was encapsulated into liposomes using soy lecithin and cholesterol. Shatavari (*Asparagus racemosus*) root extract, known for its role in managing hormonal and reproductive disorders, was incorporated as a natural bioenhancer to synergistically improve therapeutic efficacy. Formulated liposomes were characterized using UV–Vis spectroscopy, FTIR, DPPH antioxidant assay, and antimicrobial testing. Successful astaxanthin encapsulation was confirmed by a characteristic absorbance peak at 476 nm. Antioxidant assays demonstrated concentration-dependent free radical scavenging activity, indicating retained bioactivity post-encapsulation. Incorporation of Shatavari extract is expected to further enhance systemic bioavailability and offer synergistic benefits for oxidative stress-related conditions such as PCOD.

This study presents a novel, sustainable nutraceutical strategy combining marine-derived carotenoids with Ayurvedic bioenhancers, offering a promising platform for improved bioavailability and targeted application in women's reproductive health.

Keywords: Astaxanthin, Liposomal encapsulation, Shatavari, Bioavailability, PCOD, Ultrasound-assisted extraction

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Production and Microbial Application of Nano-particles Produced from Plan Extract

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Abstract

Nanoparticles, operating at the frontier of science, are one of the smallest materials known to mankind yet they carry the most consequential impacts that's quite appealing within the arena of agriculture, medicine and environmental sustainability. Nanoparticles are characterized by their nanoscale dimensions with well-known high area-to-volume ratio with emerging impacts in biomedical and antimicrobial applications. Nanoparticles are uniform throughout their properties and also exhibit unique physicochemical characteristics. In this study we synthesize ZnO nanoparticles from the two well-known medicinal plants, *Lilium candidum* (Madonna lily) belonging to family Liliaceae, and Ocimum tenuiflorum (holy basil) belonging to family Lamiaceae. These leaves were dried, powdered and extracted by heating at 60° C with distilled water and then gradually the phytochemicals were obtained. The standard laboratory equipments such as autoclave, shaker, centrifuge, hot plate, punch borer, inoculation loop, petri dishes, test tubes were used that reinforced the formation of ZnO nanoparticles. Consequently, broths were prepared to evaluate the antimicrobial and antifungal properties. This was done by inoculating 4 strains of bacteria which are Salmonella typhi a gram-negative bacteria, *Pseudomonas aeruginosa* a majorly studied bacteria additionally Listeria monocytogenes and Escherichia coli were used. 5 strains of fungus which are *Aspergillus niger* one of the most studied fungus, Aspergillus flavus that is known for producing toxic compounds, A*spergillus fumigatus* a clinically dangerous fungi, *Penicillium chrysogenum* which is the original source of penicillin and Rhizopus oryzae which represents a different fungal class were inoculated for testing the antifungal (efficacy) activity using the most common method agar well diffusion method. Results highlighted that *Lilium candidum* derived nanoparticles confirmed increased antibacterial activity compared to *Ocimum tenuiflorum* derived nanoparticles, specifically against *Pseudomonas aeruginosa* and *Salmonella typhi*. These findings highlight the transformative potential of plant mediated ZnO nanoparticles for an eco-friendly approach.

Keywords: ZnO nanoparticles, green synthesis, plant-mediated nanoparticles, lilium candidum, ocimum tenuiflorum, phytochemical extraction, antimicrobial activity, antibacterial properties, antifungal activity

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Reference-based Genome Assembly of *Jasminum* spp.: Towards Genomics-assisted breeding in Jasmine

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Abstract

Jasmine (*Jasminum* spp.) belonging to Oleaceae is a predominant ornamental crop grown in asian countries its fragrant flowers, phytochemical composition and attractive plant architecture. The high economic and ornamental significance and aesthetic value of jasmine demands the evolution of new varieties with improved quality and yield traits. Genome sequencing has become a key enabling tool to document the genetic variation at the highest resolution and use them for plant improvement. The present study evaluated thirteen *Jasminum* genotypes for their morphological, sensory, volatile and genomic characteristics to support floral fragrance improvement. Based on morphological and sensory characteristics, three *Jasminum* genotypes were considered for further analysis. Volatile metabolite profiling using GC-MS identified esters and terpenoids as the primary classes of compounds shaping fragrance profiles across contrasting genotypes. Reference-based genome assembly was attempted using the genome of *J. sambac* (GWHAZHY00000000) for genome assembly, gene annotation, and variant analysis. The generated genomic sequence data contained 15.31 Gbases with >Q30 of 39%; 7.1 Gbases for *J. sambac* Acc. Js. 35, 5.16 Gbases for *J. grandiflorum* White Pitchi and 3.02 Gbases for *J. multiflorum* CO. 1 Winter Jasmine. By mapping the reads to the reference genome, 73,575 SNPs and 8,441 InDels were detected in *J. sambac* Acc. Js. 35, 45,855 SNPs and 4,235 InDels were detected in *J. grandiflorum* White Pitchi and 96,134 SNPs and 7,767 InDels were detected in *J. multiflorum* CO. 1 Winter Jasmine.

Keywords: Floral scent biosynthesis, *Jasminum sambac*, Reference-based assembly, Structural variation

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Consumer Awareness, Dietary Preferences and Food Safety Perception in Meat Consumption: Insights from Tamil Nadu

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Abstract

Meat is a major dietary source of high-quality protein, yet consumer-level dietary preferences, nutritional awareness and food safety practices around meat remain under-studied in Tamil Nadu. This study examined meat consumption behaviour, dietary choices and food safety awareness among 260 consumers using a structured Google Form-based questionnaire administered in the Tamil language. Mutton/chevon (79.23%) and chicken (77.69%) were the most preferred meat types in the regular diet, while nutritionally valuable alternatives such as beef (10.77%), rabbit (9.23%) and pork (8.85%) remained largely outside consumer dietary patterns, reflecting a gap in nutritional awareness rather than availability alone. Nutritional value was the leading motivator for meat choice, cited by 67.31 per cent of respondents, ahead of habitual consumption (47.69%) and taste (40.38%), indicating that consumers are nutrition-conscious even where their dietary diversity remains narrow. Nearly all respondents (99.23%) sourced meat from local stalls, with quality (55.00%) as the dominant selection criterion, and weekly intake was moderate, with 57.69 per cent consuming meat one to two times a week, concentrated heavily on Sundays (95.76%). Fresh meat was overwhelmingly preferred (97.69%) over chilled or processed forms, and curry-based preparation dominated (93.85%), consistent with regional dietary tradition. On food safety, 64.62 per cent were aware of FSSAI norms for meat shops, yet only 20.00 per cent knowingly purchased from certified outlets, and 85.38 per cent held the misconception that home cooking eliminates all bacteria in meat, pointing to gaps in practical food safety literacy. High price was the foremost barrier to accessing quality meat (70.00%), with 53.08 per cent perceiving current prices as excessive. The findings point to a clear opportunity for food science and nutrition education to broaden dietary diversity toward underutilised, nutrient-rich meats, alongside targeted food safety literacy programmes addressing cooking practices and certification awareness, to support healthier and safer meat consumption among consumers in Tamil Nadu.

Keywords: Meat Consumption, Dietary Preference, Nutritional Awareness, Food Safety Perception, Tamil Nadu

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Evaluation of Samba Type Chilli (*Capsicum annum.L*) Genotypes for High Yield and Fruit Quality

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Abstract

An investigation was carried out in Chilli (*Capsicum annuum*) for the development of an improved variety in Chilli suitable for high yield with pungency. Germplasm collected from, IIVR, Varanasi Department of Vegetable Science (DVS), HC& RI and Ramaiah Gene Bank, TNAU, and and from farmers fields in chilli growing belts of Vilathikulam, Ramanathapuram, Thirunelveli and from Odukkathur Village, North Arcot were evaluated during 2024 April to October and performance of the germplasm were recorded.During 2025 twenty five germplasm were evaluated from March 2025 to August 2025 and performance was recorded and presented here. Plant height ranged from 50.55 cm (PBC-522) to 102.20cm (ODR Ch-5). The number of branches ranged from 2.2 (Pavoorchatram-1) to 6.0 (Convant). The number of fruits ranged from 13.0 (Pavoorchatram-1) to 167.50 (BS-39) followed by the accessions viz., ODR Ch-3 (155.50 fruits per plant), TVL-2 (115.0 fruits per plant), ODR Ch-14 and ODR Ch-4 recorded 107.50 and 106.80 fruits per plant (Table.1). During December 2025 to 2026Observations are being recorded on plant height which ranged from 62.0 cm (DSL-2) to 135.40 cm (ODR Ch-5). Maximum number of branches recorded in BS-39 (7.20) followed by Acc Assam-10 and minimum number of branches 2.0 recorded in PBC-776, Pavoorchathiram-2 and ODR Ch-14. ODR Ch-4 followed by BS-39 recorded 44.20, ODR Ch-3 and Ramanathapuram Local-1 recorded 35.0 and 24.75 fruits per plant.during the first harvest-Number of fruits ranged from 6.60 in CB 5886 to 55.00 in In second harvest ,number of fruits ranged from 5.30 (TVL 5) to 67 fruits per plant (ODL Ch4) followed by 45 and 43 fruits per plant recorded in BS-39 and Ramanathapuram Local-1Maximum fruit length (cm) of 11.20, 10.40 and 10.30 cm was recorded in PB -776, Kashi Gaurav and PBC - 522 and girth (cm) was recorded 5.20 (PBC -1439), 5.0 and 4.90 cm in IIHR-MS-4, TVL - 4 and TVL-5.Individual fruit weight (g) was ranged from1.64g (Pb lal) to 9.25g (TVL-4) followed by TVL-5 (8.09g) and in Kashi Gaurav (7.6g)

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Pearl Millet (*Pennisetum glaucum L.*) Drought Response and Adaptation Strategies: Physiological, Molecular, and Agronomic Perspectives

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Abstract

Pearl millet (*Pennisetum glaucum L.*) is one of the most climate-resilient cereal crops, playing a critical role in food and nutritional security across the arid and semi-arid regions of Africa and Asia. This review synthesizes current knowledge of pearl millet's drought response and adaptation strategies, integrating physiological, biochemical, morphological, genetic, and agronomic perspectives into a single analytical framework rather than a stage-by-stage summary. Despite its exceptional heat and drought tolerance, pearl millet remains most vulnerable during the early seedling and reproductive stages. Key adaptive mechanisms are organized along the classical escape-avoidance-tolerance continuum: constitutive water-conserving traits and high abscisic acid (ABA)-mediated stomatal regulation (avoidance); fast-growing primary roots and asynchronous tillering that enable recovery from intermittent drought (avoidance/escape); and the stay-green phenotype, osmotic adjustment, and antioxidant defense (tolerance). Recent multi-omics studies have identified converging molecular pathways, including phenylpropanoid biosynthesis, antioxidant defense, and hormone signaling, together with hub genes such as ABI2, P5CS, DREB, and MYB. Advances in genomics-assisted breeding, QTL mapping, genomic selection, and high-throughput phenotyping have accelerated the development of stress-resilient varieties, complemented by agronomic strategies such as optimized sowing windows, precision nutrient management, and dual-purpose varieties. This review identifies four persistent, interconnected gaps: (i) drought memory and priming responses remain largely uncharacterized in pearl millet; (ii) root system architecture has rarely been studied under realistic field soils; (iii) combined-stress responses (drought with heat, salinity, or nutrient limitation) remain understudied; and (iv) translating controlled-environment omics findings into farmer-preferred field phenotypes remains slow. Closing these gaps requires integrating multi-omics data with field-based, participatory phenotyping rather than further single-discipline work. Strengthening pearl millet's role as an opportunity crop will be essential for building sustainable food systems in marginal environments.

Keywords: *Pearl millet; Drought tolerance; Climate resilience; Genomics-assisted breeding; Adaptation strategies*

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Cytotypic Diversity as a Breeding Resource for Developing High-Yielding and Climate-Resilient Sugarcane Hybrids

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Abstract

Sugarcane improvement requires broadening the genetic base to develop climate-resilient, high-yielding genotypes to meet the future demands for sugar and bioenergy. This study explored the potential of Saccharum *spontaneum* cytotypic diversity in sugarcane pre-breeding programme through the development of interspecific hybrids with elite high sugar commercial cultivars. A total of 120 F_1 progenies were developed using four different cytotypes (2n= 60,72,64 & 80) of *S. spontaneum* and validated using SSR markers. This confirmed 71 true hybrids with hybrid confirmation rate of 59.17%. The validated true hybrids exhibited significant phenotypic variation for important agronomic characters including plant height, cane diameter, single cane weight, and number of internodes. Correlation analysis revealed a strong positive association between cane diameter and cane weight, highlighting their importance in yield improvement. Principal Component Analysis and hierarchical clustering effectively classified the hybrids into distinct groups, with stalk diameter and cane weight contributing most to genetic divergence. The integration of molecular validation with phenotypic characterization enabled efficient identification of superior recombinants possessing desirable agronomic attributes. These findings demonstrate the value of exploiting cytotypic diversity in *S. spontaneum* to enrich the genetic base of cultivated sugarcane and enhance breeding efficiency. The identified hybrids represent valuable genetic resources for developing climate-resilient, high-yielding sugarcane cultivars suited to future breeding programs.

Keywords: Sugarcane, cytotypes, interspecific hybrids, SSR markers

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PhysioIndexR: An R Package for Physiological and Stress Indices for Crop Evaluation

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Abstract

Crop production systems are increasingly challenged by climate variability, resource limitations, and biotic–abiotic stresses, making stress tolerance indices and physiological trait estimators essential for identifying stable and superior genotypes, quantifying yield stability, and understanding plant adaptive responses. Despite their importance, computing these diverse indices and traits often involves repetitive manual calculations or scattered scripts without a unified computational framework. We developed PhysioIndexR, an open-source R package published on the Comprehensive R Archive Network (CRAN), that provides a unified and reproducible platform for computing commonly used stress tolerance indices, physiological traits, and derived metrics critical for crop improvement and physiology research. The package implements eleven classical stress tolerance indices: Tolerance (TOL), Stress Tolerance Index (STI), Stress Susceptibility Percentage Index (SSPI), Yield Index (YI), Yield Stability Index (YSI), Relative Stress Index (RSI), Mean Productivity (MP), Geometric Mean Productivity (GMP), Harmonic Mean (HM), Mean Relative Performance (MRP), and Percent Yield Reduction (PYR) with a convenience wrapper to compute all indices simultaneously. Two novel composite functions, the Weighted Mean Membership Function Value for Stress Tolerance (WMFVST) and the Weighted Average Stress Index (WASI), integrate multiple indices into composite metrics using direction-aware membership function values and weighted ranking approaches, respectively. Additionally, the package estimates key physiological traits including biomass accumulation and partitioning, total chlorophyll content from SPAD and CCI values, canopy temperature depression, and crop growth analysis parameters such as Leaf Area Index (LAI), Net Assimilation Rate (NAR), and Crop Growth Rate (CGR). A flexible ranking utility further supports genotype evaluation with multiple tie-handling options. By combining physiology-based traits with quantitative stress indices within a single reproducible framework, PhysioIndexR enables comprehensive crop genotype evaluation, facilitating informed decision-making in breeding pipelines and contributing to sustainable agricultural production under changing climatic conditions.

Keywords: Stress tolerance indices, Membership function value, Crop physiology, Genotype evaluation, R package.

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Vallabhbhai Patel Farmers Welfare Trust: A Trust for Farmers and their Generation

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Abstract

Farmers are backbone of Indian Agriculture and their generation's needs to be concentrated to achieve the empowered Indians. At present the farmers generation in India is not grown up to the level when compare to other sectors. This generation is should be taken into care in Education, Health, sports, caring society and culture. This generation is diverted especially in their genetic field (Agriculture, horticulture and other allied sectors) through providing education from higher secondary level to doctorate to work in the agricultural/horticultural/ allied sectors to solve the farmers problems (they will consider us family problems) and invent new technology to increase production and productivity, nutritional security to the emerging Indian Population. The Vallabhbhai Patel Farmers Welfare Trust, Madurai is a registered non-profit organization during 2018 and working socio economic status of for farmers and their generation. The objectives of trust include

1.To create awareness among farmers generation about CUTE, ICAR-AIEEA (UG), AIEEA (PG), CSIR Fellowship
2.Opening up of Coaching centre for CUTE/ ICAR AIEEA (UG) and AIEEA (PG) at block level through State Agricultural University or Farmer Producer Organization or Trust.
3.Sponsor for centre to conduct coaching /cost of study materials
4.Impact study after 10 years, numbers of farmers generation (Sons and daughters) diverted into Agriculture sectors and their socio-economic status

The concept of Farmers Generation will become Agricultural Scientists is one of the ideas to achieve the formation of more numbers of Empowered Indians in future and to avoid diversion of farmers generation (Sons and Daughters) into other field and take in to our Bharat become Developed Country

Keywords: Vallabhbhai Patel, Non-Profit Organization, Farmers Generation, Rural Development

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Hormetic Effects of Green-Synthesized Silver Nanoparticles on the Tripartite Symbiosis in Mung Bean (*Vigna radiata L.*)

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Abstract

Intervention via nanopriming has a synergistic effect on the tripartite symbiosis network, which is closely linked to the soil nutritional pool. In this study, lower to higher concentrations of silver nanoparticles (AgNPs; 1mM to 10mM) were subsequently planted in soil under natural climatic conditions. After 35days, both physical and biochemical parameters were evaluated. Experimental measurements of the plants, along with nodules characteristics (size, color, weight), were recorded to assess the impact of nanopriming on plant growth and symbiosis. Results showed that higher concentrations (10mM) of AgNPs had a negative impact on plant height, biomass, chlorophyll content, leghemoglobin levels and AMF colonization. However, a lower concentration of AgNPs (1mM) exhibits a bio-stimulatory response, showing marginal increases in plant growth, leaf area, chlorophyll content, along with remarkable positive responses in nodules dry weight, nodules number and leghemoglobin content. Therefore, it can be concluded that green synthesized AgNPs are beneficial at lower doses, whereas higher doses exert detrimental effect. However, further research is required to reach more definitive conclusions.

Keywords: Green-synthesized AgNPs, Seed priming, Rhizobium, AMF colonization.

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Influence of Biostimulants on Growth, Yield and Cost Economics of Chilli (*Capsicum annuum* L.) var. K2

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Abstract

The present study on the influence of biostimulants on growth, yield and cost economics of chilli (*Capsicum annuum* L.) carried out at Department of Horticulture, Agricultural College and Research Institute, Madurai during 2026. The aim of the present investigation on to identify the most effective biostimulant for improving the growth, yield and cost economics of chilli. The study was laid out in a Randomized Block Design (RBD) with nine treatments and replicated thrice. The present study results revealed that among the nine treatments, T8 (Panchagavya @ 1 % + Humic acid @ 0.1 % + Sea weed extract @ 1 % + Moringa leaf extract @ 1 %) recorded the highest values for vegetative and fruiting and yield characters such as plant height (65.32 cm), number of branches per plant (10.49), number of leaves per plant (63.64), leaf length (11.71 cm), leaf width (3.88 cm), whereas the control registered the lowest values in vegetative characters. In the case of flowering and fruiting traits, T8 (Panchagavya @ 1 % + Humic acid @ 0.1 % + Sea weed extract @ 1 % + Moringa leaf extract @ 1 %) observed the highest values in days to 50 % flowering (93.39), fruit length (9.13 cm), fruit weight (35.56 g) and number of fruits per plant (12.29) whereas the control (T9) was found the lowest values in all the traits. Regarding yield characters, the same trend was noticed. T8 recorded the highest values in yield characters such as yield per plant (85.03 g plant^{-1}), yield per plot (2.126 kg plot-1) and yield per ha (2.362 t/ha). However, the control (T9) registered the lowest values in all the yield characters. T8 observed the highest cost benefit ratio of 3.07 whereas the control (T9) registered the lowest cost benefit ratio of 2.45. The present study it was concluded that the combined application of (Panchagavya @ 1 % + Humic acid @ 0.1 % + Sea weed extract @ 1 % + Moringa leaf extract @ 1 %) recorded the highest values in all the characters as well as B:C ratio also and it was performed well under Madurai conditions. This technology to be tested in farmer's field during ensuing season.

Keywords: Chilli, *Capsicum annuum*, biostimulants, growth, yield, cost economics.

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Response Surface Optimization of Wall Materials for Spray-Dried Shrimp Shell (*Metapenaeus dobsoni*) Protein Powder for Instant Soup Mix Development

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Abstract

Shrimp is one of the most export commodity from India. During the year 2024-25, around 7,41,529 MT was exported (MPEDA,2025). Shrimp processing generates 55–66% waste, widely utilized for chitin production, while protein recovery remains limited, representing an underexploited opportunity for value addition. This study focused on recovering shrimp shell protein (*Metapenaeus dobsoni*) by mechanical pressing and stabilizing it through spray-drying, using Maltodextrin, Gum Arabic, and Carboxymethyl cellulose as wall materials, for developing an instant soup mix. The shrimp shell protein soup mix formulation was optimized using Response Surface Methodology (RSM), considering colour (L*), viscosity (cP), and overall acceptability as the response variables. A constrained mixture design with 11 experimental runs was used, and a special cubic polynomial model for response variables. The obtained R^2 values indicated satisfactory model adequacy, with the non-significant Lack of Fit confirming good model fit for all responses. Experimental validation showed the optimum combination as 28.53% Maltodextrin, 29.39% Gum Arabic, and 42.08% Carboxymethyl cellulose, providing improved viscosity (176.25±4.39), Colour (L* 64.27±0.10), and overall sensory acceptability (8.53±0.24). The results suggested that Shrimp shell protein powder can be used to develop instant soup mix with improved nutritional, functional, and sensory qualities, offering a sustainable value addition.

Keywords: Shrimp shell protein, spray-drying, wall materials, soup mix, RSM

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Effect of Infrared and Microwave Treatment on the Microstructure, Functional and Antinutritional Property of Barnyard Millet

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Abstract

Barnyard millet is a climate-resilient, gluten-free cereal with high nutritional potential; however, its utilization is limited by the presence of antinutritional factors. This study evaluated the effect of infrared (IR) and microwave (MW) treatments on the physicochemical, functional, antinutritional, and microstructural properties of barnyard millet grains. Samples were treated using IR (1500 W) by varying temperature (60, 70, and 80°C), lamp-to-belt distance (190, 220, and 250 mm), and conveyor belt speed (1.7, 2.55, and 3.4 rpm), while MW treatment (750 W) was carried out at different treatment durations (10, 15, and 20 min) and compared with untreated grains. IR treatment increased total phenolic content from **107.26 to 186.14 mg GAE/100 g** and antioxidant activity from **16.23 to 38.36%**, while reducing tannin and phytate contents from **31.42 to 14.21 mg/100 g** and **612.38 to 361.99 mg/100 g,** respectively. Microwave treatment also enhanced the functional quality of barnyard millet, increasing total phenolic content and antioxidant activity while reducing tannin and phytate contents, although the improvements were lower than those obtained with IR treatment. Treated samples exhibited lower free fatty acid content and improved colour characteristics, indicating enhanced storage stability and product quality. FTIR, XRD, and SEM analyses confirmed structural modifications, including changes in functional groups, reduced crystallinity, and disruption of starch granules. The optimum treatment conditions were **80°C, 190 mm, and 2.55 rpm** for IR and **10 min** for MW, with IR showing superior effectiveness in improving the nutritional and functional quality of barnyard millet.

Keywords: Cereal Grain Processing, Bioavailability Enhancement, Antinutritional Factors, Microstructural Characterization, Electromagnetic Heating

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Comparative Assessment of Arima, ETS, Prophet, STS, And SVR for Forecasting India's Mango Sector

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Abstract

Crop performance projections are critical for agricultural logistics and agricultural trade policies. Five forecasting models (ARIMA, ETS, Prophet, Structural Time Series (STS) and Support Vector Regression (SVR)) are evaluated by using annual data for mango area, production and productivity for 1990–91 to 2023–24. Model accuracy is assessed based on RMSE, MAE, MAPE and rolling-origin cross-validation with Ljung–Box residual checks. The obtained results indicate the highest accuracy by ARIMA in area (MAPE=0.49%) and productivity (MAPE=3.63%) while SVR outperforms the others in production (MAPE=3.95%). The 5-year forecasts (2025–2029) suggest an increase in cultivated area and total production along with a decrease in productivity, a key policy information for input management and export planning.

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Elevational Patterns of Anuran Diversity in the Southern Western Ghats: Implications for Climate Change and Conservation

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Abstract

The Western Ghats, a globally recognized biodiversity hotspot, harbour a remarkable diversity of amphibians, many of which are endemic and highly sensitive to environmental change. As effective bioindicators, anurans provide valuable insights into ecosystem health and the potential impacts of climate change. However, patterns of anuran diversity along elevational gradients in the Kerala region of the Western Ghats remain inadequately documented. This study examined the influence of changing elevation on anuran diversity to generate baseline information for biodiversity conservation.

Nocturnal visual encounter surveys were conducted between 2022 and 2024 across nine transects representing three elevations (5, 400, and 1200 m above sea level). Species diversity and community composition were assessed using Shannon, Simpson, and Bray–Curtis indices analysed using the vegan package in R. A total of 16 anuran species were recorded, including 15 species endemic to Western Ghats. Higher elevations supported greater species richness and diversity, while beta diversity analyses revealed substantial species turnover between low- and high-elevation habitats. These findings emphasize the ecological importance of montane ecosystems for amphibian conservation and suggest that lowland anuran communities may be vulnerable to the combined effects of habitat modification and climate change. The study highlights the need for conservation strategies that consider elevational variation to safeguard amphibian diversity in the Western Ghats.

Keywords: Anurans, Elevation Gradient, Climate Change, Western Ghats, Conservation Biology

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Nutritional Diversity and Multivariate Characterization of Banana (*Musa* spp.) Germplasm for Identification of Superior Genotypes for Breeding

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Abstract

Banana (*Musa* spp.) is one of the world's most important fruit crops, valued for its nutritional significance and economic importance. Exploiting the genetic diversity present in banana germplasm is essential for developing nutrient-rich and high-yielding cultivars. In the present study, 135 banana genotypes representing diverse genomic groups (AA, AAA, AAB, ABB, BB, tetraploids, selected progenies, and clones) were evaluated for 15 nutritional, biochemical, yield, and fruit quality traits. Significant variation was observed among genotypes for all characters, demonstrating the wide genetic diversity available for crop improvement. Multivariate analyses, including Principal Component Analysis (PCA), Hierarchical Cluster Analysis (HCA), and heat map analysis, effectively classified the genotypes based on their nutritional and fruit quality attributes and identified the major traits contributing to genetic divergence. Several nutritionally superior genotypes were identified across genomic groups. CV Rose, Narmine, Padalimoongil, Manoranjitham, Chinese Cavendish, Manjeri Nendran, Kalibow, Poovan, Karthobiumtham, Chakkia, Manohar, Pa-03-22, Sawai, and Bhatmanohar exhibited superior performance for sugars, starch, total soluble solids, phenolics, flavonoids, and vitamin C. Considerable variation was also observed for yield and fruit traits. Neypoovan, Grande Naine, Quintal Nendran, Udhayam, Bhimkol, SH-3640, FHIA-18, Jalgaon clone, and Red Banana 18 were identified as outstanding genotypes for bunch weight, finger weight, pulp weight, fruit girth, and pulp:peel ratio.

The study revealed substantial nutritional and agronomic diversity within banana germplasm and identified several elite genotypes combining superior fruit quality with high yield potential. These genotypes represent valuable parental resources for future banana breeding programmes aimed at developing nutritionally enriched, consumer-preferred, and high-yielding cultivars.

Keywords: *Musa* spp., banana germplasm, nutritional diversity, fruit quality, PCA, hierarchical clustering, breeding

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Durum Wheat as a Reservoir of Broad-Spectrum Rust Resistance for Future Wheat Breeding

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Abstract

The emergence of new and highly virulent races of wheat rust pathogens poses a persistent challenge to global wheat improvement programmes, necessitating the identification of novel and diverse resistance sources. Durum wheat (*Triticum durum* Desf.), although cultivated on a relatively limited area, possesses a distinct genetic background that has remained under-exploited for rust resistance breeding. The present study aimed to identify broad-spectrum rust-resistant durum wheat genotypes through comprehensive evaluation under both adult plant and seedling stages.

A total of 200 durum wheat genotypes, together with six checks, were evaluated under natural rust epiphytotic conditions. Considerable genetic variation was observed for all three rust diseases, confirming the existence of diverse resistance mechanisms within the evaluated germplasm. Stem rust resistance was predominant, with 180 genotypes classified as immune or resistant, followed by leaf rust (149 genotypes), whereas stripe rust showed greater disease pressure with comparatively fewer resistant entries. The genetic studies conducted among many durum genotypes which are resistant to leaf and stem rusts indicated the presence of single or two dominant rust resistance genes giving resistance to these diseases. The findings demonstrate that durum wheat harbours a rich reservoir of broad-spectrum rust resistance that remains largely untapped in wheat breeding. The identified resistant genotypes provide valuable pre-breeding resources for broadening the genetic base of resistance, reducing dependence on a narrow set of resistance genes and developing climate-resilient wheat cultivars capable of withstanding evolving rust pathogen populations.

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Molecular Characterization of Sugarcane Genotypes: Genetic Diversity, Clustering and Marker–Trait Association with Smut Resistance

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Abstract

Sugarcane smut caused by the fungus *Sporisorium scitamineum* is one of the most devastating diseases of the crop worldwide. Marker-assisted introgression of durable smut resistance into commercially viable varieties is a viable option, but it requires an assessment of genetic diversity and marker informativeness. The study evaluated 52 sugarcane genotypes for their reaction to smut using a five-grade scale (Resistant to Highly susceptible; n = 20 (R); 5 (MR), 8 (MS), 6 (S), 13 (HS)) and 11 SSR markers yielding 133 scoreable allelic bands. These bands had an overall polymorphism of 97.7%, with 130 polymorphic, and a mean PIC of 0.35, suggesting moderate informativeness. The most informative markers were NKS38 and NKS6, with a high PIC, therefore, suitable for routine genotype fingerprinting. The Jaccard's similarity coefficients ranged from 0.169 to 0.714 (mean = 0.462) confirming a genetically diverse panel free of duplicate accessions. The UPGMA clustering separated the genotypes into four small genetically distant clusters. Two clusters contained only resistant genotypes, while one large cluster showed a non-uniform distribution of resistance levels like the rest of the population. The PCoA analysis supported the UPGMA findings, but the first two axes only explained 22.5% of the variation, suggesting no population structure associated with smut resistance on a genome-wide level. However, seven SSR bands were associated with the severity of smut at the marker level ($p < 0.05$). Specifically, NKS9_K was associated with susceptibility, while NKS48_F was associated with resistance, which was supported by both the Mann–Whitney U test and the chi-square test. Whereas NKS34_D is a secondary lead; NKS11_A, NKS1_B, NKS40_I and NKS9_J are weaker, single-test leads. While the genetic distance between genotypes based on SSR markers was not associated with their smut reaction, the analysis revealed several locus-specific bands which represent promising candidate markers for further validation in independent or bi-parental populations, offering a practical starting point for marker-assisted selection for smut resistance in sugarcane breeding programmes.

Keywords: Sugarcane, smut resistance, candidate markers, genetic diversity, marker-assisted selection

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Studies on Antimicrobial Activity of Black Seed (Nigella sativa L.) Against Pathogenic Microorganisms

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Abstract

Black seed (*Nigella sativa L.*) is a medicinal plant well known for its diverse pharmacological properties, particularly its antimicrobial potential attributed to bioactive compounds such as thymoquinone. The present study evaluated the antimicrobial activity of different solvent extracts of *Nigella sativa* against selected bacterial and fungal pathogens. Black seeds were extracted using various solvents including ethyl acetate, methanol, acetone, hexane, diethyl ether, chloroform and ethanol. Antimicrobial activity was assessed by the agar well diffusion method against bacterial pathogens including *Staphylococcus aureus, Bacillus megaterium, Salmonella typhi, Serratia marcescens, Escherichia coli, Bacillus subtilis, Pseudomonas aeruginosa, Listeria monocytogenes, Vibrio cholerae, Micrococcus luteus, Klebsiella pneumoniae and fungal pathogens including Candida albicans, Aspergillus flavus, Aspergillus niger, Microsporum gypseum, Trichoderma viride, Fusarium sp.* and *Macrophomina sp.* Hexane extract showed maximum inhibition against *Staphylococcus aureus* (12.1 mm), acetone extract exhibited the highest activity against *Salmonella typhi* (7.5 mm), *Serratia marcescens* (9.2 mm) and *Bacillus subtilis* (8.9 mm), chloroform extract was most effective against *Escherichia coli* (8.1 mm), ethanol extract showed maximum inhibition against *Candida albicans* (8.1 mm), ethyl acetate extract was most effective against *Listeria monocytogenes* (8.3 mm), while diethyl ether extract exhibited the highest activity against *Vibrio cholerae* (18.0 mm) and *Klebsiella pneumoniae* (8.0 mm). Methanolic extract showed the greatest antifungal activity against *Aspergillus flavus* (22.5 mm), whereas ethanolic extract was most effective against *Aspergillus niger* (20.5 mm). The antimicrobial activity increased with extract concentration, demonstrating concentration-dependent effects. These findings suggest that *Nigella sativa* is a promising natural source of antimicrobial compounds with potential applications in pharmaceuticals, food preservation, and agriculture.

Keywords: *Nigella sativa*, Black seed, antimicrobial activity, Thymoquinone, Pathogenic bacteria, Fungal pathogens, Agar well diffusion, Natural antimicrobial agents.

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Genetic Variability for Phosphatase Enzyme activity in Chickpea Genotypes

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Abstract

Chickpea (*Cicer arietinum L.*) is the second most widely cultivated legume worldwide, grown predominantly on marginal soils where phosphorus (P) deficiency is a major constraint to crop productivity. Although chickpea is well adapted to low-input production systems, its yield potential is frequently restricted by limited P availability due to the low mobility of phosphorus in soil and its fixation into unavailable forms. The present study was conducted during the Rabi season of 2025–26 to screen chickpea lines for phosphatase enzyme activity which is a key biochemical indicator of enhanced phosphorus acquisition potential. The study evaluated both alkaline and acidic phosphatase activities in rhizosphere soil to assess the contribution of soil microorganisms to phosphorus mineralization. Among the 11 genotypes evaluated 4 demonstrated significantly greater phosphatase activity. Significant genotypic variation was observed for both enzyme activities, with alkaline phosphatase exhibiting consistently higher activity than acid phosphatase across the evaluated samples. The assessment of phosphatase activity among chickpea genotypes provides an effective approach for identifying genotypes with superior capacity to mobilize unavailable soil phosphorus and sustain phosphorus acquisition under low-P conditions.

Keywords: Chickpea, phosphatase enzyme activity, rhizosphere

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Molecular Characterisation of the Indian Sugarcane Parental Pool for Rust Resistance

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Abstract

Sugarcane brown (*Puccinia melanocephala*) and orange rust (*P. kuehnii*) are two important sugarcane diseases globally and an emerging threat in India. Brown rust can cause considerable yield losses of as high as 50% in susceptible cultivars. Similarly, orange rust causes varied levels of crop damage. Unlike red rot, smut and others, the economic damage caused by leaf diseases is less conspicuous. However, systematic studies, particularly on susceptible cultivars, revealed that damage can be as high as 77.81% of cane weight reduction and 39.71% reduction in sugarcane recovery. The *Bru1* gene mostly dominates global efforts to develop brown rust-resistant cultivars, and it is the predominant source of brown rust resistance in most modern sugarcane varieties and breeding materials. The Indian parental germplasm was characterised using *Bru1*-specific markers, and they are also phenotyped for rust reaction under the natural incidence for three consecutive years. Molecular profiling of 198 clones in the current active crossing block using *Bru1* gene-related markers revealed that 42 clones were positive for *Bru1*, and all of them were found free from rust. However, the majority of clones were found of *Bru1* negative (156). Out of 156, rust was observed on 51 clones, and the remaining were free from rust under natural incidences. These 105 *Bru1*-negative but rust-free genotypes represent valuable genetic resources for identifying novel genes or alleles conferring rust resistance in Indian sugarcane germplasm.

Keywords: Sugarcane, Sugarcane rust, *Bru1*, Indian germplasm, rust resistance

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Green Synthesis of pH-Responsive Nitrogen-Doped Carbon Dots Derived from Coconut Coir Lignin for Fluorescent Gelatin Films in Food Spoilage Detection

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Abstract

The present study demonstrated a green and sustainable method for synthesizing nitrogen-doped carbon dots (N-CDs) using lignin extracted from coconut coir, a readily available agro-industrial waste. The produced N-CDs were extremely small, amorphous, and abundant in functional groups introduced via nitrogen doping, which notably improved their optical sensitivity to pH changes. The distinct colorimetric and fluorescence shift noted under visible and UV light, transitioning from yellowish-brown to green and green to blue, respectively, confirmed their responsiveness to the protonation-deprotonation dynamics of surface functional groups. Incorporation of these N-CDs into gelatin films resulted in a uniform, crack-free matrix with good dispersion and no visible phase separation. The composite films demonstrated significant pH sensitivity, particularly in the crucial food spoilage pH range (5-7), rendering them suitable options for intelligent packaging applications. Structural and elemental analyses, including HR-TEM, Raman spectroscopy, XRD, and EDX, collectively confirmed the successful synthesis, amorphous graphitic structure, and elemental doping of the carbon dots. The presence of prominent D bands, turbostratic carbon peaks, and significant nitrogen content further supported the functionality and potential of the developed material. This research not only introduces an eco-friendly and cost-effective platform for value-added utilization of lignocellulosic waste but also highlights the practical feasibility of applying biocompatible N-CDs in real-time food freshness monitoring. The development of such pH-responsive films has significant implications for enhancing food safety, reducing wastage, and promoting intelligent packaging systems that align with current trends in sustainable food technology. Moreover, this work opens up new avenues for exploring multifunctional sensing platforms based on carbon dots derived from renewable resources. Altogether, the findings validated that lignin-based N-CDs possess strong pH-sensitivity and can be integrated into biodegradable films for real-time food freshness monitoring.

Keywords: lignin-based carbon dots; nitrogen-doped carbon dots (N-CDs); coconut coir waste; pH-responsiveness films; intelligent food packaging.

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Long-Term Black Carbon Aerosol Dynamics at a High-Altitude Agricultural Site in the Nilgiris: A 13-Year Observational Record and Its Implications for Climate-Smart Farming

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Abstract

Black carbon (BC) aerosol, a potent short-lived climate forcer, exerts measurable influence on regional radiative balance, monsoon precipitation patterns, and crop-level solar radiation interception; yet its long-term behaviour over high-altitude agroecosystems in peninsular India remains poorly characterised. This study presents a 13-year continuous record of BC mass concentrations at the Ooty Hill Research Station (HRS), Nilgiris (2240 m above mean sea level), monitored under the ISRO Aerosol Research Facilitation Initiative (ISRO-ARFI) using AE-31 and AE-33 aethalometers. Measurements spanning 2013–2025 revealed a mean annual BC concentration of 0.75 ± 0.26 μg m^{-3}, with pronounced seasonal variability governed by prevailing meteorological conditions. Peak BC concentrations were consistently observed during the summer (March–May), with elevated levels persisting into winter (December–February), primarily due to biomass burning, enhanced regional transport, increased atmospheric stability, and reduced wet scavenging. In contrast, the southwest monsoon period (June–September) recorded the lowest BC concentrations as a result of efficient precipitation washout. Inter-annual analysis demonstrated marked year-to-year variability associated with changing meteorological conditions, regional biomass-burning activity, and long-range transport processes. Correlation with co-located meteorological variables showed a positive relationship with temperature ($r = 0.575$) and strong negative relationships with relative humidity ($r = -0.90$) and rainfall ($r = -0.74$). Ground-based Aerosol Optical Depth (AOD) also exhibited strong agreement with MODIS satellite observations ($R = 0.80–0.98$), confirming BC as a sensitive indicator of aerosol dynamics and agro-climatic variability over this high-altitude environment. As the Nilgiris is a major centre for tea, vegetable, and floriculture production, the observed seasonal behaviour of BC has important implications for optimizing crop calendars, assessing potential reductions in radiation-use efficiency, and strengthening early-warning systems under deteriorating aerosol conditions. These findings highlight the importance of incorporating long-term aerosol observations into regional climate intelligence frameworks to support resilient and climate-smart hill agriculture.

Keywords: black carbon aerosol, Nilgiris, high-altitude agriculture, long-term monitoring, ISRO-ARFI, climate-smart farming, aerosol optical depth.

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Black Carbon Aerosols as an Emerging Agroclimatic Stressor: Insights from Ambient and Simulated Exposure Studies on French Bean in Contrasting Agroecological Zones

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Abstract

Atmospheric black carbon (BC), a short-lived climate pollutant arising from incomplete combustion, is gaining recognition as a significant agroclimatic stressor with implications for crop productivity. Despite this, BC continues to be largely overlooked in climate intelligence and farm-level risk assessment frameworks, constraining the development of pollution-aware strategies for climate-resilient agriculture. This study seeks to build the evidence base needed to incorporate BC into climate intelligence systems that support risk-ready farming. A dual-site experimental framework involving French bean (*Phaseolus vulgaris* var. Ooty 1) was set up across two contrasting agroecological zones: Ooty (ambient field exposure) and Coimbatore (simulated exposure). Under simulated conditions, plants were exposed to five BC concentrations (0, 2, 5, 10, and 15 µg m^{-3}) arranged in a Completely Randomized Design with three replications. Physiological, growth, biochemical, and soil functional parameters are being assessed to characterize crop responses across the varying BC regimes. Comparing ambient and simulated exposure conditions is expected to reveal dose-response relationships and identify thresholds of crop vulnerability. By converting atmospheric BC concentrations into quantitative indicators of crop response, this study lays the groundwork for BC-inclusive climate intelligence, supporting pollution-aware advisories, adaptive crop management practices, and future early-warning systems. The findings are anticipated to reinforce risk-ready farming approaches and bolster the resilience of South Asian agroecosystems facing interacting climate and air pollution stresses.

Keywords: black carbon aerosol, French bean, Phaseolus vulgaris, agroclimatic risk, crop physiology, dose-response, climate intelligence, agroecological zones

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Cultivation, Phytochemical Profile and Industrial Prospects of *Pandanus amaryllifoli us* and *Stevia rebaudiana* under the Agro-Climatic Conditions of the Shevaroys Hills

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Abstract

Pandanus *amaryllifolius Roxb* (Rambha). (Pandanaceae) and *Stevia rebaudiana* (Bertoni) (Asteraceae) are two high-value crops of significant importance to the food, pharmaceutical and cosmetic industries, with growing relevance in the management of diabetes and other lifestyle-related disorders. Pandan, a tropical aromatic spice widely cultivated across Southeast Asia, is evolutionarily sterile and propagated exclusively through vegetative methods. Its characteristic aroma, primarily attributed to the volatile compound 2-acetyl-1-pyrroline (2AP), makes it a valued natural flavouring and colouring agent, while its rich phytochemical profile comprising phenolics, flavonoids, carotenoids, alkaloids, essential oils, and amino acids confers antioxidant, antimicrobial, anti-inflammatory, antidiabetic and potential anticancer properties. Stevia, a perennial medicinal herb, is globally recognized as a natural, non-caloric sweetener owing to its steviol glycosides, particularly stevioside and rebaudioside. The Stevia are 200–300 times sweeter than sucrose. The increasing global prevalence of diabetes, obesity and other lifestyle-related disorders has significantly enhanced demand for stevia as a low-glycemic alternative to conventional sugar. It is propagated through vegetative propagation and tissue culture for commercial-scale multiplication. Beyond its sweetening role, stevia exhibits antioxidant, anti-inflammatory, antihyperglycemic and antihypertensive activities that further support its use in diabetes management. Both crops depend heavily on favourable agro-climatic conditions for optimal growth and quality. Pandan thrives in cool, humid, partially shaded environments with fertile soils, while stevia requires well-drained fertile soils, moderate fertilizer input and appropriate temperature and irrigation management. The Shevaroy Hills offer agro-climatic conditions including moderate temperatures, fertile well-drained soils, humidity, and adequate moisture that are highly conducive to the successful cultivation of both species. This review consolidates the botanical characteristics, phytochemical composition, cultivation and propagation practices, and industrial applications of *Pandanus amaryllifolius* and *Stevia rebaudiana*, underscoring their combined potential as sustainable, high-value crops for diabetes and metabolic disorder management, agricultural diversification, value-added product development and the expanding natural products industry. The present investigation was carried out to evaluate the seasonal variation in growth and yield attributes of *Pandanus amaryllifolius* and stevia in the Shevaroys Hills during two cropping seasons, July–December 2025 (Season I) and January–June 2026 (Season II). The enhanced growth and productivity recorded during January–June 2026 indicate that the favorable seasonal environmental conditions prevailing during this period promoted greater vegetative vigor and canopy development.

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The study demonstrated that cultivation during the first half of the year is more conducive to achieving superior growth and higher productivity in *Pandanus amaryllifolius* and stevia under the agro-climatic conditions of the Shevaroy Hills. These findings provide valuable insights for optimizing crop management practices and support the potential for commercial cultivation of both the crops in the region

Keywords: *Pandanus amaryllifolius, Stevia rebaudiana* Medicinal and Pharmaceutical Properties, Seasonal Variation, Vegetative growth, Shevaroys Hills.

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Gene Expression Profiling of Seed Coat Colour in Sesame (*Sesamum indicum L.*): Molecular Insights and Implications for Crop Improvement

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Abstract

Sesame (*Sesamum indicum L.*) is an important oilseed crop valued for its high-quality oil and diverse seed coat colours ranging from white to black. Seed coat colour is an economically important trait associated with antioxidant activity, nutritional quality, disease resistance, processing characteristics, and consumer preference. Recent advances in molecular genetics have significantly improved our understanding of the mechanisms governing seed pigmentation in sesame. This review highlights current knowledge on the inheritance, genomic regions, and gene expression patterns associated with seed coat colour variation. Quantitative trait loci (QTLs) and genome-wide association studies have identified several genomic regions controlling pigmentation, while transcriptomic analyses have revealed differential expression of genes involved in phenylpropanoid and flavonoid biosynthesis pathways. Key genes such as chalcone synthase, flavanone-3-hydroxylase, polyphenol oxidase, laccases, and cytochrome P450 family members, together with transcription factors including MYB, bHLH, WRKY, DOF, and SBP, play crucial roles in pigment accumulation. Understanding these molecular mechanisms provides valuable opportunities for marker-assisted selection, genomic-assisted breeding, and gene-editing approaches aimed at developing nutritionally superior sesame cultivars with desirable seed coat colours. The integration of genomics and transcriptomics is expected to accelerate future sesame improvement programmes

Keywords: Sesame, Seed coat colour, Gene expression, Transcriptomics, Flavonoid biosynthesis, Molecular breeding

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Standardization of DNA Extraction and Development of Functional Gene-Based Markers for Early Sex Determination in Papaya

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Abstract

Carica papaya, the most popular fruit in Caricaceae family which is widely grown throughout the world's Tropics. Papaya is mainly dioecious and gynodioecious in nature, where sex of each individual can be identified only upon flowering. Exploring sexual dimorphism and identifying male or female plants at early stages saves resources during cultivation. One of the objective of the study was to standardize the DNA extraction method for four varieties of papaya *viz*. Pusa Dwarf, and CO8 (dioecious), Arka Prabath, Arka Surya (gynodioecious) from early stage leaf. Three methods of DNA extraction- Modified CTAB buffer method, Triton-X buffer method and the Triton-X buffer method followed by purification using CTAB method were compared and the Triton-X buffer method followed by purification using CTAB method yielded good quality and quantity of DNA and good quantity of DNA per gram of sample.

The next objective of the study was to develop functional gene based markers for the early identification of sex in papaya seedlings. A total of eleven primers were designed using NCBI primer designing tool which is based on X, Y and Yh chromosome of papaya. Along with these eleven primers, four reference primers were used. Among the primers tested, three primers, namely Man 5, Man 7, and Man 10, demonstrated clear and reproducible polymorphism between male, female and hermaphrodite individuals. PCR amplification generated distinct banding patterns in female and hermaphrodite samples, whereas no amplification bands could be observed in male samples.Hence, the primers Man 5, Man 7, and Man 10 can be effectively utilized for early sex determination in papaya at seedlings seedling stage.

Keywords: Genomic marker, PCR amplification, Sex determination, Primer, Papaya

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Development of Cost Effective Biogas Processing Unit for Low Capacity Biogas Plant in Rural Areas

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Abstract

Biogas marks history of more than one fifty year in India but still its huge potential as energy source and organic fertilizer developing rural mechanism in agricultural field remains underutilized. Typically, biogas contains 50–70% methane (CH_4), 30–50% carbon dioxide (CO_2), and trace levels of hydrogen sulfide (H_2S) and moisture. The presence of CO_2, H_2S, and water vapor lowers the fuel quality of biogas and hence decrease heat content. Therefore, eliminating these contaminants before utilization is essential to enhance the calorific value of the gas.

Biogas generated from cow dung and farm waste was purified by removing CO_2 by passing it through a water scrubber. H_2S was removed with the help of iron oxide developed from mild steel machining chips & moisture present in the biogas was subsequently removed by passing the gas through a silica gel adsorption bed. Reducing impurities directly increases the methane concentration; calorific value was tested after the purification process. Experiments were conducted under different biogas pressure and varying water flow rate in water scrubber to investigate their influence on calorific value of the gas. The findings indicated that both the biogas pressure and varying water flow rate significantly improved the calorific value.

Keywords: Biogas, Methane, calorific value, water scrubber.

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Comparative Analysis of Arrival and Price Variability of Tomato, Onion and Brinjal in Nagapattinam Uzhavar Santhai, Tamil Nadu

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Abstract

Vegetables are an indispensable component of a balanced diet and play a significant role in ensuring food and nutritional security. They are rich sources of vitamins, minerals, dietary fibre and antioxidants that are essential for maintaining good health. Among vegetables, tomato, onion and brinjal are widely cultivated, marketed and consumed in India because of their importance in daily household consumption and the food processing industry. Understanding the variability in market arrivals and prices of these vegetables is important for farmers, traders, consumers and policymakers for better production planning, marketing decisions and price risk management. Therefore, the present study aimed to analyse the variability in arrivals and modal prices of tomato, onion and brinjal using daily market data obtained from AGMARKNET 2.0 for Nagapattinam Uzhavar Santhai, Tamil Nadu, covering the period from November 2025 to July 2026. Descriptive statistical tools, namely mean, standard deviation and coefficient of variation (CV), were employed to examine the market behaviour of the selected vegetables. The results revealed that tomato recorded the highest mean arrival (0.29 MT), followed by onion (0.28 MT) and brinjal (0.11 MT). Brinjal recorded the highest modal price (₹5,285.55/q), followed by tomato (₹3,114.61/q) and onion (₹2,643.58/q). During the study period, tomato exhibited the highest variability in both arrivals (CV: 19.24%) and modal prices (CV: 26.99%), indicating comparatively greater market fluctuations. In contrast, onion recorded the lowest variability in arrivals (CV: 16.38%) and modal prices (CV: 9.99%), suggesting relatively stable market conditions, while brinjal exhibited moderate variability in both arrivals (CV: 18.32%) and modal prices (CV: 16.63%). Overall, the study concludes that during the study period, onion prices were comparatively stable, whereas tomato showed the highest fluctuations in arrivals and prices, and brinjal occupied an intermediate position. These findings provide useful information for farmers, traders and market planners in understanding short-term market variability and supporting informed production, marketing and price risk management decisions.

Keywords: Vegetable prices, Price volatility, comparative price analysis

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Unlocking the Potential of Organic Seed Priming for Sustainable Brinjal Production

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Abstract

Brinjal (*Solanum melongena* L.) is an important vegetable crop cultivated extensively across tropical and subtropical regions due to its high nutritional value and economic importance. Enhancing seed performance is essential for achieving uniform crop establishment and improving productivity under sustainable production systems. The experiment were carried out during 2025 at Annamalai University using brinjal cv. Annamalai to evaluate the influence of organic seed priming on vegetative growth, physiological efficiency and flowering behaviour. Seeds were primed with Panchagavya, Vermiwash, Moringa leaf extract, Pungam leaf extract and Prosopis leaf extract with concentration of 2% and soaking duration of six hours along with control treatment. The result revealed that the treatments, Panchagavya @ 2% significantly enhanced plant growth and physiological performance over the control and other priming treatments. It recorded the highest plant height (89.32 cm), number of branches per plant (18), leaf area index (2.91) and chlorophyll content (53.84 µmol m^{-2}). The treatment also promoted early flowering, requiring only 38 days to first flowering and 45 days to 50% flowering, indicating improved crop establishment and accelerated reproductive development. The superior performance of Panchagavya may be attributed to its rich composition of beneficial microorganisms, nutrients and natural plant growthpromoting substances, which enhance nutrient uptake, photosynthetic efficiency and overall plant vigour. The findings demonstrate that organic seed priming with Panchagavya is a simple, economical and environmentally friendly technology for improving physiological efficiency and vegetative growth in brinjal.

Keywords: Brinjal, Organic seed priming, Panchagavya, Physiological efficiency, Vegetative growth, Sustainable agriculture.

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Ultraviolet Radiation: A Sustainable Physical Seed Treatment for Breaking Dormancy and Enhancing Seed Quality in Green Gram (*Vigna radiata L.*) cv. VBN 5

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Abstract

Seed dormancy resulting from hard seededness is a major limitation to uniform germination and successful crop establishment in green gram. Developing sustainable, non-chemical methods to overcome physical dormancy has become increasingly important for improving seed performance and supporting environmentally responsible agriculture. The present study investigated the potential of ultraviolet (UV) radiation as an innovative physical seed treatment to alleviate dormancy and enhance seed quality in green gram (*Vigna radiata L.*) cv. VBN 5, a variety exhibiting a high level of hard seededness (46%). Seeds were exposed to two UV wavelengths (365 and 390 nm) for four exposure durations (10, 20, 30 and 40 min), along with an untreated control. Seed quality was assessed using physiological parameters including germination percentage and seedling vigour, while biochemical responses were evaluated through α-amylase and dehydrogenase enzyme activities. UV radiation significantly influenced seed dormancy release and seed performance. The treatments of 365 nm for 30 min and 390 nm for 20 min proved most effective, resulting in improved germination, enhanced seedling length and increased enzymatic activity compared with untreated seeds. The enhanced physiological and biochemical responses indicate that UV treatment promoted dormancy alleviation through seed coat modification, facilitating water imbibition and metabolic activation during germination. These findings demonstrate the effectiveness of optimized UV irradiation in overcoming hard seededness without chemical scarification or seed treatment agents. The study highlights ultraviolet radiation as a residue-free, environmentally sustainable and genotype-specific seed enhancement technology for green gram, offering a practical approach for improving seed quality, stand establishment and sustainable pulse production under climate-smart agricultural practices.

Keywords: Green gram, VBN 5, UV Radiation, Hard seededness, physical dormancy.

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Optimization of Seed Priming Treatments for Enhancing Seed Quality in Browntop Millet (Brachiaria ramosa L.)

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Abstract

Browntop millet (*Brachiaria ramosa L.*) is an important underutilized millet in terms of nutrition and agronomy and is adapted to climate conditions. However, the rate and uniformity of germination of the seeds is below optimal, which makes it difficult to establish a successful crop. The present study was conducted to standardize the appropriate seed priming methods to improve seed quality and vigour of seedlings of browntop millet, cv. HBR-2. The experiment was conducted at Department of Seed Science and Technology, Agricultural College and Research Institute, Madurai during 2025-26 to standardize priming techniques viz., priming (1% KCl @ 8hrs and 500 ppm GA_3 @ 8hrs) and biopriming (15 % Azophos @ 8hrs), nanopriming (100 ppm CaO @8hrs), hydropriming @ 8hrs along with non primed seeds. This experiment was laid out in Completely Randomized Design with three replications. Among the treatment nanopriming with 100 ppm CaO @ 8hrs recorded maximum seed germination (94%) and longest seedling growth (18.30 cm), dry matter production (0.029 g) and Vigour Index I (1720) followed by 500 ppm GA_3 @ 8hrs compared to control. Irrespective of priming treatments, seeds primed with 100ppm CaO @ 8hrs recorded the maximum seed quality attributes followed by 500 ppm GA3 @ 8hrs outperformed other treatments by recording higher germination percentage, longest seedling length, maximum dry matter production and vigour index of browntop millet.

Keywords: Browntop millet, Underutilized millet, Nanopriming, Germination, Vigour index

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Machine Learning Algorithms for Price Forecasting and Supply Chain Optimization

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Abstract

Among agricultural commodities, vegetables occupy a critical position because they are perishable, widely consumed, and subject to frequent and sometimes drastic price changes. Accurate forecasting of vegetable prices is therefore beyond the academic exercise, it has real implications for farmers, traders, consumers, and policymakers alike. This has motivated to explore machine learning (ML) and deep learning approaches. Models such as Long Short-Term Memory networks (LSTM), Generalized Regression Neural Networks (GRNN), and gradient boosting methods like XGBoost have shown promising results across various forecasting domains. The price data is historical and covers a multi-year period (2021-2026). An initial training window of 90 days was used to fit baseline models, and a sequence input length of 30 days was used for deep learning and machine learning models. The classical Auto- ARIMA achieved the best test MAPE of 7.42% and an R^2 of 0.91, indicating that it explained over 90% of the price variance at national level. XGBoost followed closely at 8.09%, while GRNN came third at 9.29%. LSTM performed noticeably worse at 17.21%, suggesting that the added complexity of the deep learning model did not provide an advantage for this relatively stable commodity. At State level, Auto-ARIMA again proved its strong applicability with the lowest test MAPE of 5.63%. Interestingly, LSTM performed second-best here (7.63%), reversing its poor national-level performance. All three ML models were clustered closely between 7.6% and 8.0%, suggesting comparable performance for TN potato prices. In case of SCM optimization, the detailed results of the Q-learning Problem suggested the Optimal routes along with their optimal results, and Total rewards help us understand the optimized and worst-case results. The high-lighted path begins at B, continues through F2, LT1, PPC1, CW2, and D1, and finally reaches WS. This route represents the most cost-effective trajectory through the various locations or waypoints in the grid. The model achieved a solution with a total cost of ₹4610 rupees and a Total Reward of -60. This outcome suggests that the RL model has balanced minimizing costs with maximizing the reward function.

Keywords: Price forecasting, ML algorithms, Supply Chain Management.

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Application of Machine Learning in Predicting Hatchability of Commercial Layer Eggs

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Abstract

Background: Hatchability is a major determinant of productivity and profitability in commercial poultry production. Egg shape index (SI) and related geometric characteristics influence hatchability, while machine learning (ML) provides an efficient approach for modelling the complex relationships among these traits to improve prediction accuracy.

Objective: To evaluate the effect of egg shape index on hatchability in commercial layer chicken eggs and develop machine learning model(s) for accurate hatchability prediction using egg morphometric characteristics.

Methods: A total of 1,200 Keystone Golden (commercial layer) eggs (weigh range: 50-65 g) were classified into elongated (<72%), standard (72-76%), and rounded (>76%) SI groups. Original morphometric features (egg length, width, geometric mean diameter, SI, sphericity, egg weight) and engineered features (egg volume, surface area, SI^2, volume-weight ratio, and shape-weight interaction) were used to develop predictive models. Ten machine learning algorithm-resampling combinations were evaluated using 5- fold stratified cross-validation, with SMOTE applied to address class imbalance.

Key Findings: Standard SI eggs (72-76%) exhibited the highest hatchability (HTES: 76.0%; HFES: 86.3%). Among the evaluated models, SMOTETomek + XGBoost achieved the best predictive performance, with a balanced accuracy of 73.8%, F1-score of 86.0%, and ROC-AUC of 76.9% during cross-validation. Following threshold optimization, the final test model achieved 77.2% balanced accuracy, 86.0% overall accuracy, 90.8% F1-score, and 98.8% sensitivity, demonstrating excellent identification of hatchable eggs.

Significance: The study shows that egg shape index and associated geometric traits can be effectively integrated with ML for non-destructive hatchability prediction, providing decision support tool for precision hatchery management and improved poultry production.

Keywords: Commercial Layer, Egg Shape Index, Egg Morphometry, Hatchability, Machine Learning

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Comparative Study of Composting Efficiency and Nutrient Enrichment of Banana Pseudostem Waste

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Abstract

In Maharashtra, banana plantations generate 40–45 tonnes of pseudostem biomass waste (PW) per hectare, which is largely dumped along field boundaries or burned despite being rich in 0.8% nitrogen, 0.3% phosphorus, and 3.0% potassium, resulting in substantial losses of organic carbon (40%) and valuable plant nutrients. Conventional decomposition of PW generally requires 5–6 months. Conversion of PW into compost using decomposers (DC) under anaerobic conditions can accelerate the decomposition process while enhancing compost nutrient status. Therefore, the present study was conducted to evaluate composting efficiency, compost maturity (C:N ratio), and nutrient status of PW using different additive layers [water and cow dung slurry (100 L t^{-1}), urea (8 kg t^{-1}) + single super phosphate (10 kg t^{-1}), and di-ammonium phosphate (20 kg t^{-1})] with and without decomposer (1 L t^{-1}) in a Randomized Block Design comprising nine treatments and three replications under the closed pit method. Among the treatments, the combination of urea and single super phosphate with DC recorded the shortest composting duration (83 days) compared with the corresponding treatment without DC (105 days). Compost prepared with DC also recorded a lower C:N ratio, indicating faster compost maturity. Compared with compost prepared without DC, the application of decomposer significantly increased total nitrogen (23%), phosphorus (30%), potassium (33%), iron (23%), and manganese (27%), whereas copper and zinc were not significantly affected. The reduction in C:N ratio was attributed to enhanced microbial activity promoted by the decomposer, while additive layers served as supplementary nutrient sources during composting. Overall, the combined application of decomposer with urea and single super phosphate proved to be the most effective treatment for rapid composting and production of nutrient-enriched banana pseudostem compost.

Keywords: Banana, composting, decomposers, nutrient concentration, pseudostem waste

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Standardization of In Vitro Regeneration and *Agrobacterium*-Mediated Genetic Transfor mation for Pod Borer Resistance in Dolichos Bean (*Lablab purpureus* (L.) Sweet)

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Abstract

The present investigation entitled "Standardization of *In Vitro* Regeneration and *Agrobacterium*-Mediated Genetic Transformation for Pod Borer Resistance in Dolichos Bean (*Lablab purpureus* (L.) Sweet)" was undertaken to standardize an efficient *In vitro* regeneration protocol and develop an *Agrobacterium tumefaciens*-mediated genetic transformation system for the cultivar Konkan Bhushan. Among the sterilization treatments, immersion of explants in 70 % ethanol for 5 minutes followed by 0.1 % $HgCl_2$ for 10 minutes resulted in the highest aseptic culture establishment (97.22%). The mature embryo axis with a single cotyledon proved to be the most responsive explant for regeneration. Maximum shoot regeneration was obtained on Murashige and Skoog (MS) medium supplemented with 6.0 mg L^{-1} BAP and 0.5 mg L^{-1} NAA, while rooting was optimized on MS medium containing 1.0 mg L^{-1} IBA. Konkan Bhushan exhibited superior regeneration potential, and the highest survival of regenerated plantlets was achieved in a soil: vermiculite: sand (1:1:1) potting mixture. The optimized regeneration protocol was successfully employed for *Agrobacterium*-mediated transformation using the Bt genes Cry1Aabc, Cry1Fa1, and Cry2Aa. Among these, Cry2Aa recorded the highest transformation efficiency (4.70% based on kanamycin selection and 2.13% by PCR confirmation). PCR and progeny analyses confirmed stable integration and Mendelian inheritance (3:1) of the transgene. The study established a reliable regeneration and transformation protocol and identified Cry2Aa as a promising gene for developing pod borer-resistant dolichos bean cultivars.

Keywords: *Lablab purpureus, Agrobacterium tumefaciens,* Genetic transformation, Cry2Aa, Pod borer resistance.

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Multi-Trait Genotype-Ideotype Distance Index (MGIDI) and Stability Index (MTSI) Unveil Drought-Tolerant Rice Landraces under Water Deficit Stress

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Abstract

Drought stress during the reproductive stage is a major constraint to global rice production, causing severe yield losses. Developing climate resilient cultivars requires simultaneous improvement of yield and stress adaptive traits. This study evaluated diverse rice genotypes under irrigated and managed reproductive stage drought conditions to identify high yielding, drought tolerant and stable ideotypes. The characterization was done for six traits viz., Days to 50% Flowering, Panicle Length, Number of Filled Grains, Spikelet Fertility Percentage, 1000-Grain Weight and Single Plant Yield. Linear mixed-effects modelling showed significant genotypic variation for all traits and significant genotype by environment interaction for yield, fertility and flowering time. Best Linear Unbiased Predictors (BLUPs) were used to estimate genetic values while minimizing environmental effects. Drought tolerance was assessed using Multi trait Genotype Ideotype Distance Index (MGIDI), while stability across environment was evaluated using Multi Trait Stability Index (MTSI). The MGIDI identified PMK 3, *Chithiraikar, Thooyamalli,* PMK 1 and *Sivappu Chithiraikar* as the best ideotypes with minimum distance to the target ideotype under drought stress. Whereas, MTSI identified PMK 3, MDU 6, *Chithiraikar, Chinnar* and *Thooyamalli* as most stable genotypes. Notably, PMK 3, *Chithiraikar* and *Thooyamalli* were consistently selected by both indices, demonstrating superior drought resilience through spikelet fertility retention, grain filling efficiency and yield maintenance under water deficit. Combining BLUPs with MGIDI and MTSI facilitates the reliable selection of climate resilient donor genotypes suitable for crop improvement programs.

Keywords: Rice, MGIDI, MTSI, BLUPs, Drought Resilience

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Role of Neurotransmitters Signaling Mechanisms in Plant Biology

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Abstract

Plant neurobiology is a newly focused in the field of plant biology research, that aims to realize how plants process the information they obtain from their ecosystem, environment to develop, prosper and reproduce optimally. The behavior of plants exhibit is coordinated across the whole organism by some form of integrated signaling, communication from cell to cell and response system. This system includes long-distance electrical signals, vesicle-mediated transport of auxin in specialized vascular tissues etc. Plant cells produce a variety of chemical compounds to ensure their survival, both as individuals and as species. Most of the plants responsive chemicals are considered secondary metabolites or compounds that do not contribute to average plant growth and development but are produced in response to environmental stimuli. Neurotransmitters, basically including i.e. melatonin, dopamine, serotonin, histamine, γ-aminobutyric acid (GABA), acetylcholine, and glutamate, are present in mammals and other living organisms. Plants are generally regarded as passive creatures. They seem to lack intelligent behavior's, largely because they are generally immobile as well as the absence of any centralized nervous systems in them. But plants are among the most successful life forms on earth and without them; our lives would be at stake. Thus, it is easily explicable that they must have an efficient information processing system to cope up with the ever-changing environmental conditions. Plants are not only able to receive diverse signals from the environment but they also possess mechanisms for rapid signal transmission. However, we investigate, how plant neurobiology is being directed toward discovering the mechanisms of signaling in whole plants, as well as among plants and their neighbors.

Keywords: Plant-signaling, Growth regulation, Gamma-Aminobutyric Acid, Neurohormones

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Agriculture as Climate Infrastructure: Reimagining Farms as Environmental Assets

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Abstract

Food security and climate mitigation symbolize two fundamental objectives of agriculture today. With the current trajectory of climate change, food production and land stewardship have often been viewed as competing goals, leaving farms unable to meet their full potential of providing food while simultaneously conserving resources. Challenges within agriculture like soil degradation, biodiversity decline, groundwater depletion and vulnerability to floods are prevalent. Despite this, farms can provide critical ecosystem services like carbon storage, water security and pollinator habitat. However, they are still overlooked in mainstream agriculture planning. This remains an unexplored area defining farms as designed ecosystems meant to resolve food production along with environmental needs. The objective of this study is to introduce a framework for Climate Infrastructure Farms (CIF) which emphasizes on five main pillars that will allow farms to be viewed as purposefully designed climate infrastructure: food production, carbon, water, biodiversity and climate resilience. Each pillar is developed through agroforestry, cover crops, farm ponds, hedgerows and soil organic carbon evaluated through indicators using carbon recharge, groundwater replenishment and microclimate regulation. This study provides researchers, farm planners and policymakers with an applicable framework to work towards meeting food security goals while mitigating and building resilience to climate change.

Keywords: Sustainability, Climate infrastructure farms, water security, pollinator habitat, biodiversity

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Characterization of *Brassica juncea* Genotypes for Drought Resilience

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Abstract

Among various abiotic stresses affecting the crop production, drought is one of the most serious constraints for global agriculture. Drought stress is one of the major contributors to the production of *Brassica juncea* worldwide. Due to drought stress the plant growth and development gets impacted paving way for the development of resilient crops. Shoot growth characteristics, particularly fresh shoot weight and biomass allocation, are considered reliable indicators for identifying drought-tolerant genotypes as they reflect the ability of plants to maintain biomass production, physiological growth under water-deficit conditions. To identify drought tolerant genotypes, 90 *Brassica juncea* genotypes were evaluated under drought and irrigated conditions including Kranti and Rohini as tolerant checks and Pusa Karisma, Pusa Bold and Varuna as susceptible checks in alpha lattice design. This study investigated some physiological parameters like fresh shoot weight, shoot length, dry shoot weight, 90 days after sowing under both irrigated and drought conditions. Significant genotypic variations were observed for related traits under both conditions. For drought screening, the most tolerant genotypes are those that maintain higher values under drought for growth traits and physiological traits. Drought tolerant genotypes exhibited greater shoot growth, higher fresh and dry biomass, reflecting better efficiency under stress conditions. The fresh shoot weight ranges from 40.26-481.13g under irrigated and from 16.12-150.24g under drought conditions. Similarly, shoot length varies from 26.8-242.2cm under irrigated and from 24.2-172.1cm under drought conditions, shoot dry weight ranges from 3.2- 65.6g under irrigated and from 1.6-26.3g under drought conditions. The results identified few drought tolerant genotypes which can serve as valuable genetic resources for breeding climate-resilient cultivars, while shoot parameters provide efficient selection criteria for drought tolerance screening.

Keywords: Drought, resilient, stress, physiological traits.

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Effect of IBA Concentration on Rooting of Stem Cutting in West Indian Cherry (Mal pighia glabra L.) for Root, Shoot and Biochemical Parameters under Periyakulam Region of Tamil Nadu

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Abstract

An investigation was carried out on Effect of IBA concentration on rooting of stem cutting in West Indian Cherry (*Malpighia glabra* L.) for root, shoot and biochemical parameters under Periyakulam region during the period 2022-2023. It was observed that, the least number of days (21.33) taken for root initiation, maximum percentage of rooting (80.00), number of roots (26.6), length of longest root (23.0 cm), maximum number of primary (8.83) and secondary root (20.83), maximum fresh (3.50 g) and dry weight of root (1.75 g) and root volume (4.50 cc) was recorded in hardwood cuttings along treated with IBA 5000 ppm. The smaller number of days taken for first sprouting (10.10), sprouting percentage (91.60), number of shoots (5.13), length of shoot (18.8 cm), diameter of shoot (2.30 mm), maximum fresh and dry weight of shoot (3.52 g and 1.76 g respectively) and number of leaves per cutting (20.50) was observed in hardwood cutting treated with IBA 5000 ppm followed by semiwood cuttings along treated with IBA 5000 ppm. Significantly total chlorophyll content (1.82 mg/g of fresh weight) of leaves and C : N ratio (8.74) was observed in cuttings treated with IBA 5000 ppm over all other treatments. The lowest total carbohydrates (4.37 %) and nitrogen content (0.50 %) was observed in cuttings treated with IBA 5000 ppm.

Keywords: West Indian Cherry, propagation, IBA, hardwood, semi hardwood & softwood cuttings, root characters, shoot and biochemical characters

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Adaptive Structural Modification and Diversity of Hill Stream Fishes of Dikhu River, Mokokchung, Northeast, India

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Abstract

Eastern Himalaya is one of the freshwater fish biodiversity hotspots in the world. Nagaland falls under two biodiversity hotspots, the eastern Himalaya and Indo-Burma. The present study is carried out to make an inventory of fish diversity and to study the adaptive structural modification of Dikhu River for two years from February 2021 to January 2023. Dikhu river flows across Mokokchung and Longleng districts of Nagaland, Northeast, India. Samples were collected by Scoop net, Cast net, Triangular net and BR fishing trap (Patented) at selected sites. Common specimens are identified, recorded and photographed at the landing site itself whereas others were brought to the laboratory of department of Zoology, NU for further studies. The specimens were identified and classified using the standard keys of Jayaram (2010), Vishwanath (2007). The present study recorded 43 species of fishes belonging to 5 orders, 11 families, and 26 genera. Among these, 5 species are nearly threatened, one (1) species is endangered, 5 species are vulnerable, 3 species are data deficient and 29 species are least concerned. Family *Cyprinidae* is the dominant family followed by *nemacheilidae* and *psilorhynchidae* respectively. Among the species, *Psilorhynchus balitora,* is the dominant species followed by *Devario aequipinnatus, Opsarius bendelesis*, and *Ambleceps apangi.* Many genera such as *Amblyceps, Balitora, Garra, Glyptothorax, Paracanthocobitis, Psilorhynchus, Olyra* and *Schistura etc* exhibit adaptive structural modification to survive in the fast following water.

Keywords: Dikhu river, BR fishing trap, *Garra*, *Glyptothorax*, *Psilorhynchus* and *Balitora.*

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Exploring the Potential of Cowpea (Vigna unguiculata) and Soybean (Glycine Max) in Herbs and Spice-Infused Tofu Production

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Abstract

Background- The global rise in vegetarianism, veganism, and plant-based diets stems from concerns like health, environment, and animal rights. Plant-based alternatives address issues such as lactose intolerance, dairy allergies, and calorie management. Tofu, a popular plant protein, is rich in protein, vitamins, minerals, and bioactive compounds like isoflavones. Cowpeas (Vigna unguiculata), an underutilized legume, are being explored as a tofu base due to their high protein, fibre, and mineral content. Incorporating herbs and spices in cowpea-based tofu enhances its sensory and nutritional profiles, offering a healthier, flavourful alternative to traditional soybean tofu while catering to evolving dietary preferences.

Purpose -This study aims to develop plant-based tofu by partially incorporating Cowpea (*Vigna Unguiculata*) with Soybean (*Glycine Max*) infused with herbs and spices and to assess the sensory characteristics of the product.

Methodology- Cowpea (100g) and Soybean (100g) were washed and soaked for 5 hours, and blended with water (500 ml). The mixture was sieved using muslin cloth and milk was extracted. The milk was boiled to 90°C, and herbs and spices were added: T1 – Crushed Garlic (*Allium sativum*) (4%), T2 – Roasted Cumin Powder (*Cuminum cyminum*) (2%), and T3 – Curry Leaves Powder (*Murraya koenigii*) (4%). Citric Acid (30g), diluted with water, was used as a coagulant. The milk was boiled for 2 minutes until curdling occurred, then sieved using muslin cloth. The curd was wrapped, pressed to remove excess liquid, and shaped into tofu. Sensory evaluation of the tofu samples was conducted using a 9-point hedonic rating scale.

Result- The data revealed that the plant-based tofu formulated with Cowpea (100g), Soyabean (100g) and T1 – Crushed Garlic (*Allium sativum*) was found to be most acceptable product in regards with appearance, aroma, taste, texture and overall acceptability. The nutritional composition of sample of 500 g T1 was (energy- 702.45 kcal, carbohydrate- 64.04g, protein- 59.32g, fat -20.82g, fibre -34.53g, moisture- 17.36g, and ash- 7.40g) respectively.

Conclusion- The study concluded that the tofu developed with Cowpea(100g), Soybean(100g) and Crushed garlic (4%) is protein rich and can be used by Vegans, Lactose intolerants and Overweight people for calorie management.

Implication- This study develops a nutrient-rich, flavourful cowpea-based tofu, addressing veganism, lactose intolerance, sustainability, and public health by offering a sensory-appealing, healthy protein alternative.

Keywords: *Vigna Unguiculata, Glycine Max, Citric Acid, Allium sativum, Cuminum cyminum, Murraya koenigii*

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Multifactorial Assessment Of Obesity Among Young Adults: Role Of Nutrition, Sedentary Lifestyle, And Association with Stress & Anxiety

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Abstract

Background: Obesity is a chronic, multifactorial disease characterized by complex interactions between genetic, metabolic, environmental, and psychological factors. According to the World Health Organization, over 1 billion people worldwide are affected, including approximately 7–8 crore individuals in India. Rising prevalence is strongly linked to unhealthy dietary patterns, sedentary lifestyle, and emerging psychological factors such as stress and anxiety, which contribute to metabolic dysregulation and increased disease burden

Research Methodology: The current study was a cross-sectional observational community-based study integrating epidemiological data, dietary patterns (via Food Frequency Questionnaire), sedentary lifestyle parameters, and psychological factors among young adults (n=1067). The collected data were analyzed using Microsoft excel in terms of percentage and obtained results were concluded

Results and Discussion: The findings indicate that while a majority of participants had normal BMI, a significant proportion showed predisposition to overweight and obesity. Daily consumption of relatively balanced foods was observed; however, frequent intake of snacks, sweets, and junk food, combined with prolonged sedentary behavior (3–4 hours/day), contributed to metabolic imbalance. Psychological assessment revealed that a notable proportion of participants experienced stress and anxiety symptoms on several days per week. Mechanistically, obesity was associated with their unhealthy food habits as well as lack of physical activity. At molecular level, changes in leptin resistance, increased ghrelin activity, insulin resistance, chronic inflammation, neurotransmitter imbalance, and enhanced lipogenesis, all promoting fat accumulation was observed. A bidirectional relationship between obesity and psychological stress was evident through HPA axis activation and cortisol-mediated fat deposition.

Conclusion: Obesity among young adults is driven by the combined effects of unhealthy diet, sedentary lifestyle, and psychological stress, mediated through complex molecular and metabolic mechanisms. Early identification of these interrelated risk factors and promotion of lifestyle modification, mental health awareness, and preventive strategies are essential to reduce obesity prevalence and its associated complications.

Keywords: Obesity, Sedentary Lifestyle, Stress and Anxiety, Insulin Resistance, Leptin Resistance, HPA Axis, Young Adults, Epidemiology

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Circular Bioeconomy through Invasive Biomass Valorization: A Sustainable Livelihood Framework for Lantana camara Management

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Abstract

Lantana camara is among the most widespread invasive alien plant species, posing serious threats to forest ecosystems, biodiversity, grazing lands, and rural livelihoods. Conventional management practices primarily focus on eradication, which is often expensive, labourintensive, and provides only temporary control due to the species rapid regeneration. Recognizing invasive biomass as a potential resource rather than waste offers an opportunity to align invasive species management with circular bioeconomy principles.

This study aims to **(i)** develop a conceptual circular bioeconomy framework for sustainable Lantana camara management, **(ii)** illustrate the invasive biomass value chain from removal to value-added products and market linkages, and **(iii)** highlight the environmental, livelihood, and policy implications of biomass valorization.

The proposed framework demonstrates a circular value chain involving community-based biomass removal, collection, processing, product development (including briquettes, handicrafts, furniture, and biochar), marketing, and reinvestment into ecosystem restoration. By converting invasive biomass into economically valuable products, the framework promotes resource efficiency while reducing ecological degradation.

The framework emphasizes multiple benefits, including restoration of native biodiversity, reduced wildfire risk, improved forest health, employment generation, income diversification, and enhanced livelihood opportunities for rural and tribal communities. It further underscores the importance of supportive policies, institutional collaboration, market development, and capacity-building initiatives to enable large-scale implementation.

The proposed circular bioeconomy framework illustrates a sustainable transition from invasive species eradication to biomass valorization, demonstrating how ecological restoration and rural economic development can be integrated to support long-term environmental sustainability and resilient livelihoods.

Keywords: Bioeconomy, lantana camara , Sustainability, Livelihood.

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Plasma-Powered Seed Enhancement: A Sustainable Strategy for Enhancing Seed Quality of Redgram (*Cajanus cajan* L.)

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Abstract

Poor seed quality, reduced seed vigour and non-uniform crop establishment are major constraints limiting redgram productivity. Conventional chemical seed treatments, although effective, may leave residues and pose environmental concerns, necessitating the development of sustainable and eco-friendly seed enhancement technologies. Cold plasma, a non-thermal ionized gas rich in reactive oxygen and nitrogen species (RONS), has emerged as a promising residue-free technology for improving seed performance. Therefore, the present study evaluated the effect of dielectric barrier discharge (DBD) cold plasma treatment on the physiological and biochemical quality of redgram (*Cajanus cajan L.*) cv. CO (Rg) 7 seeds. Seeds were exposed to three voltage levels (20, 25 and 30 kV) with five exposure durations (2, 4, 6, 8 and 10 min), along with an untreated control. The treated seeds were evaluated for germination percentage, speed of germination, shoot length, root length, seedling length, vigour index I, vigour index II, seedling dry matter production and dehydrogenase activity using standard seed testing procedures. Cold plasma treatment significantly improved seed quality compared with the untreated control. Among the treatments, 30 kV for 10 min recorded the best overall performance by enhancing germination percentage, speed of germination, seedling growth (shoot length, root length and seedling length), vigour indices, seedling dry matter production and dehydrogenase activity, indicating improved physiological potential and metabolic activity. The enhanced performance is attributed to plasmainduced surface modification, which improves water uptake and stimulates metabolic processes during germination. The findings demonstrate that optimized cold plasma treatment is an effective, residue-free and environmentally sustainable seed enhancement technology for improving seed quality and promoting uniform crop establishment in redgram, thereby contributing to resilient and sustainable pulse production systems.

Keywords: Cold plasma, Redgram, Seed quality, Seed vigour, Sustainable agriculture.

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Climate Vulnerability, Water Resource Dynamics and Resource Use Efficiency in Rice Cultivation: A Multi-Method Assessment of Nagapattinam District

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Abstract

Nagapattinam, the seaward-most district of the Cauvery Delta Zone (CDZ), presents a coastal agrarian system shaped by cyclone exposure, sea-level rise, and near-total groundwater salinisation. This study examines crop diversification, climatic trends, climate vulnerability, water footprint, resource use efficiency, and farm-level constraints in rice cultivation, drawing on primary data from 120 farmers across two taluks and secondary data from the Department of Agriculture and IMD records. The Composite Entropy Index shows a declining diversification trend from 0.391 (2013–14) to 0.270 (2023–24), with Markov chain analysis revealing a district-wide transitional shift toward cotton, most sharply from sugarcane (37.1%). Mann-Kendall and Sen's slope tests indicate significant increases in minimum temperature ($\tau = 0.4115$) and rainfall ($\tau = 0.3333$), alongside significant wind stilling ($\tau = -0.4253$), with no significant trend in maximum temperature or relative humidity. The Climate Vulnerability Index, built from Exposure (0.667), Sensitivity (0.780), and Adaptive Capacity (0.492) components, yields a normalised score of 0.423 Moderate-to-High vulnerability. CROPWAT-based estimation places the total water footprint of rice at 2,204 m^3/tonne, dominated by blue water (68.4%). Stochastic frontier analysis reveals a gamma value of 0.8365, indicating that technical inefficiency, rather than random noise, drives most yield variation, with labour and machinery as the significant frontier inputs. Economic water use efficiency is the lowest in the Cauvery Delta Zone at ₹7.92/m^3. Garrett ranking identifies water scarcity, not labour shortage, as the foremost constraint faced by farmers. The findings position Nagapattinam at the terminus of a coastward-declining efficiency gradient across the delta, with implications for salinity management, water governance, and climate-adaptive extension policy.

Keywords: Climate vulnerability, water footprint, stochastic frontier analysis, groundwater salinity, Mann-Kendall trend.

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Identifying the Weather Parameters that Contribute to Higher Disease Incidence of Bacterial Blight of Rice in Southern Tamil Nadu

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Abstract

Bacterial blight (BLB), caused by *Xanthomonas oryzae* pv. *oryzae*, is one of the most destructive diseases of rice, causing significant yield losses in the major rice-growing regions of Tamil Nadu. In order to understand disease development it is essential to understand the relationship between weather parameters and disease incidence and thereby develop a reliable disease forecast-model. Our study aimed at identifying the major meteorological factors leading to the incidence of Bacterial blight in southern Tamil Nadu. A ten-year dataset comprising maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rainfall, and disease incidence was analysed using multiple linear regression. Regression and correlation analysis revealed that the incidence of bacterial leaf blight (BLB) increases with maximum temperature, minimum temperature, morning relative humidity, and rainfall, whereas evening relative humidity negatively influences BLB incidence. The developed regression model, **PDI (Y)=−68.583 + 1.227 (Max Temp) + 1.952 (Min Temp) + 0.040 (Morning RH) − 0.013 (Evening RH) + 0.588 (Rainfall)** provides a useful framework for predicting disease outbreaks and can serve as a decision-support tool for the timely implementation of disease management strategies, thereby minimizing crop losses and improving rice productivity.

Keywords: Bacteria, blight, forecast-model, regression, management.

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Exopolysaccharide Extraction from Chlorella Ellipsoidea MZ621181 Using Rsm and Its Role in Gaba Production

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Abstract

Exopolysaccharide the most abundant polysaccharide in algae. Many factors influence the EPS production, limiting the nitrogen and phosphorus concentration in the medium. On depletion, these elements in the medium reduce algal growth and enhance EPS production by protecting the cells from starvation. This study conceptualizes the isolation and extraction of EPS from *Chlorella ellipsoidea* MZ621181, its prebiotic properties, and GABA production using soybean milk medium. *Chlorella* was isolated from the pond water, identified microscopically and they were analysed for optimal EPS yield using various methods, their composition, water holding index, solubility test, and they were characterized using UV spectrometer, FTIR, XRD, LC MS. GABA production was evaluated in soybean milk supplemented with EPS using *Lactobacillus fermentum*. Fourier Transform Infrared (FTIR) and X-ray diffraction (XRD) analyses characterized the functional groups and crystalline nature of EPS. Thermal degradation studies indicated EPS stability up to 100°C. Liquid Chromatography-Mass Spectrometry (LC-MS) further elucidated the carbohydrate composition of EPS, highlighting glucose, ribose, glucuronic acid, and xylose presence. This research underscores the potential of *Chlorella ellipsoidea* MZ621181 as a valuable source of bioactive compounds

Keywords: Exopolysaccharide, *Chlorella* sp., GABA production, Nutraceuticals, characterization.

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Processing of Plant Based Meat Alternative from Bread Fruit

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Abstract

Breadfruit (*Atrocarpus atilis*) is one of the low-fat, low-calorie foods with unique nutrients and phytochemicals. It is particularly rich in dietary fiber, potassium, phosphorous, magnesium, copper, vitamin C, B vitamins as well as bioactive components, such as polyphenols and carotenoids, especially β-carotene and lutein. It is highly perishable and climacteric in nature, ripen rapidly after harvest, which limits its fresh market potential. It is mainly used for culinary preparation. It is underutilized due to its short post-harvest life and lack of post harvest technology. Developing products from breadfruit not only minimizes post-harvest losses but also encourages its integration into mainstream food systems. The present study was undertaken to process breadfruit chunks and to study their nutrient content. Freshly harvested bread fruits were washed thoroughly, peeled, cut into slices and pre-treated with salt (0.2%) and citric acid (1%) solution for 30 minutes followed by steam blanching (3-5 minutes).The pretreated slices were immersed in the salt for 6h, drained and dried in cabinet drier at 60-70oC until the chunks reached moisture content below 10 per cent and stored for further utilization similar to meat. It contained moisture content (9.4%),protein (4.1g),fat(1.7g),crude fibre(4.0g), carbohydrate(71.3g), beta carotene (341 µg), itamin C(8.7mg) and total phenol (2.1 mg GAE g^{-1}). Ready-to-use product that can be rehydrated within 15 minutes and utilized in curries and other culinary preparations.

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Development and Standardization of Processing and Preservation Technology for Quick Dhal from Field Bean (Dolichos lablab)

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Abstract

Field bean (*Dolichos lablab*) is a nutritious and adaptable legume, but its consumption is limited by prolonged cooking time, antinutritional factors, and inadequate post-harvest handling. This study aimed to develop and standardize quick-cooking dhal flakes using a local genotype and the improved variety HA-4. The genotypes were evaluated for engineering, physicochemical, nutritional, thermal, and functional properties. Processing conditions, including soaking, microwave cooking, hot-air drying, and sodium chloride pretreatment, were optimized. Storage stability was assessed for 180 days using low-density polyethylene, polypropylene, and metallized polyester packaging. HA-4 demonstrated superior protein content, water absorption capacity, cooking behaviour, and flake-forming properties and was selected for further optimization. The best processing conditions were soaking for 90 minutes, microwave cooking for 12 minutes, and drying at 60 degrees C for 60 minutes, resulting in a maximum flake recovery of 87.17 g per batch. Sodium chloride pretreatment improved flake integrity, with the highest flake weight obtained using 2% sodium chloride. The optimized flakes contained 20.78% protein and reconstituted in approximately 3.4 minutes. Metallized polyester provided the best protection during storage, retaining sensory quality while minimizing moisture gain and microbial growth. The study established a reproducible process for producing nutritious and convenient field bean dhal flakes.

Keywords: Field bean, dhal flakes; quick-cooking, microwave cooking

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Enhancing Growth and Yield of Blackgram (Vigna mungo L.) cv. VBN 6 through Seed Priming Techniques

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Abstract

A field experiment was conducted to evaluate the effect of different seed priming treatments on the growth and yield attributes of blackgram (*Vigna mungo L.*) cv. VBN 6. The experiment was conducted at the Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu. Seeds were subjected to six treatments, namely hydropriming (distilled water for 4 h), halopriming (1% $CaCl_2$ for 4 h) and biopriming with 1% cow urine, 1% papaya seed extract and 1% Prosopis leaf extract for 4 h. along with control and evaluated the effect of these treatments on growth and yield attributes The result revealed that among the treatments, biopriming with 1% Prosopis leaf extract recorded the best performance by promoting early flowering and significantly enhancing growth, yield attributes, seed yield per plant and hundred-seed weight followed by biopriming with 1% cow urine. The results indicated that biopriming with 1% Prosopis leaf extract is an effective, economical and eco-friendly seed enhancement technique for improving the growth and productivity of blackgram (*Vigna mungo L.*) cv. VBN 6.

Keywords: Blackgram, *Vigna mungo*, seed priming, *Prosopis* leaf extract, growth traits, yield attributes.

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In Vitro Shoot Induction from Stem Node Explants of Glinus oppositifolins (L) AUG. DC

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Abstract

Micro propagation involves multiplication of genetically identical individual by asexual reproduction within a short span of time with tremendous potential for the production of high quality plant based medicines (Murch et al., 2000). Multiple shoot induction was achieved in one of the important medicinal plant of *Glinus oppositifolins* (L) MS medium supplemented with 1.0 mg/l BAP + 2.0 mg/l NAA and 3.0 mg/l L-Glutamicacid was found to be optimum to induce shoots. The present study established reliable and reproducible protocol for rapid multiple shoot induction from stem node explants of *Glinus oppositifolins* using different concentrations and combinations of Cytokinins. The effect of BAP and NAA + Kn combination on In vitro shoot regeneration and elongation was analysed in shoottip explants. The percentage of response was increased upto 2.0mgl/L to 3.0 mgl/L Kn and later gradually decreased at high concentrations. Plantlet regeneration through Cotyledon and shoottip explants and streptomycin resistant plantlet using in vitro mutagenesis was also developed in S. Surattence (Muukherjee *et al* 2011, Swamy *et al* 2005, Nasar *et al* 1997) plant regeneration callus induction. *In vitro* regeneration in the *Glinus oppositifolins* (L) study of multiple shoots MS Containing media with different and combinations of growth regulators. The effect of plant growth regulators on rooting was investigated 4-6 weeks after culture on MS medium (Subashri *et al* 2014: Devendra *et al* 2011: Verma 1996: Sunderraj *et al* 1989). Due to over exploitation for high medicinal values and destruction of the habit this Sunderraj *et al* 1989, Nasir et al 1997) meristem shoottip cultures hence there is need for *ex situ* conservation through tissue culture methods. The stem node explants were inoculated on MS medium supplemented with various cytokinins i.e., BAP and NAA. Addition of BAP at 3.0 mgl/L concentration or NAA at 3.0 mgl/L to the MS basal medium, induced regeneration from the stem node explants

Keywords: Stem node, NAA BAP, *Glinus oppositifolins*, Shoot induction

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Categorization of Surface Soil Properties and Soil Nutrient Index Assessment in Basaltic Soils of Marathwada Region

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Abstract

Categorization of surface soils based on fertility status is essential for identifying nutrient constraints and developing appropriate nutrient management strategies for sustainable crop production. The present study evaluated the fertility status of 40 surface soil samples collected from the basaltic terrain of Ithalapur village, Marathwada region, Maharashtra. The soils were predominantly neutral to slightly alkaline in reaction and all samples were categorized as non-saline. Calcium carbonate content was mainly medium with a relatively higher proportion of high calcareous soils. Exchangeable calcium and magnesium were uniformly categorized as high across all surface samples. Organic carbon was predominantly distributed in the moderate to moderately high category, whereas available nitrogen and phosphorus were consistently low, indicating widespread nutrient deficiency. In contrast, available potassium was classified as very high in all samples, reflecting the influence of basaltic parent material. Among the micronutrients, manganese, copper and boron were mainly distributed in the moderate to moderately high categories, while zinc occurred predominantly in the moderate category and iron remained largely low. The Soil Nutrient Index classified organic carbon (1.85), manganese (2.00) and boron (1.81) as medium, potassium (3.00) and copper (2.35) as high, whereas nitrogen (1.00), phosphorus (1.00), zinc (1.06) and iron (1.03) were categorized as low. The findings provide a scientific basis for balanced nutrient management to improve soil fertility and sustain agricultural productivity in basaltic soils.

Keywords: Surface soil categorization, Soil nutrient index, Basaltic soils, Nutrient status, Soil fertility.

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Bougainvillea Brilliance: DES-Driven Green Extraction, Quantification, and Nanoencap sulation of Betalains for Natural Colouring

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Abstract

Synthetic food colourants pose environmental and health risks, necessitating sustainable natural alternatives. This study optimized green extraction, quantification, and encapsulation of betalains from *Bougainvillea spectabilis* flowers using deep eutectic solvents (DES) at the Department of Floriculture, TNAU, employing a completely randomized design (CRD) with seven treatments. Choline chloride–citric acid DES (T6) achieved the highest yields: 66.24 mg g^{-1} betacyanins, 56.86 mg g^{-1} betaxanthins, 123.10 mg g^{-1} total betalains, and 24.18 mg g^{-1} total phenols. Betalain stability was optimal at −20°C (106.94 mg g^{-1}) versus 30°C. HPLC identified betanin (98.30 ppm, retention time 8.30 min). Spray-dried powder exhibited 68% recovery, 98.32% solubility, 16.84% hygroscopicity, 0.32% fibre, and desirable colour (L^* = 38.10, a^* = +29.40, b^* = +2.30). Sensory evaluation of model foods (cake cream, pudding, RTS beverages) showed high acceptability. Choline chloride–citric acid DES enables efficient, scalable production of bioactive *B. spectabilis* betalains as natural food colourants.

Keywords: Bougainvillea; betalains; deep eutectic solvents; spray drying; encapsulation; natural colourant.

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The Synergistic Effect of Melatonin and 1-MCP in Alleviating Chilling Stress of Chilli Under Cold Storage Conditions

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Abstract

Chilling injury (CI) is a major postharvest constraint limiting the storage life and market quality of chilli (*Capsicum annuum L.*) under low-temperature conditions. This study evaluated the synergistic effects of melatonin (MT; 150 µM, 15 min) and 1-methylcyclopropene (1-MCP; 900 ppb, 4 h) in mitigating chilling stress during 28 days of storage at 4°C by regulating antioxidant defence mechanisms at the physiological, biochemical, and molecular levels. The combined MT+1-MCP treatment substantially reduced chilling symptoms, producing the lowest CI index (4.50) after 28 days while maintaining membrane integrity and fruit quality, as evidenced by higher chlorophyll content (0.075 mg g^{-1} FW), greater firmness (13.15 N), and lower electrolyte leakage (13.29%) than untreated fruits. Nutritional quality was also better preserved, with higher titratable acidity (0.648%), ascorbic acid (27.75 mg 100 g^{-1} FW), and total soluble solids (4.3 °Brix), indicating delayed senescence and moderated ripening.

The combined treatment significantly enhanced antioxidant metabolism by promoting phenylpropanoid biosynthesis and the detoxification of reactive oxygen species (ROS). Increased PAL expression corresponded with higher total phenols (0.571 mg GAE g^{-1} FW), flavonoids (0.25 mg QE g^{-1} FW), and antioxidant capacity (0.89 mg AAE g^{-1} FW) during storage. Antioxidant enzyme activities were markedly enhanced, with catalase (442.66 U g^{-1} min^{-1}) and peroxidase (3.633 U g^{-1} min^{-1}) reaching their highest levels, whereas lipoxygenase (2.71 U g^{-1} min^{-1}) and Polygalacturonase (13.77 U g^{-1} FW) activities were significantly suppressed at the end of storage. Quantitative PCR further revealed approximately fourfold upregulation of CAT and POD transcripts and twofold downregulation of LOX and PG transcripts, confirming transcriptional regulation of antioxidant and cell wall degradation pathways. These findings demonstrate that the combined MT+1-MCP treatment effectively alleviates chilling injury by coordinating antioxidant defence, reducing oxidative damage, and preserving membrane and cell wall integrity, thereby providing a sustainable and practical strategy for extending the postharvest storage life and quality of chilli fruits.

Keywords: Chilli, Melatonin, 1-MCP, ROS, chilling injury, postharvest shelf life

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Exploration and Exploitation of Nitrous Oxide Reducing Bacteria for Mitigation of Post Harvest Emission of N2O from Soybean Field: An Innovative Concept

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Abstract

Nitrous oxide (N_2O) is a potent greenhouse gas with a global warming potential approximately 310 times greater than carbon dioxide over a 100-year period. Soybean (*Glycine max L.* Merr.), one of the world's most important legume crops, occupies nearly 6% of global arable land and contributes substantially to biological nitrogen fixation. However, decomposition of soybean root nodules after harvest can lead to significant N_2O emissions, contributing to agricultural greenhouse gas burdens. Microorganisms possessing the *nosZ* gene encode nitrous oxide reductase (N_2OR), the enzyme responsible for reducing N_2O to environmentally benign dinitrogen gas (N_2), thereby serving as an important biological sink for N_2O. The present study aimed to identify indigenous *Bradyrhizobium* isolates with enhanced N_2O-reducing capacity for potential mitigation of post-harvest N_2O emissions in soybean ecosystems. Four *Bradyrhizobium* isolates (Soy-NS-1, Soy-NS-2, Soy-NS-3 and Soy-NS-4) were obtained from soybean nodules collected from the same experimental field using selective media. The isolates were evaluated under laboratory conditions in sealed incubation jars injected with 100 ppm pure N_2O gas. The kinetics of N_2O reduction was monitored over a 118-hour incubation period to assess nitrous oxide reductase activity. Substantial variation was observed among the isolates in their N_2O reduction efficiency. Among the tested strains of *Bradyrhizobium*, Soy-NS-3 exhibited the highest N_2O mitigation potential, achieving 71.15% reduction of the injected N_2O, followed by Soy-NS-1 (52.54%). In contrast, Soy-NS-2 and Soy-NS-4 showed comparatively lower reduction efficiencies of 9.06% and 12.46%, respectively. The superior performance of Soy-NS-3 was reflected by a rapid decline in N_2O concentration monitored by GC throughout the incubation period, indicating enhanced nitrous oxide reductase activity. Based on its laboratory performance, Soy-NS-3 was selected for subsequent soil inoculation studies following soybean harvest to evaluate its effectiveness in mitigating post-harvest N_2O emissions under field condition. The findings demonstrate the innovative concept of native *Bradyrhizobium* strains as eco-friendly biological agents for greenhouse gas mitigation and provide a promising strategy for developing climate-smart soybean production systems through microbiome-based interventions.

Keywords: *Bradyrhizobium*, soybean nodules, nitrous oxide reductase, *nosZ* gene, greenhouse gas mitigation, N_2O reduction, biological nitrogen fixation, climate-smart agriculture

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Studies on the Co-Inoculation Effect of Phosphobacteria and Arbuscular Mycorrhizae Fungi on the Growth and Yield of Finger Millet

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Abstract

Finger millet or ragi (*Eleusine coracana L.*) is a nutrient-dense small grain crop, and it is mostly cultivated in arid and semiarid regions of Asia and Africa. India is the largest producer of finger millet in the world. Phosphorus plays an important role next to nitrogen that are required for the plant growth. Two organisms, *Bacillus megaterium* and *Glomus fasiculatum* were selected for phosphorus solubilization and mobilization. The field experiments were conducted to investigate the effect of combined inoculation of *Bacillus megaterium* and *Glomus fasiculatum* along with different graded levels of phosphorus on the growth and yield of ragi. Among the different treatments studied, the treatment T7 (75% P + *Bacillus megaterium* + *Glomus fasiculatum*) recorded the highest value for plant height (107.5 cm), dry matter production (7008 kg ha-1), number of tillers (7.0), number of ear heads hill-1 (9.00), 1000-grain weight (3.13 g), finger length (9.8 cm), and grain yield (3.08 t ha-1) compared to the control treatment (T1). The findings indicate that the combined application of *Bacillus megaterium* and *Glomus fasiculatum* with 75% of the recommended phosphorus dose can enhance ragi productivity while reducing chemical phosphorus fertilizer requirements by 25%, thereby supporting sustainable and eco-friendly crop production.

Keywords: Ragi, *Bacillus megaterium, Glomus fasiculatum*, Crop production.

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Data-Driven Identification of Climate-Resilient Rice Cultivars through Multivariate Approaches for Sustainable Production under Coastal Delta Ecosystems

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Abstract

Rice production in coastal ecosystems faces challenges due to climatic variability and environmental stresses, necessitating the identification of cultivars with superior adaptability and sustainable productivity. The present study aimed to identify high-performing rice cultivars by integrating growth and yield attributes through innovative multivariate approaches under coastal delta conditions. The field experiment was conducted during the Kharif 2025–2026 season at PAJANCOA & RI, Karaikal, India, using seven rice cultivars (CO 51, ADT 46, KKL (R) 2, IR 20, BPT 5204, Karuppukavuni and CR 1009) evaluated in a Randomized Block Design with three replications. Eleven growth and yield-related traits, including plant height, tiller number, leaf area index, productive tillers, dry matter production, panicle traits, test weight, grain yield, straw yield and crop duration, were analyzed using Principal Component Analysis (PCA), hierarchical clustering and K-means clustering. The results revealed substantial variability among cultivars, with the first three principal components explaining 92.68% of the total variation. Leaf area index, panicle weight, dry matter production, grain yield, straw yield and crop duration were identified as major contributors to cultivar discrimination. Cluster analysis grouped cultivars into three distinct clusters, with the elbow method confirming the optimal cluster number. CR 1009 exhibited superior performance with higher grain yield (6298 kg ha^{-1}), dry matter production (15944 kg ha^{-1}), maximum leaf area index at flowering (7.27), and longer crop duration (149 days). KKL (R) 2 and ADT 46 also demonstrated desirable growth and yield characteristics. The integration of multivariate analytics with crop evaluation provides a scientific framework for identifying climate-resilient cultivars, supporting sustainable rice production, efficient resource utilization and future crop improvement strategies under vulnerable coastal ecosystems.

Keywords: Climate-resilient rice; Multivariate analysis; Principal Component Analysis; Sustainable agriculture; Cultivar selection; Coastal ecosystem; Yield traits

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Exploring Nanocoating as a Shelf Life Enhancer

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Abstract

Post harvest losses of agricultural produce is a very crucial factor that impacts nations growing economy. Several remedies are being applied to overcome the hurdle but many of them failed due to their adverse effect on the environment. A novel approach was adopted in this area to extend the shelf life of the product by minimizing post-harvest losses. Silver nanoparticles have well established antimicrobial activities against pathogens. In the present study, gluconate stabilized silver nanoparticles were synthesized, characterized and applied as nanocoating to minimizes the losses caused by post-harvest pathogen *Penicillium italicum* in Khasi mandarin. The synthesized nanoparticle showed strong antimicrobial activity against *P. italicum* at 250 ppm concentration. On studying different biochemical parameters of juice extracted from nanoparticle treated and untreated mandarin, the highest TSS (10.66^{o}Brix), Fruit Weight Loss (12.54%), and the lowest ascorbic acid content (0.075 mg/100g) were recorded in Uncoated (Control). The highest (0.975) BI was recorded in juice stored in ambient conditions (22±2ºC) than the juice stored in refrigerated conditions (4ºC) (0.476). The juice extracted from nanocoated mandarin showed the highest ascorbic acid content with the lowest fruit weight loss (%). The dual antimicrobial activity of Glu-Ag NPs and their coating behaviour enhance the shelf life of *Khasi* mandarin by minimizing DSI. Thus, Glu-Ag NPs can be used as a coating material for shelf life enhancement of *Khasi* mandarin.

Keywords: Amino acid, *Penicillium italicum*, Post harvest losses, Shelf life.

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Heavy Metal Analysis in Varhala Devi Lake, Bhiwandi, Thane(Maharashtra)

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Abstract

Heavy metals represent a category of toxic elements that pose significant risks to both human health and the environment. Their occurrence in aquatic systems is alarming, as pollution from heavy metals can lead to severe consequences. These metals are frequently introduced into water bodies through various sources, including industrial effluents, agricultural runoff, and domestic waste. Inadequate treatment processes and improper disposal methods contribute to the persistent accumulation of these harmful pollutants in aquatic environments. This study aims to conduct a comprehensive analysis of heavy metals found in the water of Varhala Devi Lake, that may be affected by numerous anthropogenic activities. For a period spanning from November 2024 to October 2025, water samples were meticulously collected and analyzed using an Atomic Absorption Spectrophotometer (AAS), a precise instrument widely utilized for detecting trace metals in samples. To ensure a representative assessment, eight distinct sampling sites were strategically chosen. The focus was on measuring the concentrations of eight specific heavy metals: Manganese, Chromium, Mercury, Copper, Cadmium, Arsenic, Nickel, and Lead. These metals were selected due to their known toxicity and prevalence in polluted water bodies. Preliminary findings from this research indicate that the concentration levels of most heavy metals in the lake's water exceeded established permissible limits, thus raising significant concerns regarding the potential health risks for local communities and aquatic life. The results underscore an urgent need for the implementation of effective remediation measures to mitigate the effects of heavy metal pollution and restore the ecological balance of Varhala Devi Lake.

Keywords: Varhala Devi Lake, Heavy metals, pollution status, water quality.

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Establishment of Postharvest Infrastructure for the Empowerment of Rural Women in Vegetable Value Chain

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Abstract

The Department of Science and Technology (DST), New Delhi, is sponsoring a scheme on "Economic Empowerment of Rural Women through Postharvest Handling and Value Addition," implemented at the Department of Postharvest Technology, Horticultural College and Research Institute, Periyakulam. The project aims to establish a rural postharvest pack house and low-cost value addition unit to enhance the income and livelihood security of rural women through entrepreneurship in vegetable value chains.

Usilampatti village in Madurai District, Tamil Nadu, was identified as the intervention site. Twenty-five rural women beneficiaries were selected based on educational and socio-economic criteria and organized into three functional groups for structured training and enterprise development. A sensitization workshop was conducted to foster entrepreneurial orientation and create awareness about establishing commercial value addition units.

Hands-on training was provided on processing and value addition of high-volume horticultural crops such as tomato, onion, and moringa. A Science, Technology and Innovation (STI) Hub was established in the village through renovation of an existing building and installation of essential equipment including a pulverizer, onion peeler, packing machine, solar drier, dehydration unit, refrigerator, vegetable cutter, electronic balance, cooking accessories, and banana fibre extractor. Standardization of value-added products was undertaken, resulting in the development of tomato powder, tomato spice mix, pickles, dehydrated flakes, onion-based sauces, minimally processed onions, moringa powder, and moringa soup mixes.

Certification was obtained from the Food Safety and Standards Authority of India (FSSAI), and products are marketed under the brand name "Usilai Suvai." The STI-Hub model has strengthened livelihood outcomes by enabling pilot-scale production and local market integration. Initial market linkages have been established with local retailers and cooperative outlets, with expansion efforts targeting supply to schools under the Mid-Day Meal Programme and Anganwadi centres.

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The project demonstrates a scalable, cluster-based model for women-led micro-enterprises in postharvest value addition, contributing to sustainable rural development and nutritional security.

Keywords: Rural women empowerment, Postharvest technology, Value addition, Cluster-based model and sustainable rural development.

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Development and Quality Evaluation of Flax Seeds and Pumpkin Seeds-Based Functional Yogurt

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Abstract

Background: Functional foods enriched with nutrient-dense plant materials have gained increasing attention due to rising consumer interest in health-promoting dairy products.

Objective: This study focused on developing yogurt enriched with flax and pumpkin seeds and examined its sensory, physicochemical, microbiological, and storage properties.

Methodology: In phase I, the yogurt samples were prepared by adding flaxseed powder and pumpkin seed powder at different levels (2.5%, 5% , and 7.5%). The hedonic analysis of developed samples extracted using a 9-point hedonic scale showed that among samples, yogurt with 2.5% flaxseed and 5% pumpkin seed had the highest acceptability. Phase II involved assessing physicochemical and sensory analysis of the selected formulations after 14 days of refrigerated storage (4°C).

Results: The findings revealed that pH and titratable acidity increased gradually. The microbiological testing revealed that the Total Plate Count increased throughout the storage period and did not exceed acceptable values. Over time, there was a decline in water holding capacity and an increase in syneresis, but the seed incorporation enhanced the structural stability over the control sample. In terms of sensory score, seed-based yogurt samples remained stable throughout the storage period.

Conclusion: Pumpkin seed yogurt was found to be more sensory acceptable and stable than flaxseed yogurt. The research findings present a promising functional dairy product with health benefits related to omega-3 fatty acids, dietary fiber, and antioxidant content.

Keywords: Functional yogurt, flaxseed, pumpkin seed, physicochemical properties, sensory evaluation.

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Cage Culture: A Sustainable Approach for Enhancing Fisheries Development in the Marathwada Region of Maharashtra, India

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Abstract

Cage culture has emerged as an efficient aquaculture technology for enhancing fish production through the sustainable utilization of open water resources such as reservoirs and lakes. The Marathwada region of Maharashtra possesses several major reservoirs, including Jayakwadi, Yeldari, Vishnupuri, Siddheshwar, Manjara, Lower Terna, Sina Kolegaon, and Majalgaon, which offer significant potential for cage-based aquaculture. This review evaluates the scope of cage culture in the region with respect to fish production, employment generation, livelihood improvement, and rural economic development. Suitable species for cage farming include Indian major carps, tilapia, pangasius, and common carp owing to their adaptability and market demand.

The study highlights that cage culture can substantially increase reservoir productivity while promoting entrepreneurship and nutritional security. However, challenges such as high initial investment, feed costs, technical expertise, disease management, environmental concerns, and marketing limitations remain important constraints. Government initiatives, particularly the Pradhan Mantri Matsya Sampada Yojana (PMMSY) and the National Fisheries Development Board (NFDB), provide financial assistance, training, and infrastructure support that can accelerate adoption of cage culture. With scientific management, appropriate policy support, and capacity building, cage culture has the potential to become a key driver of sustainable fisheries development and the Blue Economy in the Marathwada region.

Keywords: Cage culture, Aquaculture, Reservoir fisheries, Marathwada, Maharashtra, Sustainable fisheries, Blue Economy.

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Optimization Studies to Enhance Production of Methylcobalamin from Freshwater *Streptomyces olivaceus* NK11

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Abstract

Methylcobalamin is a bioactive cofactor form of vitamin B12, is essential to DNA synthesis, myelin maintenance, and erythropoiesis; and is used therapeutically for cobalamin deficiencies. Conventional synthesis and animal-tissue extraction are constrained by low yields and high costs, making microbial fermentation an attractive alternative. This study investigates process optimization to enhance methylcobalamin production using *Streptomyces olivaceus* NK11, isolated from sediment-rich soils from Shimoga, Karnataka. *S. olivaceus* NK11 was cultured in starch–casein broth at 30 °C and lysed by ultrasonication (20 kHz ± 50 Hz, 40% amplitude, 10 s ON / 5 s OFF, 5 min total), with supernatant handling performed in the dark to prevent photodegradation. Growth kinetics over 15 days identified days 7–10 as the optimal harvest window. OneFactor-at-a-Time (OFAT) screening identified maltose (~55.74 µg/mL) as the best carbon source, KNO_3 (~50.21 µg/mL) as the best nitrogen source, and pH 7 (22–24 µg/mL) as the favourable acidity; acidic and alkaline conditions suppressed yields to ≤12 µg/mL. The three variables were refined by a Box-Behnken design of 17 fermentation runs. The quadratic model was highly significant ($F = 61.84$, $R^2 = 0.9876$): effect of pH was dominant ($F = 253.69$), followed by maltose ($F = 28.45$) and KNO_3 ($F = 23.33$). The maltose–pH interaction was significant ($F = 12.19$, $p = 0.0101$), and all quadratic terms showed non-linear behaviour. The model predicted a maximum of ~20.44 µg/mL at 14 g/L maltose, 3.5 g/L KNO_3, and pH 7, confirmed by validation. Product identity was verified by HPLC (retention: 2.690 min standard, 2.746 min pre-optimisation, 2.727 min post-optimisation; within the 2.0–3.0 min pharmaceutical window) and FTIR (400–4000 cm^{-1}) showing corrin-ring bands at 3257, 2920, 1624, 1508, 1376 and 1245 cm^{-1}. These findings demonstrate the potential of wild-type freshwater actinopharmaceutical gradeble, cost-effective industrial production of pharmaceutical-grade methylcobalamin.

Keywords: Methylcobalamin, Streptomyces olivaceus, Fermentation Optimization, Response Surface Methodology, HPLC, FTIR

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Isolation and Functional Characterization of Plant Growth-Promoting Bacteria from Jeevamrutha for Sustainable Agriculture

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Abstract

Jeevamrutha is a traditional organic manure prepared from cow dung, jaggery, gram flour, and soil. Itis used as a soil conditioner in organic farming to enhance the growth of plants and crops. The present study proposes to isolate and characterize bacteria from Jeevamrutha and determine their enzymatic and biotechnological potential. The soil and non-soil based Jeevamrutha were processed through serial dilution and culture-based methods to isolate the bacterial species. A total of seven isolates of different genera were characterized using Gram's staining and biochemical tests, which included Bacillus , Serratia , Aeromonas , Escherichia , and Pseudomonas

Out ofthe seven isolates, the OQ2 showed the greatest activity of lipase, protease, and amylase production. The 16S rDNAsequencing results demonstrated thatthe isolate belonged to the species *Bacillus paramycoides*. The isolate exhibited antioxidant activity when compared using theDPPH assay method.However, it did not show antibacterial activity towards *Salmonella typhimurium, Staphylococcus aureus*, and *Klebsiella pneumoniae*. The media optimization results suggested that the addition of orange peels into the culture media enhanced the production of enzymes. This study demonstrates thatJeevamrutha is an isolation media for bacterial species with high enzymatic activity. It also proves that agricultural waste such as orange peels can be used to produce economical materials with commercial value. Therefore,the current-findings contribute immensely to knowledge by unveiling the biotechnological potential of Jeevamrutha as a source of organic manure and antibiotics for sustainable farming.

Keywords: Plant Growth-Promoting Microorganisms (PGPMs), Jeevamrutha, multi-enzymatic, biofertilizer, growth kinetics, sustainable biotechnological applications.

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Development and Nutritional Evaluation of Nutrient-Dense Food Products Using Vegetable Peels

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Abstract

Vegetable peels are often discarded during food preparation and processing, but they contain several nutrients and bioactive compounds which can be utilized for various food applications. Their incorporation into food products provides us an opportunity to convert an underutilized by-product into a valuable nutritional resource. The present study focuses on the development and nutritional evaluation of nutrient-dense food products incorporating selected vegetable peels.

Selected vegetable peels were processed into suitable forms for incorporation into food formulations. The developed products were evaluated for their nutritional composition, dietary fibre and selected bioactive properties, along with sensory acceptability. Different formulations were explored to identify products which can provide improved nutritional value while maintaining desirable sensory characteristics.

The study highlights the potential of vegetable peels as functional food ingredients and demonstrates their application in the development of value-added, nutrient-dense food products. Such utilization can contribute to reducing food waste, improving resource efficiency and promoting sustainable approaches to food product development. The findings may provide a foundation for further development of affordable and nutritionally enhanced foods using locally available vegetable by-products.

Keywords: Vegetable peels; Food product development; Nutritional evaluation; Nutrient-dense foods; Functional ingredients; Food waste valorization; Sustainable nutrition.

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Effect of Land Configuration and Weed Management Practices on Productivity of Pigeonpea

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Abstract

A field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore, to assess the influence of different land configurations and weed management practices on the growth and productivity of pigeon pea. The objective of the study was to identify the most effective land configuration and weed management strategy for enhancing pigeon pea performance. The experiment comprised 15 treatment combinations arranged in a split-plot design with three replications. The main plot treatments included three land configurations: L1-Flat bed, L2- Ridges and furrows and L3-Broad bed furrow. The subplot treatments consisted of five weed management practices: W1-Weedy check, W2-Two hand weedings at 20 and 40 DAS, W3-Pre-emergence application of pendimethalin at 0.75 kg a.i. ha-1 followed by hand weeding at 30 DAS, W4-Pre-emergence application of pendimethalin at 0.75 kg a.i. ha-1 followed by early post-emergence application of imazethapyr at 60 g a.i. ha-1, and W5-Pre-emergence application of pendimethalin at 0.75 kg a.i. ha-1 followed by power weeding at 30 DAS and post-emergence application of quizalofop-ethyl at 50 g a.i. ha-1. The results showed that the broad bed furrow recorded lower total weed density at 41.46 m-2 at 20 DAS, 50.39 m-2 at 40 DAS and 67.31 m-2 at 60 DAS. The minimum weed density (30.43, 32.84 and 46.27 m-2 at 20, 40 and 60 DAS) was recorded in the pre-emergence application of pendimethalin at 0.75 kg a.i. ha-1 followed by power weeding at 30 DAS and post-emergence application of quizalofop-ethyl at 50 g a.i. ha-1 (W5).

Keywords: Chemical Control; Hand Weeding; Land Configuration; Pigeon Pea; Power Weeder

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Harnessing Bacterial Endophytes for Sustainable Management of Viral Diseases in Watermelon

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Abstract

Biological management using bacterial endophytes has emerged as a sustainable and eco-friendly alternative for enhancing plant resistance against viral infections. Bacterial endophytes colonise internal plant tissues without causing harm and promote plant growth through phytohormone production, nutrient solubilisation, and induction of systemic resistance. They also suppress viral disease development by stimulating plant defence mechanisms, producing antimicrobial metabolites, and reducing vector colonisation. The present study focuses on the isolation, characterisation, and evaluation of bacterial endophytes for their potential to manage viral diseases in watermelon under greenhouse and field conditions. A total of ten bacterial endophytes were isolated using NA medium and purified by the single-colony isolation method. Biochemical characterisation confirmed all bacterial isolates as *Bacillus* spp. Preliminary screening of the bacterial endophytic isolates identified five best-performing isolates. Screening of these superior isolates against the test virus showed a reduction in symptom expression compared to the control. Among the five isolates, the fewest lesions were observed in plants inoculated with isolate EBW3, followed by EBW5.Molecular characterisation of all five bacterial endophytic isolates using universal primers 27F and 1492R resulted in the amplification of ~1500 bp fragments. The potential isolates, *B. subtilis* (EBW3) and *B. velezensis* (EBW5), identified through screen house screening, were used in field trials as seed treatments and foliar sprays, applied either alone or in combination. A field trial was conducted at farmers' holdings using nine treatments with three replications in a randomised block design. The first-season field trial results revealed that all treatments were effective against begomovirus, except the untreated control. The minimum disease incidence was recorded in treatment T6 (seed treatment at 10 g/kg followed by foliar spray with a combined formulation of *B. subtilis* + *B. velezensis* @ 5 g/L at 30, 45, and 60 DAS). This was comparable to the chemical control, which recorded the least disease incidence. The untreated control showed the maximum disease incidence and the minimum fruit yield.

Keywords: Watermelon, begomovirus, biocontrol, endophytes etc.

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Effect of Organic Solutions in the Assessment of Suitable Methods for Seed Extraction of Brinjal (Solanum melongena)

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Abstract

Seed extraction relies on fermentation, acid treatment or alkali treatment to remove the gel sac surrounding each seed in solanaceous vegetables. However, those methods are not permitted under organic farming practices since inorganic compounds usage is strictly prohibited. Hence, Experiments were conducted at the Department of Seed Science and Technology, Agricultural College and Research Institute, Madurai to identify the effect of organic acids on seed extraction in brinjal. The different organic solutions used were, lemon fruit extract, fish amino acid, fermentation method and compared with inorganic methods. Different seed extraction methods have varied range of influence on brinjal seed. The objective of the experiment is to assess the physiological and biochemical seed quality parameters due to the organic solutions on seed extraction. The following physiological and biochemical seed quality parameters were recorded viz., germination percentage, hoot length, root length, dry matter production, vigour index, electrical conductivity of the seed leachate. The Effect of different seed treatments on seed colour, seed recovery (%) and 100 seed weight in brinjal was also assessed. The result revealed that among the seed extraction treatments, the fish amino acid 10% recorded higher germination percentage (91%), shoot length (3.27 cm), root length (8.48), dry matter production (0.026 g/ 10 seedling), vigour index I (1069), and lowest electrical conductivity value (0.13 dSm-1).

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Sustainability of Rice Farming: An Empirical Study in Cauvery Delta Zone of Tamil Nadu State

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Abstract

Rice is a global staple and plays a vital role in food security and elimination of poverty (SDG1) and hunger (SDG2). But rice is an input intensive crop and flooded rice paddies contribute to methane emissions. Sustainable rice cultivation has become the pathway for sustainable agricultural development. The study makes an empirical evaluation of farm level sustainability in Pudukkottai district of Tamil Nadu state based on primary data collected from 100 farmers comprising of NPOP/PGS certified organic (traditional and HYV) and conventional rice growers. The study adopted a participatory multi-stakeholder approach involving scientists, farmers, extension officials, NGOs, etc and review of literature to identify the sustainability indicators. About 26 indicators were shortlisted based on score of experts and information was obtained from rice farmers, using a structured interview schedule. The variables were then normalized, weighted based on factor loadings and eigen values obtained from Principal Component Analysis and aggregated to get the index. Using the criteria of Mean ± SD of index value, farms were categorized as sustainable, moderately sustainable and vulnerable.

Rice Farming Sustainability Index (RFSI) was 46.30 implying that rice farming is moderately sustainable in the sample farms. The environment component was dominant accounting for 38.97%, followed by ecological (20.82%), economic (19.79%) social (17.92%) and technology (2.50%) to the overall sustainability index. Organic traditional and HYV rice farms belonged to sustainable or moderately sustainable category while in the case of conventional rice farms, 52.50 % were unsustainable rice farms. Tobit model implied that education, farming experience, farms with wells, membership in FPO, contact with Agricultural Officers and livestock ownership had statistically significant influence on rice farming sustainability. Awareness about the benefits of organic farming, training, scientific and market support by Government along with the State Department of Agriculture would pave way for sustainable rice production in the region.

Keywords: Certified organic rice, Conventional rice, Principal Component Analysis, Sustainability Index, Tobit model

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Nano-Enabled Delivery of Delphinidin-3-O-Sambubioside (D3S) For Enhanced Xanthine Oxidase Inhibition in Hyperuricemia

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Abstract

Hyperuricemia (serum uric acid >6.8 mg/dL) causes NLRP3-mediated gouty arthritis through MSU crystal deposition. Xanthine Oxidase (XO) is a primary therapeutic target for the treatment of gouty arthritis. However, current XO inhibitors such as allopurinol and febuxostat are associated with serious adverse effects, including hepatotoxicity. Delphinidin-3-O-sambubioside (D3S), a major anthocyanin from *Hibiscus sabdariffa,* has demonstrated potent XO inhibitory activity through hydrogen bonding at Glu402, Asn261, Pro253 and Arg394. Molecular docking using PyRx showed stronger binding of D3S (ΔG = -10.8 kcal/mol) compared with allopurinol (-5.7 kcal/mol). However, the poor oral bioavailability of D3S limits its therapeutic application. To address this challenge, carbon quantum dots (CQDs) are proposed as a nanocarrier for D3S delivery. This proposed CQD–D3S nanotherapeutic framework offers a potentially safer and naturally derived strategy for managing hyperuricemia.

Keywords: Hyperuricemia, XO inhibitors, Delphinidin-3-O-sambubioside (D3S), Nanocarrier

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Effect of Biostimulants Infused Sodium Alginate Polymer Coating on Bhendi Seeds

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Abstract

Seed coating with biostimulants has emerged as a promising strategy to improve seed quality and early seedling establishment. The present study evaluated the effect of sodium alginate based polymer coating enriched with different concentrations of humic acid and fulvic acid on the germination and seedling quality of okra seeds. The experiment consisted of ten treatments, including an uncoated control, sodium alginate alone (2%), four humic acid concentrations (0.2, 0.3, 0.4, and 0.5 g), and four fulvic acid concentrations (0.3, 0.4, 0.5, and 0.6 g) infused into sodium alginate polymer. Seed quality parameters, including germination percentage (%), abnormal seedlings (%), dead seeds (%), root length (cm), shoot length (cm), dry matter production (g/ 10 seedlings), and vigour indices, were evaluated. The results revealed that polymer coating supplemented with humic acid at 0.3 g (T3) recorded superior performance in seed germination (89 %), producing the highest root length (19.57 cm), shoot length (15.26 cm), dry matter production (0.398 g / 10 seedlings) vigour Index I (3090), and vigour Index II (36) and also reduced abnormal seedlings (6%). While uncoated seeds shows the lowest seed germination (86 %), producing the highest root length (17.23 cm), shoot length (13.11 cm), dry matter production (0.343 g / 10 seedlings) vigour Index I (2609), and vigour Index II (29) and also produced maximum abnormal seedlings (6%). Humic acid at 0.2 g (T2) and fulvic acid at 0.3 g (T6) also exhibited comparable improvements over the control. In contrast, higher concentrations of humic acid (0.5 g) and fulvic acid (0.6 g) reduced germination and seedling vigour. The findings demonstrate that sodium alginate polymer coating enriched with an optimum concentration of humic acid, particularly 0.3 g, effectively enhances seed germination and seedling vigour in okra, indicating its potential as an eco-friendly seed enhancement technology.

Keywords: Biostimulant, Humic Acid, Sodium Alginate, Polymer Coating, Okra

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Volatile Organic Compound Profile of *Tribolium casteaneum* Infested Wheat Flour

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Abstract

The study was undertaken to check volatile organic compound (VOC) profile of *Tribolium castaneum* infested wheat flour using Gas Chromatography–Mass Spectrometry (GC-MS). VOC of wheat flour sample control (uninfested) and infested with 1, 3, and 5 adult insects, and insect fragments alone, were extracted using methanol and analysed by Agilent GC-MS system. Comparative GC-MS analysis results revealed distinct variations in the VOC profiles between unifested and infested samples. Results showed approximately 14 unique compounds were detected in flour samples which contained higher insect infestation (5 insects) and insect fragments levels. The major VOCs were detected as pyrazines, pyridines, pyrroles, furans, methyl-branched alkanes, long-chain esters, fatty acid methyl esters, quinoline derivatives, indole, indolizine, thiocyanic acid, and pheromone-associated compounds such as nonanoic acid and tridecane. These compounds indicate presence of insect cuticular hydrocarbons, chitin degradation products, defensive secretions, pheromone signalling, and microbial metabolism in infested flour samples. Quinoline derivatives and bacterial metabolites are indicator of contamination and quality deterioration associated with insect fragments. As the insect fragment level increases, level of characteristic VOCs increases demonstrating their potential as chemical markers for detecting hidden insect infestation and assessing flour quality during storage. The finding underscores the application of GC-MS based VOC profiling and helps in understanding cuticular chemistry of *T. castaneum*. GC-MS based detection can be a rapid and sensitive approach for monitoring insect contamination, stored-product spoilage, and food quality.

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Pre-Harvest Fruit Bagging Enhance Post Harvest Quality, Shelf Life, Volatile Flavour Profile, and Biotic Stress Resistance in Himampasand Mango (*Mangifera indica L.*)

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Abstract

Mango (*Mangifera indica L.*) is one of the most important tropical fruits, commonly referred to as the "King of Fruits" for its delicious taste, and is extremely popular among Indians. Several horticultural practices are gaining global popularity for quality fruit production with reduced chemical residues. Pre-harvest factors such as unfavourable weather conditions and the presence of destructive pests including hoppers, thrips, and fruit flies, along with diseases like sooty mould, anthracnose, and bacterial canker, significantly impact the post-harvest quality and shelf life of fruits. Preharvest fruit bagging improves the cosmetic quality of fruits, enhancing their visual appeal and increasing consumer preference. A study involving pre-harvest fruit bagging using different bag types on Himampasand mango was conducted at a mango UHDP orchard, Jain Irrigation Systems Limited R&D Farms, Udumalpet, Tamil Nadu. Among the various bagging treatments, the double-layered bag emerged as the most promising, exhibiting the highest fruit retention, improved fruit mass, superior fruit quality, and consumer-attractive fruit colour. GC-MS analysis of fruit volatiles revealed an enhanced flavour compound profile in double-layered bagged fruit compared to unbagged controls, contributing to improved sensory acceptability. ICP-MS-based elemental analysis confirmed a distinct ionic reprogramming effect induced by bagging, marked by significant calcium ion accumulation within the fruit, contributing to firmer fruit texture, reduced physiological disorders, and extended shelf life. The double-layered bag treatment also resulted in zero fruit fly incidence and yielded significant net returns per acre in Himampasand mango. These findings suggest that pre-harvest fruit bagging can be implemented as an effective, chemical-residue-free technology in protected cultivation and urban farming of mangoes for improved post-harvest quality, flavour, mineral nutrition, and marketability.

Keywords: Fruit bagging, Shelf life, Flavour volatiles, GC-MS, ICP-MS, Calcium accumulation, Residue-free

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Innovative Non-Thermal Preservation of Palmyrah Neera Using Natural Biopreservatives for Enhanced Shelf Life

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Abstract

Palmyrah neera, the naturally sweet and nutrient-rich sap of *Borassus flabellifer L.*, is a highly perishable traditional beverage with significant nutritional and functional potential. However, its rapid microbial spoilage and short shelf life present major challenges for commercialization. Conventional thermal preservation methods often compromise its sensory, nutritional and functional properties, creating the need for sustainable non-thermal preservation alternatives. This review highlights the potential of natural food-grade biopreservatives, including nisin, natamycin and ε-polylysine, as effective strategies for enhancing the microbial stability of fresh palmyrah neera. The antimicrobial mechanisms, spectrum of activity and applications of these biopreservatives are discussed, along with their compatibility with emerging non-thermal preservation technologies. The review also examines the synergistic potential of combining natural biopreservatives with innovative non-thermal processing techniques to control spoilage microorganisms while maintaining the beverage's freshness, nutritional quality and sensory characteristics. Such integrated preservation approaches offer a sustainable and eco-friendly solution for extending the shelf life of palmyrah neera without compromising product quality. Overall, this review provides insights into current advancements and future opportunities for developing safe, minimally processed, value-added palmyrah neera products, thereby enhancing their commercial potential and supporting the sustainable utilization of this traditional functional beverage.

Keywords: Palmyrah neera, Natural, Biopreservatives, Shelf life, Functional beverage

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Biostimulant Extract from Sargassum wightii and its Efficiency for Drought on *Vitis vinifera L.*

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Abstract

Formulated biostimulants of seaweeds are a useful tool for combating environmental stresses in agriculture. Drought significantly lowers proline, antioxidants, and photosynthetic pigments. The effectiveness of *Sargassum wightii* a brown macroalgae extract in reducing the negative effects of drought stress on *Vitis vinifera*. L. was assessed in this study. In order to create stress, the treatments received irrigation once in every seven days, were designed to induce stress by also reducing the water need to 50%, when compared with the unstressed control. A formulation of seaweed was applied as soil drenching and two applications with an interval of 15 days. The formulation was applied at a dose of 1.0 to 3.0 kg ha-1 and showed significantly enhanced levels when compared to unstressed vine with augmented chlorophyll A, B, total chlorophyll, carotenoids, proline accumulation, catalase, peroxidase, and brix, respectively. The stressed control showed low chlorophyll 'a' 1.58 mg/g, chlorophyll 'b' 0.41 mg/g, total chlorophyll 2.0 mg/g, carotenoids 0.59 mg/g, proline 1.2 µmol/g, catalase 0.81 µg H2O2/g.min, peroxidase 0.99 µg/g.min and brix 15. All soil drench applications showed significantly enhanced chlorophyll 'a' from 12 to 50%, chlorophyll 'b' from 14 to 82%, total chlorophyll from 12 to 55%, carotenoids from 11 to 67%, proline from 82 to 207%, catalase from 76 to 155%, and peroxidase from 25 to 149% respectively, and brix from 15 to 28%, titrable acidity from 9 to 46%, over the stressed control. Leaf and fruit analyses indicated enhanced metabolic activity, improving plant health and performance under drought stress.

Keywords: Drought, Sargassum wightii, grapes, photosynthetic pigments, proline, antioxidants

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Evaluation of Banana (Musa sp.) Genotypes for Growth and Yield Under Sodic Soil

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Abstract

Sodicity is a major abiotic constraint that limits banana (*Musa* spp.) growth, physiology and yield by impairing nutrient uptake, water relations and cellular integrity. The present study systematically evaluated thirteen banana genotypes, Poovan, Udhaiyam, Karpooravalli, Kaveri Saba, CO3, Kaveri Haritha, Kaveri Kalki, Monthan, Nendran, Rasthali, Kuttakarpooram, Adukku Monthan, and Grand Naine under sodic field conditions at Trichy in a Randomized Block Design with three replications. Morphological traits, including plant height, pseudo stem girth, leaf number, and phyllocron value, were assessed alongside physiological, biochemical, antioxidant, mineral and microscopic parameters. Kaveri Saba and Kaveri Kalki exhibited superior morphological vigour, enhanced chlorophyll content (1.42 and 1.38 mg g^{-1}), higher Chlorophyll Stability Index (79.87% and 78.45%) and increased proline accumulation (123.9 and 124.6 µg g^{-1}). Antioxidant defense enzymes catalase (4.86 and 4.72 µg H_2O_2 min^{-1} g^{-1}) and peroxidase (3.63 and 3.57 units) were markedly elevated in these genotypes, reflecting robust stress mitigation. Scanning electron microscopy (SEM) analyses revealed well-preserved root tissues, intact parenchyma, and abundant pores, supporting efficient water and nutrient uptake under sodic stress. Consequently, Kaveri Saba and Kaveri Kalki achieved the highest yield, with bunch weights of 20.4 and 19.2 kg and total yield of 48.2 and 47.3 t ha^{-1}, whereas susceptible genotypes such as Grand Naine exhibited compromised growth, physiology and yield. The integration of morphological, physiological, biochemical and anatomical traits underscores the mechanisms of sodicity tolerance and identifies Kaveri Saba, Kaveri Kalki and Monthan as elite genotypes for high-yielding, sustainable banana production in sodic soils.

Keywords: Banana, Sodic stress, Antioxidant enzymes, Proline, Root anatomy, Yield

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Ecological Impact of Goat Based Integrated Farming System in Coconut

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Abstract

Agriculture is the major contributor of green house gas (GHG) emissions *viz.,* N2O, CH4 and CO2 which is estimated to be between 10-20 % of the total anthropogenic GHG emissions and the four major sources from the agricultural sector include cropland soil management, rice cultivation, livestock enteric fermentation and livestock manure management (Beach *et al*., 2015). Coconut is an important perennial crop which has a significant bearing on the livelihood security of small and marginal farmers across the nation and coconut based IFS is gaining momentum in the context of fluctuating price chart of copra. An experiment was conducted at Coconut Research Station, Aliyarnagar during 2015-2021 to elicit the impact of IFS on soil health, system productivity and to quantify GHG emission from the system. Coconut + fodder trees (*Sesbania grandiflora, Luecaena leucocephala and glyricidia*) + pasture crops (cumbu napier hybrid and Desmanthus) were integrated with Telicherry breed of goats (6+1) across 0.4 ha of coconut garden. Carbon–di-oxide emission was computed employing IFS–GHG Estimation Tool Ver.1.0:2018 developed by the Project Directorate of Cropping Systems Research, Modipuram. Carbon-di-oxide emission expressed in CO2-e(kg) from coconut was 267.7, fodder crops was 433.4, goatery was 2393.16, and Glyricidia was 5.0 thus totaling 3099.26 units. Carbon sink was 21146.2 units and the GHG emission from the system was totally -17875.3 units. Thus it can be concluded that carbon sequestration potential of goat based IFS in coconut is high and the system is ecologically safe with negative emission of CO_2

Keywords: Coconut, Carbon sink, Fodder, Green House Gas, IFS

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Chemometric Differentiation of Indian Mango (Mangifera indica L.) Genotypes using FTIR Spectroscopy

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Abstract

The chemometric fingerprinting and functional food characterization of 15 cultivated mango genotypes across India over two seasons were performed using Fourier Transform Infrared (FTIR) spectroscopy, with multivariate preprocessing of the spectra. The differences in the distinct spectral variation were observed at O–H stretching (~3300 cm^{-1}), C–H stretching (~2920 cm-1), C=O stretching (~1740 cm-1), amide/aromatic vibrations (~1630-1510 cm-1), and carbohydrate-associated C–O stretching (~1150-1050 cm-1). Among the three pre-processing techniques tested (Standard Normal Variate (SNV), Multiplicative Scatter Correction (MSC), SNV and Savitzky–Golay derivative transformation), SNV was the best variance normalizing and the best for varietal discrimination. Then, SNV-corrected data were subjected to PLS-DA, PCA, HCA and heatmap analysis. The genotype-dependent vector association was recorded for Kalapad and carbohydrate-rich region (~1050 cm-1), Langra and proteins/amide regions (~1510 cm-1), Chinnarasam and organic acid/phenol region (~3300 cm-1), which are in line with biochemical data. The PCA results were supported by the HCA, heatmap and PLS-DA results, which demonstrated the genotype-specific clustering and chemical discrimination. These results confirm the potential of using FTIR spectroscopy as a rapid non-destructive approach for varietal fingerprinting, which can be applied to the characterization of germplasm, quality assessment, authentication, and identification of candidates of nutraceuticals/functional foods in mangoes.

Keywords: Chemometric fingerprinting, Mango genotypes, FTIR spectroscopy, Multivariate pre-processing.

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Exploration of Allelopathic Effect of Botanicals on Grassy Weeds

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Abstract

Allelopathy is a phenomenon in which plants release bioactive compounds that influence neighbouring plants and offers an eco-friendly approach to weed management. The present study evaluated the allelopathic potential of *Lantana camara, Eucalyptus globulus* and *Prosopis juliflora* leaf extracts against Bermuda grass (*Cynodon dactylon*) and Guinea grass (*Panicum maximum*) and identified bioactive phytochemicals through GC–MS analysis. The field experiment was conducted during 2026 at the Animal Husbandry Unit, AC&RI, Madurai, in a Randomized Block Design with three replications. Leaf extracts at 25 and 50 per cent concentrations were evaluated, with Glyphosate and Paraquat as standard herbicidal checks and water as untreated control. Parameters included time taken for weed drying and phytotoxicity rating. Among botanical treatments, 50 per cent L. camara recorded the fastest weed drying (4.6 days), followed by *E. globulus* (6.0 days) and *P. juliflora* (7.3 days). Herbicides achieved complete drying within one week and recorded maximum phytotoxicity. GC–MS identified 39, 40 and 31 compounds in *L. camara*, *E. globulus* and *P. juliflora,* respectively. Chiro-inositol and D-pinitol predominated in L. camara and E. globulus, while hexamethyldisiloxane dominated *P. juliflora*. Metabolite enrichment indicated carbohydrates, polyols, fatty acids and sesquiterpenoids. Overall, 50 per cent L. camara showed considerable bioherbicidal potential.

Keywords: Allelopathy, Botanical leaf extracts, Bioherbicide, Grassy weeds, GC–MS analysis.

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Age of Seedlings and Time of Planting for Mechanized Transplanting in Rice Under Cauvery delta Zone of Tamil Nadu

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Abstract

Rice is the important stable food for more than 50 percent of the world population is commonly grown by transplanting seedlings into puddled soil. Direct seeding and transplanting of rice is the common methods of rice establishment. Transplanting system is labour, water and energy intensive and is becoming less profitable as these resources are becoming increasingly scarce. The feasible option to solve the problem of labour would be the adoption of mechanical transplanting. In view of the above conditions, an attempt has been made to find out the suitability of age of seedlings and time of planting with an objective to increase the yield and reduce labour, water under Cauvery delta zone of Tamil Nadu. The field experiment was conducted at Tamil Nadu Rice Research Institute, Aduthurai during *Kharif,* 2020 in RBD design replicated three times. The treatment included were T1 –Normal planting time Mechanical Transplanting (15 days old seedlings and recommended spacing) T2 - Normal planting time Mechanical Transplanting (21 days old seedlings and recommended spacing) T3 – Delayed planting time (15 days late) Mechanical transplanting (15 days old seedlings and recommended spacing) T4 - Delayed planting time (15 days late) Mechanical transplanting (21 days old seedlings and recommended spacing) T5 – Manual transplanting – Normal time (25 days old seedlings) T6 – Manual transplanting – Delayed sowing time (25 days old seedlings) . ADT 53 was used as a test variety. Normal and delayed time of sowing was done on 15.06.2020 and 02.07.2020 respectively. Transplanting was done 30.06.20 (T1), 06.07.20 (T2), 15.07.20 (T3), 23.07.20(T4), 11.07.20 (T5) and 28.07.20 (T6) respectively as per treatment schedule. Mechanized transplanting with 15 days old seedlings recorded higher grain yield of 5511kg/ha as compared to 21 days old seedlings . The same treatment recorded higher net income of 54506 Rs / ha with B.C ratio of 2.2. whereas delayed planting time (15 days late) in mechanical transplanting with 15 days old seedlings recorded grain yield of 4833 kg/ha. It is concluded that Fourth week of June transplanting with 15 days old seedling is suitable for machine transplanting for realizing higher grain yield and Net income.

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Evaluation of Growth, Flowering and Yield Performance of Mangosteen cv. K-100 under Coconut Plantations

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Abstract

Mangosteen (*Garcinia mangostana* L.) is often regarded as the 'Queen of Tropical Fruits', is also generally considered as 'Finest fruit of the world' due to its unusual flavor and taste that strikes the ideal balance It belongs to the family Guttiferae (Clusiaceae). The mangosteen is a relatively recent addition to India's fruit crops and is still considered to be an under-adopted fruit crop due to its specific eco-physiological requirements and low genetic diversity. In general, coconut is planted at a spacing of 7.5 m x 7.5 m and the interspaces in coconut plantations are often underutilized. Mangosteen, being an exotic fruit crop, thrieves well under partial shade, making it an ideal candidate for intercropping in coconut plantations. In this context, a study was conducted at ICAR-CPCRI, during the year 2019-2025 to evaluate performance of nutritional requirements of Mangosteen cv. K-100 under coconut plantations. The experiments followed Randomized Block Design (RBD) with three treatment combinations, each replicated ten times: T1-Full organic (Vermicompost + Farm Yard Manure) + Potash in the form of Biochar, T2 –Integrated Nutrient Management (Vermicompost + Farm Yard Manure) + Potash in the form of Muriate of Potash and T3 - Control (No fertilizer or Amendments). The results indicated that application of nutrients through integrated nutrient management (Vermicompost + Farm Yard Manure) + Potash in the form of Muriate of Potash, significantly enhanced the growth, flowering and yield performance of Mangosteen cv. K-100 under coconut plantations. The highest plant height (3.51 m), plant girth at base (29.96 cm), plant girth at centre (16.82 cm) and more number of branches (38.4 nos) was recorded in T2 treatment followed by T1. Key flowering parameters such as No of days taken for flowering to fruit set (55 days), No. of days taken for fruit set to fruit harvest (98 days) and No. of days taken for blooming to harvest (153 days) which is indicated that early flowering noticed in T2 treatments when it compared to other treatments. Yield also highest recorded in the same treatment ie T2-16.57 kg per plant comparing other treatments.

Keywords: Biochar, Intercrop, Mangosteen, Coconut and Flowering

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Sustainable Postharvest Management of Heliconia (*Heliconia stricta* L.) cv. Iris Red through Optimized Floral Preservative Strategies

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Abstract

Heliconia is an emerging tropical cut flower valued for its strikingly coloured bracts, distinctive inflorescence architecture and ornamental appeal. However, short postharvest longevity and quality deterioration during marketing remain major constraints to its wider commercialization. Considering the increasing demand for tropical cut flowers and the need for sustainable postharvest technologies, the present investigation evaluated preservative-based strategies for extending the vase life and maintaining the quality of *Heliconia stricta* L. cv. Iris Red. The study was conducted at the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, during 2020–2022. Experiments were conducted in a Completely Randomized Design with three replications. Two experiments were undertaken to standardize an effective vase solution: the first assessed different concentrations of sucrose, while the second evaluated preservative chemicals in combination with sucrose. Sucrose concentration significantly influenced postharvest quality, water relations and vase life. Among the treatments, 12% sucrose effectively enhanced water uptake, fresh-weight retention, flower freshness and ornamental value, extending vase life to 12.01 days compared with 5.90 days in the control. In the preservative experiment, chemical treatments combined with sucrose improved postharvest performance. NAA 500 ppm + 12% sucrose recorded the highest water uptake, minimum transpirational water loss, superior fresh-weight retention, enhanced flower freshness and ornamental value, resulting in a vase life of 13.29 days compared with 5.09 days in the control. The study further indicated 8-HQC 500 ppm + 12% sucrose as the next promising treatment. The findings demonstrate that optimized preservative formulations can substantially improve water balance, visual quality and longevity of Heliconia inflorescences, thereby reducing postharvest losses and enhancing their marketability. Adoption of such scientifically standardized vase solutions offers a practical approach for sustainable management of tropical cut flowers and improved value retention across the postharvest chain.

Keywords: Heliconia, postharvest management, floral preservatives, sucrose, vase life, water relations, sustainable floriculture

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Management of Rice Blackbug, Scotinophara lurida Burmeister through forecasting in Rice

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Abstract

Rice is the most important field crop in India and it exhibits a good example of changing insect pest scenario in rice in recent pasts. After the green revolution in India, there has a constant increase in the number of insect pests, and a concomitant shift in their pest status, diversity and spread. In short, climate change will affect the pest incidences and their severity as limiting factors as well as favorableness of growing conditions (Ananthakrishna, 2007). Japanese rice Blackbug, *Scotinophara lurida* Burmeister (Podopidae: Hemiptera) is an emerging serious pest in rice and gains economic importance now a days. Its occurrence in Tamil Nadu was observed in all rice growing areas and endemic in many districts of Tamil Nadu and in Pondicherry UT. Rice black bug is attracted to high-intensity light and produces an offensive odour when disturbed. The movement of adult insects in the rice ecosystem at Tamil Nadu Rice Research Institute, Aduthurai was monitored by the use of light trap with 125 W mercury vapour lamp as lighting source and 12 hours of lighting period from 2011 to 2021. Daily catches of *Scotinophara* were sorted out and identified. The light trap catches of standard weeks were correlated with major meteorological data. From the results, it was observed that Black bug maximum light trap catches was observed in the month of July and August in all the above years, immediately after the receipt of rainfall, which favoured the brood emergence. Rice black bug incidences were positively correlated with Rainfall, temperature and wind velocity. There were one peaks of black bug observed in July and August during 2010- 2021. The unusual rainfall on 9.8.2010 (11.8 mm), 11.8.2011 (11.0mm), 11.8.2013 (18.4 mm), 09.08.14 (13 mm), 23.07.15 (22 mm), 29.08.16 (55.4 mm), 05.10.17 (16.4mm), 25.8.2018 (39.0 mm), 15.07.2019 (8 mm), 29.07.2020 (57.4 mm), would have favoured the emergence of adults from resting stage. Drop in mean temperature (< 28° C) in association with continuous rainfall was found to be the congenial weather condition for the incidence of the pest on rice. It is concluded that forewarning of the incidence of the Black bug on rice, based on the prevailing weather conditions that cause rainfall as well as drop in minimum and maximum temperature, could be possible through Agromet Advisory Service.

Keywords: Forewarning; Rice Blackbug; *Scotinophara lurida* Burmeister; weather parameters

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Enhancing Aonla Fruit Retention and Yield Through Foliar Application of Nutrients and Hormones

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Abstract

A field experiment was conducted at the Regional Research Station, Aruppukottai, during 2024–2025 to study the effect of foliar application of nutrients and growth hormones on fruit retention, yield and quality of aonla (*Phyllanthus emblica* L.) cv. Chakaiya. The experiment was laid out in a Randomized Block Design with three replications and ten treatments comprising foliar application of potassium nitrate, calcium chloride, magnesium sulphate, borax, NAA and their combinations. The treatments were applied at flower initiation and fruit formation stages along with recommended cultural practices. The observations on fruit quality, yield and yield-attributing characters were recorded. Among the treatments, foliar application of borax + NAA (T10) recorded superior performance for most of the quality and yield parameters. T10 recorded the highest total soluble solids (9.38%), titratable acidity (2.72%), specific gravity (1.12), ascorbic acid content (425.6 mg/100 g pulp), reducing sugar (3.52%), non-reducing sugar (2.59%) and total sugar (6.13%). It also resulted in the highest fruit length (4.16 cm), fruit width (4.53 cm), fruit weight (42.26 g) and pulp ratio (18.2). The highest yield of 36.7 kg tree^{-1} was recorded with T10 compared with 28.4 kg tree^{-1} in the control, representing a 29.2 per cent increase in yield. The results indicated that foliar application of borax in combination with NAA at critical stages of flowering and fruit development was effective in improving fruit quality, fruit size and yield of aonla cv. Chakaiya. The treatment may therefore be considered a promising nutrient and growth regulator combination for enhancing aonla productivity and fruit quality.

Keywords: Aonla, fruit retention, foliar application, nutrients, PGRs, fruit quality, yield.

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Multivariate Analysis of Salt Tolerance at Germination Stage in Brinjal (Solanum melongena L.) Genotypes for Sustainable Vegetable Breeding

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Abstract

Salinity is one of the most significant abiotic stresses limiting crop establishment worldwide and its effects are most critical at the germination stage when seedlings are most vulnerable and plant establishment depends on this stage. Reliable screening during this phase is essential for breeding programs. Multivariate analysis has proven effective in elucidating complex, polygenic tolerance responses and identifying effective selection criteria in crops such as onion and wheat (Mubushar *et al*., 2022; Kasar *et al*., 2026). However, this integrated multivariate approach is still largely unexplored in brinjal (*Solanum melongena* L.), an important vegetable in the Solanaceae family, with few reports on screening for salt tolerance at the germination stage. In the present investigation, 45 brinjal genotypes were screened under control (0 mM) and saline (150 mM NaCl) conditions and eight germination and seedling-related traits were subjected to multivariate analysis. Under salt stress, germination percentage showed a significant positive correlation with seedling vigour index (SVI) (0.98) and shoot length showed a strong negative association with root-to-shoot ratio (-0.78), pointing to a stress-induced shift favouring root proliferation over shoot growth. Principal component analysis resolved two dominant components revealing 76.4% of the total variance: PC1 (48.8%) was strongly associated with germination, root length, seedling length, SVI, fresh and dry weight, and PC2 (27.6%) represented a root–shoot biomass-partitioning axis. Ward's Hierarchical clustering separated five genotypes (Arka Avinash, Arka Shirish, Haritha, BR-5 and BR-9) as a distinct high-vigour cluster, validating their superior PC1 scores. Overall multivariate analysis identifies germination percentage and seedling vigour index as efficient, low-cost early selection indices and highlights genetically divergent, salt-tolerant genotypes as promising parental sources for brinjal salinity-tolerance breeding programmes.

Keywords: *Solanum melongena*, Salinity, Seedling vigour index, Multivariate analysis

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Virulence Diversity and Avirulence Gene Profiling of *Magnaporthe oryzae* Populations Associated with Rice Blast

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Abstract

Rice blast, caused by *Magnaporthe oryzae* (Couch & Kohn), is a major constraint to rice production, with the pathogen exhibiting considerable variation in virulence and genetic characteristics. The present study investigated the virulence diversity and avirulence (Avr) gene profiles of *M. oryzae* populations collected from major rice-growing regions of Odisha, India. Fifty-eight isolates were characterized based on morphological traits and pathogenicity on the susceptible rice variety Co39. A wide variation in disease-causing ability was observed among the isolates, with percent disease index (PDI) ranging from 40.55 to 95.65%. Isolate CRRI-LB50 was the most virulent, whereas CRRI-LB6 exhibited comparatively lower virulence. Molecular confirmation using ITS amplification and *M. oryzae*-specific primers validated the identity of the isolates, and sequences of 29 representative isolates were deposited in the NCBI GenBank database. Eleven well-characterized Avr genes were profiled to assess the genetic composition of the pathogen population. PWL2, ACE1, and Avr-Pizt were the most frequently detected genes, whereas Avr-Co39 and Avr-Pii were absent across the population. Considerable variation in the number and combination of Avr genes was observed among isolates, with some virulent isolates carrying multiple Avr genes. Genetic diversity analysis revealed relatively low variability across most loci, while Avr-Pit showed the highest polymorphism and discriminatory potential. Population structure analysis differentiated the isolates into three major genetic clusters, while factorial analysis further revealed distinct grouping patterns based on Avr gene composition. The observed variation in virulence and Avr gene profiles highlights the genetic complexity of *M. oryzae* populations in Odisha. These findings provide valuable baseline information for monitoring pathogen variability and for the strategic deployment and breeding of rice varieties with durable resistance to blast disease.

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Metabolomic Insights into Gall Mite Resistance in *Jasminum auriculatum* Mutants Revealed by GC–MS Profiling

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Abstract

Gall mite (*Aceria jasmini*) is a destructive pest affecting jasmine cultivation, leading to severe yield loss and reduced plant vigour. Understanding the biochemical mechanisms underlying pest resistance is essential for developing resistant cultivars. The present study aimed to identify metabolites associated with gall mite resistance in induced mutants of Jasminum auriculatum through Gas Chromatography–Mass Spectrometry (GC–MS) analysis. Two resistant mutant lines derived from Muthu Mullai were compared with a susceptible genotype to elucidate differences in metabolite composition. GC–MS analysis revealed the presence of several unique metabolites in resistant mutants, including fatty acids, phenolic compounds, terpenoids and phytosterols. Compounds such as trans-cinnamic acid, pentadecanoic acid, hexadecanoic acid, phytol, sitosterol and stigmasterol were detected predominantly in resistant lines and are known to possess insecticidal or defensive properties. These metabolites may contribute to enhanced resistance against gall mite infestation by influencing plant defense pathways. In contrast, the susceptible genotype showed fewer defense-related metabolites. The study demonstrates that mutation breeding combined with metabolite profiling can provide valuable insights into plant defense mechanisms and aid in identifying resistant germplasm. The identified metabolites may serve as potential biochemical markers for selecting gall mite resistant jasmine lines in future breeding programmes.

Keywords: Metabolomics, GC-MS analysis, Pest resistance, Jasmine biotechnology, Mutation breeding.

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Quantitative Assessment of Growth, Yield and Weed Interactions in Groundnut Using Correlation and Multiple Regression Analysis

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Abstract

Sustainable crop production requires a quantitative understanding of the interactions among crop growth, yield formation and weed competition. The present study assessed the relationships among growth, yield and weed-related variables in groundnut (*Arachis hypogaea* L.) using Pearson's correlation and multiple linear regression analysis. A field experiment was conducted during the winter season of 2022 in Sivagangai district, Tamil Nadu, involving twelve weed management treatments. Correlation analysis revealed strong positive associations between pod yield and plant height ($r = 0.99$), leaf area index ($r = 0.99$), dry matter production ($r = 0.95$), haulm yield ($r = 0.95$), 100-kernel weight ($r = 0.97$) and shelling percentage ($r = 1.00$). Conversely, weed density and weed biomass exhibited strong negative relationships with growth and yield variables, with correlation coefficients ranging from -0.92 to -0.99, while weed control efficiency showed positive associations ranging from 0.88 to 0.98. Multiple linear regression analysis demonstrated a strong predictive relationship between the selected growth, yield and weed variables and pod yield, with a coefficient of determination (R^2) of 0.9981 and adjusted R^2 of 0.9948. Among the explanatory variables, weed biomass exerted a significant negative influence on pod yield ($p = 0.047$), whereas dry matter production and shelling percentage showed positive and near-significant effects. The regression diagnostics indicated satisfactory model performance, with residuals showing random dispersion and no major evidence of influential outliers. The findings demonstrate that quantitative integration of crop growth and weed-related parameters can effectively explain variation in groundnut productivity. The study highlights the importance of maintaining vigorous crop growth while reducing weed biomass and provides a statistical basis for data-driven and sustainable weed management strategies. Such quantitative approaches can support improved resource-use efficiency and productivity in sustainable groundnut production systems.

Keywords: Groundnut, correlation analysis, multiple linear regression, weed competition, pod yield, sustainable agriculture

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Rapid Viability Testing in *Saccharum* True Seeds: A Standardized Tetrazolium Staining Protocol

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Abstract

The true seeds (fuzz) of sugarcane (*Saccharum* spp.) are essential for generating genetic variability in breeding programmes. Generally, the viability of true seeds is tested using seed germination test, as recommended by ISTA (International Seed Testing Association) protocol, but they are slow and labour-intensive. At this point, the tetrazolium (TZ) seed viability test stands as a rapid biochemical alternative, though it requires species-specific standardization before routine use. Therefore, a study was conducted at the ICAR-Sugarcane Breeding Institute Research Centre, Kannur, Kerala with an aim to standardize the TZ test for *Saccharum* true seeds by evaluating three TZ concentrations (0.5, 1.0, and 1.5%), three incubation temperatures (20, 25, and 30°C), and three staining durations (1, 2, and 3 h) using 50 seeds, in three replications each. The staining patterns were further evaluated topographically under a stereomicroscope. From the results it was observed that the staining intensity increased with increasing TZ concentration, temperature, and duration. The 0.5% concentration produced consistently faint staining which was difficult to interpret, whereas 1.5% TZ caused overstaining and loss of embryo detail at longer durations and higher temperatures. While, a concentration of 1.0% TZ combined with incubation at 25°C for 2 h produced the most distinct, uniform staining and the closest agreement with standard germination results, and is recommended as the standardized protocol. This optimized TZ procedure offers a rapid, reliable alternative to conventional germination testing for evaluating the viability of *Saccharum* true seeds, with practical value for breeding programmes, germplasm conservation, and seed quality assessment.

Keywords: Sugarcane, True seed, Tetrazolium test, Seed viability, Seed germination.

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Unlocking the Potential of Phyllosphere Yeasts as Next-Generation Bioinoculants for Sustainable Agriculture

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Abstract

The growing demand for sustainable and climate-resilient agricultural systems has intensified the search for next-generation microbial bioinoculants capable of enhancing crop productivity while minimizing dependence on synthetic agrochemicals. Among beneficial microorganisms, plant growth-promoting yeasts (PGPYs) have emerged as efficient multifunctional bioinoculants owing to their exceptional environmental adaptability, rapid colonization, stress tolerance, and prolonged shelf life. These yeasts promote plant growth through multiple mechanisms, including phytohormone biosynthesis, phosphate solubilization, siderophore production, ACC deaminase activity, extracellular enzyme secretion, nutrient mobilization, and suppression of phytopathogens via competitive exclusion, volatile organic compounds, killer toxins, and induced systemic resistance. In our recent investigation, foliar application of selected phyllosphere yeast strains in combination with recommended soil fertilization significantly enhanced rice growth, yield, and plant vigor, demonstrating the remarkable potential of phyllosphere yeasts as efficient bioinoculants for sustainable crop production. The study further highlighted the ability of these yeasts to establish beneficial plant–microbiome interactions that improve nutrient utilization and overall plant performance under field conditions. Coupled with recent advances in microbiome engineering, genomics, metabolomics, and nano-enabled microbial delivery systems, yeast-based bioinoculants are poised to become key components of precision and climate-smart agriculture. Their integration into microbial consortia and advanced formulations offers a promising strategy to enhance soil health, improve crop resilience against biotic and abiotic stresses, increase nutrient-use efficiency, and contribute to sustainable agricultural intensification and global food security.

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Efficacy of Insecticides and Biopesticides against Mango Fruit Fly, *Bactrocera dorsalis* Hendel (Diptera: Tephritidae)

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Abstract

The investigation entitled "Efficacy of Insecticides and Biopesticides Against Mango Fruit Fly, *Bactrocera dorsalis* Hendel (Diptera: Tephritidae)" was conducted at the District Agricultural Farm, Karimbam during 2020-21. The main objective of the work was standardizing the use of chemicals in field spray for its management. During the period of investigation, the mean maximum and minimum temperatures recorded was 36 ºC and 28 ºC respectively, with a relative humidity of 70.8 percent. Bio efficacy of insecticides were tested in field conditions. Observations on percent fruit infestation were recorded at 10 days after spray in each treatment. Total 3 sprays were done at 10 days interval after noticing the ovipositional marks on mango fruits during fruiting stage of the crop. Among the insecticides evaluated lowest reduction of percent fruit infestation was observed in treatments lambda cyhalothrin 5 EC @ 25 g a.i/ha (23.87%) and azadirachtin 0.03% @ 3 ml/l (25.18%) which are at par with each other. The next effective treatment was imidacloprid 17.8 SL @ 30 g.a.i /ha which recorded an infestation of 34.78%. The highest percent fruit infestation was recorded in the treatment *Beauveria bassiana* WP 2% @ 20 g/L (58.35%). Lambda cyhalothrin 5 EC was the superior treatment in comparison with the mean yield per plant, net monetary return and benefit cost ratio, followed by azadirachtin 0.03% and imidacloprid 17.8 SL.

Keywords: Mango, Biopesticides, Insecticides, Fruit fly, Infestation.

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Combine Effects of Fe-modified Biochar and Fly Ash with Fertilizer on Soil Fertility, Yield and Cd-Pb uptake in Spinach (*Spinacia oleracea* L.) in Semi-arid Soils of Punjab

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Abstract

Agricultural soils in semi-arid regions, are characterized by low organic matter and sandy texture of agricultural soil often leads to excessive application of chemical fertilizers. In long run may result in the accumulation of potentially toxic elements (PTEs) in agricultural soils and subsequent transfer into different food crops, raising a serious concern regarding human food safety. Low-cost amendments such as biochar (BC) and fly ash (FA) have shown potential to improve soil fertility and immobilize metals; however, their combined effects with fertilizer in Fe-modified form under semi-arid conditions remain insufficiently explored. Biochar is a carbon rich product of thermochemical conversion of organic materials that can enhance soil carbon sequestration. A pot experiment using leafy vegetable crop spinach (*Spinacia oleracea* L.) was conducted to evaluate the effects of BC, FA, and their Fe-modified forms (absence and presence of fertilizer) (with 8% w/w) on soil physic-chemical properties, crop biomass, and metal bioavailability and plant uptake in Pb-Cd contaminated sandy soil from Punjab, India. The structural characteristics of the materials were analysed using XRD, XRF, SEM, EDX, and FTIR. The results demonstrated fertilizer (F) application was strongly benefited when applied with BC and FA. BC with F outperform the other treatment, which helps to increase soil total organic carbon (TOC), cation exchange capacity (CEC) total Kjeldahl nitrogen (TKN), available phosphorus (AP), available potassium (AK), soil moisture while reducing bulk density. Improved soil health leads to greater crop health and maximises yield. As compared to the control, a significant enhancement of phenotypical properties of plants, such as plant length, root length, and fresh weight. So the control treatment biomass yield was three times less than the BC with F treatment. Although FA-based treatments with F enhanced nutrient availability, it was comparatively less effective in improving soil structure than BC treatments, hence moderate improvement in crop yield. Regarding metal immobilization, Fe-modified amendments BC/FA effectively reduced the exchangeable Cd and Pb fractions in soils (Pb up to 65% and Cd up to 83%) with maximum reduction was observed in FeFA, followed by FeFAF and FeBCFAF treatments. The decline in exchangeable metal fractions was directly reflected in reduced plant uptake. Fe-modified FA reduced maximum root and leaf Pb concentrations by 65-75% and Cd concentrations decreased by 79.8% and 80.6%, followed by combined Fe-modified FA and BC. This study highlights the combined application of Fe-modified BC and FA with fertilizer exihibited synergistic effects by simultaneously improving soil fertility, crop productivity and minimizing Cd and Pb transfer to the plant tissues. Thus, this strategy can offer a viable solution for sustainable crop production and risk mitigation in semi-arid regions of Punjab and directly support sustainable development goal-15(Life on land).

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Effect of Drip Fertigation in Direct Sown Rice

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Abstract

An experimental trial was laid out in randomised block design (RBD) with ten treatments (0.5 Cent plots with 20 x 0.9 M size) and replicated thrice during September 2023 to January 2024 to assess the effect of drip fertigation on the growth and yield of direct sown rice. The sowing was taken up on 23.09.2023 and thinning and gap filling has been done on 7th DAS. The details of the treatment tested in the experimental trial are T1 (Flooded irrigation+ RDF), T2 (Drip irrigation + RDF), T3 (Drip Fertigation (N&K through urea & MOP) + P as basal), T4 (Basal application of RDF + 20 kg ha-1 TNAU-WSF through drip in place of 3 splits of Top dressing), T5 (40 kg ha-1 TNAU WSF using drip fertigation [Fertigation of N through urea (Remaining N)], T6 [50 kg ha-1 TNAU WSF using drip fertigation (Fertigation of N through urea (Remaining N)], T7 [60 kg ha-1 TNAU WSF using drip fertigation (Fertigation of N through urea (Remaining N)], T8 [40 kg ha-1 TNAU WSF using drip fertigation (2 sprays of nano urea & 2% WSF)], T9 [50 kg ha-1 TNAU WSF using drip fertigation (2 sprays of nano urea& 2% WSF)] and T10 [60 kg ha-1 TNAU WSF using drip fertigation (2 sprays of nano urea& 2% WSF)]. The test crop taken for the study is rice variety Co 51. The initial soil is neutral, non-saline, low in available N (232 kg ha-1) and organic carbon (4.62 g kg-1), medium in available P (19 kg ha-1) and high in available K (345 kg ha-1).

The T7 treatment (60 kg ha-1 TNAU WSF using drip fertigation (Fertigation of N through urea (Remaining N) has recorded the highest plant height (91.1 cm), No. of productive tillers per plant (9.1), grain yield (6164 kg ha-1), straw yield (8582 kg ha-1) and , WUE (7.58 kg/ ha mm), WP (114.7 Rs./ ha mm) which was followed by T10 treatment (60 kg ha-1 TNAU WSF using drip fertigation (2 sprays of nano urea& 2% WSF) with plant height (90.6 cm), No. of productive tillers per plant (8.9), grain yield (6135 kg ha-1), straw yield (8568 kg ha-1) and WUE (7.54 kg/ ha mm). The lowest plant height (74.5 cm), No. of productive tillers per plant (7.2), grain yield (5147 kg ha-1), straw yield (7208 kg ha-1) and WUE (5.38 kg/ ha mm), WP (81.4 Rs./ ha mm) were observed in 100 per cent RDF with surface irrigation. The T6 treatment (50 kg ha-1 TNAU WSF using drip fertigation [Fertigation of N through urea (Remaining N)] has recorded highest net income (Rs. 53515/ ha) and BCR (2.38) which was followed by T7 treatment (60 kg ha-1 TNAU WSF using drip fertigation (Fertigation of N through urea (Remaining N) with net income (Rs. 52918/ ha) and BCR (2.30). The lowest net income (Rs. 36184/ ha) and BCR (1.81) were observed in 100 per cent RDF with drip irrigation.

Keywords: Drip Fertigation, TNAU- WSF, Rice, Water productivity, Water Use efficiency

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Estimation of Crop Coefficient for Groundnut for Drip Irrigation

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Abstract

Field experiments were conducted during two consecutive kharif seasons of 2025 and 2026 at the Department of Agronomy, Agricultural College and Research Institute, Madurai, to estimate stage-wise crop coefficient (Kc) values and develop an efficient irrigation schedule for drip-irrigated groundnut. Groundnut variety VRI 10 was evaluated under different drip irrigation levels based on 80, 100 and 120 per cent of the estimated crop coefficient. Reference evapotranspiration (ETo) was estimated using the FAO Penman–Monteith approach, while crop evapotranspiration (ETc) was determined using the soil moisture balance method. The study aimed to develop location-specific crop coefficients for the initial, development, mid-season and late-season growth stages and to optimize irrigation scheduling for enhancing water-use efficiency. During the first season, the estimated average Kc values were 0.37, 0.66, 0.73 and 0.62, respectively, compared with the FAO Kc values of 0.40, 0.70, 0.95 and 0.70. The corresponding average ETc values were 1.96, 5.68, 6.93 and 3.16 mm day^{-1}. Irrigation scheduling based on tensiometer observations indicated an irrigation interval of 2–3 days, and the total irrigation requirement was estimated at 613.05 mm. The two-season study is expected to provide reliable location-specific crop coefficient values and a practical irrigation schedule for improving irrigation efficiency and productivity of drip-irrigated groundnut under the semi-arid conditions of southern Tamil Nadu.

Keywords: Groundnut, Crop coefficient, Drip irrigation, Soil moisture balance, Irrigation scheduling, Water-use efficiency.

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Interactive Effect of Elevated Level of Ozone and Carbon Dioxide on Rice Cultivars

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Abstract

Rising atmospheric carbon dioxide (CO_2) and tropospheric ozone (O_3) are key drivers of climate change, significantly affecting crop productivity. While elevated CO_2 can enhance plant growth, ozone acts as a harmful pollutant that reduces physiological efficiency, growth, and yield, particularly in sensitive crops like rice. In South Asia, increasing levels of these gases pose a serious threat to food security. This study aimed to evaluate the interactive effects of elevated CO_2 and O_3 on rice cultivars and to identify strategies to mitigate ozone-induced damage. Two rice cultivars, CO51 (ozone-tolerant) and ASD16 (ozone-sensitive), were grown under four conditions: ambient air (control), elevated CO_2 (550 ppm), elevated O_3 (100 ppb), and a combination of elevated CO_2 and O_3. Elevated CO_2 significantly improved physiological traits, growth, and yield in both cultivars while reducing stress indicators such as malondialdehyde (MDA) and proline. In contrast, elevated O_3 negatively affected plant performance, with ASD16 showing greater susceptibility than CO51. Under combined CO_2 and O_3 exposure, both cultivars exhibited improved performance compared to O_3 alone. Photosynthetic rate, chlorophyll content, and water-use efficiency increased, while stress markers decreased, indicating partial mitigation of ozone damage by elevated CO_2. Additionally, foliar treatments, including ascorbic acid (AsA), neem-coated urea (NCU), and pink-pigmented facultative methylotrophs (PPFM), were evaluated for their protective effects. These treatments enhanced physiological performance and reduced oxidative stress under all gas regimes. The combined application of AsA, NCU, and PPFM proved most effective, particularly under the interactive CO_2 and O_3 condition. Overall, elevated CO_2 partially alleviated ozone-induced stress in rice, especially in the sensitive cultivar ASD16. The study highlights the potential of foliar protectants in mitigating multiple abiotic stresses and improving crop resilience. These findings provide valuable insights for developing adaptive strategies to sustain rice productivity under changing climatic conditions.

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Assessing Seed Longevity and Vigour in Medicinal Legumes Through Artificial Ageing Test

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Abstract

Artificial ageing, also known as accelerated ageing, is widely used to assess seed storability and predict seed longevity, as it accelerates the natural deterioration process and results in a decline in seed viability and vigour. Seed deterioration is a complex phenomenon involving several physiological and biochemical changes that ultimately lead to reduced germination and poor seedling performance. The present study was conducted to investigate the effects of artificial ageing on the physiological and biochemical attributes associated with seed deterioration in two medicinal legume species, senna (*Cassia angustifolia*) and butterfly pea (*Clitoria ternatea*). Seeds were subjected to artificial ageing for 2, 4 and 6 days at 40 ± 1°C and 98 ± 2% relative humidity, while non-aged seeds were maintained as the control. The results revealed a progressive decline in germination percentage, root length, shoot length, dry matter production and vigour index with increasing duration of artificial ageing in both species. Similarly, the proportion of abnormal seedlings and hard seeds was affected by ageing. Electrical conductivity of the seed leachate increased progressively with increasing ageing duration, indicating increased membrane deterioration and loss of cellular integrity. Overall, artificial ageing significantly accelerated seed deterioration and reduced seed viability and vigour in both senna and butterfly pea. The findings demonstrate the usefulness of the artificial ageing test for evaluating seed quality, vigour and storability in medicinal legume species.

Keywords: Artificial ageing, seed deterioration, physiological and biochemical causes

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Valorization of *Canna indica* L. Anthocyanin Pigments as a Natural Food Colourant and Functional Beverage Ingredient

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Abstract

The increasing demand for natural food colourants and value-added functional foods has stimulated interest in plant-derived pigments with potential health-promoting properties. *Canna indica* L. flowers are a potential source of anthocyanin pigments that can be explored for food applications. In the present study, the colouring potential and functional properties of *Canna indica* L. anthocyanin flower extract were evaluated through its incorporation into different tea beverages and Canna squash. The prepared tea brews were assessed for colour characteristics (L*, a*, b*), sensory attributes, total monomeric anthocyanin, total phenolic content, flavonoid content and antioxidant potential using the DPPH assay. Among the tea treatments, Canna + lemon tea recorded the highest monomeric anthocyanin content (268.34 mg c3gE/L), total phenolic content (94.67 mg PE/g) and flavonoid content (842.35 mg QE/g). Sensory evaluation also demonstrated good consumer acceptability, with the highest overall acceptability score of 4.60 recorded for the Canna + lemon tea treatment. The antioxidant potential varied among the treatments, indicating differences in radical-scavenging activity associated with the beverage formulations. The developed Canna squash contained 49.5 °Brix TSS, 54.77 mg/100 g ascorbic acid, 187.36 mg c3gE/L monomeric anthocyanin, 68.34 mg PE/g total phenolics and 605.32 mg QE/g flavonoids. These findings demonstrate the potential of *Canna indica* anthocyanin pigments for value-added food and beverage applications, particularly as a natural source of colour and bioactive compounds. The utilization of flower-derived pigments may contribute to the development of innovative functional food products and sustainable approaches to plant-resource valorization.

Keywords: *Canna indica,* anthocyanin, natural food colourant, functional beverage, antioxidant activity, value addition, phytochemicals

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Integrated Metabolomic and Targeted Transcriptomic Insights into *Bacillus subtilis*-Mediated Suppression of Citrus Greening Disease

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Abstract

Background: Citrus Greening Disease (CGD), caused by *Candidatus* Liberibacter asiaticus (*C*Las), is one of the most destructive diseases affecting citrus worldwide, severely reducing productivity and threatening the sustainability of citrus cultivation.

Objective: This study evaluated the biocontrol potential of an endophytic *Bacillus subtilis* isolate (LBS5) against *C*Las and investigated the molecular mechanisms underlying induced resistance through integrated metabolomic and targeted transcriptomic analyses.

Methods: Five *Bacillus* isolates were screened for plant growth-promoting attributes and antagonistic activity. The most promising isolate, LBS5, was evaluated for its ability to suppress *C*Las using quantitative PCR (qPCR). Host responses were characterized using integrated metabolomic analyses (GC-MS, FTIR, and ^1H NMR spectroscopy) together with targeted transcriptomic analysis of the defense-related genes *PAL* and *PR2*.

Key Findings: *Bacillus subtilis* LBS5 significantly reduced *C*Las titres from 6.33×10^8 to 9.15×10^3 copies within five days. Metabolomic and targeted transcriptomic analyses demonstrated activation of the phenylpropanoid pathway, enhanced antioxidant defense, accumulation of defense-associated metabolites, and significant upregulation of *PAL* and *PR2*, indicating coordinated activation of host immune responses.

Significance: *Bacillus* subtilis LBS5 effectively suppresses *C*Las while enhancing host immunity through coordinated metabolic and transcriptional reprogramming. These findings demonstrate its potential as an environmentally sustainable biocontrol agent and provide mechanistic insights supporting its development as an eco-friendly strategy for the integrated management of Citrus Greening Disease.

Keywords: Citrus Greening Disease, *Candidatus* Liberibacter asiaticus, *Bacillus subtilis*, Biocontrol, Metabolomics, Targeted Transcriptomics

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Influence of Drip Fertigation Regimes on Growth and Yield of Monostem Sesame (*Sesamum indicum* L.)

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Abstract

A field experiment was conducted to assess the influence of different fertigation regimes on growth and yield performance of monostem sesame (*Sesamum indicum* L.) under different planting geometries. Field experiments were carried out during the cropping season of 2026 at the Agricultural College and Research Institute in Madurai, Tamil Nadu. The experiment was laid out in a split-plot design with four planting geometries as main-plot treatments and five fertigation regimes as sub-plot treatments with three replications. The fertigation treatments included soil application of 100% recommended dose of fertilizer (RDF), drip fertigation of 100% STCR-based NPK + Nano Sulphur, drip fertigation of 125% STCR-based NPK, sensor-based drip fertigation of 100% STCR-based NPK + Nano Sulphur and sensor-based drip fertigation of 125% STCR-based NPK. Using marginal means across planting geometries, the primary impact of fertigation was evaluated. Fertigation enhanced monostem sesame production characteristics, leaf area development, and plant growth. Sensor-based drip fertigation with 125% STCR-based NPK produced the greatest plant height and leaf area index, whereas drip fertigation with 125% STCR-based NPK produced the highest number of capsules per plant (73), seed yield (566.58 kg ha^{-1}), and stalk yield (1917.26 kg ha^{-1}). F3 improved seed and stalk yields by 22.3 and 36.2%, respectively, when compared to soil-applied 100% RDF. Therefore, under the experimental conditions, drip fertigation with 125% STCR-based NPK showed significant potential for increasing monostem sesame productivity.

Keywords: Drip fertigation, monostem sesame, nutrient management, STCR, seed yield

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Studies on the Assessing the Air Quality Status of Urban and Peri-Urban Areas of Coimbatore District, Tamil Nadu

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Abstract

Globally, clean air is crucial for maintaining a balanced relationship between the environment and public health; nevertheless, the worsening of air quality brought on by the release of pollutants into the environment from a variety of sources is becoming a problem for both the climate and human health. When there is a significant amount of one or more toxins in the air, it is deemed to be polluted. Gaseous pollutants such as sulphur dioxide (SO2), carbon monoxide (CO), nitrogen oxides (NOX), ozone (O3), lead (Pb), and particulate matter (PM2.5 and PM10) are examples of criteria air pollutants caused by anthropogenic or natural pollutants. Hence, an attempt has been made to assess the air pollution range in the urban and peri-urban areas. The study area selected for assessing the air quality and pollution status are Mettupalayam and Ooty. The air quality was assessed to monitor the air pollution level across the city, by utilizing the Ambient Air quality instruments. Air Pollutants namely PM2.5, CO, NO2, SO2 was observed during summer and winter season. During the summer season at Mettupalayam, the air pollutants quality ranged from 48.2 to 80.4 µg/m3 (PM 2.5), 0.68 to 2.41 mg/m3 (CO), 13.45 to 93.36 µg/m3 (NO2), 8.42 to 28.21 (SO2) whereas in the winter season values ranged between 31.8 to 62.2 µg/m3 (PM 2.5), 0.28 to 1.98 mg/m3 (CO), 10.24 to 84.63 µg/m3 (NO2), 5.42 to 16.13 (SO2). Air pollutants at Ooty was observed to be higher at summer season with values ranged from 16.6 to 23.4 µg/m3 (PM 2.5), 0.12 to 0.54 mg/m3 (CO), 5.86 to 13.41 µg/m3 (NO2), 6.82 to 12.34 (SO2) whereas in the winter season values ranged between 14.8 to 18.6 µg/m3 (PM 2.5), 0.10 to 0.38 mg/m3 (CO), 4.34 to 11.42 µg/m3 (NO2), 4.86 to 10.62 µg/m3 (SO2). Among all the air pollutants recorded during the study, it was found that Nitrous Oxide (NO2), Carbon monoxide (CO), and Particulate matter (PM2.5) level was higher during summer season at Mettupalayam traffic zone. The results of the study necessitate the need for creating urban greening designs to minimize the impacts of air pollution and to enjoy the health benefits of green landscapes.

Keywords: Air Pollution, Summer Season, Winter Season, Urban Greening

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Next-Generation Nano-Enabled Smart Delivery Systems for Microbial Inoculants: Revolutionizing Sustainable Agriculture

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Abstract

The success of microbial inoculants in sustainable agriculture is often constrained by poor survival, limited shelf life, low colonization efficiency, and inconsistent performance under field conditions. Nano-enabled smart delivery systems have emerged as a transformative approach to overcome these limitations by enhancing the stability, viability, targeted delivery, and controlled release of beneficial microorganisms. Advanced nanocarriers, including electrospun polymeric nanofibers, nanogels, nanoemulsions, biodegradable nanoparticles, nanoclays, and hydrogel-based matrices, provide protective microenvironments that improve microbial persistence against desiccation, ultraviolet radiation, temperature fluctuations, and other abiotic stresses while facilitating gradual release in the rhizosphere and phyllosphere. These smart delivery platforms promote efficient root and leaf colonization, improve nutrient-use efficiency, stimulate plant growth, suppress phytopathogens, and enhance crop resilience under adverse environmental conditions. Recent advances in material science, nanobiotechnology, microbiome engineering, and precision agriculture have further enabled the development of stimulus-responsive delivery systems capable of releasing microbial inoculants in response to environmental cues such as soil moisture, pH, root exudates, and nutrient availability. Integration of these technologies with plant growth-promoting bacteria, beneficial yeasts, arbuscular mycorrhizal fungi, and microbial consortia offers unprecedented opportunities to develop next-generation biofertilizers and biostimulants with enhanced efficacy and field consistency. Future research should focus on biodegradable nanomaterials, biosafety assessment, large-scale manufacturing, regulatory frameworks, and AI-assisted formulation design to accelerate commercialization. Nano-enabled smart microbial delivery systems therefore represent a promising frontier for improving agricultural productivity, reducing chemical fertilizer dependency, enhancing soil health, and supporting climate-resilient and environmentally sustainable crop production.

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Sustainable Cocoa Commercialization: Economic Viability, Marketing Efficiency and Producer Value Capture in Eluru District, Andhra Pradesh

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Abstract

Cocoa has emerged as an important commercial crop in Andhra Pradesh, particularly within diversified and plantation-based farming systems. However, expansion of cocoa production does not necessarily ensure proportional improvement in farmer profitability or value capture. This study examines the economic viability of cocoa cultivation and evaluates alternative marketing channels with specific emphasis on producer value capture in Eluru district, Andhra Pradesh. Primary data were collected from 120 cocoa farmers and 30 market intermediaries using a multistage sampling approach. Secondary data on cocoa area, production and productivity were also analysed to assess growth trends. Farm-level economics were evaluated using cost and return measures, while marketing performance was assessed through marketing costs, margins, producer's share in the consumer's rupee and marketing efficiency.

The findings indicate substantial expansion of cocoa cultivation in Eluru district. The cocoa area has really gone up from 3,084 hectares in 2014 to 2015 to 17,146 hectares in 2023 to 2024. At the time, the production of cocoa also increased from 3,469 tonnes to 21,432 tonnes. The growth rate of the cocoa area is 18.71 per cent, and the growth rate of cocoa production is 19.97 per cent every year. The growth rate of cocoa production per hectare is 1.06 per cent. The main reason cocoa production has gone up is more land is being used to grow cocoa. Growing cocoa is a way to make money. It costs ₹147,056.77 to grow cocoa on one hectare of land. The total amount of money that can be made from one hectare of cocoa is ₹200,000. So the profit from one hectare of cocoa is ₹52,943.23. For every rupee that is spent on growing cocoa, ₹1.36 is made. This shows that growing cocoa is an investment. Among the identified marketing channels, Channel III recorded the highest producer's share of 78.54 per cent and the highest recalculated marketing-efficiency index, whereas Channel IV recorded the lowest producer's share of 58.32 per cent despite having the highest consumer price. The findings highlight the importance of productivity enhancement, collective marketing, improved post-harvest infrastructure, market information and stronger farmer–processor linkages for sustainable cocoa commercialization.

Keywords: Marketing Efficiency, Producer Value Capture, Smallholder Farmers

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Balancing Rice Productivity and Carbon Emissions through STCR-Based Integrated Nutrient Management under Flooded Conditions

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Abstract

Flooded rice ecosystems are important sources of greenhouse gas emissions, and integrated nutrient management offers a potential pathway to sustain productivity while improving environmental performance. A field experiment was conducted to evaluate the influence of soil test crop response (STCR) based fertilization integrated with organic amendments on rice productivity and CO_2 flux. The experiment comprised ten treatments arranged in a randomized block design with three replications. Treatments included 100% STCR-based NPK applied alone and in combination with farmyard manure (FYM), vermicompost, poultry manure and green leaf manure (GLM). Among the treatments, 100% STCR-based NPK + poultry manure @ 5 t ha-1 (T5) recorded significantly superior crop performance, registering the highest number of productive tillers (345 m-2), leaf area index (5.48), test weight (24.70 g), grain yield (5972 kg ha-1) and straw yield (8389 kg ha-1). Incubation studies revealed a progressive increase in CO_2 emission up to 42 days, followed by a decline. Under field conditions, CO_2 flux was highest with 100% STCR-based NPK alone, particularly during active tillering, declined at panicle initiation and subsequently increased at heading. Integration of poultry manure with STCR-based NPK reduced CO_2 emission relative to other inorganic–organic combinations while maintaining superior yield and economic returns. The treatment T5 also recorded the highest benefit:cost ratio. Thus, STCR based NPK integrated with poultry manure @ 5 t ha-1 provides a promising strategy for achieving productive and environmentally sustainable flooded rice cultivation.

Keywords: CO_2 flux, Greenhouse gas, STCR, Poultry manure, Flooded rice, Sustainable productivity

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Understanding Antimicrobial Resistance in Soil Bacteria: A Strategy towards United Nation's One Health

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Abstract

The United Nation's One Health and National Action Plan of Antimicrobial Resistance 2.0 (NAP-AMR 2.0), encompass the AMR in the context of human health, animal health, agriculture and the environment. Most studies of AMR have been restricted to clinical pathogens. However, soil bacteria are continuously exposed to agro-chemicals particularly pesticides which is a route cause for the spread of antibiotic resistance genes and AMR bacteria to the anthropogenic environment. Therefore, understanding the effect of pesticides on AMR in soil bacteria is utmost importance to know the continuum of AMR among soil, plant and human. In this study, the soil samples were collected from the pesticide applied (Madhya Pradesh (MP)-Vegetable field, Tamil Nadu (TN)- Grape field, Uttar Pradesh (UP)-Rice field) and pristine soils (Forest soils of Arunachal Pradesh (AR)). Forty-eight bacteria isolated from these samples were subjected for Antimicrobial Susceptibility Test (AST) against six antibiotics (Penicillin, Ampicillin, Chloramphenicol, Streptomycin, Tetracycline and Kanamycin). The results showed that the bacterial isolates obtained from pesticide applied soil is more resistance to the tested antibiotics than the isolates from forest soils. The gram-negative bacteria showed higher resistance to cell-wall targeting antibiotics, Penicillin and Ampicillin. The bacterial isolates, MP-C1 and TN-G2-1 obtained from MP-vegetable field and TN- grape field showed maximum resistance to all the tested antibiotics. Thus, the findings suggest that pesticide-contaminated soils may serve as reservoirs of AMR bacteria and resistance genes, emphasizing the need for further genomic studies which will help environmental AMR monitoring under the One Health approach.

Keywords: Antimicrobial Resistance, One health approach, Antimicrobial Resistance Genes, Soil bacteria, Pesticides

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First Report of Pokkah Boeng Disease of Maize in Aruppukottai, Virudhunagar District, Tamil Nadu, India

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Abstract

During the fixed plot survey conducted during Rabi 2025-26 in the premises of RRS, Aruppukottai it was observed that the Maize MLT entries (MLT 001 TO MLT 008 Numbers) have been severely affected by the Pokkha Boeng disease caused by *Fusarium* sp. It is expected to be the first report in Tamil Nadu. It is observed in the 48 days old maize crop. The incidence ranged from 85 to 95 %. This disease is observed during the end of last November. The symptoms were clearly observed at the first week of December. Intermittent drizzling, low day temperature, cloudy weather and high relative humidity prevailing during the November month favored the occurrence of this disease.

Various phases of Pokkha Boeng in Maize

Phase I

*Chlorotic stripes in the base of the leaf and mid leaf

Phase II

*Ladder like symptoms on the leaves and flag leaf sheaths covering the flowers

*Malformed and choked ear head

Phase III

*Top rotting or rotting of spindle leafz

Morphological and molecular confirmation

The pathogen *Fusarium* sp. was isolated from the various symptomatic parts of disease maize crop. The pathogen produced pinkish, cottony white mycelium. Macroconidia are hyaline, falcate shaped with 3 septations. The microconidia are hyaline and ovoid in shape. The macroconidia are characterized by the presence of a foot cell. This is the unique character of *Fusarium incarnatum*. PCR amplification using TEF-1α-specific primers produced an amplicon of approximately 600 bp. The amplified PCR product was sequenced, and the sequence was submitted to the NCBI GenBank database. Following sequence analysis through the NCBI submission pipeline, the isolate was confirmed as *Fusarium incarnatum*. The sequence was assigned the GenBank accession number **PZ715998** (Submission ID: **SUB16322937**; isolate **MPBC1**)

Proving Koch's postulates

Pin pricking of young leaves followed by spraying of the conidial suspension of the pathogen exhibited the chlorotic streaks under pot culture conditions. The characters of the mycelia and conidia observed from this culture resemble the characters of the fungi isolated from the initial field symptoms. By this **Koch's postulates** were proved

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Quantitative Analysis of Callose Deposition Reveals Phloem Defense Responses in Citrus Infected with *Candidatus Liberibacter asiaticus*

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Abstract

Background: Citrus Greening Disease (CGD), caused by *Candidatus Liberibacter asiaticus* (*CLas*), is a devastating phloem-limited disease that severely reduces citrus productivity. Excessive callose (β-1,3-glucan) deposition around sieve plates is a characteristic host defense response that contributes to phloem blockage and disease symptom development.

Objective: To quantify callose accumulation in *CLas*-infected citrus tissues and evaluate its potential as a biochemical marker of phloem dysfunction.

Methods: Leaf samples from healthy and *CLas*-infected citrus plants collected from five citrus-growing regions of Tamil Nadu were analyzed. Callose was extracted using a DMSO-based protocol and quantified by an aniline blue fluorescence assay, with results expressed as pachyman equivalents per gram of fresh leaf weight.

Key Findings: *CLas*-infected tissues exhibited consistently higher callose levels than healthy tissues across all locations. The highest accumulation was recorded in the MDU–THI (C2) infected sample (0.061 pachyman equivalents g^{-1} fresh weight), indicating enhanced phloem defense activation and sieve pore occlusion.

Significance: Elevated callose deposition serves as a reliable biochemical indicator of *CLas*-induced phloem dysfunction and host defense responses. Quantification of callose may complement molecular diagnostics and facilitate disease severity assessment and physiological studies in Citrus Greening Disease.

Keywords: Huanglongbing; *Candidatus Liberibacter asiaticus*; Callose; Citrus; Phloem defense; β-1,3-glucan; Disease diagnostics

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Spatio-Temporal Monitoring and Trend Analysis of Agricultural Drought in Tamil Nadu Using Google Earth Engine

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Abstract

Agricultural drought monitoring at regional scale requires consistent, long-term satellite-derived indicators capable of capturing spatial and temporal variability in vegetation and land surface conditions. This study utilized Google Earth Engine (GEE) to monitor and analyze agricultural drought over Tamil Nadu using MODIS MOD13Q1 and MOD11A2 products, based on annual average conditions covering both the South-West and North-East monsoon seasons. Vegetation Condition Index (VCI), Temperature Condition Index (TCI), Vegetation Health Index (VHI), and a composite Drought Index were computed for three representative years - 2002, 2016, and 2024 - selected to capture contrasting drought conditions based on a 24-year (2001–2024) annual mean VHI time series. The selected years corresponded to the lowest VHI (2002, indicating severe drought), the third-lowest VHI, largely driven by a severe North-East monsoon failure among the worst in 140 years as confirmed by IMD records (2016), and the highest VHI reflecting the least drought-affected conditions (2024). Mann-Kendall trend analysis of the 24-year annual mean VHI series revealed a statistically significant increasing trend ($Z = 3.15$, $p = 0.0016$) with a Sen's slope of +0.0123/year, indicating a gradual improvement in vegetation health and a corresponding decline in drought severity over the study period. The results were validated against district-level rice yield data, which showed a peak yield of 3,918 kg/ha in 2012 and a record low of 1,642 kg/ha in 2017, consistent with the lagged agricultural impact of the 2016 drought. The study demonstrates the utility of cloud-based geospatial platforms like GEE for scalable, long-term agricultural drought monitoring and provides a reproducible framework for drought risk assessment applicable to other regions of India.

Keywords: Agricultural drought, Google Earth Engine, Vegetation Health Index, Mann-Kendall trend analysis, remote sensing.

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Optimization, Phytochemical Profiling and Antioxidant Evaluation of *Clitoria ternatea* Extracts for Value-Added Functional Food Applications

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Abstract

The present study investigated the influence of post-harvest drying and extraction techniques on the phytochemical composition and antioxidant activity of *Clitoria ternatea* flowers. Drying methods including sun drying, shade drying, and hot air oven drying were standardized and evaluated for their effects on moisture reduction and bioactive retention. Hot air oven drying significantly enhanced anthocyanin retention (243.15 mg C3gE/L) compared to conventional sun and shade drying. Extraction efficiency was optimized using Soxhlet-assisted and cold extraction methods with aqueous, ethanol, and methanol solvents. The optimized treatment demonstrated high total phenolic and flavonoid content along with strong DPPH radical scavenging activity.GC-MS analysis of methanolic extracts revealed the presence of key bioactive compounds such as α-methyl mannofuranoside, erythritol, and palmitic acid, indicating diverse therapeutic potential. The validated processing conditions effectively preserved phytochemicals and improved antioxidant stability. The study provides scientific evidence for optimizing post-harvest management strategies to enhance the nutraceutical and commercial value of *Clitoria ternatea*, supporting its use as a natural food colorant and biofunctional ingredient.

Keywords: phytochemical analysis, GC-MS profiling, natural antioxidant, post-harvest optimization, food applications, *Clitoria ternatea*.

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Interactive Effects of Nitrogen and Zinc on Yield and Economics of *Rabi* Maize (*Zea mays* L.)

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Abstract

A field experiment was carried out during the *Rabi* season of 2022–23 at the Crop Research Farm of Doon PG College of Agricultural Science and Technology, Selaqui, Dehradun, Uttarakhand, India, to assess the interactive effects of different levels of nitrogen and zinc on yield parameters of maize. The soil of the experimental site was sandy loam in texture, low in organic carbon (0.24%), medium in available nitrogen (237 kg ha-1) and phosphorus (19.60 kg ha-1), and low in potassium (95.00 kg ha-1), with a pH of 7.6. The experiment was conducted in a randomised block design (RBD) with nine treatment combinations, each replicated thrice, comprising a total of 27 plots. The treatment combinations used were, T1- N 120 kg ha-1 + Zn 15 kg ha-1, T2- N 120 kg ha-1 + Zn 20 kg ha-1, T3- N 120 kg ha-1 + Zn 25 kg ha-1, T4- N 150 kg ha-1 + Zn 15 kg ha-1, T5- N 150 kg ha-1 + Zn 20 kg ha-1, T6- N 150 kg ha-1 + Zn 25 kg ha-1 , T7-N 180 kg ha-1 + Zn 15 kg ha-1, T8- N 180 kg ha-1 + Zn 20 kg ha-1, T9- N 180 kg ha-1 + Zn 25 kg ha-1. The highest yield parameters, viz., number of cobs plant-1(2.20), number of grains cob-1 (469.11), grain yield (5.99 t ha-1), and harvest index (36.96 %), were observed in T7 (N 180 kg ha-1 + Zn 15 kg ha-1). The highest gross return, net return and B:C ratio 1.73% were recorded under treatment T7 (N 180 kg ha-1 + Zn 15 kg ha-1).

Keywords: Nitrogen, Zinc, Nutrient management, Yield

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Impact of Leaf Blight Diseases on Nut Yield in Coconut Cultivation

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Abstract

Coconut (*Cocos nucifera* L.) is an important perennial plantation crop that contributes significantly to the livelihood of farmers and the agricultural economy of tropical and subtropical regions. Leaf blight diseases caused by *Lasiodiplodia theobromae*. The affected leaflets start drying from the tip downwards and exhibit a charred or burnt appearance. The affected nuts were desiccated, shrunken, deformed and dropped prematurely. Severe infection can reduce the photosynthetic efficiency and functional leaf area of palms, thereby affecting plant growth, nut development, and overall yield. The present study focuses on assessing the impact of leaf blight diseases on nut yield in coconut cultivation. Disease incidence and severity were evaluated in relation to yield parameters such as the number of nuts produced per palm, nut retention, and overall nut yield. Adult palms of 20 to 40 years of age were highly susceptible to the diseases. The nut yield of coconut palms was decreased to 10 to 25 per cent due to leaf blight incidence. The study highlights the potential association between increasing disease severity and reduced nut production, emphasizing the importance of timely disease identification, regular field monitoring, and effective disease management practices. Adoption of integrated disease management strategies, including cultural practices, removal of severely affected plant parts, improved orchard sanitation, and appropriate disease-control measures, can help minimize yield losses. The findings can provide useful information for developing sustainable management practices to maintain coconut productivity and improve farmers' returns.

Keywords: Coconut, *Cocos nucifera* L., leaf blight, disease incidence, disease severity, nut yield, yield loss, disease management, coconut cultivation.

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Effects of Microplastic Bioaccumulation in Freshwater Fishes on Environmental Sustainability

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GPGC, Kunidhar, Manila, Almora, Uttarakhand (India)

Abstract

This paper really directly looks at what happens when microplastics (MPs) spread fast through India's water worlds, and how they end up bioaccumulating in local freshwater fish (rohu, catla, and mangur). From my point as a researcher, the picture is pretty stark, like a ground reality: a big share of India's people (about 65%) lives in rural areas yet there is no government run waste management or proper waste disposal setup in place. Right now, by 2026, the situation is basically that many major FMCG (Fast-Moving Consumer Goods) and packaging companies, in India and elsewhere, are still pushing 100% single-use plastic pouches bags, and wrappers without meaningful government restrictions. Since there's a total absence of systematic management, this uncontrolled single-use waste from villages and small towns runs straight into rivers, ponds, and lakes, so into freshwater ecosystems and it keeps building up day after day. Eventually, under weather effects and UV radiation, the plastic starts breaking down and shifting into deadly microplastics and even nanofibers. In my study, I also found that these synthetic polymers (mainly fibers and fragments) end up trapped in large quantities inside the gills and in the gastrointestinal tracts of our freshwater fish. As a consequence, the fish show oxidative stress and tissue damage, not just in theory but clearly in the observed outcomes. The most serious part, at least when we think about environmental sustainability, is the food chain. Fish are the most reachable source of protein for people who are economically disadvantaged, the marginalized society. When they eat the fish whole, these micro poisons can move into their bloodstream and brain, contributing to cancer risks and hormonal disorders. Ultimately, this research pretty clearly shows that as long as decentralized waste management is not put in place in villages, and companies' EPR (Extended Producer Responsibility) policies are enforced, strictly… then our environment and society will keep dealing with this kind of silent catastrophe, unnoticed for a long time.

Keywords: Microplastic accumulation, freshwater fish, single-use plastics, rural waste management, environmental sustainability, food security, Indian conditions.

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Current Scenario of Diseases of Custard Apple and its Management

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Abstract

In custard apple, Sugar apple (*Annona squamosa*) and Cherimoya (*Annona cherimola*) are closely related, similar-tasting fruits with only a few differences. They are also called sitaphals, sharifas, sita pazham, and sweet sop, depending on the region. Annona squamosa grow well throughout the plains of India at elevations not exceeding 4,000 ft. The cherimoya prefers a tropical climate, but with cool winters. The fruit tolerates a variety of conditions, from saline soils to droughts. In custard apple, the leaf spot (*Cercospora*) and fruit rot (*Rhizopus*) were found to be the major diseases which cause economical yield loss. The leaf spot occurs severely during August and fruit rot noticed during October and November. The experiment was conducted to assess the effect of plant products and chemicals against *Cercospora* leaf spot and *Rhizopus* fruit rot. Two sprays of plant products and chemicals were given at 15 days interval starting from the occurrence of the disease. Mancozeb at 0.2 per cent was effective against *Cercospora* leaf spot recorded 3.0 PDI followed by copper oxy chloride (0.2%) (4.2 PDI) which was on par with neem oil at 3 per cent (4.8 PDI). Copper oxy chloride at 0.2 per cent was effective against *Rhizopus* fruit rot with 5.50 per cent incidence compared to control (27.83 %). The highest yield was recorded in Copper oxy chloride (0.2 %) (6.2 kgs /tree) with CB ratio of 1:3.4 followed by Mancozeb (0.2 %) (5.9 kgs /tree) which was on par with neem oil at 3 per cent (5.7 kgs/tree and CB ratio of 1:3.2) compared to control (1.8 kgs /tree). Fruit rot caused by *Lasiodiplodia (Botryodiplodia) theobromae* incidence was high in Mammoth variety recorded 45.6 per cent and nil incidence in Arka Sahan. Balanagar and APK (Ca 1) varieties respectively recorded 16.2 and 28.5 per cent. Powdery mildew incidence was high in Arka Sahan (43.6 PDI) followed by Raidurg (24.3 PDI) and least (10.2 PDI) in APK 1 variety. The pathogen *Lasiodiplodia (Botryodiplodia) theobromae* caused the fruit spot disease in *Annona squamosa*. It reduced the economic quality and more yield losses. Black coloured corky lesions were observed on custard apple flowers and such affected flowers become completely black, hardened and fall off. Corky black coloured lesions were also observed on the fruit skin, the lesions coalesce and cause rotting of fruits. The pathogen was isolated both from flowers and fruits and the isolates were submitted to ITCC, IARI, New Delhi for identification and both were identified as *Lasiodiplodia (Botryodiplodia) theobromae*. The fungus initially produced white colonies, which later turned black. The mycelium was fast spreading, immersed, branched and septate. Shiny black pycnidia were produced on the surface of the culture medium after 7–8 days at 28 ± 2°C at 12 hours photoperiod. Paraphyses were present interspersed with conidiogenous cells in the pycnidia. Conidia were initially unicellular, ellipsoidal, hyaline, thick-walled with granular content, and measuring 22.5 ×12.5 micrometer.

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Mature conidia were bicelled, dark brown with longitudinal striations. Based on its morphology, the fungus was identified as *Lasiodiplodia theobromae*. The bioagents and botanicals were used for the management of fruit spot in Custard apple under *in vitro* condition. Among them, thyme oil at 1% exhibited the nil inhibition zone of the pathogen (0.0 cm) followed by *Vitex negundo* leaf extract at 10% recorded the least inhibition zone of 1.0 cm which was found on par with copper oxychloride at 0.25% (1.6 cm) followed by *Bacillus subtilis* (2.4 cm) compared to control recorded 5.3cm.

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Assessment of Physical Characteristics of Selected Traditional Rice Varieties of Tamil Nadu

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Abstract

The present study was undertaken to evaluate the physical and milling quality characteristics of nineteen selected traditional rice varieties of Tamil Nadu. The laboratory experiment was conducted at the NABARD Post Harvest Unit, Agricultural College and Research Institute (AC&RI), Madurai during 2026. Nineteen traditional rice varieties namely Chithirai kar, Karuna, Seeraga samba, Mapillai samba, Mayil samba, Karuppu kavuni, Thooyamalli, Kudavazhai, Kuruvai kalanjiyam, Chandikaar, Kallurundai, Puzhuthi samba, Salem sanna, Kuzhiveduchan, Garudan samba, Swarna masuri, Poongaar, Chinnar and Milagu samba were evaluated for hulling percentage, milling percentage, head rice recovery (HRR), grain length, grain breadth, length-to-breadth (L/B) ratio and 1000-grain weight using standard laboratory procedures. Considerable variation was observed among the varieties for all the quality parameters studied. Karuna recorded the highest hulling percentage (86.00%), indicating superior dehusking efficiency. Milagu Samba exhibited the highest milling percentage (98.70%), while Kudavazhai, Puzhuthi Samba, Salem Sanna and Milagu Samba achieved 100% head rice recovery, reflecting excellent milling quality with minimum grain breakage. Chinnar recorded the highest grain length (9.20 mm) and L/B ratio (4.00), indicating desirable slender grain characteristics. Kuzhiveduchan and Poongaar registered the highest 1000-grain weight (31.00 g), while Seeraga Samba recorded the lowest values for several physical traits. The study demonstrated significant genetic variability among the traditional rice varieties for physical and milling quality traits. Varieties such as Milagu Samba, Karuna, Mapillai Samba, Poongaar, Kudavazhai and Chinnar exhibited desirable characteristics that make them suitable for commercial cultivation, processing industries and consumer preference. The findings also indicate that high milling percentage does not necessarily correspond to high head rice recovery, emphasizing the importance of evaluating multiple quality parameters simultaneously. Overall, the study provides valuable information for the conservation, utilization and improvement of traditional rice germplasm and offers useful baseline data for rice breeding programmes aimed at enhancing grain quality and processing efficiency.

Keywords: Traditional rice, Test Weight, Processing, Hulling, Milling, Head Rice Recovery

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Physiological Effects of Nutrients and PGRs in Managing Nutrient Mediated in Nema tode-Infested Guava (*Psidium guajava* L.)

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Abstract

Root-knot nematode (*Meloidogyne enterolobii*) is a major constraint in guava cultivation, causing yield losses of up to 65% by disrupting nutrient uptake and inducing severe physiological stress. This study investigated the effectiveness of integrated nutrient and plant growth regulator (PGR) consortia applied as foliar sprays in combination with bio-control agents applied to soil for ameliorating nematode infested dysfunction in guava cv. L49. A pot culture experiment was conducted with eleven treatments in a completely randomized design with three replications, using three month old seedlings inoculated with 100 second stage juveniles per 100 gram soil. Biocontrol agents were applied at 15 and 30 days post-inoculation, while nutrient-PGR consortia were foliar sprayed at 15 day intervals for four months. Physiological attributes including leaf phenol content, gas exchange parameters (stomatal conductance, photosynthetic rate, transpiration rate), and antioxidant enzyme activities (SOD, CAT, POX, PPO, PAL), were assessed. Integrated treatments significantly improved physiological performance and alleviated nematode stress. The synergistic application of biocontrol agents with nutrient-PGR consortia emerges as a promising integrated strategy to restore physiological balance and sustain productivity in nematode infested guava orchards.

Keywords: Guava; *Meloidogyne enterolobii;* Biocontrol agents; nutrient-PGR consortia; Physiological stress management.

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Banana Breeding for Resistant to Fusarium Wilt

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Abstract

Banana and plantain are the second largest fruit crops produced and exported in the world. It is one of the world's major food crop, ranking third in terms of total production and in terms of productivity. However, banana production is severely threatened by different types of pests and pathogens, among which Panama wilt disease caused by *Fusarium oxysporum* f. sp. *cubense* (Foc) holds major share in causing huge economic losses to the banana growers. The banana hybrids were screened for resistance to *Fusarium oxysporum* f. sp. *cubense* through the soil inoculation method, and disease severity was assessed 45 days after inoculation. Among the 28 hybrids evaluated, H-11-21, H-11-25, H-11-69, H-11-70, and H-11-76 recorded the minimum disease score of 1 and exhibited resistance to *Fusarium wilt*. The hybrids H-11-07, H-11-12, H-11-18, H-11-71, H-11-03, H-11-24, H-11-37, and H-11-65 were categorized as tolerant, whereas the remaining hybrids were found to be susceptible.

The biochemical mechanisms associated with resistance revealed that resistant genotypes exhibited higher levels of total phenols, orthodihydroxy (OD) phenols, and lignin, along with greater activities of peroxidase (POX), polyphenol oxidase (PPO), and phenylalanine ammonia-lyase (PAL), compared with susceptible genotypes following *Fusarium* infection. These enhanced biochemical responses may contribute to the increased resistance of the selected banana hybrids against *F. oxysporum* f. sp. *cubense*.

Keywords: Banana, hybrids, wilt, resistant, biochemical

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Interaction Studies of Flavonoids with Bcl-2 Protein to ReActivate Apoptosis in Jurkat T-Cells by Induced TRAIL

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Abstract

Immune cell malignancy such as Acute T- cell Lymphoblastic Leukaemia is generally associated with high rate of relapse and often does not respond to salvage therapy. Thus, identification of novel treatment regimens or cell apoptosis pathways and therapeutic agents without major side effects is necessary. TRAIL-induced apoptotic pathway is one such pathway that is usually blocked by anti-apoptotic proteins like Bcl-2. This research estimated and compared the ability of few common flavonoids to re activate TRAIL-induced apoptosis by blocking Bcl-2 protein. Studies were carried out to understand the interaction between binding energy of the Flavonoids with Bcl-2 protein in cancer cells. The pharmacokinetic and toxicity profiling was performed to study the potency of the flavonoids as a lead candidate. Baicalein was selected as lead molecule because of its lower binding energy and its ability to increase Mitochondrial Membrane Potential as studied from its ADME properties. For validation of apoptosis of Baicalein by TRAIL-induced owing to Bcl-2 analysis of cell cycle and Gene expression studies were carried out on Jurkat T cells.

Keywords: flavonoids, acute lymphoblastic leukaemia, Jurkat cells, Bcl-2 protein, TRAIL, docking, pharmacokinetic analysis, Mitochondrial Membrane Potential, baicalein, ADME properties

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Bridging Traditional Nutrition with Modern Nutrient Delivery - Nanoformulation and Characterisation of Bioactive Secondary Metabolites from Finger millet *(Eleusine coracana)*

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Abstract

Finger millet (*Eleusine coracana*) is a rich source of bioactive compounds having antioxidant and antimicrobial properties.The used of nanoemulsion in entrapping bioactive compounds may enhance the anti-microbial properties and prevent degrading of bioactive compounds. In the present study, bioactive secondary metabolites were extracted by Ultrasonic Assisted Extraction (UAE) using ethanol as solvent extract. Nanoemulsion was synthesized using the extract in different concentrations (1%FM, 2%FM, 3%FM, 4%FM, 5%FM) by O/W (oil-in-water) emulsion. Samples were analysed for their particle size, zeta potential and polydispersity index (PDI). Secondary metabolites were identified by FTIR spectroscopy. Antimicrobial assay was performed for the nanoemulsions by Agar well diffusion method using two Gram-positive (*Staphylococcus aureus & Bacillus subtilis,*) and two Gram-negative bacteria (*Escherichia coli & Pseudomonas aeruginosa*). The experiment exhibited that particle size of 1%FM, 2%FM, 3%FM, 4%FM, 5%FM were 136.1 nm, 200.8 nm, 81.9 nm, 1988 nm, and 33873 nm respectively. Zeta potential were -8.9, -7.7, -20.1, -17.0, and -13.7 respectively and PDI were 1.08, 0.5, 0.8, 2.2, and 2.4 respectively. FTIR spectra exhibited that presence of secondary metabolites like alkenes, phenols, phenolic compounds, halo compounds. Antimicrobial assay was performed for 2%FM, and 3%FM. The result revealed that the zone of inhibition in diameter (mm) for 2%FM against *S. aureus, B. subtilis, E. coli* & *P. aeruginosa* were 18 mm, 18 mm, 19 mm & 13 mm respectively while 22 mm, 24 mm, 22 mm and 16 mm respectively for 3% FM. This study suggested that bioactive compounds from finger millet in nanoemulsion may be new alternative food source.

Keywords: antimicrobial, *Eleusine coracana*, nanoformulation, secondary metabolites.

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Deciphering Ionome and Metabolome Signatures in *Jasminum sps*

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Abstract

Jasmine is a one the most highly cultivated loose flowers in India, added to its high export value for its mystical fragrance in the international luxury perfume industry. Among the highly cultivated species *Jasminum sambac* (Madurai Malli) and *Jasminum trifoliatum* also called as *Jasminum azoricum* (Mysuru mallige) possess Geographical indication (GI) status due to their regional significance and unique quality attributes. Since the commercial value of jasmine primarily lies in essential oil and its traditional use, a first of its kind study was conducted to delve into the intricate relationship between metabolome profile of essential oil in jasmine flowers and the elemental composition of soil, leaves in *Jasminum sambac* and *Jasminum trifoliatum*, *Jasminum grandiflorum* (Spanish jasmine) and *Jasminum auriculatum* (Indian jasmine). The soil, leaf and flower samples were analyzed using Inductively Coupled Mass Spectrophotometry (ICP-MS) to determine the 30 elements, that include the macro, micro and trace elements. Concurrently, essential oils were extracted from the flowers of their respective species through the solvent extraction method, and metabolome analysis of these oils was profiled using GC-MS. The resulted data was correlated and the conclusions were drawn. The study revealed hitherto undeciphered information of elemental influence on essential oil and metabolome of Jasmine making it a novel study and an underexplored integration and incorporation of multi-omics in floriculture industry.

Keywords: *Jasminum, Jasminum spp,* Ionomics, Metabolome, Essential oil, ICP-MS, GC-MS

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Phytofabrication of Silver Nanoparticles Using Dragon Fruit Pulp and Comparative Biochemical Evaluation, Antioxidant profiling, Characterization, and Application Studies

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Abstract

Dragon fruit belongs to cetacean family, well known for its exotic appearance, nutritional and medicinal properties. As an edible fruit it is enriched with water soluble fibre, antioxidants especially betalains, hydroxycinnamates and flavonoids. It aids in weight loss, strengthens immune system, reduces LDL cholesterol and helps in digestion. This study was designed to systematically evaluate and compare the nutritional and bioactive potential of dragon fruit pulp and peel both pink and white variety. Using validated spectrophotometric assays, the study quantified essential biochemical components, including carbohydrates, proteins, amino acids, and minerals such as phosphorus and iron. Comparative analysis inferred that pink pulp of dragon fruit exhibited superior nutritional and functional properties; the pulp serves as a significant sustainable resource for valorization. Antioxidant assays (DPPH, ABTS, and FRAP) identified pink pulp and white skin as possessing the most robust radical scavenging efficiency. Furthermore, the study successfully utilized these bioactive extracts—specifically phenolics, proteins, and polysaccharides as reducing and stabilizing agents for the green synthesis of silver nanoparticles (AgNPs), confirmed via SEM, EDX and FTIR analysis. Statistical validation through ANOVA ($p < 0.05$) consistently highlighted significant differences across sample types. The synthesized AgNPs demonstrated high efficiency in photocatalytic dye degradation, underscoring their potential in environmental remediation, alongside pharmaceutical and antimicrobial activity. Ultimately, this study bridges the gap between nutritional biochemistry and eco-friendly nanotechnology, supporting the integration of dragon fruit bioactives into functional foods and green chemistry.

Keywords: Dragon fruit peel/pulp extract, Antioxidant assays (DPPH, ABTS, FRAP), SEM, FRIR, EDX, Photocatalytic degradation of dye

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Pollution, Biodiversity, and Ecosystem Stability: A Theoretical Perspective on Freshwater Conservation

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Abstract

Freshwater ecosystems are among the most diverse and ecologically valuable ecosystems on the planet; they are subjected to an increasing danger of pollution and loss of biodiversity. This theoretical study reviews the interdependency and linkages between pollution, biodiversity and ecosystem stability in relation to the conservation of freshwater. Industrial effluent, agricultural runoff, urban runoff, and toxic chemicals affect water quality, ecological processes, and water quality suitability for aquatic organisms. Reducing biodiversity has a negative impact on ecosystem resilience, through diminished functional diversity and ecosystem ability to cope with environmental stressors. Pollution-induced species loss and changed community structure in ecosystems result in reduced ecosystem stability, which is a function of the complex interactions between species and habitat. This paper provides a synthesis of ecological theories and conceptual frameworks to explain how biodiversity buffers against environmental change and provides important ecosystem services, including water purification, nutrient cycling and biological productivity. It emphasises the need for a combined approach to conservation, such as pollution control and protection of biodiversity. The theoretical connections are useful in informing the policies, management, and conservation strategies for freshwater ecosystems that aim for sustainable management and ecological stability.

Keywords: Freshwater ecosystems, pollution, biodiversity, nutrient cycling

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Controlled Release of Phytohormones through Electrospun Nanofibers: A Physiological strategy for Climate Resilient Crop Improvement

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Abstract

Auxin and cytokinin, the two principal phytohormones, play a crucial role in regulating cell division, cell elongation, tissue regeneration, vascular differentiation, and wound healing, all of which are essential for the successful formation of the graft union in plant tissues. During grafting, the physical separation of stock and scion tissues temporarily disrupts the continuity of vascular connections, thereby hindering the endogenous movement of phytohormones and other signaling molecules between cells. This interruption often delays graft union formation and may ultimately lead to graft failure. To compensate for the transient imbalance of internal phytohormones, plant growth regulators (PGRs) are applied exogenously to promote faster wound healing and facilitate efficient graft union development. In the present approach, PGRs are incorporated into nanofiber matrices to enable their slow and sustained release, thereby enhancing hormone availability at the graft interface over an extended period and improving graft success. The electrospinning technique parameters (polymer concentration, flow rate, and collector distance) were optimized using Taguchi L4 orthogonal array design. Comprehensive morphological using Field Emission Scanning Electron Microscope (FESEM) and thermal characterization by Thermogravimetric Analyzer (TGA) and Differncial Scanning Calorimetry (DSC) confirmed the successful incorporation of hormones without compromising fibre integrity. Release kinetics analysis using first-order and Higuchi models revealed a predominantly diffusion-controlled release mechanism with partial first-order kinetics, ensuring sustained hormone delivery. Biological assessment revealed that PVA nanofibers with hormones enhanced the grafted plants' survival rate and better physiological changes compared to traditional grafting. There was no evidence of inhibition of useful microbes (*Trichoderma viride* and *Pseudomonas fluorescens*). The optimized nanofiber system effectively reduces the need for repeated hormone application and minimizes potential losses due to leaching or degradation at the graft union. Overall, these results show that electrospun phytohormone-loaded nanofibers as a controlled release formulation for graft healing by offering a promising climate resilient strategy in horticultural crops.

Keywords: Controlled release, Auxin, Kinetin, Electrospinning, Smart Nanofiber, Graft union

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Upcycling Food Waste into Valuable Products: A Sustainable Strategy for Nutrition and Environmental Health

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Abstract

The increasing global population and rising food demand have amplified food production and generated substantial waste, especially from fruits and vegetables. Peels, seeds, stems, and pomace are frequently discarded throughout the supply chain, representing a loss of valuable nutrients and an environmental burden. Fruit and vegetable waste contains essential nutrients and bioactive compounds such as dietary fibers, phenolics, flavonoids, vitamins, and minerals that exhibit antioxidant, antimicrobial, and anti-inflammatory properties, making them ideal for functional foods and nutraceuticals. Various processing techniques, including freezedrying, spray-drying, fermentation, and enzymatic treatments, enable efficient extraction and stabilization of these valuable ingredients from waste streams. Extracted components can be incorporated into food formulations as natural colorants, flavorings, preservatives, emulsifiers, and fortifying agents, enhancing product functionality and nutritional value. Consumer surveys indicate growing acceptance of upcycled foods, with 78% of respondents willing to try products formulated from recovered ingredients. Regulatory considerations for safety, quality, and labeling are essential to ensure compliance and build consumer trust. Upcycling fruit and vegetable waste addresses multiple challenges simultaneously such as - it reduces the environmental burden of disposal, enhances food security through cost-effective nutrient-rich alternatives, and aligns with consumer demand for natural, sustainable products. By transforming waste into sustainable food ingredients, the approach supports improved public health and reduces the ecological footprint of the food industry. This study examines methods for valorizing fruit and vegetable waste into value-added food products, demonstrating alignment with circular economy principles and contributing to sustainable development goals.

Keywords: Food waste upcycling, circular economy, bioactive compounds, sustainable nutrition, value-added products

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Endophytic alkalo-tolerant Plant Growth-Promoting Bacteria Render Maize (*Zea mays* L.) growth Under Alkaline Stress

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Abstract

Soil alkalinity is a major abiotic stress limiting crop productivity. Endophytic bacteria from plants thriving in extreme alkaline environments offer a sustainable strategy to enhance crop resilience. In this study, 48 bacterial endophytes were isolated from S*accharum munja, Calotropis procera,* and *Chenopodium album*. Based on alkaline tolerance, 15 isolates were selected and identified through 16S rRNA gene sequencing as members of the genera *Enterobacter, Acinetobacter, Stenotrophomonas, Bacillus, Lysinibacillus*, and *Mammaliicoccus*. Six isolates exhibiting superior plant growth-promoting (PGP) traits and abiotic stress tolerance were further evaluated in greenhouse experiments using maize (*Zea mays*). Inoculation with strains of *Enterobacter, Bacillus, Stenotrophomonas*, and *Lysinibacillus* significantly improved maize growth under alkaline stress, demonstrating their potential to mitigate the adverse effects of soil alkalinity. These findings highlight the potential of indigenous alkaline-adapted bacterial endophytes as bioinoculants for improving crop performance in alkaline soils. The study provides a foundation for understanding endophyte-mediated alkaline stress tolerance and supports the development of sustainable microbial interventions for climate-resilient agriculture.

Keywords: Alkaline stress; bacterial endophytes; plant growth-promoting bacteria; *Zea mays*; abiotic stress tolerance.

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Bio-Electrochemical Systems for Sustainable Water Treatment of Industrial Wastewater

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Abstract

Linear industrial discharge of complex wastewater with recalcitrant organic compounds, heavy metals, pharmaceuticals, dyes, and other emerging contaminants is a serious threat to conventional wastewater treatment technologies. By integrating electrochemical processes with the metabolism of electroactive microorganisms, bio electrochemical systems (BESs) have been developed as a sustainable and energy-efficient alternative that enables simultaneous pollutant degradation, resource recovery and renewable energy generation. This chapter critically reviews the latest developments of BESs such as microbial fuel cells, microbial electrolysis cells, microbial desalination cells and bioelectro Fenton systems for industrial effluent treatment. Special attention is given to the mechanisms of extracellular electron transfer, new materials for electrodes, new reactor designs, and operating parameters related to treatment efficiency and system stability. The chapter also addresses the combination of BESs with advanced oxidation processes, membrane filtration and biological treatment to improve contaminant removal and water reusability. New innovations, such as biochar based electrodes, nanostructured electrocatalysts, and process optimization with the help of artificial intelligence, are suggested to enhance scalability and profitability. Lastly, the challenges of scaling up reactors, stability of biofilms, durability of electrodes, and commercialization of such systems are discussed and future prospects of achieving climate-resilient, circular and carbon-neutral industrial wastewater treatment systems that benefit sustainable water ecosystems discussed.

Keywords: Industrial wastewater; Microbial fuel cells; Bioelectro-Fenton; Electroactive microorganisms; Advanced oxidation processes; Sustainable water treatment; Circular economy; Water reuse.

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Influence of Storage Temperature on Postharvest Quality, Antioxidant Metabolism, and Storability of Dragon Fruit (*Hylocereus costaricensis*)

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Abstract

Dragon fruit (*Hylocereus costaricensis*) is a highly perishable non-climacteric fruit with a limited postharvest shelf life due to rapid physiological and biochemical deterioration. This study evaluated the influence of storage temperature on postharvest quality, antioxidant metabolism, and storability of cv. Red Dragon-1. Uniform mature fruits were stored under ambient conditions and at 6°C and 10°C (90–95% relative humidity) for 21 days, with observations recorded at seven-day intervals. Storage temperature significantly influenced physiological, biochemical, and enzymatic responses throughout storage. Fruits maintained under ambient conditions showed higher physiological weight loss, increased respiration and ethylene production, rapid softening, greater decay, and poor sensory quality. In contrast, cold storage effectively delayed ripening and maintained cellular integrity. Among the treatments, storage at 6°C best preserved total soluble solids, organic acids, vitamin C, phenolics, flavonoids, carotenoids, betalains, and overall antioxidant capacity. It also enhanced antioxidant enzyme activities while suppressing cell wall-degrading enzymes, resulting in improved firmness and delayed senescence. These findings indicate that storage at 6°C is the optimum temperature for extending shelf life while preserving the nutritional, sensory, and commercial quality of dragon fruit.

Keywords: Dragon fruit, Quality, Biochemical, Antioxidant, Betalains, Storage.

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A Comparative Assessment of Drum Based Biochar Production from Diverse Biomass Feedstocks

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Abstract

Biochar production via low-cost drum kilns offers a practical, scalable pathway for converting agricultural and forestry biomass residues into carbon-rich, value-added products, particularly in resource-constrained settings. This review critically examines biochar derived from three contrasting feedstocks: maize cobs (Zea mays L.), sugarcane bagasse (Saccharum officinarum L.), and the invasive shrub Prosopis juliflora: produced through drum-based kilns, with emphasis on their physicochemical characteristics and agricultural-environmental applications. Existing literature reveals substantial feedstock-dependent variation in biochar yield and properties: maize cob biochar exhibits pronounced macroporosity favorable for microbial colonization and water retention; sugarcane bagasse biochar enhances water-holding capacity in sandy soils; and Prosopis-derived biochar, owing to elevated lignin content, demonstrates superior structural recalcitrance suited to long-term carbon sequestration. Comparative analysis indicates that drum kilns operating at 350-500 °C typically yield lower biochar output (20-30%) with elevated ash content relative to laboratory muffle-furnace pyrolysis (>35%), while resulting biochars are predominantly alkaline (pH 8.0-10.0), often necessitating modification prior to direct soil application. Co-composting with farmyard manure and mineral carriers emerges as an effective enrichment strategy, reportedly reducing chemical fertilizer requirements by 20-40% and improving nutrient use efficiency, though outcomes vary with feedstock and soil type. The review identifies priority research directions, including drum kiln design optimization, long-term field validation, life cycle assessment, and quantification of biochar's contribution to climate-smart, carbon-negative agricultural systems.

Keywords: Agricultural waste management, biochar, carbon sequestration, drum pyrolysis, soil amendment.

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Evaluation of the Ammonia-producing Ability of Phosphate-solubilizing Micro organisms Isolated from the Rhizosphere of Orange Plants in Saoner Tahsil and Assessment of their Combined Contribution to Phosphate Solubilization and Plant Growth Promotion

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Abstract

The present study was undertaken to evaluate ammonia production and phosphate-solubilizing activity of plant growth-promoting bacteria isolated from the orange rhizosphere of Saoner Tahsil. A total of 80 isolates were screened for phosphate solubilization using Pikovskaya's agar. Among them, PSMB37 showed the highest phosphate-solubilization index (PSI) of 215.33 ± 0.25, indicating strong phosphate-solubilizing potential. The selected isolates were further evaluated for ammonia production using Nessler's reagent qualitatively as well as quantitatively. The results indicated that ammonia Production and phosphate solubilization could enhance nutrient availability and encourage plant growth. PSMB37 was shown to be a promising bacterial isolate that promotes plant growth and may be used as a bioinoculant in sustainable orange farming.

Keywords: Phosphate-solubilizing Microorganisms, Orange rhizosphere, Saoner Tahsil, Ammonia production, Phosphate solubilization, Plant growth-promoting bacteria (PGPB), PSMB37, Bioinoculant.

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Synthesis of Magnetic Biochar from Pistachio Shell for Heavy Metal Removal from Industrial Effluents

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Abstract

The increasing discharge of heavy metal-contaminated industrial effluents poses significant risks to aquatic ecosystems and human health, creating an urgent need for efficient, low-cost, and environmentally sustainable remediation technologies. This study investigates the synthesis of magnetic biochar (MB) from pistachio shell, an underutilized lignocellulosic biomass, for the removal of heavy metals from aqueous systems. Pistachio shell was initially size reduced to 2 mm and analyzed for its proximate, biochemical and chemical composition. The size reduced pistachio shell was pyrolyzed at 600 ºC for 2h in a fixed bed pyrolytic reactor under N_2 flow of 150 – 200 mL/min. The produced biochar was subsequently magnetized using iron oxide (Fe_3O_4) nanoparticles via chemical co-precipitation to impart magnetic separability and enhance surface functionality. The physicochemical properties, surface morphology, elemental composition, crystallinity and magnetic characteristics of the synthesized material were systematically evaluated using analytical techniques. The adsorption performance of the magnetic biochar was investigated as a function of solution pH, contact time, adsorbent dosage, initial metal concentration, and temperature.

The study demonstrates the potential of pistachio shell-derived magnetic biochar as a sustainable, resource-efficient, and recoverable adsorbent for heavy metal remediation, while simultaneously providing a value-added pathway for agricultural residue valorization and contributing to circular approaches for industrial wastewater management.

Keywords: Magnetic Biochar; Pistachio Shell; Valorization; Heavy Metal Adsorption; Industrial Effluent Treatment

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Development of Banana Peel and Turmeric Fortified Functional Cookies for Waste Valorization

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Abstract

Banana peel is an abundant agro-food waste that contains dietary fibre, minerals, antioxidants, and other bioactive compounds, but it is commonly discarded despite its nutritional potential. Turmeric is also recognized for its bioactive compound curcumin, which possesses antioxidant and functional properties. The present study focuses on the development of functional cookies by incorporating banana peel powder and turmeric powder as value-added ingredients. Banana peels were collected, cleaned, dried, and processed into powder before incorporation into the cookie formulation. Different levels of banana peel powder substitution, along with turmeric fortification, were used to develop and evaluate the cookie samples. The formulated cookies were assessed based on sensory characteristics such as colour, flavour, aroma, texture, and overall acceptability. The study aims to identify a suitable formulation that provides acceptable sensory quality while enhancing the functional and nutritional potential of cookies. The developed product provides an approach for utilizing banana peel as a food ingredient and reducing agro-food waste. The study demonstrates the potential of combining banana peel and turmeric to develop a value-added functional bakery product with improved resource utilization and possible health-promoting properties.

Keywords: Banana peel powder, Turmeric, Functional cookies, Food waste valorization, Dietary fibre, Bioactive compounds

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Process Development for Production of Millet-Based Ready-to-Cook Functional Pasta for Nutritional Security

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Abstract

Ready-to-cook foods are gaining importance due to their convenience, reduced preparation time, easy storage, and suitability for modern lifestyles. This study focuses on the development of a millet-based ready-to-cook functional pasta using sprouted ragi, little millet, green gram, black gram, and tapioca starch as major ingredients. The product is intended to provide a convenient and nutritionally enriched food option by incorporating the nutritional benefits of millets and pulses into a popular pasta product. Different formulations will be developed and optimized based on dough handling, pasta formation, and product quality. The novelty of the study lies in developing a gluten-free ready-to-cook pasta by combining sprouted ragi and little millet with protein-rich pulse ingredients and tapioca starch to improve nutritional and functional properties. The developed pasta will be evaluated for physical characteristics such as weight, texture, colour, and appearance, along with cooking quality, chemical and nutritional properties, sensory acceptability, and shelf life. The study is expected to develop an acceptable, nutritionally enriched and convenient millet-based pasta with desirable texture and cooking characteristics, providing a potential value-added food product for nutritional security.

Keywords: Millet and Pulse based Pasta; Ready-to-Cook Food; Functional Food; Gluten-Free.

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Harnessing Chlorella vulgaris for Plastic Degradation and Polyhydroxybutyrate Biosynthesis

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Abstract

Microalgae, particularly Chlorella vulgaris, were isolated and purified from collected water samples to investigate their potential applications in biodegradation and biopolymer production. The isolation process involved microscopic analysis and culturing on BG11 media, followed by morphological characterization and 16S rRNA sequencing, which confirmed the identity of Chlorella vulgaris with 99% similarity. The ability of Chlorella vulgaris to degrade synthetic plastics was examined through gravimetric analysis and scanning electron microscopy (SEM). After a 30-day incubation period, Low-Density Polyethylene (LDPE) and Polypropylene (PP) exhibited degradation rates of 3.78% and 2.39%, respectively, with biofilm formation observed on the plastic surfaces. SEM analysis revealed surface roughness, cracks, and depressions in test samples, confirming microbial interactions leading to structural modifications. Additionally, Chlorella vulgaris was screened for poly hydroxybutyrate (PHB) production using Sudan Black B staining, which indicated intracellular PHB accumulation. Fourier Transform Infrared (FTIR)spectroscopy further confirmed PHB biosynthesis through characteristic functional group analysis. The presence of ester and aliphatic bonds in the extracted sample verified the microbial production of biodegradable plastic. To enhance biomass harvesting efficiency, different flocculants (FeCl3, FeSO4, and NaOH) were tested FeCl3 exhibited the highest flocculation was, followed by NaOH (%), while FeSO4 poor performance (%). Biomass optimization studies at varying light intensities revealed that a light intensity of 7680 lux resulted in the highest biomass yield by day 8. Overall, the findings highlight the potential of Chlorella vulgaris in plastic biodegradation and sustainable. biopolymer production. Further research is recommended to optimize conditions for enhanced degradation efficiency and biopolymer.

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Comparative Analysis of Rainfall-Induced Landslide Disasters in the Western Ghats of India

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Abstract

Landslides during rainfall are amongst the most damaging natural disasters that affect the Western Ghats of Kerala. The risk is increasing due to steep slopes, highly weathered rocks, heavy monsonal rainfall, dense drainage networks and increasing anthropogenic exposure. The Pettimudi landslide in Idukki on 6 August 2020, and the Mundakkai-Chooralmala landslide in Wayanad on 30 July 2024 are two examples. The landslides here occurred in different geological settings and geomorphology, land use, failure mechanisms, and disaster characteristics. This article reviews these landslides in terms of their triggering rainfall, antecedent rainfall conditions, geology-geomorphology susceptibility, overall failure mechanisms, debris-flow runout, land use vulnerability, early warning systems challenges, and disaster response needs. The review draws upon published evidence from the investigations conducted by the Geological Survey of India, the reports provided by the Kerala State Disaster Management Authority and the India Meteorological Department, studies based on remote sensing data and peer-reviewed literature. A comparison reveals that rainfall intensity is not the only factor that triggers landslides. The landslides were eased by pre-existing rainfall, gradual saturation of soil, steep slopes, lithologically weathered overburden, discharge through structurally controlled aquifer horizons, and good channel connection. Pettimudi landslide was a shallow planar failure at the rock-overburden interface, which subsequently transformed into a channelized debris flow. The Mundakkai-Chooralmala landslide was a series of slope failures, followed by debris flow and flash flood, in a 6 km run-out path. These events show the limitations of rainfall-only warning systems and the necessity of terrain-rainfall-hydrological models for flash flood forecasting. Such systems should incorporate high-resolution DEMs, slope, lithology, drainage and lineament characteristics, rainfall intensity–duration thresholds, antecedent wetness, soil moisture or pore-water pressure, and dynamic exposure mapping to improve location-specific early warning, evacuation planning, and landslide risk reduction across the Western Ghats.

Keywords: Rainfall induced landslide; Western Ghats; Wayanad; Pettimudi; rainfall threshold; debris flow; landslide early warning; GIS; Geomorphology

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R-Enabled Multi-Layer Bioinformatics and Molecular Simulation–Guided Discovery of Therapeutic Phytochemicals Targeting Triple-Negative Breast Cancer

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Abstract

Triple-negative breast cancer (TNBC) is an aggressive and heterogeneous form of breast cancer without much scope for targeted therapies. This study aims to develop a combined computational approach to find and rank candidate phytochemical drugs targeting TNBC. Available transcriptomics and clinical data will be processed using the R programming language and the Bioconductor platform to find out differentially expressed genes, enriched pathways, prognostic biomarkers, and protein targets associated with TNBC. Network pharmacology will combine the disease targets with the targets predicted from natural compound databases to identify phytochemicals with multi-target effects. Selected promising natural compounds will further be investigated using molecular modeling, density functional theory, drug likeness, pharmacokinetics, toxicity, and ADMET studies. Molecular docking studies will be conducted to investigate their interactions with selected proteins associated with TNBC. Most promising protein-ligand complexes will further be simulated using molecular dynamics through GROMACS to investigate their structural stability, flexibility, intermolecular interactions, and binding properties. Binding free energies of the ligands will be calculated using MM/PBSA methods.

Keywords: Triple-negative breast cancer; Phytochemicals; Network pharmacology; Transcriptome analysis; Molecular dynamics simulation

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Climate Adaptability and Production Potential of Diverse Oyster Mushroom Species in Kerala

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Abstract

Oyster mushrooms (*Pleurotus* spp.) are among the most important cultivated edible mushrooms because of their nutritional, medicinal, economic and environmental benefits. Their ability to grow on a wide range of agricultural residues makes them particularly valuable for sustainable mushroom production. Kerala's humid tropical climate, characterized by high relative humidity, moderate-to-high temperatures, and abundant agricultural residues, provides favourable conditions for oyster mushroom (*Pleurotus* spp.) cultivation. However, the suitability of individual oyster mushroom species varies considerably with temperature, humidity, substrate availability, cropping season, yield potential, fruiting characteristics, and market preference. A study was conducted to evaluate the suitability of different *Pleurotus* sp in Kerala viz., . DMRP-115, 116, 136, 205 and 392. The spawn of each species was prepared and beds laid out in sterilised paddy straw substrate. The trial was laid out in RBD with 5 treatments and 5 replication. The time taken for spawn run of these strains ranged from 11-16 days with minimum days in DMRP- 205 and maximum in DMRP-392.The days for pin head formation ranged from 13-23 days with minimum in DMRP-205.The days for first harvest ranged from 16-24days. The yield obtained was higher DMRP-115 followed by 205 and 136. The strain DMRP- 115 gave a yields of 85.38kg/100kg substrate. The average fruiting body weight was higher in DMRP-116 followed by DMRP-115. The lowest fruiting body weihht was observed in DMRP-136. All the strains were suited but the best was DMRP-115 with ggod yield higher fruiting body weight and appealing colour of mushrooms.

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Emerging Challenges in Drug Therapy and Drug Delivery: Disease-Specific Limitations, Adverse Effects and Future Directions

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Abstract

Modern pharmacotherapy has transformed the management of infectious, cardiovascular, neurological, metabolic and malignant diseases. Nevertheless, therapeutic success is frequently limited by adverse drug reactions, poor solubility, low bioavailability, rapid metabolism, nonspecific distribution, biological barriers, drug resistance and inadequate patient adherence. Conventional drug administration often exposes healthy tissues to therapeutically active compounds and may require repeated dosing to maintain effective concentrations. These limitations are particularly important for anticancer agents, antimicrobials and drugs acting on protected organs such as the brain. This review summarizes representative drug classes used against major diseases, their principal therapeutic applications, important adverse effects and major drug-delivery limitations. It further discusses conventional and emerging delivery technologies, including liposomes, polymeric nanoparticles, lipid nanoparticles, dendrimers, nanotubes, hydrogels, stimuli-responsive systems and targeted delivery platforms. The review emphasizes that improved drug delivery should not be considered simply as a method for increasing drug concentration; rather, it should aim to control spatial and temporal drug exposure while reducing systemic toxicity. Future directions include precision medicine, biomarker-guided targeting, AI-assisted formulation design, stimuli-responsive nanocarriers, combination therapy, personalized dosing and integrated pharmacokinetic pharmacodynamic modeling. Translation of these technologies will require improved reproducibility, scalable manufacturing, long-term safety assessment, regulatory standardization and clinically meaningful validation.

Keywords: Drug delivery, Drug side effects, targeted therapy, precision medicine, nanoparticles, pharmacotherapy.

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Immuno Modulatory Effect of Chekurmanis (*Sauropusandrogynus*) Green Leafy Vegetables based Soup Cubes: *In - vivo* Evidences

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Abstract

Chekurmanis (*Sauropusandrogynus*) soup cube was developed using 25 % chekurmani powder and 25 % starch.Nutritional profile and bio active compounds present in the chekurmanis soup cube were analyzed. Immunomodulatory property of the chekurmanis soup cube was studied by in-vivo method. The concentration of IL-6, percentage of nitric oxide and super oxide dismutase inhibition and histopathology was studied.The developed chekurmanis soup cube had higher amount of ʙ Carotene (11.45 mg %), iron (3.6 mg %), calcium (142 mg %), vitamin C (312 mg %), total zinc (1.5 mg). Of the 120 bioactive compounds identified using by GC-MS analysis, piperine (20.53%), 5-Hydroxymethylfurfural (17.61%), 9, 12, 15-Octadecatrienoic acid, (Z, Z, Z)-(6.315%) are the principal bioactive compounds possessing therapeutic property in chekurumani leaf based soupcubes. From the In –vivo model results, it was found that immune suppressed rat models fed with chekurmanis soup cube had higher concentration of IL-6 level (94.76 pg/ml)which indicates the immunological response of the soup cube. Higher percentage of nitric oxide and super oxide dismutase inhibition was found in test animals fed with chekurumani soup cube. Macrophages in the spleen and marked lympho-proliferation of the immune suppressed rat models fed with chekurmanis soup cubes indicate the phagocytic response. The study report clearly shows the positive immune boosting activity of the chekurmanis (*Sarophusandrogynus*)soup cube. Hence from the study, it was suggested to utilize the chekurmanis in various functional food formulations for boosting up the immunity.

Keywords: Soup Cubes, Bioactive compounds, Nutritional characteristics, Gas chromatography Mass Spectroscopy, Immunomodulatory effect

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Formulation of Protein Enriched Avocado Spread as an Alternate to Mayonnaise

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Abstract

Avocados are a super food and highly valued for their healthy fats, fiber, Vitamin C, E and K rather than as a major sources of protein. A spread is a food that is generally spread on foods like bread in order to enhance the texture and flavor of the food. Mayonnaise, is a commonly used as spread and has long been a staple in many households and culinary creations and popular for its creamy texture and rich flavor. While mayonnaise provide some essential nutrients like vitamin E and omega-3 fatty acids from the oils used in its preparation, it is also high in saturated fats and good for heart when consume in moderation. Excessive consumption of mayonnaise can contribute to weight gain and increase the risk of heart disease. Therefore a protein enriched avocado spread was formulated as a substitute to mayonnaise by incorporating with chick pea protein isolate at different levels which is ranged from 5 to 25 per cent (T_2 to T_6) and compared with control (Avocado spread without chickpea protein isolate) (T_1). Protein enriched Avocado spread was found acceptable with high preference for its colour, spread ability and taste up to the 10 per cent (T_2- T_3) with increased protein content (1.65 to 9.26 g/100g). A significant difference was found at $P<0.001$ among the treatments. Protein enriched Avocado spread was revealed an increase in pH, CHO, Energy, ash and Protein content whereas decrease in Moisture, TSS, fiber, fat , Vitamin C and sensory scores, while increased protein isolate incorporation levels.

Keywords: Avocado, mayonnaise, Protein enriched avocado spread, chick pea protein isolate, nutritional and sensory quality

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Market Arrivals, Price Dynamics & Instability of Selected Vegetable Crops in Tamil Nadu

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Abstract

Tomato, onion and potato are economically important vegetable crops whose price instability directly affects farm income, consumer expenditure and agricultural market efficiency. This study examines the Spatio-temporal behaviour of market arrivals and wholesale prices of these major vegetable crops in selected markets of Tamil Nadu. Secondary data on market arrivals and modal wholesale prices for Coimbatore, Dindigul and Madurai markets were obtained from AGMARKNET for the period June 2024 to July 2026. Monthly averages were used to analyze trends and seasonal behaviour, while the Cuddy–Della Valle Index was employed to assess instability. Non-parametric Mann–Kendall trend analysis and Sen's slope estimation were also used to identify significant movements in arrivals and prices. The results indicate substantial commodity- and market-specific differences in market behaviour. Tomato recorded comparatively high price instability across the selected markets, with CDVI values ranging from 43.86 to 46.65 per cent. Significant declining trends were observed in Dindigul tomato arrivals, Coimbatore onion prices, and Coimbatore potato arrivals and prices. The findings highlight the need for commodity- and market-specific interventions, improved post-harvest infrastructure, strengthened market intelligence, collective marketing and better supply management to enhance price stability and resilience in vegetable value chains.

Keywords: Vegetable markets, market arrivals, price instability, seasonal variation, wholesale prices, Tamil Nadu.

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Development and Evaluation of Fruit-Stuffed Frozen dessert (Ice Cream) Using Selected Tropical Fruits and Natural Fruit Shells

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Abstract

The growing popularity of fruit-based frozen dessert (ice cream) reflects current consumer preferences for healthier and more natural frozen desserts. Consumers are increasingly attracted to products containing natural ingredients, "no added sugar" claims, high dietary fiber content, and antioxidant properties. The demand for plant-based, low-calorie, and minimally processed frozen desserts is also increasing, making fruit-based ice cream a promising product for both small-scale cottage industries and large-scale food manufacturers. Environmental sustainability is another emerging aspect of innovation in frozen desserts. Serving ice cream in natural fruit shells, such as hollowed-out orange or muskmelon rinds, provides a biodegradable and visually appealing alternative to conventional packaging, thereby reducing plastic waste and promoting eco-friendly practices. The use of locally available fruits and minimal processing may further contribute to reducing the environmental impact of the product. The present study focused on the development and evaluation of fruit stuffed fruit shelled ice cream using five tropical fruits: muskmelon, mosambi (sweet lime), orange, mango, and guava. To enhance the nutritional value, sensory appeal, and functional characteristics of conventional frozen dessert (ice cream) through the incorporation of natural fruit pulp/purees and the use of fruit shells as serving containers. A standard cream base was prepared and incorporated with the respective fruit pulp/puree. The prepared cream was filled into the hollowed fruit shells and frozen. The developed products were evaluated for proximate composition, acidity, overrun, and sensory acceptability. Among the formulations, mango and guava fruit-stuffed frozen desserts showed higher sensory acceptability, indicating their potential as healthy, flavorful, and visually appealing frozen dessert alternatives. The findings suggest that fruit-stuffed frozen dessert can provide opportunities for value addition to tropical fruits while supporting sustainable and innovative food product development.

Keywords: Fruit-stuffed frozen dessert, Tropical fruits, Natural fruit shells, Sustainable food product.

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Performance Evaluation of Improved Sweet Potato Cultivars for Enhanced Productivity and Profitability in Island Ecosystems

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Abstract

Sweet potato (*Ipomoea batatas* L.) is an important tuber food crop in the Andaman Islands because of its ability to thrive in tropical conditions, short growing season, high productivity, and nutritional value. There is significant potential to enhance local food production and promote high-yielding cultivars in response to the increasing demand for fresh tubers and value-added products. This is especially crucial in Island ecosystems, where productive and locally adapted crops must be grown because of the scarcity of arable land, heavy rainfall, and reliance on outside food sources. However, sweet potato productivity is often hindered by the prevalence of low-yielding local cultivars and the limited availability of improved varieties. Accordingly, the current study assessed the productivity and economic viability of improved high-yielding sweet potato cultivars within Island agro-ecosystems. Three cultivars, *viz*., T_1-local dull red-fleshed cultivar (farmer's practice), T_2-CARI SP-1, and T_3-CARI SP-2, were tested in farmers' fields using recommended production practices. The results revealed that marked discrepancies in productivity and profitability were noted among the cultivars. CARI SP-2 demonstrated exceptional performance, achieving the highest tuber yield of 19.0 t ha^{-1}, surpassing the farmer's practice by 123.5%. The local variety exhibited the minimal tuber yield (8.5 t ha^{-1}), generating a net profit of ₹44000 ha^{-1} and a benefit-cost ratio of 1.26. The excellent productivity and monetary benefits of CARI SP-2 prove its appropriateness and promise for farming in island ecosystems. Therefore, It found that CARI SP-2 has the potential to improve the productivity and profitability of sweet potato, as well as contribute to improved livelihoods and food and nutrition security in Island ecosystems.

Keywords: Cultivars, *Ipomoea batatas*, tuber productivity, profitability

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Sustainable Nutrition - Developing Plant-Based, Low-Fat Vegetable Chips via Clean-Label Food Innovations

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Abstract

Snacking has become an integral part of the modern diet, yet traditional commercial snacks are heavily criticized for their poor nutritional profiles. Conventional potato chips and savory snacks are typically prepared using deep-fat frying, which introduces high levels of saturated fats, trans fats, and empty calories. Frying process is one of the oldest cooking methods and most widely practiced in the world. Food frying technology can extend the shelf life of fruits and vegetables, while the frying oil is used to enhance the flavor of the products, but the use of improper frying oil can have harmful effects on human health. To address these public health concerns, there is a critical need to develop healthier alternatives that do not compromise on sensory appeal. The preparation of low-fat vegetable chips serves as an ideal solution. Low fat beetroot chips were standardized by baking and dehydration technologies. Their tray load, nutritional, sensory and microbial qualities of the products were evaluated. Beet roots were washed, peeled and made to thin slices. The slices were marinated with salt and pepper and baked with a tray load of 1.13 g/cm. Alternatively, dehydrated chips were dried in cabinet drier. The fat content of baked and dehydrated chips were found to be 0.4 and 0.32 g/100g respectively. The fiber content was 4.61 and 4.48 g/100g in the chips. The acrylamide content of the dehydrated beetroot chips were lesser than baked chips but both the chips had much less acrylamide content than the toxic limit. The baked chips had an higher average score of 8.2 for colour and appearance, 8.4 for taste, 8.4 for texture, 7.2 for flavor and 8.1 for overall acceptability which were higher than dehydrated chips

Keywords: Vegetable chips, baked, low fat, acrylamide

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Physiological Evaluation of Small Onion for Water Stress Condition

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Abstract

Small onion (Allium cepa var. aggregatum) is highly sensitive to water deficit because of its shallow root system and high moisture requirement throughout its growth period. Water stress adversely affects seedling establishment, plant growth, physiological and biochemical processes, bulb development and ultimately reduces marketable yield. Hence, identification of suitable management practices to alleviate the adverse effects of moisture stress is essential for sustaining onion productivity. Keeping these facts in view, the present investigation was carried out during 2025–2026 at the Crop Physiology Unit, Agricultural College and Research Institute, Madurai, to study the physiological response of small onion to foliar application of plant growth regulating chemicals under moisture stress conditions. Moisture stress was imposed at bulb initiation (25 – 50 DAT) and bulb development stage (50 – 75 DAT) by withholding irrigation, while normal irrigation served as the control. Six foliar treatments comprising control, brassinosteroids (1.0 ppm), TNAU Crop Shine (1.0%), potassium chloride (1.0%), proline (50 mM) and Micronutrient mixture with growth regulator (2.0%) were evaluated in a split-plot design with three replications by using CO 5 onion. Foliar sprays were imposed at 35 and 50 days after transplanting during water deficit to study their effectiveness in mitigating moisture stress. Growth parameters, physiological parameters, biochemical parameters and yield attributes were recorded using standard procedures. The results clearly indicated that moisture stress significantly reduced growth, physiological efficiency, biochemical activity and yield of small onion. Among the ameliorants (PGRS) tested, Micronutrient along with growth regulator proved to be the most effective in improving growth and physiological performance under moisture stress. Foliar application of micro nutrient mixture with growth regulator followed by brassinosteroid significantly enhanced growth, physiological and yield parameters. TNAU Crop Shine, Proline and 1% KCl produced moderate improvements over the untreated control by maintaining better plant water status. Overall, all foliar treatments reduced the detrimental effects of moisture stress to varying degrees compared with untreated stressed plants.

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Conversion of Waste Tyres into Sustainable Concrete for Environmental Protection

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Abstract

The increasing generation of waste tyres has become a major environmental concern due to their non-biodegradable nature, large volume, and difficulties associated with disposal. This study investigates the utilization of waste tyres as a partial replacement for conventional aggregates in concrete as an environmentally sustainable waste-management strategy. Waste tyre rubber is incorporated into concrete in different proportions to evaluate its influence on key properties such as workability, compressive strength, split tensile strength, flexural strength, density, and durability. The use of tyre rubber can reduce the consumption of natural aggregates while providing a beneficial application for an otherwise difficult-to-dispose waste material. Although increasing rubber content may reduce mechanical strength due to weak bonding between rubber particles and the cement matrix, suitable replacement levels can provide improved impact resistance, energy absorption, and reduced density. The study aims to identify an optimum replacement percentage that provides a balance between structural performance and environmental benefits. The proposed approach promotes circular economy principles by converting waste tyres into a useful construction material and reducing landfill disposal, resource depletion, and associated environmental impacts. The findings are expected to demonstrate the potential of waste tyre concrete as a sustainable alternative for selected construction applications.

Keywords: Waste tyres, waste tyre rubber, concrete, sustainable construction, environmental protection, recycled aggregate, circular economy.

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Design and Fabrication of a Battery-Operated Winnower for Small-Scale Grain Cleaning

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Abstract

Winnowing is an important post-harvest operation for separating grain from chaff and other lightweight impurities. Conventional winnowing methods largely depend on natural wind and manual labour, making the process time-consuming, physically demanding, and dependent on prevailing environmental conditions. To address these limitations, a portable battery-operated winnower was designed and fabricated for small-scale agricultural applications. The developed machine employs a rechargeable battery-powered DC motor to generate a controlled airflow for separating grain from lighter impurities. The system consists of a feed hopper, DC motor, blower/fan assembly, rechargeable battery, sieving tray, collection tray, PVC airflow duct, electrical control arrangement, and supporting frame. The design emphasizes portability, simple operation, ease of maintenance, and reduced dependence on grid electricity and fuel-based power sources. The fabricated unit was subjected to functional field testing to assess its operation, grain separation behaviour, portability, and suitability for agricultural use. The battery-powered arrangement provided a controlled airflow and enabled winnowing without dependence on natural wind. The developed system offers a practical approach for reducing manual effort and improving the convenience of grain-cleaning operations, particularly for small and marginal farmers and in areas with limited electricity availability. The provision for battery charging through renewable energy sources further enhances the sustainability potential of the system. The developed prototype demonstrates the feasibility of battery-powered winnowing as a simple and portable post-harvest technology; however, further replicated experiments under different crops, feed rates, moisture conditions, and airflow settings are required for comprehensive performance evaluation.

Keywords: Battery-operated winnower; grain cleaning; winnowing; DC motor; rechargeable battery; post-harvest technology; small-scale farming.

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Scope and Constraints in Floral Fragrance Industry

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Abstract

The transformation of aromatic flowers into perfumes, essential oils, absolutes, attars, and other fragrance components is a growing sector within India's commercial flower industry. In commercial fragrance extraction, the most significant flower crops are not always those with the highest oil yield. Crucial considerations include fragrance quality, market demand, flower availability, extraction yield, perishability, and the price of the final product. Prominent flower crops for commercial extraction include Jasmine (*Jasminum sambac, J. grandiflorum*), Rose (*Rosa damascena, R. centifolia*), Tuberose (*Polianthes tuberosa*), Champaca (*Magnolia champaca*), Frangipani/Plumeria (*Plumeria spp.*), and Lotus (*Nelumbo nucifera*). Nationally, floral concrete is regarded as a specialized segment within the larger natural ingredients, essential oils, flavors, and fragrances industry. In Tamil Nadu, the Madurai region boasts a robust ecosystem centered around Jasminum sambac (Madurai Malli), which encompasses flower cultivation, wholesale markets, extraction facilities, and fragrance enterprises. Kannauj in Uttar Pradesh is another significant hub for fragrances in India, especially renowned for attar and natural scent products. Manufacturers in this region create floral absolutes, essential oils and attars. The method of extracting commercial flower fragrances is largely influenced by the type of flower used. For fragile flowers, such as jasmine, tuberose, and certain roses, solvent extraction is the primary industrial method. A hydrocarbon solvent suitable for food and pharmaceuticals, such as 'hexane,' is commonly employed for these delicate flowers. This solvent dissolves aromatic compounds, waxes, and other non-volatile substances.

Despite its potential, the floral fragrance industry faces several structural challenges. The most significant issue for jasmine concrete producers is the high volatility of flower prices. Additionally, the recovery rate is very low because flowers contain only a minimal amount of extractable aromatic material. Flower availability is seasonal and is influenced by factors such as rainfall, temperature, frost, pests, labour availability, festival demand, and export demand. In the realm of solvent and environmental management, conventional solvent extraction relies on hydrocarbons, such as hexane. Consequently, facilities must ensure proper solvent recovery, fire safety measures, emission regulations, and adherence to pollution control standards. For quality consistency, international fragrance companies demand uniformity in the scent profile, colour, wax content, solvent residue, GC-MS profile, pesticide residues, and traceability. These requirements pose a considerable challenge to very small producers attempting to enter the market.

Keywords: Flowers, Fragrance, Concrete, absolute, Organic solvent, Hexane

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Compounding Forest Disturbances and Livelihood Insecurity: Mapping Wildfire Regimes, bio-invasions, and Socio-ecological Vulnerability in Jharkhand, India

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Abstract

This study evaluates the coupled socio-ecological impacts of recurrent forest fire hazards, *Lantana camara* bio-invasions, and canopy degradation across the 24 districts of Jharkhand, India. Adopting the IPCC Vulnerability Framework integrated with Socio-Ecological Systems (SES) theory, we construct a Composite Socio-Ecological Vulnerability Index (CSVI) by synthesizing multi-decadal secondary datasets (2001–2023) across Exposure (E), Sensitivity (S), and Adaptive Capacity (AC) sub-indices. Spatial and econometric analyses—including Bivariate Moran's I, Ordinary Least Squares (OLS) regression, and Mann-Kendall trend testing—reveal a significant spatial convergence between fire frequency, Lantana proliferation, and the transition of Moderately Dense Forests (MDF) to Open Forests (OF). Over 29% of the state's forests are fire- prone, while *Lantana* covers ~13% of the geographical area, creating a positive feedback loop that elevates fuel loads and suppresses native flora regeneration. OLS modeling demonstrates that *Lantana* coverage ($\beta = -0.392$, $p = 0.001$) and fire density ($\beta = -0.285$, $p = 0.005$) significantly suppress Non-Timber Forest Produce (NTFP) yields, forcing forest-dependent households—particularly indigenous Scheduled Tribe communities—to travel longer distances for fuelwood. Districts in the Western Plateau (Garhwa, Palamu, Chatra, Latehar) exhibit extreme vulnerability ($CSVI > 0.75$) due to high biophysical disturbance combined with low adaptive capacity and high multidimensional poverty. The study highlights the need to shift regional forest governance from conventional timber protection toward community-based bioeconomic frameworks, such as utilizing *Lantana* biomass for local enterprises and integrating forest restoration with MGNREGA programs.

Keywords: Socio-ecological vulnerability, *Lantana camara*, forest fire hazards, NTFP extraction, Jharkhand.

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Enhancing the Market Potential of Low Curcumin Turmeric by Developing Nutraceutical Foods

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Abstract

Golden milk or latte is a niche product in the global beverage industry. It is a processed form of the traditional turmeric milk. This golden milk / turmeric latte was standardized using three different milk as dairy milk, soymilk and millet milk, a variant from the commercial latte. Milk was procured and to it sugar was dissolved completely. Turmeric powder was added to the fresh cream, made into a paste. This paste was slowly added to the milk and mixed thoroughly well. The entire mass was heated till the temperature attained 72^0 c. It was hot filled in glass bottles, crown corked and autoclaved. The bottles were then cooled and stored under refrigerated conditions. The developed golden milk was rich in nutraceuticals, yet the sensory quality remained highly acceptable. The most suited milk for golden latte was dairy and soy milk. The product had retention of nutrients and curcumin. The product had a shelf life of 30 days under refrigerated conditions. This technology proved that Wasted turmeric can be converted as a nutraceutical ingredient for the development of niche beverages such as Golden milk/ latte.

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Insect Control Services by Insectivorous bats Hipposiderous speoris and Rhinopoma hardwickii in Western Tamil Nadu

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Abstract

Agriculture is the India's largest economic sector where 45% of India's total workforce get accumulated. However, a significant barrier to these agricultural systems' sustainability and productivity is insect pests. Insect pests reduce the economic output of agriculture, on the other hand application of pesticides for controlling them deteriorate the surrounding environment. One common alternative management strategy is to keep generalized predators in order to biologically control insect pests. It is well known that bats are very successful at controlling insect pests. In this study we collected and analyzed guano from Schneider's leaf-nosed bat, *Hipposideros speoris* and Lesser mouse tailed bat, *Rhinopoma hardwickii*, roosting near agricultural field of Salem and Dharmapuri district in Western Tamil Nadu. The bat consumed insects are not getting fully digest due to the presence of chitin and so from the remnants present in the bat guano, the insect order was recorded. The remnants present in the bat guano include scales, wings, legs, antennae, tarsus, and elytra. We recorded 1784 insect body remnants from eight different orders of arthropods from four different agricultural sites. The most common prey order was Lepidoptera (30 %) followed by Coleoptera (25%), Diptera (20%), Hemiptera (10%), and Homoptera (5%) and other unidentified insects (10%). These consumption of insect prey vary between seasons and the agricultural site using the mixed-effects regression model. Our findings showed that bats are doing enormous role for controlling insect outbreak and economic loss to farmers. This study also emphasizes that protection or conservation of bats helps ecosystem services of bats which supports integrated pest management (IPM). Presently due to recent advances in the molecular biology, we could easily identify the agricultural insect pests through DNA barcoding and we are going to apply this method in our upcoming research.

Keywords: Insect pest; insectivorous bats; ecosystem services; insect pest control

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Spectral Regulation of Photomorphogenesis and Physiological Performance in J. sambac cultivar CO.1 under Shade Net Conditions

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Abstract

An experiment was conducted to evaluate the influence of different spectral light qualities on the growth and physiological responses of *Jasminum sambac* CO.1 under a shade-net environment at the Department of Floriculture and Landscape Architecture, Tamil Nadu Agricultural University, Coimbatore, during July–August 2025. The experiment was laid out in a completely randomized design with six light treatments and three replications. Plants received natural sunlight supplemented with four hours of end-of-day LED lighting comprising 100% white light (control), 100% red, 75% blue + 25% far-red, 80% red + 20% far-red, 60% red + 20% blue + 20% far-red, and 80% red + 20% blue light. Spectral treatments significantly influenced plant architecture, leaf characteristics and physiological attributes. The 75% blue + 25% far-red treatment recorded the maximum plant height (72.07 cm), number of shoots (17.33), internodal length (5.80 cm), single leaf area (28.13 cm^2), specific leaf area (168.49 $cm^2\ g^{-1}$) and specific leaf weight (0.0167 g cm^{-2}), indicating a strong influence of blue–far-red combinations on vegetative development. In contrast, 100% red light produced total chlorophyll content (1102.08 mg g-1) and carotenoid content (300.57 µg g^{-1} FW), while 80% red + 20% far-red recorded the highest chlorophyll fluorescence (Fv/Fm = 0.824). The findings demonstrate that spectral composition distinctly regulates morphological and photosynthetic attributes of *J. sambac* CO.1, with blue + far-red promoting vegetative expansion and red-rich spectra enhancing pigment accumulation and photosynthetic efficiency. Thus, spectral manipulation through supplemental LED lighting offers a promising approach for precision management of jasmine growth under protected environments.

Keywords: *Jasminum sambac*, LED lighting, Light spectrum, Photomorphogenesis, Shade-net

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Carbon-Smart Rootstocks: An Emerging Strategy for Carbon Sequestration in Climate-Resilient Horticulture

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Abstract

Carbon emissions, a serious concern, poses a significant threat to global warming. Carbon-smart rootstock breeding is a promising modern-day strategy to mitigate climate change using carbon sequestration. The root system influences the root biomass, depth, and is responsible for interaction between soil microorganisms; thus, deep and extensive roots with a large root biomass, enhances carbon incorporation in the soil. Release of higher exudations such as amino acids, organic acids and sugars lead to an increase in soil carbon stabilization. Efficient mycorrhizal associations not only lead to improved phosphorous uptake and root growth but also the formation of glomalin. This glycoprotein helps stabilize soil particles into aggregates trapping carbon and providing protection from degradation. Another promising avenue is to increase the levels of suberin - a complex, waxy hydrophobic biopolymer layer found in the cell walls that acts as a barrier against decomposition by soil microbes. The potential of carbon sequestration in apple rootstocks is being explored and similar breeding strategies can be extended to the rootstocks of citrus, mango, guava, avocado and other common horticultural fruits. Thus, carbon-smart rootstocks are a transformative strategy for carbon neutrality and sustainable horticulture.

Keywords: Carbon sequestration, Suberin, Mycorrhizal association, Carbon-smart rootstock, Apple rootstock

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Rhizosphere Actinobacterial Topical Creams and Moisturizing Gels to Combat Multidrug Resistant Pathogens

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Abstract

Current challenges in anti-infective therapy include resistance to antimicrobial drug candidates, host immune reactions and drug induced toxic effects. In our study, we explore rhizosphere actinobacterial metabolites for antibacterial and antifungal properties. We screened multidrug resistance in bacterial pathogens such as *Klebsiella pneumoniae, Salmonella typhi, Streptococcus pyogenes, Streptococcus agalactiae*, and in fungal pathogens such as *Candida albicans* ATCC10231 Ca(L) and *Candida parapsilosis* Ca(O) and subjected all MDR cultures for antibiotic sensitivity towards metabolites from rhizosphere actinobacteria. Pathogenic bacteria were resistant to Chloramphenicol, Vancomycin, Tetracycline, Streptomycin, Ampicillin etc. *Candida albicans* Ca(L) and *Candida parapsilosis* Ca(O) were resistant to Itraconazole, Fluconazole and Clotrimazole. In our expedition with ethyl acetate extracts, results were remarkable with antibacterial and anticandidal effects in the extracted metabolites of actinobacteria. Hence, the potential extracts were prepared into antibacterial creams, ointments and gel based formulates for topical applications. All the preparations were screened for antibacterial and anticandidal activity. We obtained interesting results in all the fortified anti-infective formulations. Hence, in this paper, we explore the importance of actinobacterial metabolites as antibacterial and anticandidal to resist MDR superbugs and bring promising alternatives for the future anti-infective research.

Keywords: Multidrug Resistance; Anticandidal drugs; Antibacterial drugs; Rhizosphere actinobacteria; Metabolites

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Extensive Growth and Development in the Field of Animal Science through Animal Welfare in India

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Abstract

The field of animal science in India is unlimited, because there is a huge number of different types of animals, birds and wildlife here. It is not only impossible but also very difficult to provide better treatment to all types of animals, birds and wildlife in India. There are many veterinary colleges and veterinary universities in India, all these institutions have to make separate arrangements for special study and training for the best treatment of all types of animals, birds and wildlife. So that all types of animals, birds and wildlife in the country can be treated easily and conveniently. All these veterinary colleges and veterinary universities should conduct separate special courses of study and training in coordination with the Animal Welfare Board of India (AWBI), So that cruelty to all types of animals, birds and wildlife can be reduced to a great extent and the field of animal welfare and wildlife conservation can also increase extensively. Bachelor / Master Degree in Veterinary Science and Animal Husbandry (B.V.Sc. / M.V.Sc.) are conducted in most of the veterinary colleges and veterinary universities in India. It is very important to especially include the area of animal welfare in such courses, so that various types of animals, birds and wildlife can be freed from all cruelty. Animal science not only means providing better animal health and disease prevention to all types of animals, birds and wildlife, but it is also necessary to provide better animal welfare by freeing them from all types of cruelty. So that all types of animals, birds and wildlife actually feel that animal welfare is being done by ending cruelty to them. PFA Institute of Research Uttar Pradesh are an animal welfare organization related to the Animal Welfare Board of India (AWBI), has also established a special veterinary hospital in Prayagraj district to successfully treat various types of animals, birds and wildlife. In future, PFA Institute will also provide excellent free health facilities to all types of animals, birds and wildlife. By incorporating animal welfare into animal science, the path of comprehensive growth and development in the field of animal science can be adopted by controlling all cruelty on all types of animals, birds and wildlife.

Keywords: Animal Welfare, Animal Science, Animal Cruelty, Veterinary Hospital, Wildlife Protection.

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Piriformospora indica-Mediated Defense Responses Against Anthracnose of Yard Long Bean

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Abstract

Anthracnose, caused by *Colletotrichum gloeosporioides* (Penz.) Sacc., is a major disease affecting yard long bean (*Vigna unguiculata* subsp. *sesquipedalis*), resulting in severe yield losses. The present study evaluated the potential of the beneficial root endophyte *Piriformospora indica* in suppressing anthracnose and enhancing plant growth. Field surveys conducted in Kottarakkara, Kerala, recorded a maximum disease incidence and severity of 83.0% and 73.5%, respectively. Successful root colonization by *P. indica* significantly reduced disease severity to 19.40% under in vitro conditions, 21.34% under pot culture, and 29.34% (rabi) and 22.34% (summer) under field conditions. In addition to disease suppression, *P. indica* improved plant growth and yield even under pathogen stress. Enhanced tolerance was associated with increased activities of defense-related enzymes, including chitinase, β-1,3-glucanase, peroxidase, polyphenol oxidase, phenylalanine ammonia-lyase, and total phenolics, along with reduced accumulation of superoxide radicals and hydrogen peroxide. The findings demonstrate that *P. indica* effectively enhances anthracnose tolerance through activation of host defense mechanisms while promoting plant growth and productivity, highlighting its potential as a sustainable biocontrol agent for integrated disease management in yard long bean.

Keywords: *P. indica*, Anthracnose, *C. gloeosporioides*, Yard long bean, Defense enzymes

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Microbial Dynamics During Passive and Static Composting of Caged Layer Manure with Biochar and Coconut Coir Pith Waste

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Abstract

The increasing production of poultry manure has created significant environmental and public health concerns, highlighting the need for sustainable waste management strategies. This study evaluated the influence of passive and static composting methods on the microbial profile of compost prepared from caged layer manure (CLM) amended with biochar and coconut coir pith waste (CCP). The experiment was conducted at the Livestock Farm Complex, Veterinary College and Research Institute, Namakkal, Tamil Nadu, during the summer and monsoon seasons. Compost mixtures were formulated by maintaining a carbon-to-nitrogen (C) ratio of 20:1 and a moisture content of 50–60%. Nine treatment combinations comprising different proportions of biochar and CCP under passive aeration (T-shaped and V-shaped) and static composting systems were evaluated. Samples were collected at the beginning and end of the composting process to determine total bacterial count (TBC) and total coliform count (TCC) using standard microbiological techniques. Significant reductions ($P \leq 0.05$) in both TBC and TCC were observed across all treatments following composting. The initial TBC of approximately 9.75 - 10.19 $\log_{10}$ CFU g^{-1} declined to 6.50 - 7.06 $\log_{10}$ CFU g^{-1}, while TCC decreased from 6.76 - 7.05 $\log_{10}$ CFU g^{-1} to 4.46 - 4.98 $\log_{10}$ CFU g^{-1}. Composts amended with biochar and CCP exhibited greater reductions in microbial populations than CLM alone, irrespective of season, indicating improved compost sanitation and stability. Seasonal variation had minimal influence on microbial reduction. The findings demonstrate that integrating biochar and coconut coir pith waste with caged layer manure under passive or static composting effectively reduces microbial loads and enhances compost quality. This approach offers an environmentally sustainable solution for poultry manure management by producing a safer, stabilized organic fertilizer while minimizing potential environmental and public health risks associated with untreated poultry waste.

Keywords: Caged layer manure, Biochar, Coconut coir pith waste, Composting, Microbial reduction

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Productivity and Economics of Pulse Intercropping in Drip-Irrigated Cotton

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Abstract

A field experiment was conducted at the Agricultural College and Research Institute, Madurai, during February–July 2025 to evaluate the productivity and profitability of cotton (VPT 2) based intercropping systems under the Drip Irrigated Paired Row Planting System (DIPRPS). The experiment was laid out in a Randomized Block Design with three replications. The treatments included sole cotton (T_1) and cotton intercropped with black gram, green gram and cowpea in 1:1 and 1:2 row proportions. The results showed that all intercropping treatments significantly increased seed cotton equivalent yield compared with sole cotton, indicating the positive influence of intercropping under DIPRPS. Among the 1:1 row ratio treatments, cotton intercropped with one row of black gram produced the highest seed cotton yield (2,201 kg ha^{-1}), which was statistically comparable with cotton intercropped with two rows of black gram (2,196 kg ha^{-1}). When the productivity of both component crops was expressed as seed cotton equivalent yield (SCEY), the 1:2 intercropping system performed better than the 1:1 system. Cotton intercropped with two rows of green gram recorded the highest SCEY (2,977 kg ha^{-1}), followed by two rows of black gram (2,910 kg ha^{-1}) and cowpea (2,869 kg ha^{-1}). These treatments were statistically similar to each other but significantly superior to the remaining treatments, including sole cotton. Economic evaluation further confirmed the superiority of the 1:2 intercropping systems. Cotton intercropped with two rows of green gram recorded the highest gross income (₹.1,78,620 ha^{-1}), net income (₹. 90,940 ha^{-1}) and benefit–cost ratio (2.02), followed by cotton intercropped with two rows of black gram. The findings suggest that integrating two rows of green gram or black gram with cotton under the Drip Irrigated Paired Row Planting System is an efficient and profitable production strategy. This intercropping approach enhances overall productivity and economic returns while providing a viable alternative to sole cotton cultivation.

Keywords: Cotton, Intercropping, Drip irrigation, Black gram, Green gram, Yield, Economics

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Evaluation of *Ailanthus excelsa* and *Prosopis cineraria* based Climate Resilient Boundary Plantation Agroforestry Systems in Arid Western Rajasthan

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Abstract

Boundary plantation-based agroforestry can enhance biomass production and carbon sequestration while sustaining crop productivity in arid regions. A field experiment was conducted at Bikaner, Rajasthan, to evaluate boundary plantations of *Prosopis cineraria, Ailanthus excelsa* and mixed plantation of *A. excelsa* + *P. cineraria* established around clusterbean crop fields (84m × 96m). Trees were planted at 6 m distance under drip irrigation system. Four years after planting, *A. excelsa* in the sole plantation recorded significantly higher height of 3.99 m and basal diameter of 156.8 mm which was on par with *A. excelsa* in the mixed plantation (3.69 m and 129.3 mm, respectively). The sole *A. excelsa* plantation also produced the highest wood volume (0.018 m^3 $tree^{-1}$), fresh leaf fodder (9.5 kg $tree^{-1}$), fuelwood (10.2 kg $tree^{-1}$) and total wood biomass (2.17 t ha^{-1}), including 1.72 t ha^{-1} of aboveground biomass. Maximum total carbon stock of 0.97 t ha-1 and total carbon sequestration of 3.57 t ha-1 was also recorded by *A. excelsa* alone plantation. In the mixed plantation, *P. cineraria* produced edible green pods ranged between 50 g to 1.5 kg $tree^{-1}$, providing an additional livelihood benefit. Different boundary plantations had no significant effect on clusterbean seed yield or soil properties throughout the study, indicating compatibility with annual crop. The study indicated that *A. excelsa*-based boundary plantations, alone or integrated with *P. cineraria*, can provide a productive and climate-resilient agroforestry option for the arid regions of western Rajasthan by sequestering carbon in wood, providing multiple tree products and sustaining agricultural productivity.

Keywords: Arid region; boundary plantation; agroforestry systems; clusterbean; Ailanthus.

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Ancient to Recent Innovations in Artificial Intelligence Technology in Agriculture Microbiolgy

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Abstract

Recent innovations in artificial intelligence (AI) are transforming agricultural microbiology by enabling predictive soil health modeling, intelligent design of microbial consortia, and precision crop management. Between 2025–2026, AI-driven approaches have advanced microbiome analysis, biocontrol strategies, and sustainable farming applications. AI assists in designing root-associated microbial consortia tailored to specific crops. Uses computational simulations to predict microbial interactions, stability, and plant growth outcomes. Neural networks analyze genomics, transcriptomics, proteomics, metabolomics simultaneously. AI links microbiome data with IoT sensors, drones, and satellite imaging. Real-time soil microbial monitoring guides fertilizer use and irrigation. AI-driven microbiome tools are being piloted in rice–wheat systems of the Indo-Gangetic plains. Innovative techniques in agricultural microbiology now combine advanced molecular tools, smart microbiome engineering, and AI-driven analytics to improve soil fertility, crop resilience, and sustainable farming. These approaches go beyond traditional biofertilizers and biopesticides, enabling precision agriculture and climate-resilient practices. Agricultural microbiology has moved from culture-based methods to cutting-edge innovations like metagenomics, smart microbiomes, biosensors, and AI-driven predictive tools. These techniques promise sustainable, climate-resilient farming—especially crucial for India's food security.AI in agricultural microbiology has evolved from simple rule-based soil fertility models to advanced deep learning systems that design microbial consortia, predict soil health, and enable precision biocontrol. The journey reflects a shift from descriptive to predictive and now prescriptive AI, with India poised to benefit significantly.•Biofertilizer adoption is growing in pulses and horticulture to reduce urea dependency Biopesticides are increasingly used in organic farming to meet demand for chemical-free produce. Engineered strains that improve soil carbon storage and mitigate greenhouse gas emissions. Algorithms like support vector machines (SVMs) and random forests applied to soil microbiome datasets Enabled pattern recognition in microbial diversity and crop yield correlations. Introduction of statistical modeling and GIS-based soil mapping. Microbial ecology began integrating computational models for nutrient cycling. Farmers received decision support systems (DSS) for fertilizer and irrigation scheduling. Microbiology applications were limited to nutrient management models (e.g., nitrogen fixation predictions. Explosion of next-generation sequencing (NGS) produced massive microbiome datasets.

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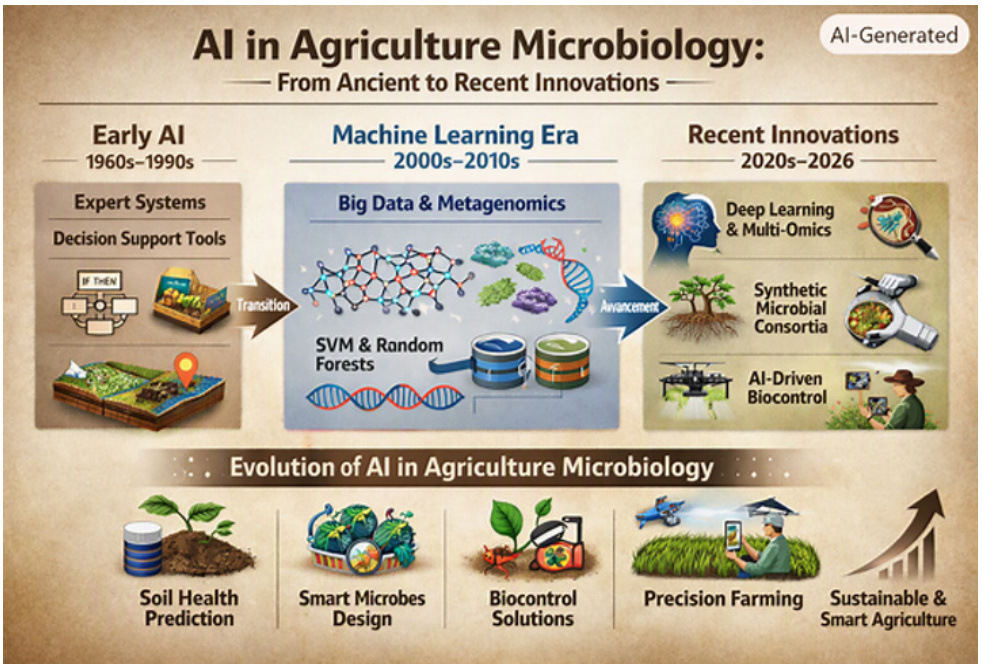
GRAPHICAL ABSTRACT



Keywords: GIS Based Soil Mapping, NGS, SVMS, Genomics, DSS, Biopesticide

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Spatial Mapping and Evaluation of Fluoride Contamination in the Agro-Ecosystem of Coimbatore District, Tamil Nadu

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Abstract

Excessive fluoride in groundwater is a widespread geogenic contamination problem across India, with prolonged intake causing dental and skeletal fluorosis. This study assessed fluoride hotspots and their transfer through the agro-ecosystem in Coimbatore District, Tamil Nadu. Groundwater, soil, and crop samples were collected from 25 villages across 12 blocks using a GIS-based grid sampling method over three consecutive years (2022–2025) and analyzed using an ion-selective electrode. Groundwater fluoride concentrations ranged from 0.31–2.59 mg/L, exceeding the BIS permissible limit (1.0 mg/L) at more than half of the sampled locations, with Pollachi South block (Thondamuthur) consistently recording the highest levels (up to 2.59 mg/L). A comparison with historical data (1970–2020) revealed a rising fluoride trend across most blocks. Available soil fluoride ranged from 0.48–1.73 ppm and correlated with groundwater levels and use of phosphatic fertilizers, while crop fluoride content ranged from 0.25–1.53 ppm, with fodder grass and leafy vegetables (amaranthus, curry leaf) showing the highest uptake, and fluoride accumulating preferentially in roots over shoots. The results indicate soil-to-plant fluoride movement consistent with bioaccumulation rather than biomagnification. High fluoride levels were associated with adverse effects on germination, chlorophyll content, and plant growth, underscoring implications for both crop productivity and food safety. The study provides a fluoride distribution map for Coimbatore District useful for targeting defluoridation interventions and offers evidence-based guidance for farmers on fertilizer and irrigation water management in fluoride-affected zones.

Keywords: Fluoride contamination; Groundwater quality; Food chain transport; Bioaccumulation; Coimbatore District

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Integrating Microbiome and Host Transcriptome Data in Colorectal Cancer Using Bioconductor: Analytical Strategies and Biomarker Opportunities

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Abstract

Colorectal cancer is a complex disease, which exhibits molecular heterogeneity and involves complex interactions among tumour cells, host immunity and the intestinal microbiome. Microbial dysbiosis, and host transcriptomic modifications, are both known to be associated with disease initiation, progression, metastasis and therapeutic response, but there is a lack of methodological approaches to integrate the analysis of both. In this review, we will explore how the use of Bioconductor tools can be used to combine both the microbiome and host (transcriptome) data into useful and robust biomarkers of colorectal cancer with a particular focus on the biology of the tumour–microbe interaction. Pre-processing the sequence data, estimating taxonomic abundance, RNA sequencing data normalization, differential abundance/expression analyses, batch-correction, functional annotation, pathway enrichment and network construction, and integration of multi-omics are some of the crucial steps in the analysis. The appropriate Bioconductor packages (including phyloseq, microbiome, mia, DESeq2, edgeR, limma, TCGAbiolinks, MultiAssayExperiment, MOFA2, mixOmics and clusterProfiler) are introduced and their use, advantages and disadvantages discussed. Analytical strategies to link microbes and their functional pathways with host immune signalling, disruption of epithelial barrier function, inflammation, metabolic reprogramming, microsatellite instability and treatment resistance are the focus of the review. Focus is on the prediction of prognosis and therapy response by specific focus on Fusobacterium nucleatum, enterotoxigenic Bacteroides fragilis, Escherichia coli, microbial metabolites and transcriptomic signatures. Machine Learning, Correlation Networks, Latent-factor Models and Supervised Multi-block integration may help to improve patient stratification, and assist in the design of diagnostic, prognostic and predictive biomarkers. Some of the most important challenges are compositionality, zero inflation, dietary and geographical confounding, platform heterogeneity, small sample sizes, non-uniformity of the metadata and lack of external validation. Key features that will have to be addressed in the future include standardized workflows, longitudinally followed cohorts, spatially resolved profiling, single-cell transcriptomics and metabolomics and prospective clinical validation. Model interpretability, transferability and relevance could be further improved in different global CRC patient groups in a clinical setting, by adding clinical characteristics, tumour stage and molecular subtype, as well as exposure to treatments. Reproducibility, FAIR principles of data sharing and clear reporting will be key towards translation to the clinic.

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Overall, Bioconductor offers a reproducible framework for decoding host–microbiome interactions and advancing precision colorectal oncology, thereby supporting Sustainable Development Goal 3: Good Health and Well-Being.

Keywords: Colorectal cancer; Gut microbiome; Host transcriptome; Bioconductor; Multi-omics integration; Biomarker discovery

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Effect of Moisture Stress at Different Phenological Stages on Soybean Yield

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Abstract

A field experiment was conducted during the Kharif season of 2022–23 at the Department of Agricultural Meteorology, AICRP on Agrometeorology, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, to identify the critical phenological stages of soybean (Glycine max L.) susceptible to moisture stress. The experiment was laid out in a Randomized Block Design with eight moisture-stress treatments and three replications. The treatments included rainfed control and imposed moisture stress during vegetative, flowering, pod formation, pod development, and their combinations. Moisture stress significantly affected crop growth, yield attributes, yield, soil moisture, soil temperature, NDVI and thermal-time indices. The rainfed control (T1) recorded the highest seed yield (2119.4 kg ha^{-1}), whereas stress during flowering (T3) resulted in the lowest pod number, seed yield $plant^{-1}$ and seed yield, with reductions of 64.3, 49.3 and 63.5 per cent, respectively, compared with T1. Flowering and pod formation were identified as the most critical stages for soybean, as moisture stress during these stages markedly reduced growth and yield. Stress treatments also exhibited lower soil moisture and higher soil temperature. The highest GDD, HTU and PTU were recorded under T1, while combined stress treatments showed the lowest thermal-time accumulation.

Keywords: Moisture stress, phenological stages, soybean, critical stage, yield, NDVI, thermal indices

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Agricultural Drought Monitoring and Assessment in Beed District, Maharashtra using Geospatial Technology

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Abstract

Agricultural drought is a recurring hydro-meteorological hazard in Maharashtra, severely impacting crop productivity, farm livelihoods, and regional water security, particularly across the arid and semi-arid tracts of Marathwada. Traditional drought monitoring methods based solely on point-source meteorological data often lack the spatial granularity required for localized, village-level decision-support.

This study demonstrates a robust multi-criteria geospatial framework integrating multi-temporal, multi-sensor satellite imagery, gridded hydro-meteorological variables, and digital soil datasets to systematically monitor and assess agricultural drought dynamics across Maharashtra. Using optical, thermal, and microwave datasets—including Sentinel-2, Resourcesat (LISS-III/IV) and MODIS—key dynamic vegetation and moisture indicators were derived, such as the Normalized Difference Vegetation Index (NDVI), Vegetation Condition Index (VCI), Temperature Condition Index (TCI), and Normalized Difference Water Index (NDWI). These indices were coupled with rainfall anomaly metrics and soil moisture parameters within a GIS-based Overlay Model to generate standardized seasonal drought severity classes (*Slight, Moderate, Severe*, and *Extreme*).

The spatial analysis effectively captured historical drought progression, peak stress windows during key crop phenological stages (*Kharif*), and spatial heterogeneity across varied agro-ecological zones. Validation against historical crop yield statistics and ground-truth field data demonstrated high model accuracy in identifying localized agricultural vulnerability. The results emphasize the critical role of integrating high-resolution remote sensing indices with soil-climatic drivers to transition from reactive drought relief to proactive risk mitigation. This framework offers a scalable, transparent decision-support tool for state line departments, disaster management authorities, and insurance entities.

Keywords: Agricultural Drought; NDVI; Vegetation Condition Index; Temperature Condition Index; Soil Moisture; Drought Severity Index.

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Collection and Selection of Potential Mushroom Species Suitable for Commercial Utilization

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Abstract

Edible mushroom species play a major role in supplementing the nutritional intake profile of our country. The nutritive profile of different types of mushrooms includes: 40-50% carbohydrate, 1-2% lipids, 25-30% proteins, 5-10% fibre. In addition to these, mushrooms are also a major source of essential vitamins and minerals. Tamil Nadu produces different types of edible mushroom species, including Oyster mushroom, milky mushroom, and button mushroom, with yields of 2700, 800 and 7500 tonnes/year, respectively. Considering the importance of mushroom cultivation in the state, we aimed to identify potential mushroom species from the different locations of Tamil Nadu suitable for commercial cultivation. We identified a total of 5 sporophores with a possibility of being edible. Evaluation of nutritional status, variations in colony colour, texture and growth pattern led to the identification of two strains of milky mushroom, TNAU (CI) MDU-2025 (1) (Identified from the base of coconut trees at the Melur region of Madurai) and TNAU (CI) MDU-2025 (2) (Identified from the base of tamarind trees at Alagar Kovil region of Madurai) as edible. Among the evaluated strains, TNAU (CI) MDU-2025 (1) was identified as the superior strain, producing **658.87g** yield per **500 g** substrate with **131.77%** biological efficiency, followed by TNAU (CI) MDU-2025 (2) producing **636.96g** yield per 500g substrate with **127.39%** biological efficiency significantly exceeding the commercial check APK-2 (**613.14g** and **122.63%**, respectively). Hence, we suggest these two strains are promising and have good yielding ability when compared to the existing commercial variety.

Keywords: Edible, mushroom, milky-mushroom, superior, nutritional

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Impact of Drone Application in Agriculture on Minimising Labour Drudgery and Enhancing Sustainable Livelihoods Through KVK Interventions

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Abstract

An impact assessment study of KVK Interventions in drone application in agriculture was conducted in Cuddalore district with 120 sample farmers during 2023-2024. Through KVK interventions, highest knowledge gain percentage in terms of drone application in agriculture was recorded for Pest and disease monitoring (71.67) followed by Sowing and planting (71.17). Before the study, the knowledge percentage possessed by the area farmers was higher for Spraying of fertilizers and agro chemicals (97.50). Around half of the progressive farmers by updating their knowledge on application of drones utilised for Irrigation scheduling of crops and Sowing and planting. The adoption level was found to be lower for application of drones in Pest and disease monitoring, Nutrient disorders, Soil and field analysis, Water stress monitoring and Crop yield estimation, disaster management, Crop monitoring and health management, Evapotranspiration, Weed identification and weeding, Livestock management, Crop biomass and damage estimation and Geo fencing.

By comparing the manual spray cost with drone spraying of fertilizers and other agro chemicals in various crops; it is observed in the study that 67.50 per cent of the farmers opined that cost of drone spray is upto Rs.1000 only than in manual (go upto Rs.3000/) by reducing the labour cost/drudgery. It is depicted clearly that drone spraying takes maximum 30 to 45 minutes for covering one acre of land while in manual spray it is almost double the time spent by the labourers. The major constraints faced by farmers in adopting the drone technology in agriculture were High cost (100%), Knowledge and skill (94.17%), Internet connectivity issue (91.67%), Scarcity of Trained Pilot (90.83%) and Techno-Economic Feasibility (87.50 %). Farmers expressed positive attitude in the efficiency and precision of drones in reducing labour and time spent on manual tasks of farming operations, but challenges like durability of drones in extreme weather conditions, connectivity issues in rural areas, and maintenance costs need to be overcome by government initiatives and schemes in enhancing the acceptance and application of drones for sustained farming and rural livelihoods.

From the study it is concluded that the farmers were made aware of drone technology as an excellent and innovative technology capable of transforming the traditional manual activities carried out in agriculture. However, the high cost of drones and limited availability of technically trained persons (known as pilots) are the major hurdles in the use of drone in agriculture. Due to the high costs involved in purchasing drones, small and medium-scale farmers are reluctant to use drones.

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Also hiring a drone with technical personal is highly expensive even for the large farmers. If at all the drone spraying is to be practiced by the farmers, drones should be made available locally with trained personnel for custom hiring. Otherwise, the farmers may be encouraged to form an enterprise and purchase their own drones.

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An Assessment of Seed Extraction with Organic Acids and Inorganic Chemicals in Tomato (*Solanum lycopersicum*)

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Abstract

Vegetable seed extraction methods widely use wet and dry methods, depending on whether the fruit is fleshy or dry. Key techniques include wet extraction, fermentation and dry extraction. Tomato is a special case among vegetables, as its seeds can only be extracted from the pulp after a fermentation step. Compared to other vegetables, tomato seed production differs in some special processing steps. Seed extraction can be carried out continuously in parallel to harvesting. However, this necessitates a large number of extractions and is therefore very labour-intensive. The fruits can be also left longer on the plant and extracted all at once. This comes with a higher risk of loss, as the probability of infections increases with a longer hanging time. The investigations were carried out at department of Seed Science and Technology, Agriculture College and Research Institute Madurai to identify the effect of seed treatment in tomato PKM1 seed extraction to assess the germination, vigour status in tomato seeds. The objectives of the experiment are to study the effect of seed extracting methods using different organic acids and inorganic chemicals viz.. citric acid, fish amino acid, HCl, H2SO4, NaHCO3, Na2CO3. and to assess the germination, root length, shoot length, vigour status and biochemical parameters in tomato. The results revealed that among the seed extraction treatments, 10% HCl showed better results in terms of germination (89%), root length (10.79 cm), shoot length (4.60 cm) and vigour index (1369) and also in biochemical parameters in Tomato. Among the organic acids, fish amino acid showed better results in terms of physiological and biochemical parameters than citric acid.

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Effect of Organics and Microbial Consortia on Seedling Establishment, Growth and root knot nematode (*Meloidogyne sp.*) of Kamalam (Dragon fruit)

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Abstract

Kamalam fruit is one of the most important suitable crops for tropical and subtropical regions. The fruit is gaining popularity for growing extensively due to its rich nutrient content and antioxidant properties. However, getting a quality seedling is lacking, because the plants that are produced from seeds are not true to type and there is a lot of variability among the plants. Therefore, seeds are generally not used for commercial plant multiplication. Besides, the lack of awareness and expertise about preferred nursery practices and production techniques leads to affecting orchard establishment and production. Hence, knowledge of quality sapling establishment is paramount importance. Therefore, an attempt was made to evaluate the seedling establishment and its root growth by application of different types of organic amendments (FYM, poultry manure and vermicompost and concentrated organic cakes like, Pongamia and neem cake) along with different types of microbial consortia. The potting medium was prepared with soil, sand and FYM (1:1:1 ratio). In place of FYM, poultry manure and vermicompost, *pongamia* and neem cake were used at recommended levels. In the potting media, microbial consortia like, Arka Microbial Consortia (AMC) liquid, Arka Actino Plus, Arbuscular Mycorhiza and Bacillus *amyloliquiefaciens* P-72 are used to stimulate more healthy roots and shoot growth in the potting media. The experiment was carried out on both red and white pulped dragon fruit cuttings for 6 months during 2023 at ICAR-IIHR's experimental farm, Hirehalli, Tumkur District, Karnataka. The experiment was laid out in a factorial randomized block design with three replications and thirteen treatments. The data were collected during the plant growth period in the nursery, and also root parameters were collected during this period through a plant destructed method. Results show that application of vermicompost (T3 treatment) in place of FYM significantly increased shoot and root length of red (67.5; 26.3 cm) and white (59.0; 31.9 cm) pulped dragon fruit, respectively. The number of shoot branches in both red and white pulped were significantly higher in T11 treatment [(soil+ sand+ neem cake (1:1:1) (300% neem cake)] 4.80 and 3.80 respectively. The number of roots is higher in T10 treatment [soil+ sand+ neem cake (1:1:1) (200% neem cake)] 20.8 and 23.3, both in red and white pulp respectively. Both shoot and root biomass were highest in T3 treatment [(soil+ sand+ vermicompost (1:1:1)] 0.60 kg plant-1 and 12.1g plant-1 in red pulped Kamalam fruit.

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The nematode population was studied using gall index as an indicator (0-5 scale), among the treatments T2 (100% Arka fermented cocopeat) and pongamia and neem cake applied treatments (T6, T9, T10, T11 and T12) recorded significantly lower gall indices in both white and red varieties of Kamalam. Thus, application of vermicompost and concentrated cake can help in establishing quality seedlings of Kamalam fruit.

Keywords: Seedling establishment, organic manures, concentrated cakes, growth parameters and nematode gall index

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Integrative Computational Biology and Network Pharmacology–Guided Discovery of Anticancer Phytochemicals Targeting Glioblastoma

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Abstract

Glioblastoma (GBM) represents the most aggressive primary brain tumor which attacks the central nervous system while showing diverse molecular features and defies treatment methods and results in unfavorable patient survival rates. The study presents a research approach which combines computational biology with network pharmacology to find plant-based bioactive substances that show promise for GBM treatment. The research team will obtain transcriptomic and clinical datasets from cancer genomics repositories which they will process through R/Bioconductor software using TCGAbiolinks and DESeq2/limma and edgeR and survival-related tools to find genes that show expression differences and molecular patterns which disrupt normal function and identify targets that influence patient survival. The research team will apply clusterProfiler and ReactomePA tools to perform functional annotation and pathway enrichment which will identify essential biological systems and communication networks that drive GBM tumor advancement. The research team will build protein–protein interaction networks through STRING which they will analyze with Cytoscape to identify important hub genes and molecular targets that relate to specific diseases. The research team will obtain anticancer phytochemicals through natural-product databases which they will use to identify potential protein targets for creating a unified network that links phytochemicals with their targets and associated pathways. The process of finding therapeutic nodes through GBM gene and phytochemical target intersection analysis will lead to the discovery of multiple active substances which affect various biological targets. The evaluation of drug-likeness and pharmacokinetic behavior and toxicity and blood–brain barrier penetration will occur through full ADMET profiling which helps select compounds that show promise for central nervous system drug development. The research team will use AutoDock Vina for structure-based molecular docking to determine how well the selected phytochemicals bind to confirmed GBM targets while identifying important contact points between molecules. The research team will select the most promising protein–ligand complexes for molecular dynamics simulations through GROMACS which will produce trajectories that scientists will analyze to study RMSD and RMSF and radius of gyration and hydrogen bonding and solvent accessibility and binding free-energy. The computational system uses multiple levels of analysis to combine transcriptomic data with systems network analysis and pharmacokinetic evaluation and molecular modeling for identifying anticancer phytochemicals which demonstrate mechanistic relevance and developing testable therapeutic approaches for glioblastoma precision treatment.

Keywords: Glioblastoma; Phytochemicals; Network Pharmacology; Transcriptomics; Molecular Dynamics

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An Integrated Data Analysis and Computational Approach to reveal Gene Signatures for Paediatric Tuberculosis Meningitis related to Non-Tuberculosis Patients

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Abstract

The burden of global disease continues to be dominated by tuberculosis. Tuberculosis meningitis (TBM) is its most important manifestation and occurs among both adults and children, with both high levels of morbidity and mortality. TBM kills up to half of the affected children, and of those who survive up to 53.9 percent will be left with some form of neurological damage. Poor outcome for TBM is largely associated with delayed diagnosis and the administration of anti-tuberculosis drugs. So, better identification of patients and timely initiation of successful therapy are essential to reduce TB in children. The ultimate goal of this research study was to find new markers which would help diagnose TB meningitis early in children, with RNA-seq being used to explore datasets of different tissues. Emphasis is placed on utilising machine learning approaches, numerous statistics and Bioinformatics with consideration given to the analysis of fixed cut-off values or p-values, to select a list of Differentially Expressed Genes (DEGs). Consequently, three new biomarkers were identified by combining the findings from RNASeq and machine learning, utilizing algorithms like multi-layer perceptron, support vector machine (SVM), and random forest (RF) to suggest the optimal model with high accuracy and performance for the identification of the new biomarkers. It was understood that the RF model surpassed the other classifiers by achieving an accuracy score of 1.0 in identifying new biomarkers of Tuberculosis meningitis in children. Then computational analysis of these genes was done with the potential drugs used for treating Tuberculosis meningitis using AutoDockTools software. This research study aligns with SDG-3: Good Health and Well-being.

Keywords: Tuberculosis meningitis (TBM), Differentially Expressed Genes (DEGs), Machine Learning, Multi-Layer Perceptron (MLP), Support Vector Machine (SVM), Random Forest.

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Multi-Omics Bioinformatics and Network Pharmacology–Integrated Quantum Chemical and Molecular Simulation Discovery of Therapeutic Phytochemicals Against Cervical Cancer

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Abstract

Cervical cancer continues to be one of the most common diseases and causes of deaths among females globally. Its development process is associated with persistent infections caused by high-risk human papillomavirus and alterations in cell DNA and cell proliferation control signaling, as well as emerging drug resistance in cancer cells.To tackle this issue, the research introduces a multi-layer computational approach combining multi-omics bioinformatics, network pharmacology, quantum chemistry modeling, and molecular dynamics simulation for systematic discovery of plant-based therapeutic agents against cervical cancer.The analysis will include transcriptomic, genomic, and clinical data acquired from publicly available cancer data sources for the identification of genes with differential expression levels, frequently mutated genes, gene expression correlation groups, biomarkers with prognostic value, and signaling pathways with altered activity. On the basis of this analysis, functional enrichment analysis, protein-protein interaction network mapping, and systems biology prioritization will be conducted for the identification of key oncogenic pathways and cancer hallmarks without specifying all six characteristics mentioned earlier. Within the network pharmacology approach, known targets in cervical cancer will be mapped with molecular targets of the candidate phytochemicals to build compound-target-pathway networks Compounds identified via this method will be evaluated using density functional theory (DFT) to analyze the electronic properties, such as energy gap between HOMO-LUMO, molecular electrostatic potential surface and global reactivity indices, which influence a compound's ability to bind with its biological target. Potential compounds will also be subjected to screening with respect to drug-likeness, pharmacokinetics and ADMET properties to evaluate their therapeutic potential. The promising candidates will be further analyzed using molecular docking to evaluate their binding affinity and critical interactions with the proteins associated with cervical cancer as the biological target. Protein-ligand complexes showing maximum efficiency will be subjected to molecular dynamics simulation using GROMACS with respect to parameters such as RMSD, RMSF, radius of gyration, hydrogen bonding profile, solvent accessible surface area, principal component analysis and free energy landscapes in order to analyze their stability with time. Binding efficiency of these complexes will be further quantified using free energy computations based on MM/PBSA model, and the prioritized molecular targets will be validated using independent transcriptomic data sets.

Keywords: Cervical Cancer; Phytochemicals; Multi-Omics Bioinformatics; Network Pharmacology; Molecular Dynamics

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Drug Delivery Systems for Cancer Wound Healing Using Biopolymer-Based Nanoparticles

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Abstract

The healing of cancer wounds is a problem which displays the characteristics of chronic inflammation, disturbed angiogenesis, very high infection risk, and the relationship between tumors and wound healing. Conventional treatment options are not really effective in such cases since they are systemic poisons and are non-specific without regeneration capabilities. Advances in drug delivery systems such as biopolymer-based nanotechnology will bring about breakthrough in delivery of stimulus-responsive, targeted and controlled therapy for oncology and regenerative medicine. The naturally available biopolymers such as gelatine, alginate, chitosan and hyaluronic acid are biocompatible and biodegradable. The biopolymers serve as good matrices for nanoparticle fabrication while synthetic polymers provide further tunability and functionalization. Different types of nanoparticles such as polymer based, lipid-based and inorganic nanoparticles like silver and gold are being fabricated using methods like emulsification and ionic gelation for functionalization. . Such nanocarriers are capable of delivering drugs, growth factors, antimicrobial agents, and gene therapy, treating different aspects of cancer wounds pathophysiology. There are some preclinical results that are promising. Emerging technologies in the sphere of 3D printed biopolymer scaffolds, artificial intelligence-assisted nanocarrier synthesis, wearable drug delivery patches, bidirectional tumour-targeted and regenerative delivery systems, are an indication of how fast the field is developing. The problems of biocompatibility, nanotoxicity, and regulation persist. It is expected that the combination of targeted nanomedicine approaches, bioelectronic devices, biosensors, and green manufacturing process would affect the future generation of cancer wound healing drug delivery systems, based on biopolymers.

Keywords: Polymeric, High-Risk Infection, Wound Healing, Drug Delivery

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Bioinformatics and Computational Genomics for Big Data Driven Precision Oncology in Chronic Myeloid Leukemia

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Abstract

Chronic Myeloid Leukemia is a hematological malignancy caused by the fusion of BCR and ABL genes, forming the BCR::ABL1 fusion gene, resulting from the Philadelphia chromosome translocation. The disease is characterized by great responses to tyrosine kinase inhibitors, although there are various challenges. The challenges include resistance and the variability of responses in individual cases. The present article discusses the bioinformatics and computational genomics-driven approach to precision oncology, which may enable the transformation of life-science data into biological knowledge for the discovery of novel biomarkers of CML. The proposed solution involves the use of bioinformatics, computational genomics, and big-data analytics to engineer an effective precision-oncology framework for the treatment of CML. The approach is based on the analysis of genomic, transcriptomic, epigenomic, proteomic, and clinical data, which may be organized using a combination of computational pipelines for data preprocessing, quality control, feature selection, statistical analysis, pathway and network analysis, and machine learning. The findings from the large-scale analysis of molecular data may be utilized to train machine-learning algorithms, such as Random Forest, XGBoost, Support Vector Machine, and neural networks, to identify patterns that can be used to predict the response to a particular treatment. In addition, multi-omics data analysis may be applied to identify the relationships between genetic variations, gene-expression changes, signaling pathways, and clinical outcomes, as well as to prioritize molecular targets for further research. Explainable artificial intelligence can be integrated into the framework to identify the most relevant factors associated with the development of resistance to TKIs and analyze the resulting biological mechanisms. The proposed bioinformatics and computational genomics approach can be applied to transform large-scale and heterogeneous data into biological knowledge and prioritize candidate biomarkers for the development of novel precision treatments. In this regard, the integration of high-throughput sequencing data, multi-omics analysis, computational biology, and artificial intelligence can be a promising avenue for big-data-driven precision oncology. The application of computational approaches to analyze heterogeneous data in life sciences is a powerful tool for studying the underlying mechanisms of CML heterogeneity, which can lead to the development of more effective and personalized treatment strategies.

Keywords: Bioinformatics; Computational Genomics; Big Data; Multi-Omics; Chronic Myeloid Leukemia; BCR::ABL1; Precision Oncology; Machine Learning; Artificial Intelligence; Biomarker Discovery.

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Influence of Different Biostimulants on Growth, Yield, Quality and Cost Economics of Tuberose (*Agave amica* Medik.) cv. Arka Prajwal

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Abstract

The present investigation entitled "Influence of different bio-stimulants on growth, yield, quality and cost economics of tuberose (*Agave amica* Medik.) cv. Arka Prajwal" was carried out at Department of Floriculture and Landscape Architecture, Horticultural College and Research Institute, Periyakulam, Tamil Nadu during 2024–2025. The objective of present study is to evaluate the influence of different biostimulants and their combinations on growth, yield, quality and cost economics of tuberose cv. Arka Prajwal was aimed at. The experiment was laid out in a Randomized Block Design (RBD) with twelve treatments and replicated thrice. Foliar applications of biostimulants, namely Panchagavya (3 %), Humic acid (0.4 %), Moringa leaf extract (3 %), and Seaweed extract (1 %), either alone or in combinations were applied at 50, 70, and 90 days after planting along with a water spray as control. The present study results showed that T11 (Panchagavya @ 3 % + Humic acid @ 0.4 % + Moringa leaf extract @ 3 g % + Seaweed extract @ 1 %) recorded significantly higher values for all growth, yield quality attributes. In the growth traits, T11 exhibited the highest values of growth, flowering and yield traits such as plant height (56.88 cm), number of leaves (48.58), spike length (89.57 cm), spike diameter (1.07 cm), rachis length (35.97 cm), number of florets per spike (41.49), floret length (6.23 cm), and highest flower yield per plant (132.28 g), flower yield per plot (3.97 kg), and yield per hectare (11.34 t ha^{-1}). Regarding bulb characters, T11 exhibited the highest values of number of bulbs per clump (10.20), bulb length (6.73 cm), bulb weight (390.45 g) and bulb yield per ha (29.26 t/ha) whereas the lowest yield traits was noticed in control (T12). In the case of quality traits, the same trend was recorded. Treatment T11 recorded the longest flowering duration (18.83 days), highest shelf life (2.65 days) and the maximum concrete content (0.192%), along with increased chlorophyll content (0.834 mg g^{-1}). However, the control (T12) registered the lowest values in growth, yield and quality traits. Regarding cost economics, treatment T11 observed the highest B:C ratio of 2.39, whereas control (T12) found the lowest B:C ratio of 2.02. The present study it was concluded that T11 treatment recorded the highest vegetative growth, floral, yield, quality and B:C ratio and suggesting that combined application of these bio-stimulants can be recommended for further evaluation and it will be tested at farmers field during ensuing season.

Keywords: Tube rose, *Agave amica*, Biostimulants, Growth, Yield, Bulb, Cost economics

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Crop Establishment Methods and Weed Management Practices on Weed Dynamics in Rice based Cropping System

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Abstract

Rice production needs to be increased vertically to ensure food and nutritional security as limited scope exists for horizontal expansion. However, achieving potential rice yields is constrained by various abiotic and biotic stresses. Among biotic stresses, weed-infestation is the prime stress which adversely affects rice grain yields. Unmanaged weeds in the field are reported to reduce yield, a systematic weed monitoring program for implementing successful IWM is required. Keeping on the above points in view, a long term experiment on weed dynamics was conducted at central farm, Tamil Nadu Rice Research Institute, Aduthurai during *Kharif*, 2020 in split plot design replicated three times. Crop establishment methods M1–Mechanized transplanting, M2 – Puddled direct seeding, M3 – Un –puddled dry direct seeding were assigned to main plot and weed management practices viz., T1 – Weed free,T2 – Weedy check, T3 – Mechanical weeding and T4 – Chemical weed control (pre & post emergence herbicide application) were allotted to sub plots. Puddled Direct seeding, Un Puddled Direct seeding and Mechanized transplanting sowing was done on 15.06.2020 and Transplanting was done on 30.06.2020. Among the weed species Leptocloa chinensis Completely dominated the dry DSR system followed by *E.grusgalli* and *E. Colonum* weeds dominated in unpuddled dry DSR System as compared to Machine planting and dry DSR. Among the crop establishment methods lower weed count was and weed dry weight, higher No. of tiller/m2 (346), No. grains/panicle and higher grain yield (5696 kg/ha) was recorded in machine transplanting with mechanical weeding followed by wet DSR and dry DSR. Higher net income (59261) and B.C ratio (2.37) was recorded in mechanical weeding followed by drum seeding + chemical weeding. It was concluded that Monocot weeds were dominant in dry DSR System. Lower weed density and dry weight was recorded in weed free condition in all the three crop establishment methods. Higher grain yield and net income was recorded in machine transplanting with mechanical weeding.

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Therapeutic Potential of Plant-Derived Essential Oils in the Modulation of Gut Microbiome Interactions and Subsequent Gastroenterological Health: A Comprehensive Review

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Abstract

Natural plant oils comprise unique molecules that provide antibacterial and antioxidant support. These organic agents affect the gut biome significantly. You should monitor how they influence microbe counts plus metabolite results like specific fatty acids. Better balance protects digestive linings plus human immunity. Such patterns help various stomach troubles like syndrome states or inflammatory bowel conditions. You get health improvement through diverse methods. Our report connects existing test results plus few human findings about pathways where plant components help intestinal systems. We weigh big hurdles such as product absorption or consistent delivery systems. Scientists must finalize proper dosage rules alongside better trials. Research goals emphasize standardizing methods for clinical doctors. We want these results because health progress relies upon scientific proof plus reliable daily practices for humans needing effective support from herbal resources for common gut wellness goals and inflammatory challenges today.

Keywords: Plant-derived oils, Microbe modulation, Digestive wellness, Dysbiosis, Syndrome states, Bowel disorders, Ulcerative conditions, Herbal oils microbiome impact, Oil agents for syndrome, Oil agents intestinal health, Dietary herbal constituents inflammation, Bacteria-focused natural oils, Plant oils lining strength.

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Exploration of Antifungal Metabolites of *Sargassum* Seaweed for Management of *Colletotrichum gloeosporioides* causing Mango Anthracnose

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Abstract

The antifungal efficacy of Sargassum seaweed extract and its purified active metabolites were tested against *Colletotrichum gloeosporioides*, the pathogen responsible for anthracnose in Mango. We have done the extraction and formulation of active metabolites of *Sargassum* seaweed using hexane as solvent and the end product alginate was formulated in liquid form. The solvent extraction of bioactive compounds / active metabolites from Sargassum seaweed was carried out under *in vitro* and the active metabolites present in the liquid formulation of seaweed extract were evaluated through GC-MS. The *in vitro* efficacy of active metabolites of *Sargassum* was assessed by Agar Well Diffusion method, to capture a full spectrum of inhibitory dynamics, including direct contact and diffusion-mediated effects. The bio-active compounds present in *Sargassum* seaweed extract with high peak values were Nonadecane, Eicosane, Cyclononasiloxane and 2-octadecyl-propane-1,3-diol. The antifungal activity of active metabolites of *Sargassum* at different concentration viz., 50, 100, 150 and 200ppm was evaluated against *Colletotrichum gloeosporioides* under in vitro by agar well diffusion method. The results revealed that the active metabolites of *Sargassum* at 200 ppm was found effective in inhibiting the mycelial growth of *Colletotrichum gloeosporioides* (2.8cm) compared to 50ppm (4.8cm), 100ppm (3.7cm), 150ppm (3.2cm) and control (8.9cm). The active metabolites of *Sargassum* seaweed possess promising antifungal properties and could be considered a potential eco-friendly alternative to chemical fungicides for managing mango anthracnose.These findings suggest that *Sargassum* seaweeds are rich reservoirs of antifungal metabolites and consistent inhibitory activity against *Colletotrichum gloeosporioides*.

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Spatial, Phenotypic and Molecular Diversity of *Alternaria porri* of Small Onion in Tamil Nadu

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Abstract

Purple blotch, caused by *Alternaria porri*, is an important disease affecting small onion production in Tamil Nadu. This study was carried out to understand the distribution, morphological variation, pathogenicity and genetic diversity of *A. porri* populations associated with the disease. A roving survey conducted during 2025 in eight major small onion-growing districts showed considerable variation in disease severity, with percent disease index (PDI) ranging from 9.80 to 76.80%. The highest mean disease severity was recorded in Theni (65.97%), followed by Madurai (54.16%), while the lowest was recorded in Salem (12.20%). Thirty-one *A. porri* isolates were collected from infected onion leaves and studied based on their cultural, morphological and pathogenic characteristics. The isolates varied in colony colour, texture, growth pattern, sporulation, conidial size, septation and beak characteristics, and were grouped into four morphological groups. Pathogenicity tests showed that all isolates were pathogenic, but their virulence differed considerably, with PDI values ranging from 11.20 to 76.80%. Among them, MAP (ALA)-7, TAP (THR)-20 and MAP (KOT)-8 were highly virulent. Molecular identification using ITS amplification and sequencing confirmed the isolates as *A. porri*, with 98–100% similarity to reference sequences. Species-specific PCR further confirmed their identity. Phylogenetic analysis grouped the isolates into four major clades and showed moderate genetic variation among them. Interestingly, several highly virulent isolates were grouped in Clade IV, indicating a possible relationship between genetic grouping and pathogenicity. Overall, the study highlights considerable variation in the distribution, morphology, pathogenicity and genetic characteristics of *A. porri* populations in Tamil Nadu. These findings provide useful baseline information for disease monitoring, selection of representative isolates for disease management studies and future research on onion *A. porri* interactions.

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Isolation, Characterization, and Molecular Identification of Potential Probiotic Bacteria from Milk, Milk Products, and Fermented Food Sources

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Abstract

Probiotics are good bacteria that help keep the body healthy. They improve gut health, support the immune system, and also help stop the growth of harmful bacteria. Milk, milk products and fermented foods are good natural sources of these bacteria (especially lactic acid bacteria). The aim of this study was to isolate, identify, and compare LAB from different milk samples, milk products, and fermented foods. The samples used in this study were cow milk, buffalo milk, goat milk, curd, yogurt, buttermilk, dosa batter, kombucha, and pickle. The bacteria were grown on selective media and identified based on morphological, biochemical, and molecular methods. Their probiotic properties were studies by carrying out tests like, acid tolerance, bile salt tolerance, carbohydrate fermentation, and antimicrobial activity tests. Selected bacterial isolates were further identified using 16S rRNA gene sequencing. The sequencing results identified *Staphylococcus epidermis, Streptococcus equinus, Streptococcus thermophilus, Weissella cibaria, Enterococcus faecalis, Escherichia coli,* and *Weissella confusa* from different samples. The results showed that the probiotic properties varied among the isolates. Some strains survived well under acidic conditions and in the presence of bile salts, while others showed good antimicrobial activity against harmful bacteria. These results suggest that some of the isolated bacteria have good probiotic potential and may be useful in developing probiotic and functional food products. This study provides useful information about bacteria found in commonly consumed milk, milk products, and fermented foods. It also highlights their role in improving food quality and supporting human health.

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Isotopic Tracing of Foliar Nano Urea Plus Internalization and Nutrient-use Efficiency in Maize

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Abstract

Efficient foliar nanofertilization requires evidence that applied nitrogen is internalized, assimilated and converted into crop growth and yield. A pot experiment with maize compared 100% recommended nitrogen as soil-applied urea (U100) with 75% soil-applied urea supplemented by two 0.7% foliar sprays of nano urea plus (U75 + NUF0.7). Fluorescence observed along cell boundaries, vascular tissues and localized intracellular regions provided qualitative evidence of foliar absorption, internalization and translocation. From 45 days after sowing, U75 + NUF0.7 became comparable or superior to U100, producing greater final plant height, root length and root volume while sustaining chlorophyll, Fv/Fm, gas exchange and photosynthetic activity during later growth. Grain yield reached 91.4 g plant-1 and total nitrogen uptake reached 2,020 mg plant-1, compared with 1,850 mg plant-1 under U100. Phosphorus and potassium uptake also increased through improved root exploration and biomass demand. Later-stage nitrogen-metabolizing enzyme activity indicated continued assimilation and redistribution. The 15N tracer study recorded fertilizer-use efficiency of 46.5% under U75 + NUF0.7 versus 44.2% under U100 despite 25% less soil-applied nitrogen, demonstrating effective supplementation rather than complete replacement of basal nitrogen.

Keywords: 15N isotope tracing, nano urea plus, foliar internalization, nitrogen assimilation, nutrient-use efficiency, maize

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Unravelling the Defense Mechanism and Antibiosis effect Induced by Novel Biochar Granule Formulation in Improved Kavuni CO 57 against the Rice Leaf Folder, *Cnaphalocrocis medinalis*

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Abstract

The present study investigated the potential of a newly developed biochar granule formulation to induce resistance against the rice leaf folder, Cnaphalocrocis medinalis in traditional rice variety Improved Kavuni CO 57. A biochar granule formulation comprising biochar, rice husk ash and lignite fly ash was developed, evaluated and the optimized formulation was assessed in combination with potassium silicate and azadirachtin under laboratory conditions. Among the treatments T7 - basal application 50% biochar granules at 500 kg/ ha + 1% potassium silicate + azadirachtin 3000 ppm 2ml/l resulted enhanced structural and biochemical attributes, including silicified cells (27.96 cm^{-2}), trichome density (55.61 cm^{-2}), silicon accumulation (1.84 mg g^{-1}), phenol (0.61 mg g^{-1} GAE), tannin (3.85 mg g^{-1} TAE), peroxidase (2.12 Δ460 min^{-1} mg^{-1}) and phenylalanine ammonia lyase activity (2.73 Δ290 µmol m^{-1} ml^{-1} g^{-1}). These defence responses translated into pronounced antibiosis against C. medinalis, which was evidenced through reduced larval weight (54.19 mg), larval survival (65.08%), pupal weight (35.08 mg), fecundity (14.57 eggs $female^{-1}$), adult emergence (18.39%) and growth index (0.67), accompanied by prolonged developmental duration. Further volatile profiling revealed biochar induced modulation of herbivore responsive plant volatiles, with 1-pentyn-3-ol (52.49%), linalool (17.31%), 4-methyldocosane (4.25%), hexadecane or nonanal (2.22%) and carvone (1.69%) as prime constituents. These volatile changes were demonstrated through olfactometer assays, where Trichogramma chilonis exhibited enhanced activity of 87.63% towards volatiles from biochar treated herbivore infested plants (+ BC + HE) compared with 62.23% in untreated plants (- BC – HE). In addition, metabolomic profiling also reveals the enhanced defense priming in Improved Kavuni CO 57 through accumulation of defense associated metabolites viz., mannitol, linoleic acid, oleic acid, azelaic. Thus, this multifaceted defense mechanism exhibits that newly developed biochar granule formulation as a promising eco-friendly component for sustainable traditional rice pest management.

Keywords: Biochar, Improved Kavuni CO 57, silicon, rice leaf folder, metabolomics

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Pseudomonas protegens CS11 as a Biocontrol Agent Against *Sclerotinia sclerotiorum* in Tomato: Genomic Insights, Functional Mechanisms and Integrated Application with Lemongrass Essential Oil

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Abstract

Tomato (*Solanum lycopersicum* L.) cultivation is challenged by fungal pathogens, including Sclerotinia sclerotiorum. Biological control using antagonistic rhizobacteria offers a sustainable alternative to chemical pesticides, but the genomic basis of their biocontrol activity and integration with complementary strategies remain underexplored. This study investigated the biocontrol potential *Pseudomonas protegens* CS11 against *S. sclerotiorum*, focusing on its genomic characterisation, greenhouse performance, plant defence induction, and integration with lemongrass oil. CS11 exhibited complete (100%) inhibition of *S. sclerotiorum* growth *in vitro* and possessed multiple plant growth-promoting traits. Comparative genomic analysis with *P. protegens* CHA0 revealed unique genetic features in CS11, as well as gene clusters associated with antifungal secondary metabolites, supporting its antagonistic activity. Greenhouse application of CS11 suppressed disease progression and enhanced defence-related enzyme activities, including GLU, Chi, PAL and PPO, while upregulating genes associated with salicylic acid- and jasmonic acid-mediated defence pathways. Furthermore, integration of CS11 with lemongrass oil provided effective disease suppression and modulated plant defence responses while maintaining plant growth compared with individual treatments. Overall, this study highlights the potential of *P. protegens* CS11 as a biocontrol agent and provides a foundation for developing integrated microbial-essential oil strategies for sustainable management of *S. sclerotiorum* in tomato.

Keywords: Biocontrol, Fungal pathogen, Genome, Plant Defence, *Pseudomonas,* Lemongrass oil

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Performance of Grafted Brinjal against Soil Borne Diseases in Villupuram District

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Abstract

Grafting in vegetable crops is a simple method of propagation where preferred rootstocks are used to set increased vigour, precocity, more yield and better survival under wide range of abiotic and biotic situations. This technique has been successfully used in the management of soil borne diseases such as Verticillium, Fusarium, Ralstonia and root knot nematodes. Hence, an attempt was made jointly by KrishiVigyan Kendra, Villupuram and Water Technology Centre, Tamil Nadu Agricultural University, Coimbatore through Tamil Nadu Irrigated Agriculture Modernization Project (TN-IAMP) to accelerate crop diversification from crops requiring more water to high remunerative and less water requiring horticultural crops, through promotion of hi tech cultivation technologies and water conservation technologies in Lower pennaiyar sub basin. Grafted Brinjal cultivation was introduced in Villupuram district to enhance the productivity of Brinjal with the recommended package of practice. The grafted brinjal recorded higher yield (79.09 t/ha) than conventional method of brinjal cultivation (61.20 t/ha). The incidence of wilt and root rot diseases were observed low in grafted brinjal and it also required less number of irrigation than the farmers practice. Grafted brinjal recorded higher net return (Rs.1,04,660/ha) with higher benefit cost ratio (2.95) as compared to farmers practice.

Keywords: Grafted brinjal, Villupuram, Lowerpennaiyar

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Yield Gap Estimation of Paddy in Cauvery Delta Zone of Tamil Nadu State

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Abstract

Rice (Oryza stativa.L) is the world's most important cereal crop and a primary source of food over one third of world population. Even though India stands first in rice area (43.00 million hectares) and second in production (112.91 million tons) next to china and the productivity is 2,585 kg/ha (Anon 2018a). Increasing rice production with available resources are highly challenging one. The estimated requirement of rice by the year 2050 for consumption purpose alone is 136 million tons for an expected population of 162 million (Ramesh Chand 2012). This study was conducted in the Districts viz,Tiruchirppalli, Thanjavur, Thiruvarur and Nagappattinam of Cauvery Delta Zone, Tamil Nadu state.

Yield Gap I was estimated among the salt tolerant rice varieties released by Anbil Dharmalingam Agricultural College & Research Institute, Trichy, Tamil Nadu Agricultural University viz., TRY1, TRY2, TRY3, TRY4 and TRY5. The yield Gap I can be defined as the difference between Potential yield-PY (Researchers yield) and Actual farm yield-AFY.

Using quota sampling procedure, sample size was fixed as 200 farmers for the study. Primary data was collected using well-structured interview schedule. Using percentile analysis and yield estimation formula the yield gapI was assessed among the salt tolerant rice varieties. The maximum percentile yield Gap(%) was observed in TRY2 Rice variety 12.5%, which is followed by 3.91%, 2.7%,1.72% and 1.42% (TRY1, TRY4, TRY5 and TRY3 respectively). The maximum yield Gap could be due to four major factors viz,1. Environmental/ Biophysical factors such as soil quality, pests and diseases, weeds and erratic weather patterns.

Keywords: Yield Gap, Biophysical, GAP and POP

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A Study on Paddy Farmers' Adaptation Measures to Climate Change

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Abstract

This study examined the adaptation measures of Paddy farmers on Climate Change in Nagapattinam district of Tamil Nadu. Nagapattinam district is situated in coastal area and very often subjected to natural calamities which were mainly reflected on the paddy cultivation to the worst status. Data were collected from 200 respondents in the study area by adopting simple random sampling technique. The study revealed that more than half of the respondents (59.00 %) followed medium level of adaptation measures to climate change followed by low (22.00 %) and high (19.00 %) levels. Further, activity wise adaptation measures followed by the Paddy farmers were also studied. The result showed that the majority of the respondents were involved in restoring of existing wet lands (95.00 %), adopting salt tolerant paddy varieties (91.50 %) and short duration varieties (89.50 %) to adapt with climate change. Leaching soil with good quality water (72.00 %) and scrapping and removal of silt (66.00 %) Increase irrigation water use efficiency (72.50 %) and de-silting of irrigation canal (56.00 %) were the major practices followed by majority of the respondents as soil and irrigation management. Application of green manure (91.00 %) and increased use of gypsum application (82.50 %) were practiced by the farmers to improve the soil fertility. More than half of the respondents were invested more in fisheries activity other than the investment in agriculture to sustain their family. Educational status, farming experience, contact with extension agency, innovativeness and awareness level of the Paddy farmers in Nagapattinam district had shown positive and significant contribution with the adaptation to climate change. (R2 = 0.563). The overall adaptation level of paddy farmers to climate change in the study area was observed medium.

Keywords: Climate change, Adaptation measures, Paddy, Coastal area, Nagapattinam district

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Critical Analysis on Adoption Pattern of Salt Tolerant Rice Varities in Tamil Nadu State

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Abstract

This study was conducted to know about the farmers awareness and adoption pattern of salt tolerant rice varieties in order to increase the production and productivity in salt affected soil. Tiruchirappalli district was selected as study area using random sampling procedure among the salt affected area. In Tiruchirappalli District the total geographical area is 4,40,412 ha. Among this 7362 ha are slightly salt affected, 10728 ha are moderately salt affected area and 64 ha are strongly salt affected. To cater the needs of the farmers, five salt tolerant rice varieties released from Tamil Nadu Agricultural University, Anbil Dharmalingam Agricultural College & Research Institute (ADAC&RI), Trichy Viz., TRY1, TRY2, TRY3, TRY4 and TRY5. Using random sampling procedure 200 farmers were selected as sample size. The primary survey was conducted using interview schedule. The awareness rate was recorded for the salt tolerant Rice varieties as 100% , 87.5%, 84%, 72.5% and 57.5% for TRY3, TRY1, TRY5, TRY4 and TRY2 respectively. Similarly the highest rate of adoption was noticed for TRY3 varieties as cent percentage. This is followed by TRY1, TRY5, TRY4 and TRY2 respectively. The reason for cent percentage awareness and adoption was studied among the farmers. The farmers opined that TRY3 gives assured yield, suitable for samba season, highly amenable for value addition as idly making and export potential, and also it is a substitute for CR 1009 and highly suitable for salt affected soil.

Keywords: Non-lodging, salt tolerant, production and productivity

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Influence of Thermal Processing on the Antidiabetic Potential of Athalakkai (*Momordica Cymbalaria*)

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Abstract

Momordica cymbalaria, commonly known as Athalakkai in Tamil, is an underutilized cucurbitaceous fruit traditionally consumed in various parts of India and recognized for its potential health-promoting properties. The fruit has been traditionally associated with the management of diabetes mellitus and other ailments and has been reported to possess hypoglycaemic, hypolipidaemic, cardioprotective, hepatoprotective, nephroprotective and antioxidant properties. The present study was undertaken to evaluate the influence of different thermal processing methods on the nutritional, antioxidant and antidiabetic potential of Athalakkai. Fresh fruits were subjected to five different processing treatments, including dehydration, steaming, boiling, stir-frying and deep-fat frying. The processed samples were evaluated for selected nutritional constituents, antioxidant activity and α-amylase inhibitory activity. Dehydrated Athalakkai exhibited appreciable levels of dietary fibre, vitamin C, calcium, potassium and zinc. Among the processing methods, stir-fried Athalakkai demonstrated the highest antioxidant activity, followed by the steamed sample, whereas boiled and deep-fat-fried samples exhibited comparatively lower free-radical scavenging activity. Dehydration resulted in the highest α-amylase inhibitory activity among the treatments, indicating greater potential for reducing starch hydrolysis and postprandial glucose release. Overall, the findings suggest that processing significantly influences the bioactive potential of Athalakkai, with dehydration emerging as a promising processing method for retaining or enhancing its antidiabetic potential. The study highlights the potential of Athalakkai as an underutilized indigenous fruit for the development of functional foods and value-added products targeting metabolic health.

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Processing and Nutritional Benefits of Avocado (*Persea americana Mill.*) Oil: A Comprehensive Overview

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Abstract

Avocado (*Persea americana Mill.*) pulp is used to produce avocado oil, a nutrient-dense oil prized for its unique composition and diverse applications in the culinary, medical, and cosmetic industries. Along with important bioactive substances like phytosterols, tocopherols, carotenoids, and polyphenols, it is especially prized for its high concentration of monounsaturated fatty acids, primarily oleic acid. These constituents to the oil's notable antioxidant activity and health benefits, including cardiovascular protection, cholesterol regulation and anti-inflammatory effects. Extraction methods significantly influence the yield and quality of avocado oil. While conventional techniques, such as solvent extraction and mechanical pressing, are still employed, innovative approaches like cold pressing, supercritical CO2 extraction, and ultrasound assisted extraction are gaining attention for their ability to retain nutritional integrity and enhance environmental sustainability. The oil possesses favorable physicochemical and thermal properties, including a high smoke point and oxidative stability, making it suitable for both culinary and industrial uses. Nonetheless, it is susceptible to degradation from light, oxygen, and heat. Strategies such as antioxidant incorporation and microencapsulation are employed to preserve quality and extend shelf-life. In conclusion, avocado oil is a multifunctional, health-promoting oil with expanding market potential driven by ongoing advancements in extraction and preservation technologies. Avocado byproducts are often discarded despite their rich nutritional content and bioactive compounds. Moreover, the medicinal properties of these by-products could lead to new pharmaceutical applications as well as health supplements as functional foods. The cosmetic industry also stands to benefit, as avocado by-products can be utilized in developing natural skincare and beauty products. The continuous recycling of waste products in the production cycle will contribute to the creation of a more sustainable system. In general, this strategy encourages a circular, responsible, and efficient economy. By focusing on these areas, significant value to the avocado fruit industry can be promoted.

Keywords: Avocado oil, Multifunctional, Extraction techniques, Therapeutic benefits, Bioactive compounds

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Microbial Modulation of Soil Fertility, Nutrient Cycling, and Nutrient Use Efficiency in Agricultural Systems

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Abstract

Reduced soil fertility, nutrient imbalances, and low nutrient use efficiency (NUE) are significant limitations to sustainable crop production. Microorganisms have a special place in the relationships between the soil and plants because of their role in regulating the nutrition of crops and accumulating nutrients in the soil. The activities of diverse soil microorganisms such as nitrogen fixation, solubilization of phosphorus and potassium, provision of micronutrients and siderophores, decomposition of organic matter, and production of phytohormones play an essential role in agricultural ecosystems. They directly and indirectly affect nutrient cycles, availability, and plant absorption and utilization processes. Moreover, microorganisms control biochemical processes in the soil through various enzymes involved in the cycling of carbon, nitrogen, and phosphorus, thus improving the overall biogeochemical cycling, health, and fertility of the soil. In this regard, using PGPM's as a sole inoculant or a mixture of different bacteria to improve the efficiency of nutrient use is a promising way to optimize fertilizer use and reduce agroecosystems' dependence on synthetic fertilizers. Liquid forms, carrier-based products, encapsulated microbes, and advances in formulation technology have also helped create more stable and viable microbial inoculants that are beneficial for plant growth and nutrient absorption. Nevertheless, PGPMs' application has several shortcomings, including inconsistency in performance under different environmental conditions, inhibition of inoculant bacteria by local microflora, compatibility problems in the formulation, poor survivability after application, and insufficient knowledge of formulation properties after storage. To ensure a steady supply of nutrients and nutrient availability to plants while maintaining soil health, it is critical to combine the right amount of fertilizer with effective microbial technology and appropriate agronomic practices. The critical areas for further research on microbial technology to improve the efficiency of nutrient use are the use of multifunctional and stress-resistant strains, development of compatible formulations, the study of plant-microorganism-soil relationships, the assessment of performance under different conditions, and proper agronomic practices, which will help optimize nutrient use, improve crop productivity, and maintain fertile soils for the future.

Keywords: Microbial inoculants; microbial formulations; soil fertility; microbial consortia; nutrient mobilization; sustainable agriculture.

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Development of Functional Milkshake Enriched with Palmyrah (*Borassus Flabellifer*) Sprout Flour

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Abstract

Palmyrah sprout (*Borassus flabellifer*) obtained from the germinated seed of the palmyrah is a traditional food consumed in many parts of South India. It is recognized for its nutritional value and contains complex carbohydrates, dietary fibre, resistant starch, essential minerals, and various bioactive compounds. A palmyrah sprout powder milkshake was developed as a functional beverage with the objective of providing a nutritious and convenient product suitable for health-conscious consumers. The milkshake was prepared using standardized processing methods to ensure uniform quality, desirable sensory characteristics and nutritional consistency. Three different compositions of palmyrah sprout milkshake comprising skimmed milk, palmyrah sprout powder, sugar and cardamom powder were prepared and subjected to sensory evaluation using a 9-point hedonic scale. The sensory evaluation of the three preliminary treatments of palmyrah sprout milkshake revealed noticeable differences in the sensory attributes. Treatment I received comparatively lower scores for appearance, flavour, consistency, taste, and overall acceptability, with an overall acceptability score of 7.5 ± 0.71. Treatment II showed an improvement in all sensory attributes, achieving an overall acceptability score of 8.3 ± 0.48. Treatment III obtained the highest scores for appearance (9.0 ± 0.00), flavour (8.8 ± 0.42), consistency (8.9 ± 0.32), taste (8.9 ± 0.32), and overall acceptability (8.9 ± 0.32). The higher acceptability of Treatment III may be attributed to the optimum level of palmyrah sprout powder, sugar and cardamom powder, which provided a desirable balance of flavour, sweetness, aroma, and consistency.

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Preservation of Peeled Small Onions (*Allium ascalonicum L.*) by Edible Chitosan Coating

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Abstract

Small onions are important commercial vegetable crops grown in India used daily for culinary purposes for its characteristic pungent flavour and taste. But peeling of small onions is time consuming and makes the labour to tire. If the peeled small onions available in the market it will reduce the time, labour and energy. However peeling will change the physicochemical qualities of onions during storage. The edible chitosan coating will minimize the alteration in peeled onions and extend the shelf life by reducing weight loss and maintaining other quality parameters. In this study small onions (*Allium ascalonicum L.*) crop of CO-5 variety was procured from the local farmer. The chitosan (85% deacetylated) coating solution was prepared according to the method described by El Ghaouth *et al.* (1991) and adjusted the pH to 5.6. Peeled small onions were coated with standardised chitosan solution (1.5% and 2.0% in lactic acid) by dipping method, surface dried, packed in Netlon bags and kept at ambient (27-32^{o}C & 60-84% RH) and refrigeration (8^{o}C) conditions. The coated onions were analysed for physicochemical parameters such as physiological loss in weight, respiration rate, firmness, pungency, total soluble solids and consumer acceptability for a period of one month in regular intervals. The results showed that application of chitosan coating at 1.5 and 2.0 per cent in lactic acid helps to improve shelf life with minimal changes in quality parameters up to 20 days at both ambient and refrigerated storage. From this study it is concluded that there was relatively lower per cent physiological loss in weight of onions coated with chitosan due to creating a barrier and modified atmosphere around the peeled onion which may reduce the water vapour transmission rate. Also, the coated onions were shiny and glossy in appearance and retain good sensory qualities.

Keywords: Small onions (*Allium ascalonicum L.*), Edible chitosan coating, physicochemical parameters, shelf life

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Comparative Analysis of Tender and Mature Coconut Water

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Abstract

Coconut water is a naturally occurring, sterile liquid found inside the fruit of the coconut palm (*Cocos nucifera L.*) and is widely recognized as a nutritious beverage because of its rich electrolyte composition and refreshing properties. The biochemical composition of coconut water changes significantly as the fruit matures, influencing its nutritional quality, physicochemical characteristics, and suitability for different food and industrial applications. This study was conducted to compare the physicochemical properties and mineral composition of tender and mature coconut water collected from different coconut varieties, namely Malayan Orange Dwarf (MOD), Chowghat Orange Dwarf (COD), Malayan Yellow Dwarf (MYD), Ayyampalayam and Arasampatty Tall, East Coast Tall (ECT), West Coast Tall (WCT).

The analysis focused on important quality parameters such as pH, total soluble solids (TSS), and electrical conductivity (EC), along with the concentrations of essential mineral nutrients including potassium (K), sodium (Na), calcium (Ca) and magnesium (Mg). Standard laboratory methods were employed to determine these parameters and evaluate the influence of fruit maturity on coconut water composition.

The results revealed that tender variety of MYD (640 ml) have high volume of water while control (100 ml) has low volume of water. The MYD (5.02-6.32) shows highest and lowest pH value. The tender varieties of Ayyampalayam (9.14 Ds/m) have highest EC, while mature Control (7.14 Ds/m) has the lowest. The mature varieties of ECT (6.5 °Brix) hold highest TSS and tender Control (1.8 °Brix) lowest value. Mature COD (45.56 mg/100ml) have observed highest sodium content, while tender MYD (7.74 mg/100ml) have the lowest. Potassium concentration to be found highest in mature Arasampatty Tall (168 mg/100 ml) while tender Control (144.7 mg/100ml) the lowest. Calcium and Magnesium was found to be higher in mature variety of COD (89.32 mg/100ml) and Ayyampalayam (37.5 mg/100ml) respectively. While the tender variety of MOD holds the lowest calcium and magnesium concentration 33.9 mg/100ml and 14.3 mg/100ml respectively.

A better understanding of the compositional variations between tender and matured coconut water can support the development of innovative coconut-based products, improve post-harvest utilization, reduce wastage of coconut resources and enhance the economic value of the coconut industry. Such knowledge also contributes to promoting sustainable utilization of coconut water while meeting the growing consumer demand for natural, nutritious and functional beverages.

Keywords: Fruit maturity, Mature coconut water, Mineral composition, Physicochemical properties, Tender coconut water.

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Healing through Fragrance

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Abstract

Aromatherapy is a complementary and integrative therapeutic approach that utilizes natural volatile compounds extracted from aromatic plants, commonly known as essential oils, to promote physical, psychological and emotional well-being. These essential oils are obtained through processes such as steam distillation or cold pressing from different plant parts including flowers, leaves, bark, roots and peels. The practice of aromatherapy has historical roots in ancient civilizations such as Egypt, Greece, China and India, where plant-based fragrances and extracts were used for medicinal, spiritual and cosmetic purposes. The therapeutic effects of aromatherapy are primarily mediated through inhalation and topical application. Inhaled aromatic molecules stimulate the olfactory system, influencing the limbic system of the brain, which is associated with emotions, memory and stress regulation. Topical application allows certain bio-active compounds to penetrate the skin and exert localized or systemic effects. Scientific investigations suggest that specific essential oils may exhibit antimicrobial, anti-inflammatory, anxiolytic, analgesic, antioxidant and sedative properties. Commonly used oils include lavender for relaxation, peppermint for mental alertness, eucalyptus for respiratory support, tea tree for antimicrobial activity and chamomile for its calming effects. In recent years, aromatherapy has gained increasing attention in healthcare settings as a supportive intervention for managing stress, anxiety, pain, sleep disturbances and treatment-related symptoms. It is widely used in hospitals, palliative care, rehabilitation centres and wellness programs to improve patient comfort and quality of life. Although growing evidence supports its therapeutic potential, clinical outcomes may vary depending on essential oil composition, dosage, method of administration and individual response, highlighting the need for further evidence-based research.

Keywords: Aromatherapy, Essential oils, Volatile plant compounds, Complementary therapy, olfactory system, Inhalation.

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Occurrence and In Vitro Management of Die Back, Gummosis and Stem End Rot on Acid Lime

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Abstract

Acid lime is affected by several fungal diseases leading to low productivity. Among them, die back, gummosis and stem end rot caused by *Lasiodiplodia* sp. are the most destructive resulting in significant economic losses to the farmers. Timmer *et al*., 2000 has reported that the fungal disease damages Citrus and related genera globally accounting for 10 to 30% of losses in orchards worldwide. A survey conducted in acid lime growing regions of Tamil Nadu revealed that die back (25.60 %), gummosis (22.00 %) and stem end rot (18.35 %) was high in Kenathupatti of Dindigul district, Sothuparai of Theni district and Salaipudur of Erode district respectively. *Lasiodiplodia* sp. was isolated from the diseased samples using PDA medium and the pure culture was maintained at 4°C on PDA slants. *In vitro* studies to screen antagonists against *Lasiodiplodia* sp. showed that among the bacterial isolates tested, isolate 16 was effective against *Lasiodiplodia* sp. exhibiting mycelial inhibition of 85.56 % over control. The isolate 16 was further sequenced and confirmed to be *Bacillus tequilensis*. In case of screening fungicides, the fungicides fosetyl -AL 80 % WP, propineb 70% WP, zineb 75% WP and carbendazim 12% + mancozeb 63% WP recorded 100 per cent inhibition of mycelial growth of *Lasiodiplodia* sp. over control.

Keywords: Acid lime, *Lasiodiplodia* sp., management, antagonist, fungicide

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Deep Learning-Based Detection of Nutrient Deficiencies in Rice Using Convolutional Neural Networks

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Abstract

Timely identification of nutrient deficiencies is essential for improving rice productivity and nutrient management. This study developed a convolutional neural network (CNN) model to detect major nutrient deficiencies in rice using leaf images captured under field conditions. A total of 1,670 images representing nitrogen (N), phosphorus (P), potassium (K), iron (Fe) and zinc (Zn) deficiencies were collected. The dataset was divided into training and testing sets to evaluate model performance. The CNN model was trained for 50 epochs and showed progressive improvement in both training and validation accuracy with stable convergence. The model classified Fe and Zn deficiencies with near-perfect accuracy of 99.2% and 99.9%, respectively. Nitrogen deficiency achieved an accuracy of 96.9%, while phosphorus and potassium deficiencies recorded accuracies of 91.5% and 92.0%, respectively. Precision, recall and F1-score values confirmed balanced performance across all nutrient classes, with macro and weighted averages of approximately 0.92. The overall Cohen's kappa coefficient of 0.843 indicated almost perfect agreement and demonstrated the reliability of the model. The results highlight the effectiveness of CNN for accurate nutrient deficiency detection in rice. The proposed approach provides a rapid, non-destructive and cost-effective tool that can support precision nutrient management and improve decision-making in modern rice production systems.

Keywords: Convolutional neural network (CNN); Rice; Nutrient deficiency; Deep learning; Precision agriculture.

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Field Evaluation of Megatex Spray for Ectoparasite Management and Its Subsequent Impact on Productive Performance in Crossbred (Kanni Aadu × Kodi Aadu) Goats of Pudukkottai District

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Abstract

Background: Ectoparasitic infestations present severe economic bottlenecks in traditional caprine husbandry across Tamil Nadu, causing persistent skin irritation, anemia, and stunted growth. This study evaluated the field-level therapeutic efficacy of Megatex spray against common ectoparasites and its consequent impact on production gains in indigenous crossbred goats.

Methodology: An On-Farm Trial (OFT) was designed and implemented by KVK, Pudukkottai from June to December 2025 across three distinct veterinary blocks: Pudukkottai, Viralimalai, and Thiruvarankulam. Prolific crossbred goats (Kanni Aadu × Kodi Aadu; n = 150) exhibiting visual clinical signs of infestation and positive skin scrapings were treated with topical Megatex spray applications spaced 14 days apart. Parameters including immediate parasite clearance, recurrence intervals up to 90 days, and longitudinal body weight variations were systematically recorded. Statistical analysis was performed using RStudio (v2025.12.0) to compute paired t-tests and Chi-square values.

Results: Topical administration of Megatex achieved a peak parasite clearance efficiency of 98.5% within 48 hours. The incidence of recurrence was remarkably low (4.0%) over the 90-day post-treatment observation period across all three blocks. Relieved from parasite-induced stress, the treated crossbred goats demonstrated a significant turnaround in growth metrics, recording a mean cumulative body weight gain of 2.15 kg per animal over 60 days compared to the untreated control group ($t(198) = 8.42$, $p < 0.01$).

Conclusion: Megatex spray serves as a highly potent, farm-accessible, and economically viable ectoparasiticide for indigenous crossbred meat goats. Its deployment effectively curtails parasite burdens, prevents rapid reinfestation, and directly enhances the meat production potential of caprine herds in South Indian agro-climatic zones.

Keywords: Goat, Ectoparasites, Herbal spray

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Natural Food Colorants from Agricultural Crops- The Role of Fermentation in Enhancing Functionality

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Abstract

The demand for natural substitutes for synthetic food colorants, which are linked to possible negative health effects and stringent regulations, has increased due to growing consumer awareness of food safety and health. The Tropical agricultural commodities offer abundant and diverse sources of natural pigments, including anthocyanins, carotenoids, chlorophylls, and betalains, which also exhibit functional bioactivities such as antioxidant and antimicrobial properties. However, challenges related to pigment stability, bioavailability, and efficient utilization of agro-industrial waste remain significant. This aims to evaluate the potential of natural pigments derived from tropical agricultural commodities and their enhancement through fermentation processes for application as functional food colorants.

This provides the indication that the fermentation process using different microorganisms such as bacteria, yeast and molds plays vital role in developement of pigment structure, maintaining or increasing the stability under environmental conditions and therefore enhancing the biological activity through enzymatic activity. Therefore, the use of tropical agriculture waste materials including fruit peel and the residues during processing provides an opportunity for sustainable production of pigment, supporting waste vaporization . Fermentation process mainly contribute to the improving pigment extractability and functionality, making it suitable for incorporation into food systems.

Overall integration of the whole process with fermentation technology presents a promising approach to produce sustainable and functional natural food colorant s. And further the process will be helpful for the optimization and scale up the production process for industrial activities.

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Smart Vertical Farming: Transforming Sus tainable Agriculture for Future Food Security

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Abstract

The world's population, the effects of climate change, urbanization and the dwindling availability of arable land are all huge problems for sustainable and available food production. Smart Vertical Farming (SVF), a new approach to vertical crop cultivation that enables cultivation throughout the year in a small space, using the latest technologies such as hydroponics, LED grow lights, Internet of Things (IoT) monitoring and automated climate control systems. The aim of this review is to evaluate the potentials and opportunities of smart vertical farming to sustainably fulfill food needs without compromising safety. Some recent studies have demonstrated that there are potential benefits to using SVF compared to traditional farming, including a 90-95% reduction in water use, reduction in pesticide use, increased crop productivity and land use optimization. Although these benefits are encouraging there are technical requirements, energy use and high up-front costs to consider if this is to be widely adopted. This paper reviews the recent advancement, environmental issues, economic issues, and future prospects of the smart vertical farming. The findings suggest that a sustainable use of renewable energy, AI and precision agriculture technologies may also enhance the efficiency and sustainability of vertical farming systems. Smart Vertical Farming can be considered a groundbreaking solution for achieving resilient food production and is playing a role in global sustainable development and food security.

Keywords: Smart Vertical Farming, Sustainable Agriculture, Food Security, Hydroponics, IoT, Precision Agriculture.

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Artificial Intelligence-Based Facial Recognition for Individual Identification of Sheep/Goats Using ConvNeXt

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Abstract

Individual identification of goats is an important requirement for precision livestock farming, particularly for automated monitoring of growth, feeding, health, and production performance. Conventional identification methods such as ear tagging require physical handling and may limit the development of fully automated livestock management systems. Artificial intelligence and computer vision technologies offer a contactless approach for identifying individual animals through their facial characteristics. This project focused on the collection and processing of labelled goat face images for developing a ConvNeXt-based facial recognition system. Images were collected from a herd of 15 goats using mobile phone cameras under natural farm conditions during morning, midday, and late-afternoon periods to incorporate variation in lighting. Multiple facial views, including frontal, left-profile, and right-profile images, were captured and systematically labelled according to individual goat identification numbers. Images affected by poor lighting, blurriness, or facial obstruction were removed before model development. The cleaned dataset was divided into training, validation, and testing sets in a ratio of 70:20:10 and subsequently used for initial ConvNeXt model training. The model achieved an initial classification accuracy of approximately 60%, providing a baseline for further improvement. Variations in natural lighting, similarities in facial and coat characteristics, limited image numbers per individual, and animal movement were identified as major challenges influencing recognition performance. Increasing the number and diversity of images, particularly underrepresented poses and lighting conditions, together with appropriate data augmentation and iterative model training, could improve recognition accuracy. In conclusion, AI-based facial recognition demonstrates promising potential as a stress-free and contactless method for individual goat identification and could support future automated systems for weighing, feeding, health monitoring, and precision livestock management.

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Studies on the Performance of the Tree Borne Oilseeds in Comparison with Avenue Trees under Agro Forestry System in Rainfed Alfisol tracts of Sivagangai District of Tamil Nadu

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Abstract

A field experiment was carried out during the period from 2022-2024 at Dryland Agricultural Research Station, Chettinad, Sivagangai, Tamil Nadu to study the comparative performance of the tree borne oil seeds and avenue trees in the agro forestry system. In the present study, eight tree species were taken for the experimentation. Among these, three tree species of tree borne oilseeds (Mahua, Pungam and Neem) and five avenue tree species (Red gulmohar, Yellow gulmohar (Shield tree), Rain tree, Poovarasu and Golden shower) were taken to study in the rainfed alfisol tracts of Sivagangai district. The observations like plant height, stem girth (Bottom, middle and top), number of branches and biomass yield were recorded. Among the tree borne oilseed species, Neem (*Azadirachta indica*) found to be superior growth characters in comparison with other species like Pungam (*Pungamia pinnata*) and Mahua (*Madhuca longifolia*). Among the avenue tree species, Shield tree (*Delonix regia*) was found to be better tree species in terms of morphological behavior and other growth parameters as compared with other avenue tree species.

Keywords: Raifed alfisols, Tree borne oilseeds, Avenue trees.

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Bio-efficacy of Novel Insecticides Against the Pod Borers Of Mungbean (Vigna radiata L.)

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Abstract

A field experiment was conducted at the student agricultural farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, during Kharif 2023-24 to evaluate the bio-efficacy and economics of selected insecticides against major pod borers, Helicoverpa armigera and Maruca vitrata, in mungbean. Eight insecticidal treatments, viz., chlorantraniliprole 18.5 SC, flubendiamide 20 WG, flubendiamide 480 SC, lufenuron 5.4 EC, thiodicarb 75 WP, indoxacarb 14.5 SC, pyridalyl 10 EC, and novaluron 10 EC, were compared with an untreated control in a replicated field trial. Two sprays were applied, and larval populations were recorded before spraying and at 3 and 7 Days After Spray (DAS) for each application. The results revealed that all insecticidal treatments significantly reduced larval populations of both Helicoverpa and Maruca compared to the untreated control. Chlorantraniliprole 18.5 SC proved most effective, recording the lowest Helicoverpa population (0.13 larvae/plant at 7 DAS after second spray) and Maruca population (0.20 larvae/plant at 7 DAS after second spray), compared to 2.06 and 1.06 larvae/plant, respectively, in the untreated control. Flubendiamide 20 WG and flubendiamide 480 SC were statistically at par with chlorantraniliprole, maintaining low larval populations of Helicoverpa (0.20-0.26 larvae/plant) and Maruca (0.26-0.33 larvae/plant) at 7 DAS after the second spray. Pyridalyl 10 EC and indoxacarb 14.5 SC also provided effective control, whereas lufenuron 5.4 EC, thiodicarb 75 WP, and novaluron 10 EC were comparatively less effective but still superior to the control. Economic analysis showed clear differences among treatments. The highest grain yield was recorded with chlorantraniliprole 18.5 SC (708.33 kg ha^{-1}), followed by flubendiamide 20 WG (700.00 kg ha^{-1}), flubendiamide 480 SC (683.33 kg ha^{-1}), and pyridalyl 10 EC (629.16 kg ha^{-1}), compared to only 495.83 kg ha^{-1} in the untreated control. Additional yield over control ranged from 79.83 kg ha^{-1} (novaluron 10 EC) to 212.50 kg ha^{-1} (chlorantraniliprole 18.5 SC). Correspondingly, the highest net returns were obtained from chlorantraniliprole 18.5 SC (₹13,785.75 ha^{-1}) with the maximum incremental cost-benefit ratio (ICBR) of 1:3.13, followed by flubendiamide 480 SC (1:2.48) and flubendiamide 20 WG (1:1.91). Treatments such as lufenuron, thiodicarb, and novaluron recorded lower ICBR values (<1.0), indicating poor - viability. Overall, chlorantraniliprole 18.5 SC emerged as the most effective and economically viable insecticide for managing mungbean pod borers under eastern Uttar Pradesh conditions, followed by flubendiamide formulations, and can be recommended as an important component of integrated pest management strategies.

Keywords: Mungbean, Helicoverpa, Maruca, Chlorantraniliprole 18.5 SC

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Microplastics as Hitchhikers in Marine Ecosystems

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Abstract

Microplastics (MPs) are increasingly recognized as persistent contaminants in aquatic ecosystems, posing ecological and public health risks due to their ability to act as substrates for microbial colonization and as vectors for pathogens, antibiotic resistance genes, and virulence factors. Estuarine systems, characterized by dynamic hydrology and strong anthropogenic influence, are particularly vulnerable to MP accumulation and associated microbial hazards. This study presents a comprehensive investigation of MPs across estuarine and coastal environments of Karnataka, India, focusing on the post-monsoon season. MPs collected from five estuaries and coastal seafood samples were isolated and characterized, followed by high-throughput metagenomic and experimental analyses to assess microbial diversity, functional potential, and trophic transfer. The analyses revealed diverse microbial communities associated with MPs, including clinically relevant pathogens, antibiotic resistance genes, and virulence determinants, highlighting their role as reservoirs and vectors of microbial risk. In parallel, MPs were detected in a subset of seafood species, with polyethylene and fragment-type particles being predominant. Experimental exposure studies further demonstrated that MPs can be taken up across trophic levels and induce oxidative stress responses in aquatic organisms in a concentration-dependent manner. Overall, these findings demonstrate that MPs not only serve as carriers of potentially harmful microorganisms but also bioaccumulate within marine food webs, leading to measurable biological stress. This integrated assessment provides important baseline data to understand the ecological and public health implications of MP contamination in estuarine and coastal systems and underscores the need for effective strategies to mitigate plastic pollution and its cascading impacts.

Keywords: Marine environment, Microplastics, Plastisphere, Seafood, Trophic transfer

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Effect of Mango Peel Compost on Growth and Yield of Finger Millet

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Abstract

Finger millet respond well to application of manures and compost. To study the effect of mango peel compost on the growth and yield of finger millet a field experiment was conducted during *Rabi* 2024 under irrigated condition. The experiment was laid out in a Randomized Block Design (RBD) with eight treatments and three replications. The treatments included mango peel compost @ 5 t ha^{-1} and farmyard manure (FYM) @ 12.5 t ha^{-1} in combination with 75% and 100% soil test-based NPK recommendations. The experimental soil was sandy clay loam in texture, slightly alkaline in reaction and non-saline. Finger millet variety ATL 1 was cultivated by following the recommended package of practices. Observations on growth and yield attributes were recorded at the time of harvest. The results revealed that treatment T8, comprising soil test-based 100% NPK along with mango peel compost @ 5 t ha^{-1} recorded superior growth and yield attributes. The treatment registered the highest plant height (84.4 cm), number of tillers per plant (6.11) and number of ear head per plant (4.33). Similarly, the highest grain yield (2630 kg ha^{-1}) and straw yield (5213 kg ha^{-1}) were also obtained under treatment T8. The lowest grain yield (2086 kg ha) and straw yield (4320) was recorded in treatment T3 receiving FYM @ 12.5 t ha^{-1}.

Keywords: Mango peel, Compost, Growth, Grain yield, Finger millet

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Influence of Ultrasonication and GRAS Chemicals on the Quality and Shelf-Life of Minimally Processed Cluster Bean (*Cyamop sis tetragonoloba L.*) cv. Pusa Navbahar

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Abstract

Cluster bean is a highly nutritious vegetable grown in dry areas of several states of India such as Rajasthan, Gujarat, Madhya Pradesh etc. This research was done to popularize cluster bean among urban people. This study follows the new trend in food culture i.e. "Ready-to-Cook" (RTC) without the extensive preparation time. In this experiment, minimally processed cluster bean pods were treated with ultrasonication and GRAS (Generally Recognized As Safe) chemicals at different concentrations to evaluate their effects on shelf-life and quality characteristics. Freshly harvested pods were cut into small pieces (2cm long) and subjected to ultrasonication using an ultrasonic water bath (40kHz, 5 minutes). After air drying, the cut pieces were treated with two concentrations of chitosan (0.2% and 0.4%), calcium chloride (2% and 4%), clove oil (0.1% and 0.2%) and orange oil (0.1% and 0.2%). The treated pieces were air dried, packed in sample containers and stored in refrigerator (5 ± 2^0C) for 30 days. Physio-biochemical parameters were recorded at 0th day, 10th day, 20th day and 30th day. The experimental results revealed that on the 30th day of storage at 5 ± 2^0 C, cluster bean pods exposed to ultrasonication coupled with 2% calcium chloride (T5) treatment, exhibited significantly higher values for firmness (2.65 lb force), colour values (L*= 55.07, a*= -5.46, b* = 23.79), moisture content (84%), total antioxidant activity (80.89 mg/mL), total phenolic content (70.12 mg/mL), total flavonoids (34.80 mg/mL), soluble protein (2.08 mg/g FW), total chlorophyll content (2.31 mg/g FW), superoxide dismutase enzyme activity (0.385 Units/mL). The same treatment also registered significantly lower physiological loss in weight (0.40%), pectin methylesterase enzyme activity (0.140 Units/mL) and spoilage (14.20%) on 30th day of storage compared to other treatments including the control. This research highlights the promise of GRAS chemicals and ultrasonication as environment friendly, cost-saving and non-toxic substances for achieving post-harvest quality maintenance and shelf-life extension of minimally processed cluster bean pods for 30 days in refrigerator (5 ± 2^0C). Ultrasonication and GRAS chemicals match increasing consumer trend for safer, healthier and more sustainable value addition strategy.

Keywords: Ready-to-Cook, GRAS chemicals, ultrasonication, calcium chloride, antioxidant, spoilage, enzyme activity, shelf-life.

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Influence of Intrapersonal Intelligence and Technical Awareness Among Farm Women in Choosing an Entrepreneurial Career in Tamil Nadu

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Abstract

Well perceived self-competence and self awareness have always been the key factors behind many successful entrepreneurs. Entrepreneurship careers involve a robust risk bearing capacity to develop a successful enterprise. Basic awareness about the entrepreneurship environment coupled to a strong personality with a deep intrapersonal understanding are the optimum qualities that one can have, to take on the path of entrepreneurship. Intrapersonal intelligence is a core component of emotional intelligence. Enhanced intrapersonal skills and intelligence help in steering through complex decision making processes with a greater ease. Several studies have shown that emotional intelligence can improve entrepreneurial performance and potential. This study attempts to quantify the level of self-awareness and technical awareness and the effect it has on entrepreneurial decisions among 1000 farm women of Tamil Nadu and recommendations were given based on the results. A set of statements were included in the questionnaire that is used for the survey to assess the level of intrapersonal intelligence and basic awareness among the farm women relating to involvement in business aspects such as education & training, finance, legal, marketing and business practices. Ranks were given based on the score obtained with rank - I indicating a very low level of awareness and so on. From the responses, it was found that the level of self awareness & initiative to start a business was at rank- II (score - 4.32), representing a low level of intrapersonal intelligence. Maximum score (5.0) was obtained in the aspects such as financial awareness, legal or procedural awareness and market and marketing awareness, bringing the level of awareness to rank - I, demanding immediate interventions to increase the awareness. The aspects, awareness regarding education & training awareness regarding business practices have comparatively scored low (4.8 & 4.72 respectively). Nevertheless, they need serious interventions as well. The results showed that the selected farm women's overall awareness level on different aspects were very poor, which was scored as rank - I, indicating a very low level of awareness about enterprise qualification. Although around 45% level of awareness about the NGOs and SHGs, reveal an intertwined connection between SHGs and rural women community. While it is evident that the technicalities can be taught through professionals and experts of the respective fields, it is recommended that conducting sessions to farm women under study, that involves captivating lectures from the successful individuals/ entrepreneurs and sharing the success story articles in local language will help to boost the self-esteem and the level of self -awareness of the individuals involved.

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Host Plant-driven Differences in Behavioural Responses and Life-history Performance of Fruit Fly, *Zeugodacus cucurbitae*

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Abstract

Host selection in polyphagous tephritids such as *Zeugodacus cucurbitae*, is intricately mediated by plant-derived volatile organic compounds (VOCs), which function as critical determinant for reproductive success and fitness. This study investigated the olfactory orientation, ovipositional preference, and demographic fitness of *Z. cucurbitae* across three major cucurbit hosts: sponge gourd (*Luffa aegyptiaca*), bottle gourd (*Luffa siceraria*), and bitter gourd (*Momordica charantia*), utilizing fruits at distinct developmental stages. Gravid females displayed strong and stage-specific olfactory preferences, with maximum attraction toward 3-day-old sponge gourd and bottle gourd fruits and 5-day-old bitter gourd for oviposition. In contrast, virgin females showed non- significant attraction, underscoring the influence of reproductive status on host-seeking behaviour. When responses were compared among host species, gravid females exhibited a clear hierarchy of preference. Sponge gourd emerged as the most attractive host, followed by bottle gourd, whereas bitter gourd consistently showed the lowest attractiveness. Oviposition assays further demonstrated host discrimination, with sponge gourd receiving the highest egg deposition under both choice (554 ± 20.39 eggs/female) and no-choice bioassay (519 ± 12.59 eggs/female). Population reared on sponge gourd yielded highest intrinsic rate of increase r (0.102), finite rate of increase λ (1.108), and net reproductive rateR0 (62.29), confirming its suitability for offspring development and population establishment. By establishing a direct linkage between VOCs-mediated host selection and offspring performance, these findings provide a critical foundation for isolating stage-specific semiochemicals to advance behavioural manipulation strategies.

Keywords: Semiochemicals, Cucurbits, *Zeugodacus cucurbitae,* Pest management, volatile organic compounds (VOCs)

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Waste to Wealth: Circular Economy Approach using Multisubstrate Fruit Waste Derived Activated Carbon

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Abstract

Heavy metal pollution in water poses significant public health and ecological risks. Traditional remediation methods often struggle with high costs and low efficiency. Activated carbon from fruit waste serves as a sustainable adsorbent for water contaminants. When paired with electrospun nanofiber membranes that have a high surface area, this approach provides an efficient and eco friendly solution for addressing heavy metal pollution in water.

The present investigation entitled *"Formulation and evaluation of multisubstrate granular activated carbon and electrospun membrane made from fruit wastes for remediation of heavy metal polluted water"* was carried out in the year 2025 at the College of Horticulture, Mojerla, Sri Konda Laxman Telangana Horticultural University. The experiment was conducted using a Completely Randomized Design (CRD). The study comprised eight treatment combinations (T0 to T6). Treatments were as follows: T0G is designated as a granulated carbonized carbon which is subjected for further chemical activation to improve textural properties and T0M designated as carbonized carbon incorporated into the membrane system with different chemical activating agents ($ZnCl_2$ + KOH + K_2CO_3 + H_3BO_3 + HNO_3 + H_3PO_4) along with the polymer ingredients like cellulose acetate, precursor materials from fruit wastes (pomegranate peel, jackfruit rind, bael shell, banana pseudo stem, aidan fruit and protein (MoCP)) subjected to pyrolysis and activation at high temperature (600 °C) for carbonization time (1 hour) to produce activated carbon with improved efficiency in adsorption of heavy metals (Arsenic and Cadmium).

The work attempted to investigate characterization of activated carbon produced from different fruit wastes (pomegranate peel, jackfruit rind, bael shell, banana pseudo stem, aidan fruit and moringa protein). It was observed that the morpho physicochemical properties of multisubstrate granular and powdered activated carbon varied significantly across treatments.

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Among the treatments, T4 had the highest moisture (15 ± 0.68%) content, while T6 had the lowest moisture content (4 ± 0.83%). The volatile matter of activated carbon was maximum (30 ± 1.03%) in T4, while the minimum (9 ± 0.15%) volatile matter content was observed in T5. The ash content was highest (16 ± 0.73%) in T2 and the lowest (10 ± 0.17%) ash content was observed in T4. The treatment with the highest (69 ± 4.78%) fixed carbon content was T5, followed by T6 at 67 ± 2.32% and T1 at 64 ± 1.10%, while T4 exhibited the lowest (45 ± 1.55%) fixed carbon content. The results obtained on the pH of activated carbon varied from 9.7 ± 0.44 to 3.76 ± 0.13. Among the treatments, T1 powdered activated carbon presented an alkaline nature (pH = 9.7± 0.44), followed by T0M (9.55 ± 0.16) and T4 (9.52 ± 0.43), while T5 granular activated carbon exhibited a more acidic (3.76 ± 0.13) pH.

The results of the activated carbon yield revealed that the yields of the formulated activated carbons varied significantly, ranging from as low as 32.62 ± 0.5% to as high as 61.62 ± 2.13%. Among the treatments, T3 recorded the highest (61.62 ± 2.13%) yield and the lowest carbon yield (32.62 ± 0.5%) was recorded in T0.

The data pertaining to the BET surface area of formulated granular activated carbon and electrospun membrane varied from 537 m^2/g to 36.41 m^2/g. The results show that the T3 electrospun membrane recorded the highest (537 m^2/g) specific surface area and the total pore volume was recorded highest in T6 (1.387 cm^3/g). The highest average pore diameter (39.76 Å) was exhibited in the T0M electrospun membrane. However, the data obtained from the BET specific surface area recorded the lowest (36.41 m^2/g) in T6 granular activated carbon. Additionally, the total pore recorded the lowest (0.071 cm^3/g) in T0, while the average pore diameter was recorded lowest (9.86 Å) in T5 granular activated carbon.

Keywords: Waste to wealth, Circular economy, Fruit waste valorisation, Granular activated carbon, Chemical activation, BET surface area

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Smart Composting: From Municipal Waste to Commercial Compost

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Abstract

Rapid urbanization and industrialization have resulted in a substantial increase in municipal solid waste (MSW) generation, leading to serious environmental pollution and public health concerns. Sustainable waste management through efficient composting technologies is essential for reducing waste accumulation and converting biodegradable waste into value-added organic manure. The present study aimed to standardize an improved composting technique using a TNAU novel microbial consortium for rapid decomposition of municipal solid biowaste and to evaluate the quality of the compost produced. The study was conducted at three Micro Compost Centres (MCCs), namely Menenthal, Thiruppalai, and Thirumangalam, covering eleven wards of Madurai Corporation. The investigation included characterization of biodegradable waste, standardization of the composting process using the TNAU microbial consortium as an alternative to the conventional Effective Microorganism (EM) solution, and evaluation of compost quality. The consortium consisted of P*hanerochaete chrysosporium, Pleurotus sajor-caju,* and *Trichoderma erinaceum.* One tonne of segregated municipal biowaste was inoculated with the consortium and composted under controlled conditions of 60% moisture, aeration by turning once every two days, and temperatures maintained between 32 and 60°C. Compost maturity was assessed through changes in colour, odour, texture, pH, and electrical conductivity, followed by analysis of total NPK, organic carbon, and heavy metals. The TNAU novel microbial consortium reduced the composting period to 40-45 days, compared to 65-70 days with the conventional EM method, while producing superior-quality compost. The findings demonstrate that the TNAU microbial consortium is an eco-friendly, efficient, and sustainable technology for rapid compost production and effective municipal solid waste management.

Keywords: Municipal solid waste (MSW), Biowaste composting, Microbial inoculantl, Rapid decomposition, Circular bioeconomy.

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Elicitation of Oilseed Crops for the Essential Fatty Acids Production in the Callus Tissues Through Plant Growth Regulators

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Abstract

Oilseed crops are the major source of fatty acids in human and the major fatty acids varies from oleic acid (OA), linoleic acid (LA), and α-linolenic acid (ALA) that are all together known as essential fatty acids (EFAs). These fatty acids are highly essential for humans to synthesize omega 3 fatty acids. Humans are unable to synthesize these EFAs and hence it acid must be provided through the diet through plant oils. ALA is the first precursor for the biosynthesis of all other omega 3 fatty acids in humans that are required for normal health, especially for brain development and function. Available reports suggest that many people have a diet with low ALA content and it needs to be increased in the available oilseed plants. Oilseed crop has the regeneration capacity that can be induced by using plant tissue culture technique, when the immature embryos, cotyledons, hypocotyls and also mature cotyledonary nodes are used as explants. At the same time, the regeneration efficiency can be varied based on the genotype and explants of the oilseed plants. Previous reports suggests that an abiotic factor such as plant growth regulator (PGR) and its combination increases the total lipid as well as the individual fatty acid content in oilseed crops. However, correlating the effect of the plant growth regulator on the whole plant in the field condition may lead to misinterpretation of the result as many biotic and abiotic factors influence the fatty acid biosynthesis. Here, the plant growth regulators such as auxin, cytokinin, GA3 and their combinations with varying concentrations were studied in the plant tissue cultured callus of major oilseed plant for the enhanced production of essential fatty acid production with special reference to α-linolenic acid (ALA) were discussed briefly. This study will be useful for the production of EFAs and other secondary metabolites through tissue cultured system without depending on the field level cultivation.

Keywords: Plant Growth Regulator (PGR), Essential Fatty Acids (EFAs), Oilseed α-linolenic acid (ALA), Linoleic acid (LA).

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A Comprehensive Review of River Pollution Dynamics from Source to First Impoundment: Environmental and Ecological Perspectives in Tamil Nadu

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Abstract

Rivers in Tamil Nadu originate predominantly from the Western and Eastern Ghats and traverse heterogeneous landscapes before reaching their first impoundments, where flow regulation modifies natural hydrological and ecological processes. According to the River Continuum Concept (Vannote *et al.*, 1980) and subsequent watershed-scale assessments (Allan, 2004; Dudgeon *et al.*, 2006), longitudinal gradients strongly influence nutrient cycling, sediment transport, and biological assemblages. However, intensifying anthropogenic pressures including agricultural expansion, forestry operations, urbanization, industrialization, and untreated domestic effluents have disrupted these natural processes in many Indian river basins (Central Pollution Control Board reports; Ramachandra *et al.*, 2018).

This review synthesizes available literature on spatial and temporal patterns of river pollution from headwaters to first impoundments in Tamil Nadu, examining contaminant sources, transport pathways, transformation mechanisms, and cumulative ecological impacts. Diffuse agricultural runoff introduces nutrients, pesticides, and sediments (Tilman *et al.*, 2001), while municipal and industrial discharges contribute organic loads, heavy metals, and emerging contaminants (Pal *et al.*, 2010). Monsoonal hydrology plays a decisive role in pollutant mobilization, dilution, and deposition across catchments (Goswami *et al.*, 2006). As rivers approach their first impoundments, reduced flow velocity enhances nutrient retention and sediment-bound contaminant accumulation, often intensifying eutrophication and ecological shifts (Wetzel, 2001; Thornton *et al.*, 1990).

Ecologically, these stressors alter physicochemical regimes, restructure microbial and benthic communities, affect native fish diversity, and weaken overall riverine integrity (Malmqvist & Rundle, 2002). By integrating hydrological connectivity concepts (Pringle, 2003) with watershed management frameworks, this review identifies critical gaps in longitudinal monitoring, cumulative impact assessment, and reservoir–river interaction studies in Tamil Nadu. The synthesis highlights the need for integrated basin-scale management strategies that prioritize headwater conservation, improved wastewater treatment, and evidence-based policy interventions to safeguard riverine and reservoir ecosystems.

Keywords: Tamil Nadu rivers, river continuum, pollution gradient, first impoundment, nutrient loading, heavy metals, ecological integrity, watershed management.

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