International Symposium on Agriculture & Environment 2026

Data-Driven Green Agriculture Transitions: From Healthy Soils to Healthy People

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Proceedings

Organized by the Faculty of Agriculture, University of Ruhuna

International Symposium on Agriculture & Environment 2026

Proceedings of the International Symposium on Agriculture and Environment (ISAE) 2026

"Data-Driven Green Agriculture Transition: From Healthy Soils to Healthy People"

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Faculty of Agriculture
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Preface

With great pleasure and enthusiasm, the Editorial Board is honored to present the Proceedings of the International Symposium on Agriculture and Environment (ISAE 2026), held under the timely and forward-looking theme **"Data-Driven Green Agriculture Transition: From Healthy Soils to Healthy People."** As the Editor-in-Chief, it is both a privilege and a responsibility to introduce this volume, which compiles innovative research, scientific insights, and forward-looking perspectives shared at ISAE 2026 on 2nd September 2026.

Agriculture is facing increasingly complex challenges arising from climate change, soil degradation, environmental pressures, resource limitations, food and nutritional security, and the growing need for sustainable development. At the same time, advances in digital intelligence, biotechnology, engineering, and data-driven technologies are creating new opportunities to transform agricultural systems. In this context, the integration of scientific knowledge, technological innovation, and responsible resource management is essential for building productive, resilient, and sustainable agriculture.

The theme of ISAE 2026, "Data-Driven Green Agriculture Transition: From Healthy Soils to Healthy People," highlights the interconnectedness of soil health, agricultural productivity, environmental sustainability, food quality, and human well-being. Healthy soils provide the foundation for sustainable food production, while responsible management of natural resources and innovative technologies can improve productivity, resource-use efficiency, and resilience. Data-driven approaches further provide opportunities for evidence-based decision-making and the development of smarter and more sustainable agricultural systems.

The symposium brings together a diverse range of research contributions, initially collected under ten thematic tracks covering crop, soil and water resource management; horticulture and plantation crops; agricultural biology and biotechnology; livestock and aquatic sciences; agricultural engineering and post-harvest technology; food and nutrition; agricultural economics, agribusiness and community engagement; climate change, environment and natural resources; emerging frontiers including standards and circular economy; and digital intelligence for climate-smart and sustainable agriculture. These diverse contributions are brought together within **five major scientific sessions**: **(1) Agricultural Engineering, Technology and Digital Intelligence, (2) Soil, Plant and Environment (3) Food Science and Post-harvest Technologies, (4) Agricultural Economics, Extension and Agribusiness, and (5) Trends in Biological Research for Sustainable Development.** Together, these sessions reflect the breadth and interconnectedness of contemporary agricultural and environmental research.
A special feature of ISAE 2026 is the **Belt and Road Session**, which provides a valuable platform for international knowledge exchange, collaboration, and sharing of experiences in sustainable agricultural development. This session strengthens the international dimension of the symposium and creates opportunities to build partnerships that can contribute to addressing shared agricultural and environmental challenges.

ISAE 2026 also continues its strong commitment to empowering the next generation of agricultural scientists and professionals through the **Young Graduates' Forum (YGF)** and the **Three-Minute Industrial Training Session (3MIT)**. The YGF provides an important platform for outstanding young graduates to showcase their research and engage with the scientific community, while 3MIT enables undergraduates to communicate their industrial training experiences and demonstrate the practical application of their academic knowledge. These initiatives celebrate young talent, creativity, and innovation while strengthening the links between education, research, and industry.

The Proceedings of ISAE 2026 embody the spirit of innovation, sustainability, collaboration, and transformation. Each contribution adds to a growing body of knowledge dedicated to addressing contemporary agricultural and environmental challenges. From healthy soils and sustainable production to food and nutrition, biological innovations, digital intelligence, circular economy approaches, and agricultural development, this collection reflects our shared commitment to building resilient and sustainable agricultural systems.

On behalf of the Editorial Board and Publication Committee, I extend my deepest appreciation to the Chief Guest, Guest of Honour, keynote speakers, session chairs, reviewers, and above all, the authors for their invaluable scholarly contributions. I also sincerely acknowledge the dedication of the Symposium Coordinator, Publication Committee, Editorial Board, and all those who contributed to the successful organization of ISAE 2026 and the preparation of these Proceedings. As we move towards an increasingly data-driven and environmentally conscious agricultural future, let us remain committed to collaboration and innovation that connect scientific knowledge with practical solutions. It is our hope that ISAE 2026 will inspire meaningful dialogue, new partnerships, and innovations that accelerate the transition towards greener agriculture from healthy soils to healthy food systems, healthy people, and a healthy planet.

Senior Prof. Wathugala G.D. Lakmini
Editor-in-Chief
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Message from the Vice Chancellor

University of Ruhuna, Sri Lanka

It is a distinct pleasure to extend my warm greetings to participants of the International Symposium on Agriculture and Environment (ISAE 2026), organized by the Faculty of Agriculture, University of Ruhuna. The theme, **"Data-Driven Green Agriculture Transition: From Healthy Soils to Healthy People,"** is both timely and transformative, urging us to rethink agriculture not only in terms of productivity but also as a system that sustains ecological integrity, human well-being, and long-term food security.

At the heart of this transition is soil. Healthy soil regulates water, cycles nutrients, sustains biodiversity, and underpins crop productivity and climate resilience. Yet soil degradation, inefficient resource use, biodiversity loss, and climatic uncertainty increasingly challenge agricultural sustainability. The pathway from healthy soil to healthy people, therefore, begins with recognizing soil as a living system that connects agricultural productivity with environmental quality, nutrition, and public health.

A data-driven green transition provides a critical response to these challenges. Precision agriculture, remote sensing, GIS, sensor networks, artificial intelligence, and data analytics enable us to understand spatial and temporal variability, diagnose constraints, and optimise the use of water, nutrients, and energy. However, data alone do not transform agriculture. Their true value emerges only when they are translated into knowledge, and knowledge into informed decisions and responsible actions that generate measurable benefits for farmers, ecosystems, and society. Technology, therefore, must serve as an enabler rather than an assistive method for finding solutions and seeing the possible end of challenges in agricultural settings. Agricultural transformation requires a careful balance between productivity and sustainability, innovation and accessibility, technology and ecology, scientific advancement and realities of farmers' lives, and so on. When integrated with ecological understanding and indigenous knowledge, digital tools can support regenerative practices, improve resource efficiency, and ensure that innovation remains practical and inclusive.

This theme further reminds us that agricultural decisions extend across entire food systems. Soil health influences crop quality; farming practices shape water resources and biodiversity; and the resilience of food systems determines nutrition, livelihoods, and community well-being. In this sense, healthy soils, healthy crops, healthy environments, healthy food systems, and healthy people form an inseparable continuum that must guide research, policy, and practice. Within this framework, ISAE 2026 serves as an important platform for connecting data, disciplines, innovations, and people. By bringing together scientists, academics, policymakers, industry professionals, practitioners, innovators, and young researchers, the symposium fosters interdisciplinary dialogue, evidence-based decision-making, responsible innovation, and meaningful collaboration to address pressing agricultural and environmental challenges.

For the University of Ruhuna, this initiative reflects our commitment to advancing knowledge through teaching, research, innovation, and service to society. Our aspiration to be the prime intellectual thrust of the nation requires academic knowledge to extend beyond the university to support regional and national development. In agriculture, this means ensuring that scientific progress translates into resilient farming systems, improved resource stewardship, and sustainable livelihoods.

I sincerely commend the Faculty of Agriculture and the organizing committee for this initiative and extend my appreciation to all contributors, reviewers, keynote speakers, participants, and partners.

I am confident that ISAE 2026 will help transform agricultural knowledge from data to decisions, from research to responsible action, and from healthy soils toward resilient food systems, healthier communities, and sustainable development.

Senior Prof. P. A. Jayantha
Vice Chancellor
University of Ruhuna
Sri Lanka

Message from the Dean

Faculty of Agriculture, University of Ruhuna, Sri Lanka

It is my profound honour and privilege, as Dean of the Faculty of Agriculture, University of Ruhuna, to welcome our distinguished guests, keynote speakers, researchers, academics, industry leaders, policymakers, development partners and students from Sri Lanka and around the world to the International Symposium on Agriculture and Environment 2026 (ISAE 2026).

I extend a special welcome to our Chief Guest, Hon. Prof. Chrishantha Abeysena, Minister of Science and Technology, whose presence adds immense significance to this occasion. I also warmly welcome our Guest of Honour, Her Excellency Ms. Ruth Baird, Deputy High Commissioner of Australia to Sri Lanka, and appreciate her commitment to science, innovation and national development. Since 2008, ISAE has connected science, technology, policy, industry and society, fostering knowledge exchange, partnerships and practical solutions for sustainable agriculture and environmental stewardship.

The theme of ISAE 2026, **"Data-Driven Green Agriculture Transition: From Healthy Soils to Healthy People,"** with the supporting theme "Catalyzing Smart Fertilizer Management, Circular Economy, and Climate Resilience through ICT and AI Integration," is timely. Human health is inseparable from healthy soils, water, biodiversity, climate and food systems, which sustain nutritious diets, productive societies and resilient economies.

We meet amid intensifying droughts, floods, heat stress, soil degradation, biodiversity loss and pollution. Geopolitical instability and disruptions to energy, fertilizer and supply systems compound these pressures. In Sri Lanka, they directly affect input costs, farmer livelihoods, food prices and national food security. Agriculture must therefore provide nutritious food while restoring ecosystems, conserving resources, reducing pollution and improving farmer incomes. Healthy soils are central to this transformation, sustaining biodiversity, regulating water and storing carbon. We must move towards site-specific nutrient management informed by soil testing, sensors, spatial information, crop demand and environmental thresholds.

The 21st century offers unprecedented tools. Artificial intelligence can integrate satellite, drone, sensor, weather and market data for predictive decisions. Digital twins, the Internet of Things, robotics, remote sensing and precision agriculture can improve productivity while reducing labour constraints and environmental footprints. Yet technology is a means, not an end. It must improve farmers' lives, create employment and strengthen food security. Artificial intelligence must be responsible, explainable, accessible and locally relevant, addressing privacy, cybersecurity, bias and the rural digital divide so that smallholders benefit alongside larger enterprises.

The green transition must also embrace renewable energy and circular bioeconomy. Solar irrigation, renewable-energy powered cold chains, efficient machinery, biogas and biomass conversion can reduce emissions and costs, while agricultural residues can become compost, biochar, animal feed, biomaterials, energy, while creating new sources of rural income.

Scientific discoveries cannot transform agriculture while confined to laboratories, theses and journals. Universities must drive technology transfer, enterprise creation and national development, with success measured through farmer adoption, marketable products, patents,

start-ups and employment. This requires university–industry–government–community collaboration from problem identification to validation and scaling. Our graduates must become job creators, not only job seekers, converting ideas into useful products, services and sustainable enterprises.

The Faculty of Agriculture, University of Ruhuna, advances this transformation through its seven departments, interdisciplinary programmes, research, industry partnerships and community engagement. Our HARVEST Innovation and Incubation Centre help identify, prototype, protect, incubate, commercialize and scale promising student and staff innovations.

ISAE 2026 is more than a research forum; it is a platform for interdisciplinary partnership and action. Its tracks span crop, soil and water resources; horticulture and plantation crops; biology and biotechnology; livestock and aquatic sciences; agricultural engineering and post-harvest technology; food and nutrition; economics, agribusiness and community engagement; climate and natural resources; emerging frontiers, standards and the circular economy; and digital intelligence for sustainable agriculture.

I am particularly proud of the Young Graduates' Forum and the Three-Minute Industrial Training (3MIT). These initiatives enable emerging researchers and students to communicate findings and industrial-training experiences, engage with professionals and strengthen their scientific, professional and entrepreneurial readiness. They demonstrate how research can progress from an idea to a prototype, product and enterprise.

I sincerely thank the Symposium Coordinator, Prof. B. C. Walpola; Secretary, Prof. S. R. Amarasinghe; committees; reviewers; technical teams; sponsors; partners; and volunteers who made ISAE 2026 possible. I also thank our dignitaries, keynote speakers and participants for sharing their expertise.

May ISAE 2026 inspire research that progresses from publication to application, innovations that move from laboratories to society, collaborations that cross boundaries, and enterprises that create employment, resilience and shared prosperity. Together, let us build agriculture that is intelligent yet inclusive, productive yet regenerative, technologically advanced yet human-centred, globally connected yet locally grounded, and capable of creating a healthier, equitable and sustainable future.

Senior Prof. Guttila Yugantha Jayasinghe
Dean
Faculty of Agriculture
University of Ruhuna
Sri Lanka
2 September 2026

Message from the Coordinator

International Symposium on Agriculture and Environment (ISAE) 2026

It is with great pride and a sense of profound honor that I convey this message on the occasion of the **International Symposium on Agriculture and Environment (ISAE) 2026**, organized by the Faculty of Agriculture, University of Ruhuna, under the timely and highly relevant theme, **"Data-Driven Green Agriculture Transition: From Healthy Soils to Healthy People."**

Agriculture is at a critical juncture, necessitating a comprehensive restructuring of global food production paradigms. The challenges posed by anthropogenic climate change, ecological degradation, diminishing soil health, widespread nutritional insecurity, and the growing pressure for sustainable food systems, demand an immediate transition in agricultural governance, resource utilization, and consumption patterns. Simultaneously, accelerated advancements in science, digital technologies, data analytics, precision agriculture, and innovation provide unprecedented opportunities to transform our agricultural systems towards greater productivity, systemic resilience, ecological sustainability, and socioeconomic inclusiveness.

ISAE 2026 provides a valuable platform for researchers, academics, policymakers, industry professionals, development practitioners, and young scientists to share knowledge, exchange experiences, and explore innovative solutions to the pressing challenges. The symposium brings together diverse perspectives across agriculture, environmental sciences, soil and crop sciences, food systems, biotechnology, climate action, digital technologies, and related disciplines.

The theme of this symposium reflects an important continuum—from **healthy soils to healthy crops, healthy food, healthy people, and a healthy planet**. Harnessing reliable data and scientific knowledge to guide agricultural decision-making will be essential in achieving this transition. Of parallel significance is the strengthening collaboration among researchers, institutions, policymakers, farmers, and other stakeholders so that scientific innovations can be translated into practical and meaningful solutions.

The proceedings of ISAE 2026 represent the collective contribution of researchers and professionals who are committed to advancing agricultural and environmental sustainability. Each contribution reflects an effort to generate knowledge, address real-world challenges, and contribute to a more resilient and sustainable future. I sincerely appreciate the dedication and commitment of all authors, reviewers, keynote and invited speakers, session chairs, members of the scientific and organizing committees, sponsors, partners, and everyone who has contributed to making ISAE 2026 a reality. I particularly acknowledge the enthusiasm and valuable contributions of our young researchers, whose ideas and innovations will play a vital role in shaping the future of agriculture and the environment.

I hope that the knowledge shared through these proceedings will stimulate new ideas, strengthen collaborations, inspire further research, and ultimately contribute to meaningful transformations in agricultural and environmental practices. On behalf of the Organizing Committee, I wish you all a productive, inspiring, and memorable symposium.

Senior Prof. B.C. Walpola
Conference Coordinator - ISAE 2026

Message from the Chief Guest

International Symposium on Agriculture and Environment (ISAE) 2026

It is with great pleasure that I extend my warm greetings and best wishes to the organizers, distinguished keynote speakers, researchers, academics, industry professionals, students, and all participants of the **International Symposium on Agriculture and Environment (ISAE) 2026**, organized by the Faculty of Agriculture, University of Ruhuna.

The theme of this year's symposium, **"Data-Driven Green Agriculture Transition: From Healthy Soils to Healthy People,"** reflects the urgent need to harness science, technology, and innovation to transform agriculture into a more resilient, productive, and environmentally sustainable sector. As nations strive to address the complex challenges of climate change, food security, natural resource conservation, and public health, scientific research and technological advancement remain indispensable in shaping evidence-based solutions.

Sri Lanka possesses a strong foundation of scientific talent and agricultural expertise. By integrating digital technologies, artificial intelligence, precision agriculture, biotechnology, geospatial sciences, and data analytics into our agricultural systems, we can accelerate innovation, improve productivity, enhance resource-use efficiency, and strengthen national food security while safeguarding our environment for future generations.

International scientific forums such as ISAE provide an invaluable platform for knowledge exchange, interdisciplinary collaboration, and the development of partnerships among researchers, policymakers, industry leaders, and development partners. Such collaborations are essential for translating research into practical innovations that benefit farmers, communities, and society at large.

I commend the Faculty of Agriculture, University of Ruhuna, and the Organizing Committee for their dedication and vision in convening this important international event. Their continued commitment to promoting excellence in research and fostering global scientific collaboration is highly commendable.

I am confident that the deliberations and outcomes of ISAE 2026 will contribute significantly to advancing sustainable agricultural development and strengthening Sri Lanka's journey towards a knowledge-based, innovation-driven economy.

I wish ISAE 2026 every success and hope that all participants enjoy a productive, enriching, and memorable symposium.

Hon. (Prof.) Chrishantha Abeysena, M.P.
Minister of Science and Technology
Democratic Socialist Republic of Sri Lanka

Keynote Speech of the Inaugural Session

More Food, Fewer Resources: What Sensors Are Teaching Us?

Matteo Poggio*
Agrocares, Wageningen, Netherlands

Abstract:
From the first analysis of an agricultural product by a Near-Infrared (NIR) spectrometer, carried out by Norris and Williams in the late 1960s and early 1970s, to today's arable fields managed almost entirely by robots, the development of sensors and their associated calibration models for measuring environmental properties has been continuous. Today, we have affordable handheld sensors and sensor networks that generate data continuously within a matter of seconds. With a single analytical methodology, we can measure soil, leaves, feed, milk, and manure alike; or build sensing platforms that integrate multiple sensors, each examining the sample from a different perspective. We have reached the point where generating accurate data on crop and soil status is rapid and easily achievable. We now have the luxury of two path ahead of us. On one side lies the research path, where we can dive deep into soil and crop processes long hidden from us by limitations in data, computing power, and model complexity. We can revisit long-held assumptions accepted for lack of better information and build digital twins of soil pedons to explore future scenarios under different climate projections. On the other side lies the adoption path, where we strive to reach as many farmers and stakeholders as possible with field sensors that support their daily routines. With the support of specialized AI agents, we can help interpret sensor-generated data and translate it into measurable actions, helping farmers tackle the challenge we all face: producing healthy food, for more people, with fewer resources.

Keywords: Artificial Intelligence; Near-Infrared (NIR) Spectroscopy; Precision Agriculture; Sensors; (AI); Sustainable Agriculture

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Message from the Secretary

International Symposium on Agriculture and Environment (ISAE) 2026

It is with immense pleasure to share this message and extend my warmest greetings and a cordial welcome to all distinguished guests, keynote speakers, researchers, academics, industry professionals, policymakers, students, and participants to International Symposium on Agriculture and Environment (ISAE 2026) organized by the Faculty of Agriculture, University of Ruhuna. The theme of this year's symposium, **"Data-Driven Green Agriculture Transition: From Healthy Soils to Healthy People,"** supported by "Catalyzing Smart Fertilizer Management, Circular Economy, and Climate Resilience through ICT and AI Integration," reflects the urgent need to harness innovative technologies and interdisciplinary collaborations to address contemporary challenges in agriculture and environmental sustainability. The integration of data-driven decision-making, artificial intelligence, and information and communication technologies presents transformative opportunities for promoting sustainable agricultural practices, enhancing resource-use efficiency, strengthening climate resilience, and ultimately improving human well-being through healthier ecosystems.

On behalf of the Organizing Committee, I am deeply honored to extend my sincere appreciation to our Chief Guest, Hon. (Prof.) Chrishantha Abeysena, Minister of Science and Technology and our Guest of Honor, Her Excellency Ms. Ruth Baird, Deputy High Commissioner of Australia to Sri Lanka for graciously accepting our invitation. I sincerely appreciate our Keynote Speaker Dr. Matteo Poggio, Soil and Sensor Specialist, Wageningen, the Netherlands for sharing his invaluable knowledge, insights, and experiences with the symposium participants. I would also like to express my profound gratitude to our Vice Chancellor, Snr. Prof. PA Jayantha, University of Ruhuna and the Dean, Snr. Prof. GY Jayasinghe, Faculty of Agriculture, University of Ruhuna for their visionary leadership, continuous encouragement, and unwavering support in making this international symposium a reality. Their commitment to fostering excellence in research, innovation, and academic collaboration has been instrumental in the successful organization of this event. The proceedings of ISAE 2026 represent the collective efforts of researchers and practitioners from diverse disciplines who have contributed original scientific findings, innovative ideas, and practical solutions to advance sustainable agriculture and environmental stewardship. It is our sincere hope that these proceedings will serve as a valuable source of knowledge, encourage meaningful discussions, inspire future collaborations, and contribute significantly to the development of resilient agricultural systems and sustainable communities.

I would like to extend my heartfelt appreciation to the Coordinator of ISAE 2026, Snr. Prof. BC Walpola and all members of the organizing committee, reviewers, session chairs, authors, co-organizers, sponsors, and everyone whose dedication, professionalism, and tireless efforts have made ISAE 2026 possible. Their commitment and teamwork have been fundamental to the success of this symposium. As the Secretary of ISAE 2026, I sincerely wish every success for this symposium. May ISAE 2026 provide an inspiring platform for intellectual exchange, foster lasting collaborations among researchers and stakeholders, and generate innovative solutions that contribute to a healthier soil, greener, smarter, and more sustainable future for agriculture, the environment, and society.

I wish all participants a rewarding, productive, and memorable experience at ISAE 2026.

Prof. S.R. Amarasinghe
Conference Secretary – ISAE 2026

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International Symposium on Agriculture and Environment (ISAE) 2026

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Can Investment in Carbon Reforestation Reverse Soil, Water and Biodiversity Degradation?

Richard J. Harper
School of Agriculture Sciences, Murdoch University, Australia.

Globally, the causes and consequences of soil, water and biodiversity degradation are well known. However, despite legislative reform and significant investments in research, education, and on-ground programmes, these issues continue to persist. In Western Australia, productive agricultural systems are beset with widespread soil and stream salinity and recurrent wind erosion. Deforestation for agriculture has resulted in 17,000 km^2 of farmland being affected by dryland salinity, the salinization of several major rivers, the endangerment of 684 native plant and animal species and damage to rural infrastructure, including towns, roads and railways. This is a water-limited environment where dammed rivers are relied upon to provide water supplies for both urban populations and farmland irrigation. The implementation of effective management practices is hindered by the scale of the problem, the challenge of securing substantial capital, and the challenge of providing land-use alternatives that are as economically viable as current practices.

Just as salinity is caused by deforestation, it can be reversed by reforestation, provided that it occurs across extensive areas. In the mid-1980s, the Western Australian Government tried an alternative approach to address river salinity in agricultural regions. It promoted private investment in fast-growing eucalypt pulpwood plantations on farmland through a range of measures. This resulted in over 4,000 km^2 of reforestation and the reversal of stream salinity in some watersheds. Importantly, despite the establishment of a new pulpwood industry, there has been no compensation for the enhanced water quality.

In the mid-1990s there was emerging concern about climate change, and it was recognised that land-based activities such as reforestation, revegetation and cropland management could mitigate greenhouse gas emissions. The anticipated investment in carbon credits aimed at meeting industry and government emissions reduction targets was considered to be substantial, thus presenting an opportunity to fund widespread land-use change and provide environmental co-benefits, reminiscent of the earlier pulpwood initiative. Land-based carbon investment is now a mainstream activity embedded in several UN Conventions (UNFCCC, CBD, UNCCD), the Sustainable Development Goals and national and corporate programmes to both meet emissions reduction targets and tackle water, soil and biodiversity degradation. Strong legislative frameworks for generating carbon credits have been developed.

This presentation describes research conducted over the last three decades that has explored both the science and policy dimensions of climate mitigation through bioenergy, reforestation and soil management. The land-use systems analyzed encompass mangroves, rangelands, agroforestry, natural and plantation forests, and dryland agriculture. This research includes innovations that enhance environmental co-benefits particularly in relation to soil and water management where numerous persistent and complex challenges exist. Additionally, the effects of carbon mitigation on food security and the application of market-based strategies to address other environmental issues (such as forest water yield and biodiversity conservation) have also been explored.

This work suggests there is enormous potential to offset carbon through the land-based projects. However, it is essential to consider the overall profitability of these projects, including associated costs, risks, trade-offs and their effects on rural livelihoods. Claims related to yields need to be rigorously examined, as these can be overstated by policymakers and project proponents. While some approaches will also provide watershed, land, and biodiversity co-benefits and provide a very real option for dealing with some long-standing issues (e.g. salinity, biodiversity decline), further efforts are needed to quantify these benefits and facilitate payments from them. Finally, the capacity of land to mitigate carbon is finite, and land-based offsetting should be considered as a component of greenhouse gas mitigation approaches, not the only one.

Keywords: Biodiversity conservation; Carbon credits; Dryland salinity: Reforestation; Soil restoration

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Temperature alters the Monensin-induced stress responses in white clover (*Trifolium repens* L.*)* seedlings

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Abstract:
White clover (*Trifolium repens L.*) is an important pasture legume, and its early growth is strongly influenced by environmental temperature. Monensin, an ionophore antibiotic widely used as a cattle feed additive, enhances feed digestibility and rumen function. However, up to 50–90% of administered monensin is excreted through manure, leading to its accumulation in pasture fields via manure application and contaminated irrigation water. Therefore, this study examined the effects of temperature on the seedling physiology of *T. repens*, under monensin exposure. The experiment was conducted under aseptic laboratory conditions at 300 μmol m^{-2} s^{-1} PAR, with a 12 h:12 h light–dark photoperiod, across temperatures of 15–25 °C in multiple trials. Seeds were exposed to 0–500 μg L^{-1} monensin for a 10-day exposure period. Oxidative stress (OS) and antioxidant (AO) levels in the seedlings were measured. At low monensin concentrations, temperature had no significant effect on OS levels in *T. repens*. At the highest concentration, OS increased significantly with temperature up to 20 °C, then declined at 25 °C. For intermediate concentrations, increases in temperature led to significant OS elevation. AO levels were significantly induced to mitigate elevated OS, and higher temperatures increased the sensitivity of AO defense mechanisms. Overall, temperature variations between 15–25 °C significantly altered the physiological state of *T. repens* under monensin exposure. However, long-term field studies are needed to fully assess the environmental and agronomic impacts of these treatments.

Keywords: Monensin; Stress responses; *Trifolium repens*; Temperature effect

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Effects of nano-silica and chitosan seed priming on root architectural traits of maize seedlings under drought stress

A.A.P.M Amarasinghe[1], N.D.M Kodikara[2], T.D.M Gimhani[1], G.H Thiranagama[1], Chanaka Sandaruwan[3,4] and H.W.K.S.L Kumara[1*]

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[4]Research and Innovation Centre for Graphene and 2D Materials (RIC2D), Khalifa University, Abu Dhabi.

Abstract:

Drought stress during early growth stages severely restricts maize (*Zea mays* L.) seedling development and yield potential. This study aimed to investigate the effects of chitosan (CS) and nano-silica (NSi) seed priming treatments on root architectural traits, chlorophyll content, and dry matter content of maize seedlings under drought conditions. Seeds were primed with CS (100 ppm), NSi (200 and 250 ppm), and their combinations, with water as the control. Primed seeds were grown in pots in a greenhouse (29–32 °C) using a completely randomized design (n = 3), with drought stress maintained at 40% of field capacity for 14 days. Root architectural traits, including primary root length (PRL), root surface area (RSA), and root growth angle (RGA), were analyzed on day 14 using ImageJ software. The chlorophyll content and seedling dry matter content were also determined. NSi at 250 ppm produced the greatest PRL (17.10 cm), likely due to enhanced root cell division and elongation. All priming treatments exhibited steeper RGAs than the control. The highest root surface area was observed in the combined nano-silica and chitosan treatments, CS 100 + NSi 200 (112.43 cm^2) and CS 100 + NSi 250 (107.28 cm^2), as well as the individual NSi treatment at 250 ppm (110.58 cm^2). Chlorophyll and dry matter contents were not significantly different ($P > 0.05$), suggesting that under drought stress conditions, maize seedlings may tend to prioritize root development to enhance water uptake, whereas aboveground growth is maintained at a lower rate until sufficient resources become available.

Keywords: Chitosan; Drought stress; Maize; Nano-silica; Root architectural traits

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ID 141

Evaluating the mineralization dynamics of different compost pellets

P.V.G.M. Malshi[1], G.N. Rupasinghe[2*] and S. R. Amarasinghe[1]
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Abstract:
Sustainable nutrient management is essential for maintaining soil fertility and enhancing agricultural productivity. The objective of this study was to evaluate the nutrient mineralization patterns of compost pellets produced from gliricidia, wild sunflower, and guinea grass as primary plant materials. A two-month laboratory incubation study was conducted using a completely randomized design with four treatments (T1–gliricidia-based compost pellets (GlCP), T2–wild sunflower-based compost pellets (WCP), T3–guinea grass-based compost pellets (GuCP), and T4–control) and four replicates. Compost pellets were incorporated into the soil at a rate of 10 t ha^{-1}, and soil samples were collected weekly to determine pH, electrical conductivity (EC), total nitrogen (N%), available ammonium nitrogen (NH_4^+-N), and available nitrate nitrogen (NO_3^--N). Available phosphorus (P) and exchangeable potassium (K) were measured once every four weeks. Results showed that soil pH ranged from 4 to 6.5 across all treatments during the incubation period. Changes in EC were significantly different among treatments over the incubation period. WCP and GlCP showed the most effective nutrient release patterns during the incubation period. WCP recorded the highest N% (0.56% at week 5), rapid K release (129.84 ppm at week 4), and the highest P release (17.70 ppm at week 8). GlCP ensured sustained NO_3^--N release at later stages. Therefore, gliricidia-based and wild sunflower-based compost pellets have strong potential as sustainable organic fertilizers for improving soil fertility and supporting agricultural productivity.

Keywords: Compost pellets; Gliricidia; Incubation study; Nutrient mineralization; Soil fertility

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Effect of different pollen diluents on pollination success in hybrid green chili (*Capsicum annuum* L.) seed production under protected conditions

G.D.R.S. Wijesinghe, W.M.A.M. Karunarathne* and H.K.M.S. Kumarasinghe
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Abstract:
Successful pollination is essential for obtaining high seed yield in hybrid seed production. Consequently, pollen dilution techniques are increasingly explored to improve the efficient use of pollen during artificial pollination. Therefore, the present study was conducted to evaluate the effect of different pollen diluents on pollination success in hybrid green chili seed production. Five pollen diluents, namely talc, wheat flour, glucose, sucrose, and agar, were tested at different dilution ratios under protected conditions. The treatments included T1 (100% pollen - control), T2 (1:1 pollen:talc), T3 (1:2 pollen:talc), T4 (1:1 pollen:wheat flour), T5 (1:2 pollen:wheat flour), T6 (1:1 pollen:glucose), T7 (1:2 pollen:glucose), T8 (1:1 pollen:agar), T9 (1:2 pollen:agar), T10 (1:1 pollen:sucrose), and T11 (1:2 pollen:sucrose). The experiment was arranged in a completely randomized design with 12 replicates. Data were recorded on pollination success rate, number of seeds per pod, and dry seed weight per pod. Statistical analysis was carried out using one-way ANOVA in Minitab 17 software, and treatment means were compared using Dunnett's test. Among the diluted pollen treatments, significantly higher pollination rates were recorded in T4, T5, T7, T8, T9, and T10 ($P \leq 0.05$). The highest number of seeds per pod was observed in T9 (53 seeds), while the highest dry seed weight per pod was recorded in T7 (0.246 g) and T9 (0.245 g) compared with the control. The results indicated that glucose and agar at a 1:2 pollen dilution ratio are the most effective treatments for improving pollination efficiency and hybrid green chili seed production.

Keywords: Green chili; Hybridization; Pollen diluents; Pollination success; Seed yield

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ID 164

Salicylic acid-dependent coordination of plant immunity and longevity

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Abstract:

Salicylic acid (SA) is essential for plant immunity, but excessive SA accumulation accelerates leaf senescence, necessitating tight control of its biosynthesis. Although AVRPPHB SUSCEPTIBLE 3 (PBS3) is a key enzyme in SA biosynthesis, how its abundance is regulated to coordinate immunity and longevity remains unclear. Genetic, biochemical, and physiological analyses demonstrated that PBS3 functions as a quantitative regulator of the immunity–longevity balance. Loss of PBS3 compromises disease resistance but delays senescence, whereas graded increases in PBS3 abundance progressively enhance pathogen-induced SA accumulation, systemic acquired resistance (SAR), and senescence severity. The E3 ubiquitin ligase PLANT U-BOX PROTEIN 13 (PUB13) was identified as a direct regulator of PBS3. PUB13 physically associates with PBS3 and promotes its polyubiquitination and degradation through the 26S proteasome pathway. Disruption of PUB13 stabilizes PBS3, resulting in greater SA accumulation, enhanced SAR, and accelerated leaf senescence. Time-course analyses revealed that pathogen-induced PBS3 accumulation and SA biosynthesis are transient in wild-type plants but remain elevated in *pub13* mutants, indicating that PUB13 promotes the attenuation of immune-associated SA production after defense activation. These findings establish the PUB13–PBS3 module as a post-translational mechanism that fine-tunes SA biosynthesis, enabling immunity while preventing prolonged SA accumulation and its detrimental effects on plant longevity.

Keywords: AVRPPHB susceptible 3; enzyme; salicylic acid; systemic acquired resistance

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Agricultural Engineering, Technology and Digital intelligence

Oral Presentations

Keynote Speech

Biochar-organic-mineral amendment synergistically restores microbial function and productivity in aridland soils

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Abstract:
Aridland agriculture is constrained by alkaline pH, salinity, low organic matter and limited microbial activity. This keynote examines how biochar, elemental sulfur and organic amendments can be combined to restore soil biological function while improving salinity management and crop productivity. Evidence was integrated from two complementary studies conducted in Omani soils. The first evaluated the effects of biochar, elemental sulfur and compost on microbial abundance, enzyme activities, metabolic responses, functional gene abundance, and bacterial and fungal communities. The second compared biochar pre-incubated with sulfur and organic amendments against their direct co-application in saline soil irrigated with poor-quality water (EC 3 dS m^{-1}). Biochar increased bacterial, fungal and actinomycete abundance and reduced the microbial metabolic quotient, consistent with improved habitat conditions and more efficient microbial carbon use. It also increased the abundance of genes involved in carbon degradation. Elemental sulfur selected for specialized sulfur-transforming communities and increased the representation of pathways associated with nitrification, denitrification and sulfur oxidation, although sulfur applied alone suppressed urease activity. The combined application of biochar, sulfur and compost produced the greatest urease activity and the most balanced stimulation of soil enzymatic functions and coupled carbon–nitrogen–sulfur cycling. In the saline soil study, direct co-application of biochar and sulfur decreased soil pH from 9.7 to 8.7 and reduced topsoil electrical conductivity by approximately 50%. It also increased sodium and calcium removal in leachates by more than 20% and 60%, respectively. Compost or vermicompost had limited direct effects on salt leaching but, when combined with biochar and sulfur, nearly tripled wheat yield and increased grain size by more than 20%. Direct co-application generally produced stronger responses than pre-incubating biochar with sulfur and organic amendments. These findings show that biochar provides a persistent microbial habitat and sorptive matrix, sulfur regulates alkalinity and nutrient transformations, and organic amendments supply readily available substrates and nutrients. Their complementary functions offer an effective strategy for rebuilding biological activity, improving salt removal and increasing crop productivity in degraded aridland soils.

Keywords: Alkaline soil; Biochar; Elemental sulfur; Microbial functions; Salinity; Soil restoration

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ID 73

Deep feature fusion with vegetation indices for wheat lodging detection using UAV multispectral imagery

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Abstract:
Winter wheat lodging is a major threat to crop productivity, making accurate and timely monitoring crucial for regional food security. In this study, we developed a UAV-based framework that integrates multispectral imagery with machine learning algorithms for effective lodging detection. Sensitivity analysis identified VARI, EXG, and MCARI as the most informative vegetation indices, which were combined with the original spectral bands for feature extraction using YOLOv8, YOLO12, SAM1, and SAM2. The SHAP method was employed to evaluate feature importance and improve model interpretability. Three types of feature representations spectral features, deep features, and fused features were assessed, with YOLO12-derived deep features coupled with a BP classifier achieving the highest performance, including an accuracy of 98.20%, precision of 98.38%, recall of 98.56%, and F1-score of 98.56%. These findings demonstrate that incorporating deep features substantially improves the detection of winter wheat lodging, providing a precise and efficient approach for crop monitoring using UAV multispectral data.

Keywords: UAV remote sensing; Winter wheat; Lodging detection; deep features; machine learning; SHAP analysis

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ID 103

Enzyme-responsive functionalized lignin nanoparticles for synergistic pesticide–fertilizer delivery

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Abstract:
To advance sustainable agricultural development, this study designed an enzyme-responsive, amino acid–based lignin nanoparticle system for the co-delivery of a model insecticide and a nitrogenous amino acid fertilizer. The nanocarrier was synthesized via a green self-assembly process using a purified dealkylated lignin derivative and the target amino acid. The resulting nanoparticles exhibited a uniform spherical morphology (approximately 250 nm in diameter), high pesticide loading capacity, and excellent colloidal stability. The system enabled intelligent, enzyme-triggered release and significantly improved the wettability, adhesion, and leaching resistance on crop foliage. Importantly, it overcame the poor systemic mobility of the free insecticide, achieving bidirectional transport and targeted accumulation within the plant. Bioassays against a major lepidopteran pest demonstrated superior insecticidal and growth-inhibitory effects compared with a commercial formulation, attributed to enhanced midgut damage and induction of apoptosis. Concurrently acting as an efficient nano-fertilizer, the system up-regulated key nitrogen metabolism enzymes, promoted photosynthetic carbon assimilation, and activated antioxidant defenses, thereby synergistically improving crop growth, nitrogen–use efficiency, and stress tolerance. The nanocarrier also exhibited excellent biosafety, showing no adverse effects on seed germination or seedling development. This work provides a novel strategy for developing integrated pesticide–fertilizer delivery platforms, supporting green plant protection and precision agriculture.

Keywords: Controlled release; Integrated agrochemical application; lignin; nano-pesticide; insecticide

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ID 124

Practical method for the large-scale synthesis of 4′-chloro-2-nitrobiphenyl: A key intermediate of Boscalid

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Abstract:
Boscalid is a key pesticide with annual peak sales of >300 million euros whose key intermediate, 4′-chloro-2-nitrobiphenyl, is synthesized using a Suzuki-Miyaura coupling reaction. Indenylphosphine ligands play an important role in organometallic chemistry and transition metal-catalyzed transformations by influencing the stability and reactivity of the metal and have been widely studied by the scientific research community. In this study, we used an electron-rich, polyaryl-large phosphine ligand, (2-(anthracen-9-yl)-1*H*-Inden-3-yl) dicyclohexylphosphine, which was previously developed by our research group, to form a catalytic system with Pd $(OAc)_2$. The key intermediate of boscalid, 4′-chloro-2-nitrobiphenyl can be synthesized with high efficiency and selectivity. The target product can be prepared in up to 94% yield with 95% purity. The amount of precious metal palladium was reduced to 5 parts per 10,000 (molar ratio), i.e., 228 g of palladium metal is required per ton of 4′-chloro-2-nitrobiphenyl produced. This approach provides a practical foundation for the industrial development of this pesticide intermediate. However, in actual pilot-scale and industrial-scale production, the process requires further optimization and expansion.

Keywords: High efficiency and selectivity; Indenylphosphine ligands; Intermediate of boscalid; Pesticide intermediate; Transition metal-catalyzed

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ID 127

Engineering nanozymes at the atomic scale for enhanced sensing

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Abstract:
Nanozymes have attracted significant interest as a rapidly emerging research area, and have been intensively explored across various fields, including sensing and biomedical applications. Nanozymes with diverse atomic compositions and complex structural features pose greater challenges in identifying the true active sites and for further elucidating the structure–activity relationship. The rational synthesis of highly active nanozymes and an in-depth understanding of catalysis at the atomic scale are highly desirable. To further enhance enzyme-like catalytic activities, we focus on the precise mimicking of natural enzymes and the rational design of new atomic-scale materials with superior enzyme-like activities. Moreover, an in-depth understanding of their catalytic nature for small-molecule activation is expected, which will provide practical guidance on the design of advanced nanozymes. Based on the excellent enzyme-like activities of atomic-scale materials, their sensing applications have been explored, enabling sensitive detection of a wide range of target molecules, including pesticides.

Keywords: Atomic-scale materials; Nanozymes; Pesticides; Sensing

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ID 138

The ontology-based AI framework for precision diagnosis and treatment of coconut diseases and pests in Sri Lanka

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Abstract:
Coconut cultivation in Sri Lanka faces significant economic losses due to pest and disease outbreaks, while many farmers lack timely access to expert diagnosis and treatment guidance. This research aimed to develop an intelligent decision support system, named COCOGUARD, integrating image-based disease detection, symptom-based reasoning, and knowledge-based advisory support into a unified framework. To address these challenges, a DenseNet121 deep learning model was implemented to classify Weligama coconut leaf wilt disease into four diagnostic classes (healthy, flaccidity, yellowing, and drying of leaflets), achieving a 99.26% classification accuracy on the test dataset. Additionally, an Attention U-Net model with an EfficientNetB3 encoder was deployed to segment leaf blight-infected regions. The model computes the infected area percentage to automatically estimate disease severity across mild (10–19%), moderate (20–29%), and severe (≥30%) disease severity levels. A domain-specific OWL 2 DL ontology was constructed to represent complex relationships among 18 conditions, symptoms, and treatment plans, answering 13 competency questions without logical inconsistencies under HermiT reasoning. Furthermore, a retrieval-augmented generation -based chatbot was integrated to provide natural, farmer-friendly advisory responses. The system's robustness was validated through independent test datasets and field evaluations conducted in the Kurunegala District involving 20 farmers and agricultural extension officers. Empirical validation demonstrated promising real-world applicability, yielding a 95% adoption willingness, a usability satisfaction score of 4.25/5.0, and a decision-making usefulness score of 4.40/5.0. These findings indicate that the COCOGUARD framework effectively supports precision disease diagnosis and sustainable disease management in coconut cultivation.

Keywords*:* Coconut diseases; Decision support system; Deep learning; Ontology; Precision agriculture

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ID 160

Smart girth measuring device for monitoring immature rubber plantations

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Abstract:
Efficient monitoring of immature rubber plantations is essential for achieving optimum tree growth and maximizing the proportion of tappable trees at maturity. However, conventional girth census methods rely on manual measurements, paper-based record keeping, and labor-intensive data processing, resulting in measurement errors, delayed decision-making, and limited traceability of plantation performance. This study presents the development of a smart girth measuring device, an integrated digital solution that combines bluetooth-enabled digital Vernier calipers, a smartphone-based field data collection application, global positioning system (GPS) tracking, and a centralized web-based management platform. The system automatically acquires trunk diameter measurements, calculates girth, records geographic coordinates and timestamps, and captures canopy and trunk images for growth and disease monitoring. A centralized admin panel provides real-time dashboards, spatial visualization, analytics, and audit trails to support plantation management. Field evaluation demonstrated that the proposed system reduces operational costs by approximately LKR 4,900 per hectare compared with conventional girth census methods while significantly improving measurement accuracy, data integrity, and operational efficiency by eliminating manual transcription and calculation errors. GPS-enabled traceability and photographic documentation facilitate continuous monitoring of individual trees, enabling early detection of growth abnormalities and plantation health issues. Offline data collection capabilities further enhance usability in remote plantation environments with limited network connectivity. The proposed system represents a practical precision agriculture solution that supports data-driven decision-making, optimized resource allocation, and sustainable plantation management. Future enhancements will incorporate RFID/QR-based tree identification, AI-assisted disease diagnosis, predictive growth analytics, and commercialization as a scalable digital platform for rubber and other perennial crop plantations.

Keywords: Internet of things (IoT); Plantation management; Precision agriculture; Rubber plantation monitoring; Smart girth measurement

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Trends in Biological Research for Sustainable Development

Oral Presentations

Keynote Speech

Green Glycosyl Compound Synthesis via Enzymatic Tandem Catalysis and Crop Protection Applications

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Abstract:
Glycans are the abundant natural biopolymers on Earth. Chitin from seafood waste can be converted into chitosan oligosaccharides (COS), which are key plant immunity elicitors against pathogens and abiotic stress. Conventional acid/alkali hydrolysis produces heterogeneous COS with inconsistent bioactivity, as the fine COS structure (acetylation pattern, chain length) determines its biological function. Pure single-structure chitobioses (the smallest COS unit) are prohibitively expensive for commercial applications. Meanwhile, biosynthesis of plant glycosides relies on costly sugar nucleotide donors (e.g., UDP-GlcNAc), restrict green biomanufacturing. An AI based protein mining workflow identified high-selectivity chitinase CT10 from *Paenibacillus elgii*, yielding pure diacetylchitobiose (AA) with negligible monosaccharide byproducts. One-pot coupling of CT10 with regioselective deacetylases NodB/VcCDA generates four discrete chitobiose isomers (AA/AD/DA/DD) from colloidal chitin without harsh chemicals. These isomers exhibit structure-specific bioactivities: DA shows superior free radical scavenging activity (verified by ESR); all isomers mitigate cadmium toxicity in rice by elevating antioxidant enzyme activities and stress gene expression, while AA specifically promotes seedling root growth. A bimetallic Ni-ZIF-8 co-immobilizes His-tagged BlNahK and PmGlmU. for efficient UDP-GlcNAc synthesis. Spatial confinement creates substrate channeling, with intermediate GlcNAc-1-P accumulation locally confirmed by SRS microscopy. This nanocomposite boosts catalytic efficiency 4.4-fold free enzymes, achieving a 92% UDP-GlcNAc yield within 30 minutes with wide pH and thermal tolerance and five-cycle reusability. The addition of pyruvate kinase enables continuous ATP cofactor recycling to reduce production costs. Enzymatic tandem catalysis enables eco-friendly upcycling of seafood chitin waste into uniform chitobioses and low-cost biostimulants for crop stress resistance. MOF-supported multi-enzyme systems resolve sugar nucleotide cost bottlenecks for green glycoside manufacturing. This chemical-free bioprocess provides a sustainable route for agricultural bioprotectants and plant natural product synthesis.

Keywords: Chitobiose; Green glycan production; MOF biocatalyst; Plant abiotic stress; Sugar nucleotide; Tandem biocatalysis

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ID 31

Molecular diversity and pathogenicity analysis of the rice false smut pathogen (*Ustilaginoidea virens*) in selected regions of Sri Lanka

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Abstract:
Rice false smut (RFS), caused by *Ustilaginoidea virens*, is an increasingly prevalent disease that reduces both yield and grain quality in rice cultivation. This study investigated the genetic and pathogenic diversity of *U. virens* isolates collected from selected rice-growing regions of Sri Lanka. A total of 30 pathogen isolates were collected from 15 different locations representing agroecological zones under dry zone, wet zone and intermediate zone conditions in Sri Lanka. Based on prior reports of disease occurrence and their cultural characteristics, only 10 samples were selected for further study. The strains were successfully purified on potato sucrose agar (PSA). Pathogenicity was evaluated using the susceptible rice variety BG 375. Plants at the booting stage were inoculated by injecting the inoculum suspension into the boot cavity using a sterile syringe. The spore suspension was adjusted to a concentration of 1×10^6 conidia/mL using a hemocytometer. The experiment was arranged in a completely randomized design with four replicates. Re-isolation confirmed Koch's postulates. Disease severity was graded based on a standard 0-4 scale. Isolate Uv.10 (wet zone) showed the highest disease incidence (30% ± 0.0 3), followed by Uv.08 (intermediate zone) (29 % ± 0.03). Uv.07 (wet zone) exhibited moderate severity (23% ± 0.66), while Uv.06 (13% ± 0.00 4) and Uv.02 (11% ± 0.0 0) showed lower but statistically distinct disease levels. In contrast, Uv.01, Uv.03, Uv.04, and Uv.09 showed little or no infection (~0). For molecular identification, genomic DNA was extracted using the SDS method, and ITS regions were amplified using ITS1/ITS4 and ITS5/ITS4 primers. Sequence analysis using BLAST confirmed 87–100% similarity with known *U. virens* sequences. Phylogenetic analysis grouped isolates into distinct sub-clusters, with Uv.08, Uv.10, and Uv.07 forming a closely related cluster, while others formed separate lineages. These findings reveal significant genetic and pathogenic variability among Sri Lankan isolates of *U. virens*.

Keywords: Genetic diversity; Koch's postulates; Pathogenicity; Rice false smut; *Ustilaginoidea virens*

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ID 67

A hydrogen transfer strategy for C-H functionalization: Building bioactive molecular scaffolds with herbicidal activity

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Abstract:
Precise haloalkane conversion is vital in organic synthesis, as exemplified by Grignard, Pd-coupling and Ullmann–Ma reactions. Alkyl halides are challenging substrates in two-electron cross-coupling; copper catalysis was adopted with single-electron radical pathways to overcome barriers in oxidative addition and reductive elimination, enabling asymmetric C–C coupling of alkyl halides and tandem cyclization for strained rings. To bypass problematic site-specific halogenation, radical HAT with copper redox catalysts was developed to selectively functionalize remote inert C–H bonds through bond energy and polarity tuning. Building on our prior *Angewandte* work, a 1,5-HAT-mediated C–H alkenylation strategy shifts reactive sites from N-α to carbonyl-α, selectively activating carbonyl α-C(sp^3)–H without pre-functionalization to assemble quaternary-carbon butenolides. The protocol features high step efficiency, mild conditions and good stereocontrol. Bioassays confirmed that these butenolides bind the PSII D1 protein's Ser264 site to block photosynthesis and suppress weeds; one dichlorophenyl derivative exhibited herbicidal potency comparable to bromoxynil. This work translates selective C–H functionalization methodology into new green herbicide lead scaffolds.

Keywords: Copper catalysis; C–H functionalization; Hydrogen atom transfer (HAT); Butenolide; Herbicidal lead compound

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ID 84

Repeated compost inputs as a strategy for soil carbon sequestration in tropical Sri Lankan cereal–legume crop rotations

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Abstract:
Soil carbon (C) sequestration is a key approach to climate change mitigation and agricultural sustainability, but its potential in tropical farming systems has not been adequately described. The study aimed to determine the impact of repeated compost application, along with different levels of inorganic nitrogen (N), on soil carbon accumulation at two depths (0-20 cm and 20-40 cm) in a representative tropical cropland in Matara, Sri Lanka under a cereal–legume crop rotation for two seasons. A two-factor factorial experiment with four replications in a randomized complete block design was established. Treatments included two compost levels (no compost and 15 Mg ha^{-1} dry weight compost) crossed with four levels of nitrogen fertilizer (0, 70, 150, and 200 kg N ha^{-1}), resulting in eight treatment combinations. Findings revealed that the addition of compost consistently led to significant increases in soil C at both layers, whereas inorganic nitrogen alone did not result in significant increases. The highest amount of carbon was recorded in the 0-20 cm layer of the zero-nitrogen plus compost treatment, reaching 50.6 Mg C ha^{-1}. Only the zero-nitrogen and 200 kg N ha^{-1} compost treatments experienced statistically significant increases across the entire 0-40 cm profile. The higher performance of compost without added nitrogen indicates that inorganic N can promote microbial mineralization, which may counteract compost-based carbon gains to a certain extent. The results indicated that the repeated compost application, especially without additional inorganic nitrogen, is an efficient and feasible approach for enhancing soil carbon sequestration in tropical agricultural systems.

Keywords: Compost; Maize-soybean rotation; Repeated compost; Soil C; Tropical soil

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ID 98

Octenol as a novel fumigant against invasive fire ant: disrupting social behavior through fatty acid and olfactory pathway interference

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Abstract:
The red imported fire ant (*Solenopsis invicta*) poses significant ecological and agricultural threats globally, with current chemical control methods showing limited effectiveness and environmental concerns. This study investigated the potential of 1-octen-3-ol (octenol), a naturally occurring volatile compound, as an alternative fumigant against *S. invicta*, to examine its toxicological effects and underlying molecular mechanisms. We conducted fumigation toxicity assays to determine lethal concentrations, Y-tube olfactometer tests to assess behavioral responses, and evaluated impacts on aggregation and necrophoric behaviors. RNA-seq transcriptomic analysis identified differentially expressed genes, which were validated by qPCR. Fatty acid synthase activity and cuticular fatty acid compositions were quantified using ELISA and GC-MS/MS. Odorant-binding proteins were heterologously expressed, and their binding affinities to fatty acids and octenol were characterized. Octenol demonstrated significant fumigant activity with an LC_{50} of 0.044 μg cm^{-3} over 4.5 days. Exposure induced strong avoidance behaviors (94.2% at 830 mg mL^{-1}) and severely disrupted critical social behaviors, reducing aggregation from 97% to 13.3% and impairing necrophoric behavior. Transcriptomic analysis revealed 364 differentially expressed genes, with notable downregulation of fatty acid synthesis pathways and detoxification enzymes. Correspondingly, fatty acid synthase activity decreased by 44%, with significant reductions in cuticular oleic (12%), linoleic (25%), and palmitoleic (18%) acids. SiOBP5 expression decreased while SiOBP15 increased, showing differential binding affinities for the affected fatty acids and octenol. Octenol is a promising dual-action biocontrol agent that combines direct fumigant toxicity with disruption of colony-essential social behaviors by interfering with fatty acid metabolism and olfactory signaling pathways. This multi-target approach offers a sustainable alternative for invasive ant management, warranting further development for integrated pest management applications.

Keywords: Enzyme activity; Fatty acid; Gene expression; Necrophoric behavior; Volatiles

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ID 121

Brood-driven demand and colony size constraints regulate foraging efficiency in *Apis cerana indica*

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Abstract:
Understanding how honeybee colonies regulate resource acquisition is important for commercial management. While colony state influences foraging allocation, its effects on individual pollen foraging efficiency remain poorly understood in the Asian honeybee *Apis cerana indica*. This study investigated how brood level, colony-level pollen foraging activity, and colony size influence pollen collection efficiency (PCE) in *A. cerana indica*. Brood levels (high vs. low) were experimentally manipulated in eight standardized colonies, and colony size was quantified using frame coverage estimates (2.5–4.0 frame equivalents; ~3750–6000 bees). Colonies were monitored weekly over eight weeks in the mid-country wet zone of Sri Lanka (Kandy, WM2) from April to May in 2025. Colony performance index (CPI), a colony-level indicator of pollen collection efficiency (PCE), was calculated as the squared number of pollen foragers entering the hive divided by the product of the total number of incoming bees and observation time. PCE varied significantly with colony-level pollen-foraging activity, brood level, and colony size. CPI, representing pollen foraging intensity, had a strong positive effect on PCE ($F_{1,60} = 226.20$, $P < 0.001$; $\beta = 0.066 \pm 0.004$), indicating that individual efficiency increases with colony-level allocation to pollen foraging. Brood level exerted an additional independent effect, with high-brood colonies showing significantly greater efficiency than low-brood colonies ($F_{1,4.27} = 109.28$, $P < 0.001$; 2.82 ± 0.047 vs. 2.05 ± 0.041 mg min^{-1}). Colony size also influenced PCE ($F_{1,40.89} = 5.98$, $P = 0.019$), with efficiency increasing as colony size increased. At comparable CPI levels, high-brood colonies maintained higher PCE, demonstrating that brood demand enhances individual performance beyond colony-level foraging intensity. Together, these results indicate that PCE is jointly regulated by colony-level allocation and brood-driven demand, with the size of the colony affecting efficiency. This highlights efficiency as a key mechanism linking colony state, resource prioritization, and adaptive foraging in tropical honeybee systems.

Keywords*: Apis cerana indica*; Brood demand; Colony performance index; Foraging efficiency; Pollen collection efficiency

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Food Science and Post Harvest Technologies

Oral Presentations

Keynote Speech

Advances in Food Science and Postharvest Technologies for Reducing Food Losses and Enhancing Sustainable Food Systems

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Abstract:
Postharvest losses remain a major global challenge, threatening food security, economic development, and environmental sustainability. The Food and Agriculture Organization (FAO) estimates that approximately 13–14% of food produced worldwide is lost between harvest and retail, while postharvest losses of fresh fruits and vegetables in many developing countries often range from 20% to 40%. These losses result largely from poor harvesting practices, inadequate storage and transportation, limited processing facilities, and inefficient supply chains. Besides reducing food availability and farmers' income, they lead to substantial losses of water, energy, land, and other valuable resources while increasing greenhouse gas emissions. Reducing these losses is therefore essential for meeting the growing global demand for safe, nutritious, and sustainable food. This keynote speech highlights recent advances in food science and postharvest technologies that help preserve quality, improve food safety, extend shelf life, and reduce postharvest losses across the food supply chain. It discusses both conventional and emerging approaches, including cold chain management, controlled and modified atmosphere storage, edible coatings, smart packaging, non-thermal processing technologies, nanotechnology, biotechnology, and digital monitoring systems integrating the Internet of Things (IoT) and artificial intelligence (AI). The speech also explores sustainable processing, food loss valorization, and circular bioeconomy strategies that convert agricultural by-products into value-added products while improving resource efficiency. In addition, the speech critically examines the key challenges limiting the adoption of these technologies, including inadequate infrastructure, high implementation costs, technical capacity gaps, regulatory constraints, and the increasing impacts of climate change. By bringing together recent scientific advances and sustainable postharvest strategies, this provides an integrated perspective on improving food quality, minimizing postharvest losses, and strengthening resilient food supply chains. The findings emphasize that combining technological innovation with supportive policies, industry collaboration, and capacity building will be essential for developing efficient, climate-resilient, and sustainable food systems capable of meeting future global food demands.

Keywords: Circular bioeconomy; Food science; Food Security; Postharvest losses; Postharvest technologies; Sustainable food systems; Smart packaging

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ID 44

Rapid FTIR screening of sugar adulteration in Sri Lankan bee honey using chemometrics

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Abstract:
Honey adulteration with sugar syrups threatens the authenticity of Sri Lankan honey, yet reference methods remain inaccessible to local laboratories. The study develops and evaluates an attenuated total reflectance Fourier-transform infrared (ATR-FTIR) spectroscopy approach combined with chemometric modeling for the qualitative screening of sucrose-adulterated multifloral honeys. To the best of our knowledge, this is one of the first studies applying ATR-FTIR chemometric screening to Sri Lankan honey. Authentic honeys from 10 Sri Lankan regions were spiked with 70 °Brix sucrose syrup to obtain 60 samples and analyzed using ATR-FTIR (4000–650 cm^{-1}). Each concentration was prepared in triplicate for each sample. Spectral data were preprocessed using standard normal variate (SNV) normalization and baseline correction prior to chemometric analysis. Principal component analysis (PCA) revealed spectral clustering trends between authentic and adulterated samples. Orthogonal partial least-squares discriminant analysis (OPLS-DA) achieved clear class separation ($R^2X = 0.894$, $R^2Y = 0.759$, $Q^2 = 0.745$), delivering a 91.3% cross-validated classification accuracy. Variable importance in projection (VIP) analysis identified fingerprint-region bands associated with C-O-C and C-O stretching vibrations as the primary discriminants, reflecting sucrose-induced compositional shifts. Model robustness was confirmed via permutation testing ($P<0.01$) and cross-validated ANOVA. Application to five Sri Lankan bee honey market samples demonstrated classifications consistent with model predictions and physicochemical profiles, supporting preliminary the real-world applicability of the method for locally produced samples. The proposed ATR-FTIR workflow enables reagent-free, rapid qualitative screening using portable instrumentation suitable for routine Sri Lankan market surveillance.

Keywords: ATR-FTIR; Chemometrics; Honey adulteration; OPLS-DA; Qualitative screening

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ID 53

Valorization of palmyrah fruit caps as a novel plant-based reductant in the green synthesis of silver nanoparticles

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Abstract:
Nanotechnology has gained significant attention in various fields including medicine, agriculture, electronics, and food technology. However, conventional chemical synthesis methods often involve hazardous reagents and high energy consumption, raising environmental and safety concerns. As a sustainable alternative, this study explores green synthesis of silver nanoparticles using palmyrah (*Borassus flabellifer* L.) fruit caps as a reducing agent. Phytochemicals in the extract facilitate the reduction of Ag^{+} to Ag^{0}. Aqueous extracts (2%, 4%, 6% and 8 % (v/v)) were prepared to optimize nanoparticle formation using two approaches: direct addition of extract and dropwise addition under magnetic stirring (1500 rpm) at room temperature. Nanoparticle formation was indicated by a color change from colorless to dark brown and confirmed by UV-Vis spectroscopy, displaying surface plasmon resonance peaks at 400-450 nm. The 6% extract produced a strong, well-defined peak and stable nanoparticles. Scanning electron microscopy revealed predominantly spherical nanoparticles with sizes ranging from 1-100 nm, along with a few larger aggregates up to 550 nm. Incorporation of the nanoparticles into packaging films helped maintain higher pH levels and reduce microbial growth in stored palmyrah pulp compared to the control without nanoparticle incorporation. Overall, palmyrah fruit caps provide a low-cost, environmentally friendly source for the green synthesis of silver nanoparticles with potential applications in active packaging. Further research is required to evaluate safety aspects and potential nanoparticle migration before commercial-scale application.

Keywords: Green synthesis of silver nanoparticles; Palmyrah fruit cap; Plasmon resonance; Scanning electron microscopy surface

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ID 78

In vivo investigation of pesticide residues in garlic using solid-phase microextraction-gas chromatography-mass spectrometry

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Abstract:
In this study, a novel multiwalled carbon nanotubes/polyaniline-polypyrrole@polydimethylsiloxane (MWCNTs/PANI-PPy@PDMS) fiber was prepared by a facile electrodeposition strategy followed by polymer surface modification and used as the sorbent for in vivo solid-phase microextraction (in vivo SPME). The custom-made fiber exhibits better enrichment capacity than four commercial SPME fibers. Ultra-high enrichment factor, satisfactory thermal and mechanical stability, and excellent matrix compatibility and anti-biofouling ability render the fiber attractive as an in vivo sampling probe. Combining in vivo SPME with gas chromatography-mass spectrometry (GC-MS), a convenient and sensitive method was successfully developed for the rapid determination of pesticides (hexachlorobenzene, chlorothalonil, fipronil, chlorfenapyr) in garlic. Under the optimal conditions, the proposed method displays a relatively wide linear range (three or four orders of magnitude) with a coefficient of determination above 0.9944 in both the standard solution and spiked homogenized garlic samples. Low detection limits ranging from 0.38 to 1.90 ng g^{-1} were obtained in homogenized garlic samples. Relative standard deviations of less than 15.5% and recoveries between 84.0% and 108.2% indicate satisfactory precision and accuracy of the method. In summary, a promising non-lethal method based on in vivo SPME-GC-MS was developed in this study, which provides a green, efficient, economical and rapid strategy for the detection of pesticide residues in edible plants.

Keywords: Garlic; *In vivo* solid-phase microextraction; Multiwalled carbon nanotubes; Pesticide residues; Polyaniline-polypyrrol

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ID 83

Data-driven FTIR-based classification of black tea for geographical origin authentication

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Abstract:
Tea (*Camellia sinensis*) is recognised as the second most consumed beverage worldwide. As the global demand for origin-labelled teas has increased, the likelihood of food fraud through adulteration, substitution, and mislabeling has also increased. In this study, fourier transform infrared (FTIR) spectroscopy was employed to evaluate the potential for classifying black tea samples according to their geographical origin. A total of 490 orthodox black tea samples collected from Sri Lanka, India, China, Vietnam, and Kenya were analysed over the spectral region 4000–600 cm^{-1}. Spectral data were subjected to chemometric analysis using principal component analysis (PCA) and partial least squares discriminant analysis (PLS-DA). The resulting spectral profiles exhibited broadly similar patterns across all origins. A broad absorption band around 3300 cm^{-1} attributed to O–H stretching vibrations of polyphenols and carbohydrates was observed in all samples. Additional spectral features in the regions of 3000–2800 cm^{-1}, 1650–1600 cm^{-1}, and 1200–1000 cm^{-1} were associated with aliphatic groups, aromatic compounds, and carbohydrate structures, respectively. PCA revealed geographical variability among tea samples, although complete separation was not achieved. However, PLS-DA modelling demonstrated distinct clustering according to origin, with classification accuracy exceeding 94%. Model performance was assessed using repeated stratified cross-validation and an independent holdout test set. The findings indicate that spectral differences observed in the fingerprint region are mainly linked to variations in polyphenol composition and carbohydrate structures. Overall, FTIR spectroscopy combined with chemometric analysis provides a rapid and reliable approach for differentiating black tea origins.

Keywords: ATR-FTIR spectroscopy; Black tea; Chemometric analysis; Geographical origin; Principal component analysis

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ID 95

Machine learning and chemometrics-based detection of sugar adulteration in black tea using UV-visible spectroscopy

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Abstract:
Tea (*Camellia sinensis*) is one of the most widely consumed beverages worldwide and ensuring quality is essential for consumer safety and quality control. However, adulteration with low-cost substances such as sugar remains a significant issue in the tea industry. This study presents a rapid, non-destructive approach for detecting sugar adulteration in black tea using UV-Visible spectroscopy combined with chemometrics and machine learning techniques. A total of 250 orthodox black tea samples were collected from seven major tea-growing regions of Sri Lanka, from which 100 representative samples were selected for analysis. Tea and sugar samples were separately ground and sieved, and sugar-adulterated tea samples were prepared gravimetrically at 0.05%–40% (w/w) by homogenization. Spectra were recorded over 190–1100 nm, with five independent replicates. Spectral data were pre-processed using Savitzky-Golay smoothing followed by mean-centering and auto-scaling to reduce noise and improve signal quality. Principal component analysis was applied for exploratory data analysis and dimensionality reduction, revealing that the first two principal components accounted for 79.8% of the total variance. Partial least squares discriminant analysis (PLS-DA) was used for supervised classification, achieving strong model performance with R^2 = 0.866 and Q^2 = 0.851, demonstrating good predictive ability and model robustness. In addition, a support vector machine classifier with a radial basis function kernel was developed, achieving an overall accuracy of 88% and effectively classifying adulterated samples. The PLS-DA model was internally validated using cross-validation, and machine learning models were evaluated using a 70:30 train–test split. The results confirm that integrating UV-Visible spectroscopy with multivariate analysis provides a reliable, rapid, and non-destructive method for detecting sugar adulteration in black tea, with strong potential for application in food quality control and product authentication.

Keywords: Black tea; Chemometrics; Sugar adulteration; Support vector machine; UV-Visible spectroscopy

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Agricultural Economics, Extension and Agribusiness

Oral Presentations

Keynote Speech

Smallholder commodity landscapes: knowledge, incentives and jurisdictional sustainability

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Abstract
Sustainability transitions in smallholder commodity landscapes depend not simply on the availability of better data, but also on how knowledge is interpreted, applied and connected to economic and institutional realities. Four key propositions is shaped by farm economics, including investment costs, risk, access to finance and the distribution of sustainability benefits across value chains. Second, agricultural interventions need to account for heterogeneity among farmers and landscapes. The Options by Context approach helps identify which options are suitable for different farmers and under specific social, economic and ecological conditions. Third, piloting, adaptation and knowledge facilitation are critical for turning technical evidence into workable practices. Farmer learning, trusted extension relationships and two-way feedback between local experience and formal knowledge are central to this process. Fourth, many sustainability challenges extend beyond individual farms and require coordination at landscape and jurisdictional scales, where public planning, environmental management, producer support and market incentives can be aligned. Certification, traceability and deforestation-related due diligence are also considered, particularly where standardized compliance systems may inadequately represent heterogeneous and tree-rich agricultural landscapes. Jurisdictional sustainability can complement farm-level approaches by connecting producer information with territorial governance. Effective sustainability transitions therefore, require actionable knowledge, viable incentives, locally appropriate options and institutions capable of coordinating change across smallholder commodity landscapes.

Keywords: Commodity landscapes; Jurisdictional sustainability; Landscape governance; Smallholder agriculture; Sustainability transitions

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ID 12

Sustainable biogas production from cow dung and food waste: A community-level implementation study

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Abstract:
This study evaluated the technical feasibility and community-level applicability of small-scale biogas production using cow dung and household food waste in the Kamburupitiya area of Sri Lanka. The objective of the study was to develop and assess a sustainable biogas system capable of managing organic waste while generating renewable energy for rural households. Ten household-scale biogas units were constructed and operated over a five-month period. Each unit consisted of a 500 L anaerobic digester, a 70 L floating gas holder, a slurry outlet, and a bubbling chamber designed for pressure regulation and monitoring gas flow. The design parameters were determined based on the average daily feeding rate of 5 kg of cow dung and supplementary food waste inputs with an estimated hydraulic retention period suitable for continuous anaerobic digestion. Initially, each digester was charged with 50 kg of cow dung, 20 L of water, and sugar solution to enhance microbial activity. Daily feeding rates gradually increased from 2 kg to 5 kg of food waste. The pH remained stable between 6.9 and 7.2 throughout the operational period, indicating favorable digestion conditions. The biogas units produced an average of 0.20–0.30 m^3 of biogas per day, with methane-rich gas providing stable combustion during burner tests. The generated gas was equivalent to approximately 0.10–0.14 kg of LPG per day, sufficient for preparing one to two household meals daily. The study demonstrates that community-based biogas systems can effectively convert organic waste into renewable energy while improving sanitation and supporting sustainable rural livelihoods.

Keywords: Anaerobic digestion; Biogas production; Cow dung; Food waste management; Renewable energy

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ID 43

Application of farmer field school approach to the extension system: A field experience

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Abstract:
The Farmer Field School (FFS) extension model was developed by the FAO. The FFS is a participatory method, and the concept mainly focuses on learning by doing. To organize an FFS programme in a locality, certain principles must be fulfilled. Farmer groups, facilitators, curriculum and demonstration plots are the main components. The approach conducts training for a specific group of farmers throughout the FFS sessions with a qualified facilitator who disseminates interventions according to a pre-prepared curriculum. A demonstration plot serves as the platform for farmer interactions. The Smallholder Agribusiness and Resilience Project (SARP) deployed the FFS as the extension approach to reach the target farmers. This paper explains the application of the principles of the FFS model to the agricultural extension programme conducted in the Vavuniya District of Sri Lanka. The database maintained by the SARP, extension officers' records, farmers' records, and prepared formats were used to obtain relevant information. The lessons learned from the field situation reveal that the SARP implemented eight FFSs during the *Yala* season 2025 (April to Sep.) in the district, and on average, 25 farmers participated in each FFS. The Agricultural Instructors (AIs) functioned as the facilitators and conducted special topics based on pre-designed curriculum. Further, demonstration plots were established and maintained. This provided the weekly experience in learning by doing under micro-ecological conditions. The performance evaluation demonstrated an 80% success in the conduct of FFS programme. Overall, the FFS model is a viable agricultural extension intervention that can be incorporated to extension systems.

Keywords: Agricultural extension; Curriculum; Demonstration; Participatory learning

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ID 48

Performance determinants of women entrepreneurs in small and medium enterprises in Mannar District

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Abstract:
Small and medium enterprises (SMEs) are an integral part of the Sri Lankan economy, with women entrepreneurs contributing to employment generation and poverty alleviation, particularly in rural regions. However, their performance is often constrained by various factors. This study examines the determinants, challenges and potential solutions related to the performance of women-owned SMEs in Mannar District, Sri Lanka. Primary data were collected through a structured questionnaire, administrated to 220 women-owned SMEs, purposively selected from the industrial development board registry. Most respondents operated Palmyra-based enterprises. The analysis employed multiple linear regression for production per annum and net return, and negative binomial regression for household dietary diversity score (HDDS) using STATA software to examine the relationship between dependent variables, such as production per annum, net return, and HDDS, and independent variables such as age, education, experience, ownership, digital literacy, credit access, training and business registration. The findings indicate that annual production was positively and significantly influenced by education, family ownership and business registration. Net return was positively associated with experience and credit access, while HDDS was positively affected by age and education, with significance observed at the 1%, 5%, and 10% levels, respectively. Conversely, limited credit access, unregistered businesses, and limited job creation remain major constraints. This study concludes that strengthening entrepreneurial education and training, improving access to finance and simplifying formal registration are essential to enhance the sustainability of women-led SMEs. This research provides useful insights for policymakers, and future researchers to support inclusive economic development and women's empowerment in Sri Lanka.

Keywords: Enterprise performance; Multiple linear regression model; Negative binomial model; Small and medium enterprises (SMEs); Women entrepreneurs

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ID 96

Impact of employee green behavior and employee motivation on organizational sustainability performance

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Abstract:
Organizational sustainability remains a critical challenge for the Sri Lankan apparel sector, where firms often struggle to translate sustainability initiatives into measurable outcomes due to a limited understanding of employee green behavior and motivation. This study examines the effects of employee green behavior and employee green motivation on organizational sustainability performance, with employee green motivation as a mediator. The study was conducted among 90 randomly selected executive-level employees from three apparel companies in Sri Lanka using a pre-tested, structured questionnaire. Data was analyzed using descriptive and inferential techniques, including reliability analysis, the Wilcoxon signed-rank test, and structural equation modeling. The Wilcoxon signed-rank test confirmed statistically significant positive perceptions of employee green behavior, green motivation, and sustainability performance. The findings indicate high levels of employee green behavior and employee green motivation among respondents. Structural equation modeling results revealed significant positive relationships between employee green behavior and employee green motivation ($\beta = 0.763$, $P < 0.05$), employee green behavior and sustainability performance ($\beta = 0.289$, $P < 0.05$), and employee green motivation and sustainability performance ($\beta = 0.638$, $P < 0.05$). Furthermore, employee green motivation significantly mediated the relationship between employee green behavior and organizational sustainability performance. The study concludes that strengthening employee green behavior and motivation enhances organizational sustainability performance. Apparel firms should integrate green behavior indicators into performance appraisal systems, implement structured green training and awareness programs, and establish recognition and reward mechanisms for environmentally responsible workplace practices. These actions collectively support long-term sustainability improvements and foster a stronger organizational green culture.

Keywords: Apparel sector; Employee green behavior; Green motivation; Sri Lanka; Sustainability performance

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ID 117

Potential for green training in the batik-making process: A case study of the Kegalle District

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Abstract:
The batik industry in Sri Lanka plays an important role in cultural preservation and provides rural employment. However, batik production generates significant environmental concerns, particularly due to the discharge of untreated wastewater containing hazardous chemicals associated with synthetic dyes. Despite the increasing importance of sustainable production, limited attention has been given to implementing green training practices among batik entrepreneurs in the Kegalle District. Therefore, this study aimed to identify the strengths, weaknesses, opportunities, challenges, and strategies associated with implementing green training in the batik-making process. A quantitative research approach was adopted, and primary data were collected from all 60 registered batik entrepreneurs in the Kegalle District using a census sampling approach from January to April 2024. Data were analysed using SPSS software. Both descriptive and inferential statistical techniques were employed. Descriptive statistics including frequencies, percentages, mean values, and bar charts were used to present the findings. Cronbach's alpha test confirmed the reliability of the dataset with an alpha value greater than 0.80. The Wilcoxon signed-rank test was used to examine entrepreneurs' perceptions regarding strengths, weaknesses, opportunities, challenges, and strategies related to implementing green concepts. A 5-point Likert scale was used to measure respondents' perceptions (1 = very low, 5 = very high), and the data were treated as interval data for analysis. The results revealed that 72% of respondents discharge liquid waste directly into drainage channels without treatment, while the adoption of green practices remains low. Key strengths of batik entrepreneurs for implementing green training included high environmental concern (M = 4.52) and willingness to adopt environmentally responsible practices (M = 4.48). Major barriers to implementing green training included difficulties in adopting eco-friendly practices (M = 4.78) and lack of skilled labour (M = 4.72). The Wilcoxon signed-rank test indicated that all identified strengths, weaknesses, opportunities, challenges, and implementation strategies were statistically significant ($P < 0.05$). Financial support, wastewater management strategies, awareness of sustainable production materials, and collaboration among batik entrepreneurs were identified as key strategies for promoting green training among Batik entrepreneurs. The study concludes that green training programmes can improve environmental sustainability, worker safety, and competitiveness in the batik industry.

Keywords: Batik industry; Eco-friendly practices; Green training; Sustainability

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Belt and Road

Session 01

Oral Presentations

ID 32

Screening of rice advanced inbred lines for salinity and submergence tolerance based on *SALTOL* and *SUB1* molecular markers

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Abstract:
This study evaluated 27 advanced inbred rice lines and three standard varieties under field conditions to identify genotypes carrying *SALTOL* and *SUB1* loci associated with salinity and submergence tolerance while selecting high-yielding lines. The experiment was conducted using a randomized complete block design with two replications. Morphological and yield-related traits were analyzed using one-way ANOVA and Duncan's Multiple Range Test at $p<0.05$. Molecular screening was performed using SSR markers RM493 and RM1287 for *SALTOL* and RM8300 and RM219 for *SUB1*. Significant variation was observed among the evaluated genotypes. Bg 94/1 and Ld 368 were susceptible to both salinity and submergence stresses, whereas At 354 was tolerant to both stresses. Molecular analysis identified six salinity-tolerant inbred lines, including Ld 20-5-19-1, Ld 20-5-16, Ld S_2B_7, Ld N_2B_4, and Ld C_128, with improved yield-related traits. Nine inbred lines were identified as submergence tolerant, and several lines demonstrated superior grain filling ability and thousand-grain weight compared with the standard varieties. Among them, Ld 20-5-19-1, Ld 20-5-16, and Ld S_2B_7 showed tolerance to both salinity and submergence stresses. The salinity- and submergence-tolerant lines Ld 20-5-19-1, Ld 20-5-16, and Ld S_2B_7 exhibited average number of filled grains per plant ranging from 111.0 ± 11.2 to 142.5 ± 12.9, plant heights between 113.3 ± 2.5 cm and 127.5 ± 1.5 cm, and thousand-grain weights varying from 25.3 ± 0.7 g to 28.6 ± 1.5 g. Therefore, Ld 20 5-19-1, Ld 20-5-16, and Ld S_2B_7, can be considered promising candidates for the development of future multi-stress-tolerant rice varieties.

Keywords: Marker-assisted selection; Morphological traits; Salinity tolerance; Submergence tolerance; SSR markers

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ID 49

Immunoinformatics-based design and *in vitro* evaluation of a multi-epitope DNA vaccine against *Edwardsiella piscicida*

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Abstract:
Edwardsiella piscicida represents a gram-negative facultative bacterium causing edwardsiellosis. The outer membrane protein assembly factor BamA is a highly conserved membrane protein in gram-negative bacteria. The present study evaluated the safety and effectiveness of an *in silico*-designed, BamA protein targeted multi-epitope vaccine using *in silico* immune simulations and *in vitro* immune functional assays, with the aim of supporting its potential for future vaccine development. Immunogenic epitopes of BamA protein were predicted using multiple bioinformatics tools. The selected epitopes were combined to construct a multi-epitope DNA vaccine targeting *E. piscicida*. Computational immune simulations were performed using the C-ImmSim server to observe the predicted immune responses. The vaccine construct was cloned into a GFP reporter plasmid, and its expression and immunostimulatory potential were evaluated by transfecting human embryonic kidney 293T (HEK293T) cells and analyzing immune gene expression using qRT-PCR. *In silico* immune simulations demonstrated that the primary immunization triggered early IgM and IgG responses, whereas booster immunization enhanced IgG titers, with increased magnitude and prolonged persistence. The detection of GFP expression at 24 hours post-transfection verified efficient translation of the DNA vaccine construct, demonstrating successful expression of the encoded epitope sequences. qRT-PCR results showed strong upregulation of TNF-α and IL-8 (>5-fold) and moderate increases in IL-6 and IL-12 (>1.5-fold) compared with untreated controls, supporting simulation predictions. Overall, the DNA vaccine demonstrated promising immunomodulatory potential *in vitro* in the absence of an adjuvant, supporting further *in vivo* evaluation to assess immune responses and protective efficacy. Future studies will incorporate suitable adjuvants to evaluate their potential to enhance immunogenicity.

Keywords: Antigenicity; Aquaculture; DNA vaccine; *Edwardsiella piscicida*; Vaccine design

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ID 125

Enhancing secondary metabolite profiles in *Mentha spicata* via targeted narrow-band phototherapy

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Abstract:
The transition into sustainable agricultural practices calls for the use of methodologies supported by data-driven insights in order to enhance the quality and nutritional benefits derived from crops without the need for synthetic chemicals. In this study, the intersection of biomedical engineering with agricultural biotechnology is explored by leveraging the advanced technology of narrow-band light therapy systems designed for human application in order to effectively manipulate the biological and biochemical characteristics of *Mentha spicata*. The experimental aspect of the project involved the use of a custom-developed spectral delivery array that could emit narrow bands from LED clusters of red (660 nm) and blue (450 nm) light at specific intensities. Unlike broad-spectrum lighting methods used in previous studies, this approach involves targeting certain wavelengths to stimulate particular photoreceptors and regulate the activity of the secondary metabolic pathways associated with antioxidant production. The bioinformatics analysis focused on the modeling of the relationship between the photon flux density and the synthesis of important volatile oils. Preliminary findings showed that the optimal 3:1 red-to-blue light ratio led to a significant increase in carvone and limonene contents. The integration of deep learning frameworks further allowed predictive modeling of metabolic shifts, identifying optimal harvest windows when phytochemical density reaches its peak. Ultimately, this study confirms that biomedical precision lighting technology can be successfully recalibrated for smart agriculture, effectively bridging the gap between healthy soils and healthy people by delivering nutrient-dense products to the end consumer.

Keywords: Biotechnology; Bioinformatics; *Mentha spicata*; Phototherapy; Secondary metabolites

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ID 140

Determination of the activity of a UDP-sugar regeneration system for flavonoid glycosylation using GmSUS coupled with YjiC

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Abstract:
Glycosylation is a key biochemical modification that enhances the solubility, stability, and bioactivity of flavonoids and other plant-derived secondary metabolites; however, its application is often limited by the high cost of UDP sugar donors. This study aimed to evaluate a cost-effective enzymatic cascade system for flavonoid glycosylation by coupling the glycosyltransferase YjiC from *Bacillus licheniformis* with sucrose synthase from *Glycine max* (GmSUS) for in situ UDP-sugar regeneration. The genes encoding YjiC and GmSUS were cloned into pET-28a (+) and heterologously expressed in *Escherichia coli* BL21(DE3). Recombinant proteins were purified using Ni^{2+}-NTA affinity chromatography, and their molecular weights (~44.7 kDa for YjiC and ~93.1 kDa for GmSUS) were confirmed by SDS–PAGE. Enzymatic activity was evaluated in a coupled reaction system containing 100 mM Tris–HCl buffer (pH 7.5), 10 mM $MgCl_2$, 0.3 mM UDP, 100 mM sucrose, 1 mM substrate, and 2 μM enzymes at 45 °C for 3 h. A range of flavonoid and polyphenolic substrates, including resveratrol, apigenin, baicalein, diosmetin, naringenin, hesperidin, kaempferol, luteolin, and myricetin, were tested. Reaction products were analyzed using reverse-phase HPLC with a C18 column. The coupled system showed enzymatic activity toward most substrates, as indicated by changes in chromatographic profiles, whereas no detectable activity was observed with myricetin, indicating the broad substrate scope of YjiC. The integration of GmSUS enabled continuous regeneration of UDP-sugars, reducing dependence on externally supplied cofactors and improving process feasibility. Overall, this study presents a sustainable and efficient biocatalytic platform for flavonoid modification.

Keywords: Glycosylation; Sucrose synthase; UDP-glycosyltransferase

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ID 161

Biochar regulation of soil water dynamics: integrating hydrophobicity and water retention for sustainable agricultural management

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Abstract:
Under intensifying climate change, global agroecosystems are increasingly exposed to severe water stress, making efficient soil water management essential for food security and ecological sustainability. Soil water repellency and water retention are key factors governing soil water dynamics; however, they are commonly treated as independent mechanisms, limiting understanding of their intrinsic linkage and long-term evolution. Biochar, as a multifunctional soil amendment, has been widely applied to improve soil hydraulic properties, yet its integrated effects on soil hydrophobicity and water retention remain insufficiently synthesized. This study employs keyword-based literature retrieval and comprehensive synthesis to examine the multi-scale mechanisms by which biochar regulates soil water processes, by linking microscale chemical driving factors with macroscale hydrological responses, this study places hydrophobicity and water retention within a unified conceptual framework to explore their dynamic balance across spatial and temporal scales. Existing evidence indicates that hydrophobic organic components, aromatic carbon structures, and surface physicochemical properties of biochar modify soil wettability, influencing rainfall infiltration initiation and preferential flow formation. Meanwhile, enhanced pore structure and aggregate stabilization optimize soil water transport pathways, improve soil water retention capacity, and increase plant-available water. Synthesized findings demonstrate that soil hydrophobicity and water retention are not contradictory properties but operate at sequential stages of water entry, redistribution, and storage, jointly regulating soil water dynamics. This unified soil water dynamics framework advances understanding of biochar regulation mechanisms and provides theoretical support for optimizing agricultural water management and promoting sustainable agricultural practices under climate change.

Keywords: Biochar; Soil hydrophobicity; Soil water dynamics; Sustainable agriculture; Water retention

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ID162

Interactions between microplastics, soil carbon, and biochar in agricultural soils

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Abstract:
Microplastic pollution in agricultural soils has become an increasingly prominent environmental issue due to its persistence, widespread distribution, and potential interference with soil ecological functions and carbon sequestration processes. Clarifying the interactions among soil microplastics (MPs), carbon pools, and amendments is of great significance for improving soil health and promoting sustainable agricultural management. This study aimed at systematical evaluation of the environmental behavior of soil MPs and their effects on soil carbon dynamics, with a focus on the regulatory role of biochar amendments. A systematic literature review was conducted using Web of Science database with searches combining the keywords "soil microplastics", "soil carbon pool", and "biochar". More than 100 peer-reviewed studies published between 2015 to 2025 were analyzed to assess the physical, chemical, and biological interactions between MPs and soils, as well as their influences on soil carbon transformation. The results indicated that MPs could alter soil physicochemical properties, microbial metabolism, and aggregate stability, affecting carbon mineralization and sequestration. The type, size, and abundance of MPs exhibited differential effects on the content and fractions of soil organic carbon under varying environmental conditions. Numerous studies demonstrated that biochar application could enhance soil carbon storage by improving soil aggregate structure and stimulating microbial activity, thereby partially mitigating the negative impacts of MPs. Interactions between biochar and MPs may further influence the mobility and transformation of carbon fractions. Overall, MPs affect soil carbon cycling through multiple pathways, while biochar shows considerable potential for mitigating associated ecological risks and promoting sustainable soil management. Future studies should prioritize long-term field experiments and establish standardized evaluation systems to more accurately assess the ecological risks and carbon sequestration potential of MP-contaminated soils.

Keywords: Agricultural soils; Biochar; Microplastics; Soil carbon; Soil health

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ID 163

Mechanisms and applications of modified biochar in saline-alkali soil amelioration

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Abstract:
Soil salinization, a major form of soil degradation, threatens global food security and agricultural sustainability. Although biochar is commonly used as a soil amendment due to its functional groups and complex microstructure, its direct application in saline-alkali soils is limited by feedstock composition and pyrolysis conditions. This study therefore aims at elucidating how biochar properties influence its ameliorative effects and to explore the mechanisms and application outcomes of physical, chemical, and biological modification approaches for enhancing biochar functionality. A systematic literature search was conducted in the Web of Science and ScienceDirect, retrieving more than 150 peer-reviewed papers published from 2003 to 2025. The results show that biochar application improves soil physical structure and chemical properties, thereby enhancing plant salt tolerance. In addition, biochar acts as a microbial carrier, supplying nutrients and providing a suitable microenvironment to promote soil microbial activity. Different modification methods lead to distinct differences in biochar performance and mechanisms of saline-alkali soil amelioration. Among them, chemically modified biochar exhibits the most prominent effect in alleviating saline-alkali stress, primarily through ion exchange and physical adsorption, followed by pore entrapment, precipitation, and complexation. In conclusion, this review systematically elaborates on the potential of biochar for ameliorating saline-alkali soils and summarizes the relevant mechanisms under different modification methods, providing a theoretical basis for soil improvement and arable land expansion. Future research should strengthen the assessment of potential environmental risks associated with biochar and its modified materials in saline soils.

Keywords: Biochar; Modification; Mechanism; Saline-alkali stress; Soil salinization

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Belt and Road

Session 02

Oral Presentations

ID 01

Green Mart: A user-centered mobile application for sustainable online shopping

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Abstract:
The increasing demand for environmentally responsible consumption has highlighted several limitations of conventional e-commerce platforms, including inadequate sustainability-related information, difficulties in identifying genuinely eco-friendly products, and reduced consumer trust caused by greenwashing practices. Addressing these challenges, this study presents the design and usability evaluation of GreenMart, a prototype sustainable e-commerce platform developed using User Experience Engineering (UXE) principles. Unlike general online marketplaces, GreenMart incorporates product verification mechanisms and sustainability-oriented information features designed to assist consumers in making informed purchasing decisions while supporting environmentally responsible vendors. The platform is intended to encourage responsible production and consumption practices aligned with the Sustainable Development Goals (SDGs). A user-centered UXE methodology was employed, comprising user analysis, persona development, task analysis, prototyping, and usability evaluation. Interactive prototypes were developed using Figma to simulate key functionalities for consumers, vendors, and administrators. Usability was evaluated through Nielsen's heuristic evaluation conducted by five UX professionals and a think-aloud study involving 23 representative users. The evaluation identified strong performance in areas such as system visibility, the correspondence between the system and the real world, interface aesthetics, and recognition rather than recall. However, several usability issues were observed, including limitations in feedback mechanisms, error recovery support, navigation efficiency, and contextual user guidance. Quantitative findings indicated that most identified issues were classified as low-to-moderate severity, while user feedback suggested a generally positive perception of ease of use and trustworthiness. The findings demonstrate how UX engineering can contribute to the development of trustworthy and user-friendly sustainable e-commerce platforms. Although further empirical validation is required to assess long-term behavioral impacts, the study provides a practical framework for designing digital marketplaces that support sustainable consumption and environmentally responsible supply chains.

Keywords: Human-computer interaction; Sustainable e-commerce; Sustainable online shopping; Usability evaluation; User experience design

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ID 02

Plantify: A user-centered mobile application for sustainable urban plant care

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Abstract:
Rapid urbanisation has reduced access to natural green spaces while increasing interest in indoor and small-scale urban gardening as a means of enhancing well-being and environmental sustainability. However, many urban residents struggle to maintain healthy plants due to limited gardening knowledge, inconsistent care routines, and uncertainty regarding sustainable plant management practices. This study presents Plantify, a user-centred mobile application designed to support sustainable urban plant care through personalised guidance and digital engagement. The application was developed using a User Experience (UX) Engineering approach comprising problem identification, user and task analysis, scenario-based design, prototyping, heuristic evaluation, and think-aloud usability testing. Five personas representing diverse urban gardening needs were developed to guide the design decisions. The high-fidelity prototype incorporated plant identification, personalised care scheduling, reminder systems, eco-friendly plant care guidance, and community-based knowledge sharing. Usability evaluation was conducted through a heuristic inspection involving five UX experts and a think-aloud study with seven representative users. The evaluation demonstrated high learnability, intuitive task flows, and positive perceived usefulness, while identifying opportunities for improvement in navigation feedback, visual clarity, confirmation mechanisms, and error prevention. Unlike many existing plant care applications that primarily provide information, Plantify integrates sustainable behaviour support, personalised care management, and community engagement within a single user-centred platform. By encouraging responsible plant maintenance and environmentally conscious practices, the proposed solution contributes to sustainable urban agriculture initiatives and aligns particularly with the United Nations Sustainable Development Goal 11 (Sustainable Cities and Communities) and Goal 12 (Responsible Consumption and Production). The study highlights the importance of iterative usability evaluation in designing digital solutions that support data-informed sustainable urban living.

Keywords: Urban gardening; User experience design; Sustainable plant care; Mobile application; Usability evaluation

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ID 06

Shinystat: An integrated web-based platform for one-way ANOVA and publication-ready XRD and UV–Vis visualization

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Abstract:
The increasing dependence on experimental data across biotechnology, materials science, and agricultural research has created a growing demand for accessible statistical analysis and high-quality scientific visualization tools. However, early-career researchers and students often face significant barriers due to limited statistical literacy, high costs of proprietary software, and the technical complexity of programming-based tools. This study presents ShinyStat, a web-based R Shiny application developed to simplify one-way analysis of variance (ANOVA) and automate the generation of publication-ready visualizations for X-ray diffraction (XRD) and ultraviolet–visible (UV–Vis) spectroscopy data. The primary objective of ShinyStat is to provide an intuitive, cost-free platform that enables users to perform essential statistical analyses and scientific graphing without requiring prior programming experience. The principal novelty of this work lies in the unified integration of these distinct analytical modules combining UV–Vis spectral visualization, Tauc plot-based optical bandgap estimation, XRD pattern visualization with peak annotation, and one-way ANOVA with automated assumption checking and post-hoc testing into a single, streamlined ecosystem. By bridging the gap between raw experimental data and publication-ready insights, ShinyStat significantly reduces the software related challenges typically encountered in multidisciplinary materials science workflows. Developed in R Shiny with a modular analytical architecture, the platform supports CSV data upload, automated statistical diagnostics, real-time visualization using ggplot2-based workflows, and the export of publication-quality outputs in standard formats (PDF and JPG). Benchmarking against SAS demonstrated complete concordance in ANOVA statistics, assumption diagnostics, and post-hoc outputs, confirming analytical reliability. Overall, ShinyStat provides a robust, user-friendly solution that enhances accessibility to statistical analysis and scientific visualization, supporting reproducible research and improving the quality of data interpretation and reporting in multidisciplinary scientific contexts.

Keywords: Open-source scientific software; R Shiny; UV–Vis spectroscopy; XRD visualization

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ID 22

Autonomous AI-driven monitoring for large-scale composting: A mechatronic approach to reducing greenhouse gas emissions and spontaneous combustion

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Abstract:
Large-scale thermal composting is an essential component of circular waste management, yet it poses significant operational risks including spontaneous combustion and the sustained emission of greenhouse gases such as methane (CH_4), carbon monoxide (CO), and carbon dioxide (CO_2). Conventional monitoring approaches rely on manual probe measurements, which are labor-intensive, hazardous to operators, and capture only periodic snapshots of pile conditions leaving critical thermal and chemical changes undetected between inspections. This research details the development of an autonomous rover-mounted system for continuous, non-invasive environmental monitoring of industrial compost windrows. The system integrates a multi-gas and temperature sensor array with a Decision Tree classifier that categorizes pile conditions into Normal, Warning, and Critical states, supporting early identification of thermal instability and anaerobic zones before they escalate into fire or emission events. Validation trials confirmed temperature measurement accuracy within ±0.5 °C of manual reference methods. Additionally, CO_2 concentrations reaching 2800 ppm were recorded during testing, and real-time alerts were successfully triggered at defined hazard thresholds, demonstrating the system's responsiveness under realistic operating conditions. Together, these capabilities suggest the platform can support more timely corrective interventions compared to conventional periodic manual monitoring. The system offers a low-cost, accessible alternative to proprietary industrial solutions and represents a practical step toward data-driven, instrumented management of large-scale agricultural composting operations.

Keywords: Autonomous Monitoring; Composting; Embedded systems; Greenhouse Gas emissions; Machine learning

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ID 92

UV-Vis HADP profiling for authenticity screening of cane sugar adulteration in coconut toddy

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Abstract:
Sri Lankan coconut toddy is a nutritionally rich, traditional beverage that is increasingly compromised by cane sugar adulteration and dilution. This study evaluated UV-Vis spectroscopy after alkaline heat treatment as a rapid screening tool for toddy authenticity. Genuine toddy samples from three coastal locations (*Aluthgama*, *Kakapalliya*, and *Batapaththala*), one laboratory-prepared artificial toddy sample made from a 16% sucrose solution inoculated with toddy, three commercial toddy samples, and a sucrose solution control were treated with calcium hydroxide at 90 °C. The formation of hexose alkaline degradation products (HADPs) was monitored at 272 nm and 284 nm, and the A_{284}/A_{272} ratio was calculated from triplicate measurements. Genuine toddy showed elevated absorbance values, with *Kakapalliya* (A_{272} = 0.768 ± 0.024, A_{284} = 2.162 ± 0.032) and *Batapaththala* (A_{272} = 0.685 ± 0.021, A_{284} = 2.064 ± 0.038) exhibiting the highest responses, while *Aluthgama* showed comparatively lower values (A_{272} = 0.391 ± 0.005, A_{284} = 0.699 ± 0.003). The artificial toddy produced a comparable profile (A_{272} = 0.648 ± 0.007, A_{284} = 1.955 ± 0.023; ratio 3.02), indicating that sugar-based fermented analogs can generate similar UV-active degradation products under alkaline conditions. Commercial sample 2 showed variable and generally lower absorbance, particularly Commercial 2 (A_{272} = 0.080 ± 0.005, A_{284} = 0.098 ± 0.003), suggesting dilution or adulteration. These findings indicate that UV-Vis HADP profiling is a simple screening tool for suspicious toddy samples, but it alone cannot distinguish genuine toddy from sugar-based artificial toddy. Therefore, it should be used in conjunction with sulfated ash analysis for more reliable authenticity assessment.

Keywords: Cane sugar adulteration; Coconut toddy authenticity; Fermentation-derived UV-active compounds; Hexose alkaline degradation products; UV-Vis spectroscopy

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ID 134

Effect of plant spacing and establishment method on yield and biomass distribution of Mukunuwenna (*Alternanthera sessilis* L.)

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Abstract:
Alternanthera sessilis (L.) R. Br. ex-Roth (Mukunuwenna), belonging to the family Amaranthaceae, is a widely consumed leafy vegetable in Sri Lanka. Despite its extensive commercial cultivation, scientifically validated studies evaluating planting techniques to optimize yield per unit area remain limited. This study evaluated the main and interaction effects of plant spacing and establishment methods on the growth and yield of *A. sessilis*. The experiment was conducted in the WL2a agroecological zone of Sri Lanka using a two-factor factorial layout in a Randomized Complete Block Design (RCBD) with three replicates. Treatments comprised three plant spacing levels (S_1: 10 cm × 20 cm, S_2: 10 cm × 10 cm, and S_3: random spacing) and two establishment methods (M_1: single-stem and M_2: three-stem). Yield data were analyzed using a Linear Mixed Model (LMM) with field blocks treated as a random effect, alongside residual diagnostic checks for normality (Shapiro-Wilk $W = 0.949, p = 0.412$) and homoscedasticity (Levene's test $F = 0.594, p = 0.705$). The mixed-model ANOVA revealed that the establishment method had a statistically significant effect on total yield ($F_{1,10} = 5.47, p = 0.0414$), with the three-stem method (M_2) producing a significantly higher mean yield (1006.0 ± 155.0 g) than the single-stem method (M_1, 704.0 ± 155.0 g), delivering a net yield advantage of $+302.0$ g ($p = 0.0414$). Conversely, plant spacing ($F_{2,10} = 0.065, p = 0.9373$) and the spacing × establishment method interaction ($F_{2,10} = 0.285, p = 0.7582$) were not statistically significant. The random block variance component accounted for 38.7% of total variance ($\sigma^2_{\text{Block}} = 47{,}221$), confirming substantial field micro-site heterogeneity and justifying the RCBD structure. These results demonstrate that adopting a three-stem establishment method (M_2) significantly increases *A. sessilis* yield by 42.9% compared to single-stem propagation. Because plant spacing within the tested range did not influence yield, farmers can select spacing based on labor efficiency and planting material costs while adopting multi-stem propagation to maximize crop productivity.

Keywords: *Alternanthera sessilis*; Establishment method; Plant spacing

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Poster Presentations

ID 03

Evaluation of antibiosis resistance in Sri Lankan *Oryza nivara* populations to brown planthopper (*Nilaparvata lugens*)

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Abstract:
Sri Lankan *Oryza nivara* represent an underexplored genetic reservoir for brown planthopper (BPH) resistance, offering potential solutions to annual yield losses of 5-10% caused by this destructive pest. This study evaluated antibiosis resistance mechanisms in five *Oryza nivara* populations collected from geographically diverse regions across Sri Lanka (Anuradhapura, Kilinochchi, Batticaloa, Mannar, and Katharagama) against BPH. Antibiosis resistance was evaluated using the Standard honeydew excretion test and measurements of total sugar content in stem juice, using Ptb 33 as the resistant check and Bg 380 as the susceptible check. Experiments were conducted in a completely randomized design with four replicates, and data were analyzed using ANOVA with means separated by Duncan's Multiple Range Test at 5% significance level. All tested *O. nivara* populations exhibited superior resistance compared to both check lines. The Batticaloa population displayed the highest antibiosis resistance with minimal honeydew excretion (3.7 ± 0.6 mm^2) and lowest stem sugar content (6.54 ± 0.12 °Brix), followed by Mannar (5.2 ± 0.9 mm^2, 6.82 ± 0.13 °Brix) and Kilinochchi (8.9 ± 1.2 mm^2, 7.44 ± 0.17 °Brix). Anuradhapura and Katharagama showed moderate resistance (24.8 ± 1.6 mm^2, 8.54 ± 0.11 °Brix and 27.5 ± 2.1 mm^2, 8.82 ± 0.12 °Brix, respectively). A strong positive correlation ($r = 0.84$, $P < 0.05$) between stem sugar content and honeydew excretion suggests reduced phloem sugar concentration as a critical biochemical antibiosis mechanism. The susceptible check Bg 380 recorded maximum honeydew excretion (384.7 ± 12.0 mm^2) and highest sugar content (10.68 ± 0.36 °Brix). These findings highlight genetic diversity within Sri Lankan *O. nivara* populations, particularly Batticaloa and Mannar accessions, representing valuable germplasm resources for sustainable BPH-resistant breeding programs.

Keywords: Antibiosis resistance; Brown planthopper; Genetic reservoir; *Nilaparvata lugens*; *Oryza nivara*

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ID 08

Development of a plant-based functional soy milk fortified with encapsulated spirulina

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Abstract:
Spirulina (*Spirulina platensis*) is a nutrient-dense microalga rich in protein, antioxidants, and bioactive compounds. However, its use in foods is limited due to its intense color, characteristic odor, and instability of sensitive compounds. This study developed a plant-based functional soy milk fortified with calcium–alginate encapsulated *Spirulina* and evaluated its sensory, physicochemical, nutritional, and microbiological properties. Encapsulated *Spirulina* beads were incorporated into soy milk at 1%, 3%, and 5% (w/v), while non-fortified soy milk served as the control. *Spirulina* biomass was encapsulated using the calcium–alginate method and incorporated into pasteurized soy milk. Physicochemical properties, including pH, titratable acidity, and total soluble solids, were evaluated during refrigerated storage. Proximate composition and microbiological quality were determined using standard analytical methods. Sensory evaluation was conducted using a 5-point hedonic scale with 30 semi-trained panelists. The 3% (w/v) formulation achieved the highest overall acceptability score (4.2 ± 0.18), indicating the best balance between sensory quality and nutritional enhancement. During storage, pH decreased from 6.82 ± 0.02 to 6.45 ± 0.03, while titratable acidity increased from 0.21 ± 0.01% to 0.38 ± 0.02%. Total soluble solids increased from 8.4 °Brix to 8.9 °Brix, and protein content reached 22.84 g 100 g^{-1} (dry basis). Total plate count increased from 1.2×10^3 to 3.6×10^3 CFU mL^{-1}, while yeast and mold counts remained below acceptable limits ($<10^2$ CFU mL^{-1}). The fortified soy milk remained microbiologically stable for 10 days under refrigerated storage.

Keywords: Antioxidants; Encapsulation; Functional beverage; Soy milk; *Spirulina*

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ID 09

Effectiveness of natural and synthetic attractants on fruit fly assemblages (*Bactrocera* and *Zeugodacus* spp.) in a snake gourd field

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Abstract:
Fruit flies are one of the major economically important pest groups damaging fruits and vegetables. However, the existing knowledge on the use of natural attractants in addition to synthetic compounds to control fruit flies is limited. This study was thus conducted to investigate the effectiveness of natural and synthetic attractants to trap fruit flies in a selected snake gourd vegetable cultivation site at Midigama Fruit Farm, Matara, from September to November 2025. Five fruit fly traps (a trap with a 5 cm diameter and 10 cm height with two circular openings, each containing one attractant coated sponge (3 cm×3 cm): cue-lure (synthetic), methyl eugenol (synthetic), cue-lure + methyl eugenol (synthetic), ginger (*Zingiber officinale*) aqueous extract (2 g m L^{-1}), (natural) and control (distilled water)), were used. Each trap was hung 1.5-4 m above the ground in the center of each sub-sampling site (5 m × 5 m) in the same site. Trapped fruit flies were collected once per week, and attractant-coated sponges were replaced in each visit. Settings were repeated five times. Among all attractants, cue-lure showed the highest fruit fly attraction (30%), while ginger showed the lowest attraction (22.62%). A moderate number of fruit flies were attracted to the methyl eugenol (23.61%) and the combination of cue-lure and methyl eugenol (23.77%). Fruit fly abundance among the four lure types did not differ significantly ($P > 0.05$). *Zeugodacus cucurbitae* was the most abundant (56.88%) attracted fruit fly species for all four attractant types, while *Z. caudatus* (13.11%), *Z. tau* (5.8%), *B. dorsalis* (18.85%), and *B. musae* (10%) were recorded with moderate abundance in different cues. *Zeugodacus diversus*, *B. kandiensis*, and *B. nigrofemoralis* were not recorded in ginger. The study reveals that synthetic combined attractants are more effective in attracting economically important fruit flies than natural attractants such as ginger. However, ginger can be used as a natural, biodegradable, and environmentally friendly attractant for fruit flies.

Keywords: Attractiveness; Fruit fly; Natural attractant; Synthetic attractant

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ID 11

Impact of natural biofilter media on water quality and growth performance of platy (*Xiphophorus maculatus*) in a recirculating aquaculture system

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Abstract:
Recently, low-cost, biofilter materials have been used as environmentally friendly alternatives in recirculating aquaculture systems (RAS). This study evaluated three natural biofilter media, coconut shells (CS), bivalve shells (BS), and dried bamboo strips (DB), to determine their effects on water quality and growth performance of platy (*Xiphophorus maculatus*) in a small-scale RAS. The experiment was conducted over six weeks (42 days) in 56 L (60 × 30 × 40 cm) glass tanks with four treatments: control (CT, no biofilter), CS, DB, and BS (three replicates each), stocking ten juvenile platy per tank (0.22–0.24 g; 2.32–2.37 cm). Growth parameters and water quality parameters were assessed during the experimental period. CS produced the highest final mean weight (1.42 ± 0.19 g) and total length (4.39 ± 0.12 cm), along with the highest average daily gain (18.80 ± 1.86%), specific growth rate (5.14 ± 0.25%), and feed conversion ratio (1.81 ± 0.57) compared to the other treatments, whereas BS showed the poorest performance. The survival rate was highest in CS (83.33 ± 7.07%) and lowest in BS (23.33 ± 7.07%). By day 42, nitrate concentrations ranged from 13.5 to 14.8 mg L^{-1} in all treatments. Bivalve shells increased calcium hardness, while dissolved oxygen remained stable (7.70–8.20 mg L^{-1}) across treatments. Overall, coconut shells demonstrated the best performance in maintaining water quality and promoting fish growth and survival, while dried bamboo showed moderate effectiveness, and bivalve shells were less suitable. Coconut shells are therefore recommended as an inexpensive and locally available biofilter medium for RAS.

Keywords*:* Biofilter materials; Growth performance; Platy fish; Recirculatory aquaculture system; Water quality

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ID 17

Assessment and validation of phthalate migration from plastic packaging into oil simulants

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Abstract:
Phthalates are endocrine-disrupting chemicals that may pose adverse health effects following prolonged exposure. This study evaluated the migration of six phthalates (DIBP, DBP, BBP, DEHP, DINP, and DIDP) from plastic food-contact materials used for storing oily foods obtained from the Pettah market, Sri Lanka. Ten samples from each type of container (PET, HDPE, and PP) were tested. Migration testing was performed using 95% (v/v) ethanol as a fatty food simulant in accordance with Regulation (EU) No. 10/2011, and samples were exposed for 10 days at 40 °C, simulating long-term storage under ambient conditions. Plasticizers were extracted with chloroform and analyzed by gas chromatography–mass spectrometry. Method validation was performed to evaluate the working range, accuracy, precision, limit of detection (LOD), and limit of quantification (LOQ), confirming the suitability of the analytical method for phthalate determination in food simulants. DINP, DIDP, DIBP, and BBP were not detected. DBP was detected in four PET, one PP, and four HDPE samples, while DEHP were detected in six PET, six PP, and one HDPE sample. Among these, one PET and one PP sample exceeded the LOQ for DBP, with migration levels of 0.034 and 0.036 mg L^{-1}, respectively. Both values remained below the GC–MS reporting limit of 0.05 mg L^{-1}. Kruskal–Wallis analysis revealed significant variation (P<0.05) among DEHP concentrations. All detected migration levels were below the EU specific migration limits, indicating minimal exposure risk. Future studies should apply more sensitive analytical methods (µg L^{-1} level) to assess phthalate migration under varied storage conditions.

Keywords: Food packaging safety; GC–MS analysis; Method validation; Phthalate migration; Plastic food-contact materials

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ID 18

Occurrence and distribution of microplastics across the growth stages of cultured *Penaeus vannamei* in Puttalam district, Sri Lanka

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Abstract:
Microplastics are pervasive pollutants in aquatic ecosystems, posing risks to humans through trophic transfer. This study evaluated the abundance, types, and colors of microplastics in *Penaeus vannamei* across different growth stages. Five shrimps from each growth stage, 50 g samples of feed and 5 L samples of water were collected from a shrimp farm in Puttalam District and subjected to chemical digestion. Microplastics were identified using a photomicroscope and confirmed through Nile Red staining under UV illumination. One-way ANOVA (95% confidence level) revealed significant differences in microplastic abundance (MP/shrimp) across growth stages: 156.2 ± 46.42 (PL 14), 254.2 ± 33.89 (28 days), and 391.8 ± 56.46 (57 days). The exoskeleton showed higher microplastic abundance in stage 2 (125.80 ± 33.45) and stage 3 (150.6 ± 83.77) than gills, gut and flesh. Microplastic abundance was highest in pond water (245.67 ± 15.31 MP L^{-1}), followed by lagoon water, and lowest in storage tank water. Microplastics were identified as fragments, fibers, and films, with fragments being dominant. Black fragments were most abundant, followed by blue and red fragments, in pond water and shrimp samples. The prevalence of black fragments may be associated with black polyethylene pond linings, whereas blue fibers likely originated from bird nets surrounding ponds. Microplastic abundance in feed showed a weak negative correlation with shrimp microplastic abundance ($r = -0.448$, $P = 0.705$). FTIR analysis identified polypropylene and polyethylene terephthalate as the dominant polymers. Polyethylene was absent, possibly due to misidentification from overlapping peaks. Overall, microplastics were detected at all shrimp growth stages, indicating that water and aquaculture materials may contribute to contamination and emphasizing the need for improved monitoring and management practices in aquaculture systems.

Keywords: Fourier Transform Infrared Spectroscopy; Growth stages; Microplastic abundance; *Penaeus vannamei*;; Shrimp feed

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ID 19

Evaluation of nutraceutical potential of mee (*Madhuca longifolia*) flowers and seeds

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Abstract:
Madhuca longifolia, belonging to the family Sapotaceae, is an underutilized tropical tree found in Sri Lanka. Traditionally, various parts of the plant are consumed, suggesting that *M. longifolia* may serve as a potential source of natural bioactive compounds. Therefore, this study evaluated the nutraceutical potential of air-dried *M. longifolia* flowers and seeds through proximate composition and functional properties using five different solvent extracts. Proximate analysis showed that flowers had higher moisture content (17.11 ± 0.02%) and ash content (5.01 ± 0.41%) than seeds (5.66 ± 0.42% and 1.54 ± 0.04%, respectively). Seeds contained significantly higher crude fat (39.39±0.58%) and crude fiber (15.52 ± 0.48%) than flowers (0.84 ± 0.04% and 2.32 ± 0.06%, respectively) (P<0.05). Total sugar content was significantly higher in flowers (91.53 ± 0.40%) than in seeds (12.06 ± 0.51%). Seeds exhibited higher antioxidant activity in ethanol (IC_{50}= 31.14 ± 1.06 µg mL^{-1}) and cold-water extract (IC_{50}= 59.04 ± 1.14 µg mL^{-1}), along with higher reducing power, attributed to their higher total phenolic and flavonoid contents. The petroleum ether extract of seeds and ethyl acetate extract of flowers showed higher sterol contents (2.75 ± 0.17 mg g^{-1} and 8.23 ± 0.80 mg g^{-1}, respectively). None of the extracts showed antifungal activity in yeast model testing. Cytotoxicity analysis indicated significantly greater toxicity in seed extracts, with lower brine shrimp lethality assay (BSLA) IC_{50} value of 1601 ± 369 µg mL^{-1} and higher red blood cell hemolysis 17.52 ± 2.90% compared with flower extracts (5841 ± 924 µg mL^{-1} and, 6.69 ± 0.69%, respectively). These findings demonstrate that *M. longifolia* flowers possess favourable nutritional benefits and lower cytotoxicity, highlighting their potential as a nutraceutical ingredient, whereas the higher toxicity observed in seeds emphasises further investigation before their application in food-related products.

Keywords: Antioxidants; Cytotoxicity; *Madhuca longifolia*; Nutraceuticals; Phytochemical properties

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ID 20

Nutritional enhancement through germination: A comparative evaluation of pearl millet grains and microgreens for functional food application

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Abstract:
Pearl millet (*Pennisetum glaucum*)**,** a climate-resilient staple cereal of Africa and South Asia, holds underutilized nutritional potential. Germination into microgreens offers a low-cost strategy to improve cereal nutritional quality. This study comparatively evaluated proximate composition, anti-nutrient content, antioxidant properties, and functional characteristics of pearl millet grains and microgreens for application in fortified functional food supplements. Grains were germinated under controlled conditions; both samples were analyzed for proximate composition (AOAC methods), anti-nutrients (phytates and condensed tannins), antioxidant activity (DPPH, ABTS, FRAP, TPC, TFC, and total antioxidant capacity), and functional properties. Proximate analysis revealed that grains had higher carbohydrate content (63.00 ± 0.16% DW) with moderate protein content (11.72 ± 4.39% DW), while microgreens showed markedly elevated protein (24.91 ± 3.01% DW) and ash content (2.35 ± 0.3% DW), indicating superior mineral density. Both samples contained phytates and condensed tannins within acceptable safety limits; phytate levels were 392.34 ± 17.45 mg 100 g^{-1} DW in grains and 437.06 ± 4.38 mg 100 g^{-1} DW in microgreens, with condensed tannins being minimal in both. Microgreens demonstrated substantially greater radical-scavenging activity: DPPH IC50 of 12.69 ± 1.02 µg mL^{-1} and ABTS IC50 of 11.41 ± 0.91 µg mL^{-1}, versus 38.40 ± 1.38 µg mL^{-1} and 36.27 ±0 .20 µg mL^{-1} in grains. Phenolic profiling confirmed superior antioxidant capacity in microgreens: TPC 0.767 ± 0.04 mg GAE g^{-1} DW, TFC 0.810 ± 0.03 mg CAE g^{-1} DW, FRAP 0.01 ± 0.006 µmol Fe^{2+} g^{-1} DW, and total antioxidant capacity 0.670 ± 0.03 mg AAE g^{-1} DW. Under functional properties, only the water absorption capacity showed slight differences; other characteristics remained the same. These findings support incorporating pearl millet microgreens as a nutrient-dense biofortificant in functional food products to address protein-energy malnutrition and micronutrient deficiencies in vulnerable populations.

Keywords: Antioxidant activity; Anti-nutrient properties; Microgreens; Pearl millet grains; Proximate analysis

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ID 23

Functional properties of a spice cube fortified with chicken bone powder and a mixture of leafy greens

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Abstract:
This study aimed to develop a fortified natural spice cube with chicken bone powder as a natural calcium source, and a leafy green powder mixture consisting of moringa (*Moringa oleifera*), muguna (*Alternanthera sessilis*), and kankun (*Ipomoea aquatica*) in a 1:2:1 ratio selected based on preliminary sensory considerations. Four formulations were prepared by varying the leafy green powder content as 0% (control), 10% (F1), 20% (F2), and 30% (F3), while maintaining constant levels of spices and chicken bone powder. Formulation F_1 demonstrated the highest sensory acceptability, with 30 untrained panelists through a five-point hedonic scale. The selected formulation revealed that the moisture, crude-fat, crude-protein, ash, IC_{50}, and the total phenolic content were 18.2 ± 0.12%, 8.9 ± 0.08%, 7.8 ± 0.07%, 22.6 ± 0.10%, 68.6 ± 0.01 μg $mL^{-1,}$ and 4.2 ± 0.01 mg GAE $g^{-1,}$ respectively. The 5 g cube serving per 250 mL of hot water showed promising calcium and iron contents of 59.34 and 2.31 mg. The spice cube completely dissolved in hot water within 120 s. Shelf-life stability was confirmed with water activity and pH ranges as 0.65–0.70, and 5.0–5.5 respectively, and absence of coliforms, *Salmonella*, *Shigella*, and yeast/mold counts <30 CFU g^{-1} over six months under room-temperature storage in sealed glass containers wrapped with aluminum foil. This research highlights the value addition of underutilized leafy green vegetables and chicken bone incorporated spice cubes have shown higher functional and enhanced nutritional content with higher consumer acceptability.

Keywords: Chicken-bone powder; Functional food; Leafy greens; Spice cube

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ID 26

EHP infection, water quality & vibrio abundance in pacific white shrimp *(Litopenaeus vannamei*) farming in Sri Lanka

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Abstract:
Shrimp aquaculture is one of the fastest-growing sectors of the global aquaculture industry and contributes significantly to export earnings, employment, and food security. However, disease outbreaks and inadequate water-quality management remain major challenges to sustainable shrimp production. Among the emerging pathogens, *Enterocytozoon hepatopenaei* (EHP) and *Vibrio* spp. have become significant threats affecting shrimp health, growth performance, and farm productivity. This study investigated the prevalence of EHP infection and its potential relationship with physicochemical and bacteriological parameters in shrimp ponds located in the Northwestern Province of Sri Lanka. Pond water and shrimp hepatopancreas samples were collected from *Litopenaeus vannamei* culture ponds across five major shrimp-farming zones. Physicochemical parameters including temperature, pH, salinity, dissolved oxygen (DO), alkalinity, and total ammonia nitrogen (TAN) were analyzed according to APHA (2017) standard methods. Total *Vibrio* counts were determined using Thiosulphate Citrate Bile Salt Sucrose (TCBS) agar, while EHP infection was detected through DTAB–CTAB DNA extraction followed by nested PCR amplification and agarose gel electrophoresis. The results revealed a positive relationship between *Vibrio* abundance and pH, alkalinity, and ammonia concentrations, indicating that nutrient-rich and alkaline conditions favor bacterial proliferation in shrimp ponds. In contrast, Vibrio abundance showed a negative relationship with increasing salinity levels. Furthermore, EHP-positive ponds were generally associated with higher ammonia concentrations and lower dissolved oxygen levels compared with EHP-negative ponds. These findings highlight the importance of maintaining optimal water-quality conditions to reduce pathogen proliferation and minimize disease risks. Effective water-quality management, together with improved biosecurity practices, is essential for enhancing disease resilience and promoting sustainable shrimp aquaculture development in Sri Lanka.

Keywords: Dissolved oxygen; *Enterocytozoon hepatopenaei*; Shrimp aquaculture; *Vibrio* spp; Water quality

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ID 29

Evaluation of the antioxidant properties of lime waste

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Abstract:
Lime is a widely produced, economical fruit that is nutritious and healthy. Processing lime produces large amounts of waste, including peel, pulp, pomace, and seeds, and improper disposal can lead to environmental pollution. This study aims to investigate the antioxidant properties of different portions of lime waste as a functional ingredient, helping to valorize by-products and mitigate environmental pollution. Lime waste was obtained and separated into peel (P1), pulp (P2), and a mixture of both (P3). The samples were dried at 60 °C for 12 hours and ground into flour (particle size 150 µm). Methanolic extracts were prepared using 5 g of each waste and 50 mL of methanol, and the total phenolic content (TPC), total flavonoid content (TFC), 2,2-diphenyl-1-picrylhydrazyl (DPPH), 2,2-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS), and ferric reducing antioxidant power (FRAP) assays of the lime waste extracts were analyzed in duplicate. Overall, peels had significantly higher polyphenols (27.35 ± 0.06 mg GAE g^{-1}), while pulp (17.526 ± 0.28 mg GAE g^{-1}) and the mixture of peel and pulp (19.256 ± 0.08 mg GAE g^{-1}) had significantly lower polyphenol contents (P<0.05). A similar pattern of high results was observed for the antioxidant potential of lime peel among the waste portions in TFC (0.068 ± 0.01 mg QE g^{-1}) and in the IC_{50} values of DPPH (0.200 mg mL^{-1}), ABTS (0.069 mg mL^{-1}), and FRAP (0.154 mg mL^{-1}) assays. In conclusion, polyphenols, flavonoids, and other antioxidants are present in lime waste, with levels significantly higher in lime peel, intermediate in the mixture of both, and lowest in pulp. Hence, lime waste contains beneficial compounds, making it a functional raw material that helps valorize by-products and mitigate environmental pollution.

Keywords: Antioxidant; Environmental pollution; Lime waste; Polyphenols; Valorization

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ID 30

Comparative assessment of growth and yield of Muria F1 capsicum under protected vs. open environments of Bandarawela, Sri Lanka

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Abstract:
Capsicum (*Capsicum annuum* L.) is a highly valued vegetable crop cultivated for its nutritional quality, culinary versatility, and economic significance. Its growth and productivity are strongly influenced by environmental conditions, including temperature, humidity, and light intensity. Protected cultivation systems, such as polytunnels, provide a controlled microclimate that can enhance plant growth, accelerate development, and improve fruit yield. This preliminary study compared the growth and yield performance of the Muria F1 capsicum hybrid under polytunnel (L1) and open field (L2) environments. The experiment was conducted using one-month-old seedlings of uniform height transplanted into polybags containing coco peat. Both treatments received identical irrigation and nutrient management to ensure that differences were attributable to the cultivation environment. Plant growth, flowering initiation, fruit number, and fruit weight were recorded weekly. Results showed clear differences between the two environments. By the second week of March, polytunnel plants reached 152–158 cm in height (average 155 cm), while open field plants were 96–101 cm (average 98 cm). Flowering occurred 10–15 days earlier in polytunnel plants. Polytunnel plants also produced more fruits (26–31 fruits per plant; average 29) compared with open field plants (11–14 fruits per plant; average 13), and average fruit weight was higher under polytunnel conditions (116 g) than in the open field (67 g). However, as a single polytunnel unit was used, employing multiple independent polytunnel units in future studies would improve replication and enable more rigorous statistical inference, alongside systematic recording of microclimatic data. Overall, these preliminary findings suggest that protected cultivation offers a potential advantage over open field conditions in enhancing capsicum productivity and crop efficiency under the agro-climatic conditions of Bandarawela, Sri Lanka.

Keywords: *Capsicum annuum*; Flowering time; Muria F1 hybrid; Polytunnel cultivation; Protected agriculture; Yield performance

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ID 34

Development of *Moringa oleifera* powder enriched vegetable burger patties and computational characterization of their bioactive compounds

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Abstract:
This study aimed to develop functional meat alternatives by incorporating *Moringa oleifera* leaf powder, utilizing its exceptional nutritional density and rich bioactive profile to enhance product health benefits. Vegetable burger patties were formulated using cowpea, soybean, oyster mushroom, breadcrumbs, wheat flour, dehydrated vegetables, and spices, with moringa leaf powder incorporated at 0.5%, 1.0%, and 1.5%. Sensory evaluation indicated that the 1.5% moringa formulation achieved the highest scores for overall acceptability, taste, appearance, color, aroma, and texture, and was selected for further analysis. Proximate analysis of the selected sample showed 13.77% protein, 8.93% fat, 22.46% carbohydrates, 4.91% fiber, 2.47% ash, and 47.47% moisture. Shelf-life evaluation during frozen storage at −18 °C for 12 weeks demonstrated stable pH values between 5.32 and 5.34. The product contained low sodium (0.35 g 100 g^{-1}) and sugar (5.49 g 100 g^{-1}) and demonstrated an antioxidant capacity of 0.19 mg Trolox equivalents per gram. Microbiological analysis after three months of frozen storage showed an aerobic plate count of 4.2×10^5 CFU g^{-1}, while yeast and mold counts remained low and total coliforms were undetected, remaining within permissible standard values. Computational characterization examined the interaction of moringa flavonoids (quercetin, rutin, kaempferol) with xanthine dehydrogenase, an enzyme associated with reactive oxygen species formation. The results indicate moderate inhibitory potential and suggest that moringa-enriched vegetable patties serve as a nutritionally balanced functional food.

Keywords: Bioactive flavonoids; *Moringa oleifera*; Random forest modeling; Vegetable burger patties; Xanthine dehydrogenase inhibition

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ID 35

Post-COVID constraints and sustainability of micro and small-scale women floriculture entrepreneurs in Matara District, Sri Lanka

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Abstract:
The floriculture industry represents a significant agribusiness opportunity with the potential to strengthen women entrepreneurs in Sri Lanka. The sector has been adversely affected by the COVID-19 pandemic and the subsequent economic crisis. Despite growing recognition of women's contribution to agricultural entrepreneurship, there is limited district-level empirical evidence on the specific challenges they face in Matara and their impact on business performance and sustainability. This study aimed to assess business performance, identify key constraints, and propose sustainability strategies for micro and small-scale women floriculture entrepreneurs in the Matara District, Sri Lanka. A sample of 45 participants was purposively selected from the Matara and Kamburupitiya Divisional Secretariats to ensure the inclusion of individuals actively engaged in the sector. Data were collected using a structured questionnaire, supported by informal discussions, and analyzed using descriptive statistics. The major constraints identified were marketing difficulties, infrastructure limitations, post-pandemic impacts, and social challenges. The findings indicate that infrastructure problems affected 28% of participants, while 25% experienced marketing constraints. These constraints were found to limit business expansion, reduce income stability, and hinder long-term enterprise sustainability. Strengthening government support programs such as Vidatha, promoting producer networks and cooperatives, providing targeted modern floriculture skill development training and organizing flower exhibitions in Matara to enhance market opportunities. The findings highlight the importance of improving institutional support, strengthening market linkages, and enhancing technical skills to sustain micro- and small-scale women-led floriculture enterprises in the Matara District.

Keywords: Floriculture industry; Women entrepreneurship; Micro- and small-scale enterprises; Business performance; Sustainability

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ID 38

Scotch bonnet production in underutilized marginal spaces: A systematic evaluation of an upside-down 2-in-1 hanging bottle system and traditional pots in Karagoda Uyangoda, Sri Lanka

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Abstract:
Rapid urbanization and declining cultivable land necessitate space-efficient and resource-conscious food production systems. This study evaluated the productivity and sustainability potential of an upside-down 2-in-1 hanging bottle system for scotch bonnet pepper (*Capsicum chinense*) production under limited-space conditions in Karagoda Uyangoda, Sri Lanka. The system reused 5 L plastic bottles to simultaneously cultivate scotch bonnet and water spinach (*Ipomoea aquatica*), thereby integrating vertical farming with container recycling and dual-crop production. A 24-week comparative experiment was conducted using 50 plants arranged randomly with two treatments:16 x 16-inches black-coloured traditional pots (control) and upside-down hanging black-coloured bottle systems. Plant height, leaf number, flowering, fruit number, and weekly yield were recorded and statistically evaluated under identical soil-compost media and irrigation schedules. Statistical analysis using one-way ANOVA revealed a highly significant difference in mean yields between the two systems ($F(1,48) = 21.5$, $P < 0.001$). Traditional pots achieved a mean yield of 130 g plant^{-1} with lower variability (CV = 13%), while the hanging bottle system produced 92 g plant^{-1} with greater variability (CV = 19%). Flowering and fruiting occurred earlier in pots, confirming reduced physiological stress and more stable performance. Despite lower yields, the hanging bottle system offered clear advantages in vertical space utilization, plastic waste reuse, and dual-crop potential. Economic analysis showed a production cost of Rs. 4,800 and net profit of Rs. 19,200. While traditional pots delivered higher and more stable yields, upside-down bottles provide a practical, sustainable option for urban and peri-urban farming, supporting resource-efficient food production aligned with green transition goals.

Keywords: *Capsicum chinense*; Scotch bonnet; Sustainable food production; Vertical farming

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ID 45

Epidemiology of subclinical mastitis in dairy cows in five selected veterinary ranges in Monaragala District, Sri Lanka: Bacterial etiology and antimicrobial resistance

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Abstract:
Subclinical mastitis (SCM) is one of the most economically important diseases affecting dairy cattle worldwide. Despite its significance, information on the bacterial etiology and antimicrobial resistance patterns associated with SCM in dairy herds of Monaragala District, Sri Lanka, remains limited. This cross-sectional study investigated the prevalence, bacterial etiology, and antimicrobial resistance patterns associated with SCM in dairy herds in Monaragala District, Uva Province, Sri Lanka. Five veterinary divisions were randomly selected, and a total of 175 dairy farms and 607 lactating cows without clinical mastitis were enrolled a using multi-stage stratified random sampling method. SCM was diagnosed using the California Mastitis Test (CMT), and bacteriological and antimicrobial susceptibility analyses were performed on milk samples collected from SCM-positive cows. Of the 114 CMT-positive cows, 110 yielded bacterial growth. The predominant pathogens were *Staphylococcus aureus* (79.1%) and *Staphylococcus epidermidis* (16.4%), while gram-positive organisms *Bacillus* spp., and gram-negative organisms including *Escherichia coli*, *Klebsiella* spp., were detected at low frequency (4.6%). Antimicrobial susceptibility testing revealed high levels of resistance to commonly used antimicrobials such as neomycin (89.8%), ampicillin (67.6%), and sulphamethoxazole-trimethoprim (60.2%), whereas most isolates remained susceptible to enrofloxacin (81.1%). Multidrug resistance was detected in 31.8% of all isolates, with the highest prevalence observed among *S. aureus.* These findings emphasize the need for targeted mastitis prevention programs and prudent antimicrobial use to limit further emergence of antimicrobial resistance in Sri Lankan dairy systems.

Keywords: Antimicrobial susceptibility; Dairy cattle; Subclinical mastitis

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Development and quality evaluation of a value-added Tilapia fish cake

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Abstract:
The increasing global demand for sustainable and nutritious food highlights the need for innovative value-added fish products. Tilapia (*Oreochromis* sp.), a widely available freshwater fish, remains underutilized due to its characteristic muddy odor and flavor despite its high nutritional value. The present study aimed to develop an acceptable and economically viable tilapia-based fish cake to enhance consumer acceptance. Minced tilapia flesh was marinated and steamed with cinnamon leaves (5 g per 100 g of fish) for five minutes to reduce undesirable odor and flavour. Chickpea flour was selected as the binding agent over corn starch. Different fish mince-tochickpea flour ratios (55:45, 50:50, 45:55, 60:40, 47:53, 53:47, 40:60 w/w) were formulated and evaluated using a seven-point hedonic scale with 30 semi–trained panelists. The fish mince-to-chickpea flour ratio of 53:47 (w/w) was identified as the most acceptable formulation. Proximate analysis of the optimized product (before frying) showed moisture content of 42.34 ± 0.64%, crude protein content 26.02 ± 0.93%, crude fat content 15.97 ± 0.20%, ash 5.41 ± 1.65%, and crude fiber 0.31 ± 0.23%. Texture profile analysis indicated acceptable structural properties, while color parameters (lightness = 47.74 ± 0.55, Redness = 4.88±0.89, Yellowness = 16.62 ± 1.09) and pH (6.17 ± 0.02) were within desirable ranges. Microbiological analysis (Total Plate Count: $9.6 \times 10^4 \pm 1.02 \times 10^4$, Yeast Mold Count: $4.6 \times 10^1 \pm 0.32 \times 10^1$) confirmed acceptable quality immediately after preparation, and the product remained suitable for consumption after six weeks of storage at −20 °C. Cost analysis demonstrated economic feasibility, with a production cost of approximately 87.40 LKR per 50 g unit. Overall, the developed tilapia fish cake shows strong potential as a nutritious and shelf-stable value-added product.

Keywords: Fish cake; Proximate composition; Sensory evaluation; Shelf-life; Tilapia

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ID 56

Integrated optimization of soilless potting media and nutrient management for export-oriented cultivation of *Adenium obesum*

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Abstract:
This study was conducted to evaluate the effective soilless potting mix and the best fertilizer management package for growing grafted *Adenium obesum* (Desert Rose) for commercial production. The experiment was conducted at Agunakolapalassa, Hambantota District, (DL1a), Sri Lanka. Four potting compositions were prepared using different ratios of sand, compost, soil, coir chips and coir dust as follows: T_1 (sand 50%: compost 25%: soil 25% (control). T_2 (coir dust 25%: coir chips 25%: sand 50%), T_3 (coir dust 25%: coir chips 50%: sand 25%), and T_4 (coir dust 50%: coir chips 25%: sand 25%). Grafted plants were evaluated using a completely randomized design with 15 replicates for each treatment. Growth parameters, including plant height, number of leaves per plant, stem thickness, and root volume, were recorded and statistically analyzed using SAS software, with mean comparisons performed using Dunnett's test. Root volume was significantly higher in T4, while the other growth parameters showed no significant differences among treatments. Based on the significantly high root volume, T_4 is recommended as a soilless culture medium to cultivate *A. obesum.* Fertilizer experiments were conducted with grafted *A. obesum* seedlings grown in a T_4 medium under randomized complete block design based on caudex diameter using 144 plants to evaluate the effects of different fertilizer formulations on plant growth and flowering. The study tested post-grafting fertilizer treatments (high N-30:10:10, high P-10:52:10, and 12:12:7) and pre-blooming fertilizer treatments (Balance-14:14:14, Balance-20:20:20, 12:11:18, and 14:14:21). Key growth parameters, including plant height, number of leaves, caudex diameter, and flowering performance, were measured and statistically analyzed using SAS software, with mean separation performed using Duncan's Multiple Range Test. Plant height and number of leaves per plant were significantly higher in the 10:52:10 treatment, while the other measured parameters showed no significant differences among the treatments. At the pre-blooming stage, no significant differences were observed among the treatments. Based on the experimental results, the 10:52:10 formulation is recommended to promote strong vegetative growth. In addition, fertilizers 12:11:18 and 14:14:21 were identified as economical pre-blooming fertilizer formulations when used with the T_4 potting medium.

Keywords: *Adenium obesum*; Fertilizer formulations; Ornamental plants; Soilless potting media

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Evaluation of fruit quality attributes during post-harvest storage of tomato genotypes (*Solanum lycopersicum* L.) in Sri Lanka

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Abstract:
This study evaluated post-harvest quality of 17 Sri Lankan grown tomato varieties. Fruits harvested at a uniform stage (color changes from green to yellow) stored under ambient conditions and assessed for over 25 days using a Completely Randomized Design with three replicates. Significant variation in shelf life was observed, with field-2 (23.33 ± 1.50 days), KC-1 (21.67 ± 1.28 days), and field-1 (21.00 ± 2.50 days) exhibiting the longest storage potential. Initial total soluble solids ranged from 5.33 ± 2.50 °Brix (Goraka) to 10.57 ± 1.50 °Brix (field-2). High-Brix varieties (>9.0 °Brix), including field-2 and Bathiya, maintained superior sweetness during early storage but declined after 15 days. Fruit firmness decreased significantly ($p \leq 0.001$) from 3.70 N to 1.08 N within 14 days, indicating progressive softening. Color analysis revealed a decline in lightness (L*), particularly in KC-1 (−22.86), while redness (a*) increased in most varieties, notably KC-1 (+26.21). Weight loss differed significantly, with Field-2 and Goraka recording lower losses (≤7% by day 10), whereas Cherry and L. Sour exceeded 15.00 ± 0.50% by day 15–20. Wrinkling scores indicated faster deterioration in Bathiya and Rashmi compared to Wal and KC-1. The highest lycopene levels at 5 days after picking were recorded in Kaha, Goraka, KC-1, L-Sour and T-245 with values exceeding 12 mg/100 g. SSR-63 analysis detected a ~250 bp allele in eight varieties. Overall, Biththara, Cherry, L-Sour, Goraka, Kaha, KC-1, Thilina and field-2 demonstrated desirable traits, including low weight loss, high total soluble solids (TSS), high lycopene content, and better storage quality, making them potential candidates for future tomato breeding programs.

Keywords: Germplasm evaluation; molecular markers; post-harvest quality; physicochemical properties; shelf life

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ID 66

Dietary effects on growth and survival of early juvenile sandfish (*Holothuria scabra)*

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Abstract:
High mortality and reduced growth of juveniles are major constraints in the culture of sandfish (*Holothuria scabra*). This study evaluated the effects of three dietary treatments on the growth performance and survival of juvenile sandfish over a 25-day period. Early juveniles with an initial mean weight of 0.0043 ± 0.0020 g were stocked in nine indoor tanks (200 L) at a density of 0.54 juveniles L^{-1} (108 for 200 L). Three dietary treatments, *Thalassiosir*a *sp*. diatom only (control); *Thalassiosira sp* diatom combined with *Sargassum sp*, slurry (TS); and *Thalassiosira sp*. diatom, *Sargassum sp* slurry and *Thalassia hemprichii* slurry (TST) were compared along triplicates after randomly assigning treatments to the tanks. All treatments received 2000 mL of diatom culture (10 mL L^{-1}), while TS and TST were supplemented with 200 mL of *Sargassum* slurry, and TST additionally received 200 mL of *Thalassia hemprichii* slurry. Water quality parameters remained stable with no significant differences among treatments. Growth and survival data were analyzed using one-way ANOVA followed by Tukey's test ($P < 0.05$). The control showed the lowest SGR% (6.0 ± 0.4), which was significantly lower than both TS (12.4 ± 3.3) and TST (14.4 ± 0.6) treatments. However, there was no significant difference observed among TS and TST treatments in SGR%. The percentage length gain also followed the same pattern as SGR%. Survival rate was significantly affected by the treatment, and was highest in TS (89.5 ± 4.38%) and TST (92.5 ± 1.85%) while the control diet showed the poorest survival rate (34.87 ± 17.08%). The estimated production cost per surviving juvenile was lowest in TS (LKR 81.62), followed by TST (LKR 91.96) and Control (LKR 133.05). TS was identified as the most cost-effective diet for early juvenile rearing.

Keywords: Cost-effectiveness; Sandfish *(Holothuria scabra); Thalassiosira sp; Sargassum sp.; Thalassia hemprichii*

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ID 69

Effects of water spinach (*Ipomoea aquatica*) on growth and body coloration of Southern platy fish (*Xiphophorus maculatus*)

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Abstract:
Natural feed additives are recognized as vital for improving both the health and market value of ornamental fish aquaculture. This eight-week study assessed the suitability of *Ipomoea aquatica* as a dietary supplement for the growth and body coloration of platy fish, *Xiphophorus maculatus*. Diets were formulated with different levels of water spinach leaf powder as control (0%), low dose (LD, 2.5%), medium dose (MD, 5%), and high dose (HD, 7.5%). A total of 120 platy fry with uniform initial body weight (0.29 ± 0.10 g) were randomly distributed into 12 glass tanks (15 L) at a 1.5 fish L^{-1} of stocking density with three replicates per treatment. Fish were fed to satiation twice daily. At the end of the experiment, growth performance, feed utilization efficiency, survival rate, total carotenoid content (TCC), and carotenoid retention were analyzed using one-way ANOVA. The MD treatment demonstrated significantly higher mean body weight gain (0.34 ± 0.02 g), average daily gain percentage (2.11 ± 0.90), and specific growth rate percentage (1.39 ± 0.41) compared to the control ($P < 0.05$). The feed conversion ratio of treatments ranged from 1.93 ± 0.21 (control) to 3.20 ± 0.26 (HD). Mean length gain, relative condition factor, and survival rate were not significantly affected by the treatments. Carotenoid deposition increased with the inclusion level, while the HD treatment showed the highest total carotenoid content in the skin (40.76 ± 0.68 μg g^{-1}). TCC measurements were consistent with the results of the MATLAB analysis. These findings indicate that water spinach is an effective carotenoid source for ornamental fish diets, with 5% inclusion identified as the optimum level to promote pigmentation, growth, and feed utilization in southern platy fish.

Keywords: Color enhancement; Growth; Natural carotenoids; Platy fish; Water spinach

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ID 71

Establishment of a micropropagation protocol for rapid clonal propagation of *Evolvulus alsinoides* (Vishnukranthi)

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Abstract:
Evolvulus alsinoides (Vishnukranthi) is an important medicinal plant valued for its diverse therapeutic properties and bioactive secondary metabolites. Conventional propagation through seeds and stem cuttings may result in low multiplication rates, variable plant establishment, and seasonal limitations, restricting the availability of uniform planting material for large-scale cultivation. This study was conducted to develop an efficient *in vitro* micropropagation protocol for *E. alsinoides*. Shoot-initiated nodal explants obtained from *in vitro*-established plantlets were cultured on B5 medium supplemented with plant growth regulators. A total of 216 explants were used in the experiment. The multiplied shoots were subcultured at four-week intervals. After four subculture cycles, regenerated shoots were transferred to rooting media containing different auxin combinations. All experiments were arranged in a completely randomized design, and data were analyzed using ANOVA followed by duncan's multiple range test using SAS software. Among the treatments tested, B5 medium supplemented with 1.0 mg L^{-1} BAP, 0.1 mg L^{-1} kinetin, and 0.1 mg L^{-1} NAA produced the highest shoot proliferation, yielding an average of six shoots per explant with a mean shoot height of 4.67 cm after four weeks ($P < 0.05$). For root induction, the combination of 1.5 mg L^{-1} IBA and 0.5 mg L^{-1} IAA produced the best response, producing an average of five roots per plantlet after eight weeks ($P < 0.05$). Successfully rooted plantlets were acclimatized under controlled conditions. The results demonstrate that the developed protocol can be used effectively for rapid, large-scale propagation of *E. alsinoides*, providing a reliable method for producing uniform planting material to support its cultivation and sustainable utilization.

Keywords: *Evolvulus alsinoides*; *In vitro*; Rooting; Shoot proliferation; Vishnukranthi

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ID 75

AI-guided discovery of an efficient chitinase enables green production of chitobioses with distinct cadmium stress-alleviating efficacy in rice

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Abstract:
Abiotic stresses, particularly heavy metal contamination, induce excessive reactive oxygen species in plants, causing oxidative damage and severe crop yield losses. Structurally defined chitobioses are promising natural antioxidants that hold great promise as biostimulants to enhance plant stress tolerance in sustainable agriculture. However, their green and cost-effective synthesis remains a bottleneck. Here, we employed an artificial intelligence (AI)-driven, structure-based enzyme mining strategy to identify a thermostable, highly specific endochitinase (CT10) from *Paenibacillus elgii*, which efficiently hydrolyzes low-cost colloidal crustacean chitin into N, N′-Diacetylchitobiose (GlcNAcβ1-4GlcNAc, AA) with minimal byproducts. Coupling CT10 with regioselective chitin deacetylases (VcCDA/NodB) in a one-pot cascade reaction yielded three additional structurally defined chitobioses: GlcNAcβ1-4GlcN (AD), GlcNβ1-4GlcNAc (DA), and GlcNβ1-4GlcN (DD), all with >95% purity. Among these, DA exhibits superior hydroxyl radical (OH•) scavenging activity comparable to L-ascorbic acid. Exogenous application of the four chitobioses alleviated cadmium (Cd) stress in rice (*Oryza sativa* L.), restoring growth, reducing ROS/MDA accumulation, and upregulating antioxidant enzyme genes (*sod*, *pod*, *cat*). Notably, DA showed the highest efficacy in promoting root biomass recovery and activating antioxidant defense pathways. This study establishes a scalable, green platform for the synthesis of structurally defined chitobioses and delineates their structure-specific roles in alleviating heavy metal toxicity, providing a nature-based strategy to improve crop resilience in agricultural systems affected by abiotic stress.

Keywords: Artificial intelligence; Chitinase; Chitobioses; Cadmium stress; Rice

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From banana to spread: Development and quality assessment of *Ambul* banana-chocolate spread

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Abstract:
Banana (*Musa* spp.) is a widely consumed tropical fruit that experiences significant post-harvest losses, highlighting the need of valorize to extend the shelf life. Thus, the current study aimed to develop an *Ambul* banana-incorporated chocolate peanut spread as a solution to the post-harvest losses of *Ambul* banana, and to evaluate its sensory, nutritional, and physicochemical properties. To achieve this, four different chocolate peanut spreads were developed by incorporating different percentages of banana pulp (40%, 50%, 60% and 70%) and the best ratio of banana pulp was determined using a sensory evaluation with 35 semi-trained panelists using a seven-point hedonic scale. Based on the results obtained, 40% banana-incorporated spread was selected as the most acceptable formulation with an acceptability index of 82.9%, and no significant difference ($P > 0.05$) was observed compared to the control prepared without banana. Nutritional analysis revealed that the developed banana-incorporated spread contained higher moisture, crude protein, crude fiber, and potassium, while exhibiting significantly lower fat (29.67 ± 1.35%) compared to the control (45.49 ± 1.37%), and thereby classifying it as a low-fat spread. Physicochemical analysis indicated lower pH (5.93 ± 0.03) and higher titratable acidity (49.17 ± 3.87) in the developed sample. Total soluble solids were reduced (68.70 ± 3.34 °Brix) compared to the control (73.23 ± 2.06 °Brix). In conclusion, the developed product represents a nutritionally improved, low-fat spread, showing its potential as a value-added product to minimize post-harvest losses of bananas.

Keywords: Banana; Chocolate spread; Nutritional properties; Physicochemical properties; Sensory properties

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ID 80

Impact of fertilizer formulations on soil, plant nutrient status and yield in tea (*Camellia sinensis*) plantations

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Abstract:
Efficient nutrient management is essential in tea cultivation to maintain soil fertility and meet crop nutrient requirements. Magnesium (Mg) is primarily supplied to tea plantations through the application of dolomite ($MgCO_3 \cdot CaCO_3$) during pruning, mainly for soil pH correction. As cation exchange capacity (CEC) is low in lower elevations, applications of NPK may affect Mg availability due to K-Mg antagonism. Furthermore, intensive nitrogen (N) and potassium (K) fertilization may suppress Mg uptake, leading to Mg deficiency in the soil, adversely affecting healthy plant growth and yield. A field experiment was conducted in a low-country tea-growing area at Rekadahena Estate, Galle, Baddegama, Sri Lanka, to compare three widely used fertilizer formulations (U709, UT1625, U834) in tea plantations in terms of soil and plant nutrient status and yield components. The study followed a randomized complete block design with three treatments and three replicates for three months. No significant differences were observed among treatments for "active" and "Banji" bud dry weight or total yield. However, the highest value was observed in plots treated with UT1625. The soil P (29.7–30.6 mg kg^{-1}; P = 0.9662) and K (52.0–57.0 mg kg^{-1}; P = 0.7432) levels showed no significant variation, whereas soil Mg content (64.0–113.0 mg kg^{-1}) differed significantly (P = 0.0027). Application of different fertilizer formulations resulted in significant differences in mature leaf nitrogen content among treatments (P = 0.0301), rising from 3.11% (U709) to 3.32% (U834) and 3.34% (UT1625). However, no significant differences were detected among treatments with respect to K and P, and Mg contents in mature leaves. Kieserite-fortified fertilizers significantly enhanced soil Mg (42%–76.6%) and leaf nitrogen content (6.8–7.4%) relative to non-kieserite mixture U709. Given that tea is a perennial crop, the present findings based on three months of data are preliminary, and longer-term evaluation is required to draw definitive conclusions.

Keywords: Active & banji buds; Kieserite fortified mixtures; Mg availability; Tea; Low country

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Quality assessment of ice used in the fish supply chain in Dondra

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Abstract:
Ice is the primary chilling agent used in the fish supply chain in Sri Lanka to maintain freshness and safety. The overall quality of fish is greatly affected by the quality of ice. This study was conducted to evaluate the microbial and physicochemical quality of ice used in Dondra, Southern Province, Sri Lanka. Thirteen ice samples were collected from July to August 2025, including samples from three ice plants, five multiday boats, and five fish vendors. Samples were analyzed in triplicate for fecal and total coliforms, total plate count, and *Vibrio sp*., alongside physicochemical parameters including hardness, conductivity, total dissolved solids, salinity, dissolved oxygen, and pH in melted ice. According to one-way ANOVA analysis, results indicated that while fecal and total coliform levels did not differ significantly across the chain, total plate count was significantly lower in ice plants ($2.77 \times 10^3 \pm 1.34 \times 10^3$ CFU mL^{-1}) compared to vendors ($28.26 \times 10^6 \pm 6.06 \times 10^6$ CFU mL^{-1}) and boats ($22.33 \times 10^6 \pm 6.22 \times 10^6$ CFU mL^{-1}). Similarly, *Vibrio sp*. counts were significantly lower ($P < 0.05$) in ice plants compared to vendors ($10.20 \times 10^6 \pm 5.48 \times 10^6$ CFU mL^{-1}) and boats (5.41-$\times 10^6 \pm 2.06 \times 10^6$ CFU mL^{-1}). Physicochemical properties remained largely stable, except for dissolved oxygen, which significantly decreased as ice moved towards vendors. The study concludes that the microbial quality of ice significantly deteriorates as it moves from production to final retail outlets. While ice produced at plants has lower initial microbial loads, contamination during storage on boats and handling by vendors represent a major risk. To ensure food safety and minimize post-harvest losses, these findings highlight an urgent need for strict sanitation protocols, worker training, and improved hygienic practices throughout the supply chain.

Keywords: Dondra; Fish supply chain; Ice quality; Microbial contamination; Sanitary practices

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Foliar nutrition in mature tea: assessing fertilizer use efficiency and cost–benefit analysis

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Abstract:
The field experiment was conducted in a low-country tea-growing area of Deraniyagala, Kegalle District, Sri Lanka, to evaluate the effect of foliar nutrient application on made tea yield, fertilizer use efficiency, production cost, and profitability. The study employed a randomized complete block design with five replicates, comprising five treatments across 25 plots (each containing 50 tea bushes) to account for field variability. T_1 (U709 ground fertilizer–control), T_2 (U709 + zinc sulphate foliar), T_3 (U709 + urea foliar), T_4 (U709 + epsom salt foliar), and T_5 (U709 + zinc sulphate + urea + epsom salt foliar). All plots received a uniform ground application of U709 at 312.5 kg ha^{-1}. Foliar treatments were applied 10 days after ground fertilization at rates recommended by the Tea Research Institute guidelines. Yield and productivity were statistically analyzed using one-way analysis of variance (ANOVA) with SAS software. The results revealed that there was a significant difference in made tea yield ($P < 0.0001$), with T_5 recording the significantly highest yield (2067 kg ha^{-1}), representing a 63 kg ha^{-1} increase over the control (T_1). Fertilizer use efficiency ranged from –0.40% to 3.14%, with the highest efficiency observed in T_5. Total production costs varied among treatments, with the lowest cost recorded in T_4 (Rs. 1,267,461.40 ha^{-1}) and the highest in T_5 (Rs. 1,312,520.55 ha^{-1}). Despite the comparatively higher production cost, T_5 achieved the highest revenue (Rs. 2,480,400 ha^{-1}) and producer margin (Rs. 1,167,879.45 ha^{-1}), indicating that combined foliar nutrient application is economically viable. Overall, the findings demonstrate that balanced, multi-nutrient foliar application (T_5) is both agronomically effective and economically beneficial in mature tea cultivation, resulting in higher yields, improved nutrient use efficiency, and enhanced profitability without substantially increasing production costs.

Keywords: Cost-benefit analysis; Fertilizer use efficiency; Foliar fertilization; Tea nutrition

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Allelopathic effects of different plant part extracts of *Mimosa pigra* L. on germination and seedling growth of traditional rice varieties

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Abstract:
Mimosa pigra L. is an invasive plant in the family Fabaceae which is among the top 100 worst invasive species in the world. It has impacted ecosystems worldwide and significantly affected wetland–based ecosystems in Sri Lanka, especially in the Mahaweli and Nilwala river basins. *M. pigra* severely affects neighbouring plants by releasing allelochemicals. This study evaluated the effects of aqueous extracts from different plant parts of *M. pigra* on seed germination and seedling growth of three traditional rice varieties: *Kaluheenati*, *Gonabaru* and *Madathawalu* using 10% aqueous extracts from *M. pigra* plant parts (stem, leaves and roots). The experiment was conducted in a completely randomized design with nine replicates. For each treatment, germination percentage, shoot height, root length, fresh weight, and dry weight were measured. The data were not in normally distributed and non-parametric tests were used. According to the results, rice variety significantly affected all five growth parameters ($P < 0.001$). Root growth showed the highest sensitivity to allelopathic inhibition. *Kaluheenati* showed the greatest tolerance to the allelopathic effects of *M. pigra*. Plant part extracts significantly affected only shoot height and fresh and dry weight inhibition. Leaf extracts exhibited the highest allelopathic effect. There was a significant interaction between variety and plant part for height inhibition ($F = 8.49$, $P < 0.001$). These findings indicated that the allelopathic effect of *M. pigra* depend on the plant part extracts and rice variety and suggest that *Kaluheenati* may have greater potential for cultivation or ecological restoration in *M. pigra* invaded lowlands.

Keywords: Allelopathic compounds; Invasive species; Mimosoideae; *Oryza sativa*; Traditional rice

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Global sensitivity analysis of cultivar parameters influencing APSIM-potato yield simulation in *Seetha Eliya*, Sri Lanka using Gaussian process emulation

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Abstract:
Potato is a major highland crop in Sri Lanka, where climate-driven yield variability complicates cultivar selection and reduces productivity. This study addresses the lack of global sensitivity analysis for the APSIM-Potato model by quantifying the effects of cultivar parameters on simulated tuber yields for the 'Granola' potato cultivar at *Seetha Eliya*. The model was parameterized with site-specific soil data (NE-3, Map Unit 22) and 10 years (2015–2024) of daily weather observations. Thirteen cultivar parameters were systematically varied within ±50% of their biological bounds and analyzed using a Gaussian Process Emulator-based global sensitivity framework across 3,000 simulations. The emulator was highly reliable, with root mean square standardized error values of 0.43 to 1.00. Simulated yields ranged from 2.59 to 8.23 t ha^{-1}, reflecting significant inter-annual climate sensitivity. Results consistently showed that tuber dry-matter partitioning (Y2) dominated yield variance, accounting for more than 90% of the total effects annually. Secondary influences were identified in the initial dry-matter partitioning parameter (Y1) and the branching coefficient (Bran3), while phyllochron and leaf number parameters had negligible impacts. Notably, the sensitivity of Y2 peaked during high-radiation years, whereas the influence of Y1 increased during climatically unfavorable years with low radiation and thermal stress. These findings indicate that Y2 governs yield potential, while Y1 contributes to yield stability under environmental stress conditions. Prioritizing partitioning-focused calibration is therefore essential for reliable simulations. Future research should extend this framework across diverse agro-ecological zones and cultivars to improve model generalization. Such expansion will strengthen data-driven, climate-resilient breeding and sustainable management strategies, thereby contributing to food security under environmental variability in Sri Lanka.

Keywords: APSIM-Potato; Cultivar parameters; Dry-matter partitioning; Gaussian process emulator; Sensitivity analysis

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Characterization of Kithul (*Caryota urens* L.) flour as a bioactive food ingredient: its physicochemical and functional evaluation

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Abstract:
The investigation into Caryota urens L., an underutilized arboreal plant resource, underscores its burgeoning potential as a sophisticated functional food ingredient characterized by a high-carbohydrate profile and significant bioactive efficacy. This study systematically evaluated the physicochemical properties, proximate composition, and antioxidant capacity of kithul flour, while evaluating the comparative efficiency of aqueous and dry extraction methods. Results showed that water extraction had a higher yield. Accordingly, the empirical data revealed a substantial disparity in extraction efficiency, with water extraction yielding a superior 28.70% compared to the 11.73% recovered using the dry extraction method. Despite these quantitative differences, both flour variants-maintained a near-neutral pH ranging from 7.1 to 7.2 and exhibited definitive starch characteristics, asserting their structural suitability for integration into diverse food matrices. Nutritionally, the flour is defined by an expansive carbohydrate fraction exceeding 86%, while maintaining a lean macronutrient profile with protein and lipid concentrations remaining below 2% and 1%, respectively. Phytochemical analysis quantified a total phenolic content of 33.21 mg GAE 100 g-1 for water-extracted samples and a slightly higher 37.62 mg GAE 100 g-1 for dry-extracted samples. Furthermore, antioxidant assays demonstrated a heightened radical scavenging affinity toward ABTS+ over DPPH, suggesting a complex synergism between hydrophilic and lipophilic bioactive compounds within the flour. Practical application via the incorporation of kithul flour into rotti formulations, specifically when blended with kurakkan flour, yielded significantly ($P < 0.05$) superior sensory performance as evaluated by 30 semi-trained panelists using a 5-point hedonic scale, and consumer preference scores. Microbial examination [total plate count, yeast and mould count and coliform counts] and longitudinal stability assessments confirmed a robust shelf-life, remained stable for 7 days at ambient temperature, 3 months under refrigeration at 4 °C, and up to 9 months under frozen storage at -18 °C, with negligible variation between extraction methods. These findings suggest that kithul flour has a potential for functional food applications and collectively validate that kithul flour serves as a versatile, antioxidant-rich ingredient for food product development. Ultimately, the strategic utilization of C. urens L. not only facilitates value addition to neglected botanical resources but also functions as a catalyst for sustainable rural agro-based economic advancement particularly in Sri Lanka and globally.

Keywords: Antioxidant activity; Caryota urens; Functional food; Kithul flour; Value-addition

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Identification of temporal dietary shifts in fish species based on stable isotope assessment

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Abstract:
Changes in food item selectivity by fish and temporal shifts in their feeding niches, driven by food availability, are not clearly visible at a superficial level. Seasonal changes in food preferences are important for fisheries' enhancement. This study was conducted to assess temporal changes in trophic structure in *Deduru Oya* Reservoir in Sri Lanka from 2020 and 2022. Stable isotope ratios of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) in common fish species in the reservoir were used to evaluate trophic position and carbon source pathways. In addition, Layman metrics were applied to evaluate the niche width, trophic diversity and community structure. Results revealed that there was an increase in the nitrogen isotope range and carbon isotope range compared with 2020 compared with 2022 in the same species. Result indicates that broader trophic positions and greater diversity of basal carbon sources in 2022 compared with 2020. In addition, decreases in mean distance to centroid (2.57 to 2.11) and mean nearest neighbor distance (1.72 to 1.33) between 2020 to 2022 suggest niche compression and increased trophic redundancy, possibly due to stronger competition or environmental stress. Overall, the findings indicate that the reservoir food web became more diverse in resource use. Moreover, it shifted toward a more compressed niche structure from 2020 to 2022. This variation may have occurred due to changes in the availability of food items in the reservoir. It may be due to changes in the natural environment, and these findings will be useful for planning fisheries enhancement strategies in the reservoir.

Keywords: Freshwater food web; Fish ecology; Stable isotope; Trophic dynamics

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Impact of SME customer orientation strategies adopted by banks on SME customer satisfaction and loyalty: a case study in public sector bank

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Abstract:
Small and medium enterprises (SMEs) account for nearly 75% of enterprises in Sri Lanka and contribute approximately 52% of the national GDP. In the increasingly competitive banking sector, sustaining profitability depends heavily on customer satisfaction, loyalty, and trust. This study examined customer-oriented strategies adopted by a public sector bank for SMEs customers, assessed current levels of satisfaction and loyalty, and proposed strategies to strengthen long-term customer relationships. Primary data were collected using a pre-tested structured questionnaire from 80 SMEs randomly selected from the regional SME registry in *Monaragala*. Data were analyzed using partial least squares structural equation modeling, correlation analysis, and descriptive statistics. The findings revealed that effective communication, technology adoption, customer interaction and efficient service systems significantly enhanced customer satisfaction ($P \leq 0.001$). Among these, technology adoption ($r = 0.423$, $P < 0.001$) and efficient service systems ($r = 0.356$, $P < 0.001$) demonstrated moderate positive relationships with customer satisfaction, while efficient service systems showed the strongest association with customer loyalty ($r = 0.630$, $P < 0.001$). Customer satisfaction also played a significant mediating role in strengthening customer loyalty ($\beta = 0.357$). The model explained 46.8% of the variance in customer satisfaction and 35.4% of the variance in loyalty, indicating substantial explanatory power. The study highlights that improving service efficiency, reducing administrative complexity, and enhancing transactional transparency are practically important strategies for strengthening SME loyalty in public banking sectors. These findings emphasize the strategic value of customer-oriented strategies.

Keywords: Customer loyalty; Customer satisfaction; SME banking; SME customer orientation strategies

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Assessment of morphological diversity among 18 selected cassava (*Manihot esculenta* Crantz) accessions in Sri Lanka at the vegetative stage

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Abstract:
Cassava (*Manihot esculenta* Crantz) is a staple tropical crop valued for its starchy roots and resilience under poor soils and drought. The genetic diversity of cassava is a valuable resource for breeding, but in Sri Lanka, it has not been fully exploited. This study characterized 18 cassava genotypes and high-yielding genotypes were identified for future breeding programs. Plant materials were collected from different agro-ecological zones such as low country dry zone (DL3 & DL4), low country wet zone (WL2a), low country intermediate zone (IL2) and mid-country wet zone (WM1a) in Sri Lanka. The field experiment was conducted in a randomized complete block design with four replications. The characterization of cassava genotypes revealed significant morphological diversity at the vegetative stage. Leaf lobe numbers ranged from six to eight, central lobe length varied between 18.67 and 32.22 cm and petiole length from 25.67 to 41.41 cm. Correlation analysis highlighted strong positive correlations of leaf lobe number with petiole length (r = 0.70) and central lobe length (r = 0.65). In principal component analysis, principal component 1 accounted for 60.39% of the total variation and was mainly associated with central lobe length (49.9%). Principal component 2 explained 27.27% of the total variation and was influenced by petiole length (74.3%). Cluster analysis grouped accessions into three clusters. Cluster I was characterised by long lobe lengths and very narrow lobe width. Cluster II was influenced by shorter lobe lengths and petiole lengths. Cluster III was grouped by moderate lobe lengths, widths, and longer petioles. The above findings indicate high-yielding potential for breeding programs.

Keywords: Breeding potential; Germplasm characterization; *Manihot esculenta*; Morphological diversity

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Diversity analysis of selected mung bean (*Vigna radiata* L.) accessions in Sri Lanka

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Abstract:
Mung bean (*Vigna radiata* L.) is an important short-duration grain legume widely cultivated across Asia. In Sri Lanka, it is primarily grown in the dry and intermediate zones, contributing significantly to food security and farmer livelihoods. However, Sri Lankan mung bean accessions remain poorly characterized, highlighting the need for detailed evaluation to support germplasm conservation and the development of high-yielding varieties. This study evaluated 25 mung bean genotypes collected from the Angunakolapelessa Research Station in Sri Lanka. The experiment was conducted in a randomized complete block design. Agro–morphological data were recorded at flowering, maturity, and harvesting stages. Quantitative data were analyzed using ANOVA, DMRT, cluster analysis, and principal component analysis in R software. The results indicated a significant variability among genotypes for growth, reproductive, and yield-related traits. Plant height at harvest ranged from 36.06 to 82.38 cm, while cumulative yield ranged from 4.08 to 11.40 g plant^{-1}. Correlation analysis confirmed strong positive associations, such as seed length with seed width (r = 0.86) and plant height with yield (r = 0.50). PCA explained 48.81% of the total variation through the first two principal components. Cluster analysis grouped accessions into three categories: Cluster I comprised vigorous, high-yielding genotypes (5–10.78 g plant^{-1}), Cluster II included moderately performing (8.21 g plant^{-1}), and Cluster III consisted of genotypes with comparatively lower or variable productivity (4.08–11.40 g plant^{-1}). The study demonstrated substantial morphological diversity among the evaluated mung bean genotypes, emphasizing their potential use in breeding programs aimed at improving mung bean productivity in Sri Lanka.

Keywords: Breeding potential; Genetic diversity legumes; Morphological diversity*; Vigna radiata* L. accessions

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Morphological characterization and yield evaluation of selected *Dioscorea* genotypes in Sri Lanka

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Abstract:
The genus *Dioscorea*, commonly known as yam, is one of the most significant tubers that play an essential role in ensuring food security in tropical climates. This study was carried out to morphologically characterize 36 *Dioscorea* genotypes and assess their yield capacity. The study was conducted using a randomized complete block design with six plants per replication. *Dioscorea* genotypes were planted using tuber cuttings at a spacing of 1 m × 1 m in the field. Morphological characters and yield data were collected eleven months after planting. Data were analyzed using R and significant differences were observed ($P \leq 0.05$) in stem diameter, petiole length, leaf characteristics, number of tubers per hill, and total tuber yield. The maximum value for tuber yield was recorded in *Guru-ala* at 14.53 kg hill^{-1}, followed by *Ini-ala* at 7.65 kg hill^{-1} and *Ambepussa-weli-ala* at 7.43 kg hill^{-1}. In principal component analysis, PC1 contributed 40.19% of the total variation, primarily influenced by stem diameter (25.40%) and mature leaf length (19.47%). PC2 explained 25.40% of the total variation, with petiole length (30.61%) and mature leaf width (30.39%) being the dominant contributing traits. Hierarchical cluster analysis grouped the genotypes into three clusters: Cluster I included 11 genotypes, Cluster II included 21 genotypes, and Cluster III included four genotypes. Positive correlations were observed between total yield and stem diameter (r = 0.483) and mature leaf width (r = 0.461). These results indicate that the high-yielding genotypes have considerable potential for conservation breeding and use in *Dioscorea* crop improvement programs.

Keywords: Dioscorea; Genetic diversity; Morphological characterization; Tuber yield

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ID 108

A preliminary study on performance of selected 16 cowpea (*Vigna unguiculata* (L.) Walp.) genotypes and their diversity

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Abstract:
Cowpea (*Vigna unguiculata* (L.) Walp.) is an important climate-resilient grain legume species that provides superior nutritional value and benefits the soil by fixing atmospheric nitrogen. This study analyzed the agronomic performance and genetic diversity of sixteen cowpea genotypes, consisting of nine breeding lines and seven recommended varieties, in a randomized complete block design, the data were analyzed using R. The results showed considerable differences among the genotypes in quantitative traits, including days to flowering (36.33 to 42.83 days), pod length (12.33 to 21.61 cm), and vegetative traits. According to principal component analysis, PC1 accounted for 29,34% of the variation, while PC2 contributed 23.83%, giving a cumulative explanation of 53.17% of the total variability. Correlation analysis showed that seed length, seed weight, and pod width were strong positive associations (r = 0.75–0.90). Further, days to flowering showed a strong positive association with the number of seeds per pod (r = 0.72) and shoot height (r = 0.53). Yield per plant did not exhibit strong direct correlations with any trait in this analysis, suggesting that yield is a complex trait influenced by multiple interacting components. Cluster analysis grouped the cowpea accessions into three major clusters, with Cluster I contain the majority of genotypes, Cluster II comprising two highly divergent accessions, and Cluster III including five closely related genotypes. The clustering pattern indicates substantial diversity among accessions, highlighting potential parental lines for breeding programs. The study revealed morphological and agronomic variation in selected cowpea genotypes. It also showed that multiple traits must be considered for cowpea improvement.

Keywords: Agronomic performance; Cowpea genotypes; Genetic diversity; Low country wet zone

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ID 109

Exploiting natural variation in root nodulation among selected cowpea (*Vigna unguiculata* (L.) *Walp.)* genotypes in Sri Lanka

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Abstract:
Cowpea is an important pulse crop worldwide due to its nutritional value and its capacity for biological nitrogen fixation facilitated through symbiosis with *Rhizobium spp*. Nodulation efficiency varies due to genetic differences among genotypes, however, this variation has not been adequately characterised among Sri Lankan genotypes. This study evaluated 16 cowpea genotypes, including seven recommended varieties and nine breeding lines, to identify variations of root nodulation under indigenous soil conditions. The experiment was conducted without applying chemical fertilizers to evaluate *natural* nodulation with indigenous *Rhizobium Spp*. At the maturity stage, qualitative and quantitative traits were recorded. Duncan's multiple range test revealed significant variation among genotypes in nodulation characteristics. Nodule shape varied as spherical, oval, irregular, and lobed, while nodulation patterns included lateral dominance, basal dominance, and uniform distribution. Lateral nodulation was generally higher (8.17–47.83) than basal nodulation (0-19) across genotypes. Root nodule biomass ratio differed widely among genotypes, with *ANKCM20-2* (31.75) and Bombay (21.44) showing the highest values, indicating stronger relative nodule contribution. Correlation analysis showed weak to moderate relationships between nodulation efficiency and yield per plant, indicating that nodulation efficiency alone does not strongly determine productivity. Principal component analysis showed that PC1 explained 51.34% of the total variation, whereas PC2 explained 20.22%. Further, PC1 was associated with basal nodule traits (nodule size, nodule fresh weight, nodule dry weight, nodule number), while PC2 was mainly influenced by root nodule biomass ratio, lateral nodule fresh and dry weight. Cluster analysis grouped genotypes into three clusters, confirming substantial genetic diversity. The results indicate considerable variation in nodulation among cowpea genotypes, and selecting genotypes that combine nodulation efficiency and high yield is important for sustainable agriculture.

Keywords: Cowpea genotypes; Natural variation; Nodulation efficiency; Root nodulation

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Assessment of nodulation efficiency and trait relationships in mung bean genotypes under low-input conditions

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Abstract:
Mung bean productivity under no fertilizer conditions depends on efficient biological nitrogen fixation than under fertilized conditions. The genotypic differences of the nodulation pattern have not been studied in the selected mung bean genotypes yet. This study evaluated 25 Sri Lankan mung bean genotypes for variation in nodulation efficiency and agro-morphological traits in a pot experiment with six replications. The morphology of nodules was observed to be significantly different among mung bean genotypes with shapes varying from spherical, oval, and irregular to lobed. Nodulation traits varied widely, especially lateral root nodule number per plant (8.17–47.83), nodule fresh weight (0.14–0.72 g), and root nodule biomass ratio (5.75–47). Correlation analysis showed a negative relationship between root nodule biomass ratio and the number of lateral nodules (r = -0.69), indicating that nodulation efficiency is lower when nodules are crowded. Principal component (PC) analysis revealed that 54% of the total variation was explained by PC1 and PC2. PC1 was mainly influenced by nodule dry weight (16.11%), root dry weight (12.14%), lateral root nodule number (12.01%), leaf area (11.07%), and nodule fresh weight (10.67%), whereas PC2 was primarily associated with nodule size (15.56%), nodule fresh weight (13.76%), leaf area (12.11%), root fresh weight (10.99%), and root length (10.74%). Cluster analysis grouped genotypes into three clusters, separating high-efficiency genotypes based on RNBR. *MB118* recorded the highest RNBR (47) despite having the lowest lateral root nodule number (8.17), nodule fresh weight (0.15 g), and dry weight (0.01 g) among the evaluated genotypes. Some genotypes, such as *MIMB1005, MIMB914, MIMB998*, and *201602,* had very high lateral root nodule numbers (44.5–47.83) and higher nodule biomass, but much lower RNBR values (5.75–9.25), indicating that producing more nodules did not necessarily improve efficiency. The results identify promising genotypes for breeding programs aimed at sustainable, low-input agricultural systems.

Keywords: Genetic variability; Mung bean; Nitrogen fixation; Nodulation; Root nodule biomass ratio

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Exploring the morphological diversity of pinwheel flower (Wathusudda: *Tabernaemontana divaricate* L.) in southern Sri Lanka

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Abstract:
Tabernaemontana divaricata (Family: Apocynaceae), commonly known as crepe jasmine or "*Wathusudda*" is a perennial ornamental shrub widely cultivated in Sri Lanka and other tropical regions. Despite its horticultural and medicinal importance, systematic evaluation of morphological diversity among local germplasm remains limited. This study assessed 27 accessions collected from different locations in southern Sri Lanka. Data were collected from ten replicates per accession using a completely randomized design. Eight vegetative and floral traits were measured at the flowering stage, and the data were analyzed using ANOVA, correlation analysis, principal component analysis (PCA), and hierarchical clustering in R software. Results revealed significant variation in floral morphology, ranging from single obovate petals to double, wavy flowers, while petal length (1.2–2.5 cm), floral diameter (1.6–4.8 cm), leaf length (3–20 cm), and internodal distance (0.4–3.9 cm) exhibited wide quantitative diversity. Correlation analysis indicated moderate associations between floral and vegetative traits. PCA summarized variation into two components: PC1 (54.45%) associated with floral and leaf size, and PC2 (17.08%) linked to corolla tube length and internodal distance. Cluster analysis grouped accessions into three clusters: large-flowered, broad-leaf types (Cluster I); a distinct double-flowered accession (Cluster II); and compact forms with smaller traits (Cluster III). These findings emphasize significant phenotypic diversity within the selected germplasm and identify accessions with larger flowers and vigorous vegetative growth as desirable traits for breeding.

Keywords: Floral traits; Morphological diversity; Ornamental breeding; *Tabernaemontana divaricate*; Vegetative traits

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Characterization of morphological diversity in red shoe flower (*Hibiscus rosa-sinensis*) accessions using multivariate analysis

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Abstract:
The genus *Hibiscus* in the family Malvaceae comprises nearly 400 species, with *Hibiscus rosa-sinensis* widely cultivated as an ornamental plant that blooms year-round and is also used in ayurvedic medicine. Despite its importance, studies on its morphological diversity remain limited, necessitating further systematic evaluation. In the present study, eighteen accessions of *H. rosa-sinensis* were collected from different locations in Sri Lanka and assessed under a completely randomized design. Observations were recorded at the flowering stage, and data were analyzed using principal component analysis (PCA), and hierarchical cluster analysis in R software. Results revealed substantial diversity in vegetative and floral traits: petal numbers ranged from 5–47, flower diameters from 2.06–13.98 cm, and leaf lengths from 7.63–14.46 cm. Correlation analysis showed a positive relationship between leaf petiole length and leaf length (r = 0.60), while flower diameter was negatively associated with vegetative growth (r = Sr-0.46*)*, and petal number was identified as an independent, genetically inherited trait. PCA explained 60.84% of the total variation (PC1 and PC2 explaining 37.20% and 23.64%, respectively), and PC1 was primarily influenced by leaf petiole length (57%) and leaf length (51.28%). Cluster analysis grouped accessions into three clusters. Cluster I represented high-vigour types with long leaves but smaller flowers, Cluster II combined moderate vegetative traits with a high number of petals, and Cluster III exhibited unique floral diversity with large flowers. These findings highlight valuable phenotypic diversity that could be utilized in ornamental breeding programs.

Keywords: Floral traits; *Hibiscus rosa-sinensis*; Morphological diversity

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Effect of substrate composition and variety on growth and yield of cucumber (*Cucumis sativus* L.) under soilless shade house conditions in the dry zone of Sri Lanka

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Abstract:
Cucumber (*Cucumis sativus* L.) production in the dry zone of Sri Lanka is frequently constrained by poor soil quality, drought, high temperature, disease spread and pest infestations. Soilless substrate cultivation in shade houses offers a viable alternative for achieving high-quality yields. This study evaluated different soilless substrate compositions for cucumber cultivation at the Crop Farm, Faculty of Agriculture, University of Jaffna, Sri Lanka, from June to October 2025. Three varieties (Vantage F1 Hybrid, Bonofid F1 hybrid, and Mini Cucumber MultiStar RZ) were evaluated across four substrates: S1 (100% coco peat); S2 (coco peat 30%, compost 20%, cattle manure 50%); S3 (coco peat 30%, compost 10%, cattle manure 30%, goat manure 30%); and S4 (coco peat 30%, compost 10%, cattle manure 20%, goat manure 20%, vermicompost 20%). A two-factor factorial experiment was conducted in a randomized complete block design with three replications. While the interaction between variety and substrate was not significant ($P > 0.05$), main effects were pronounced. Substrate S4 resulted in the tallest plants (190 cm) and the highest average yield (1.45 t ha^{-1}). Fruit dimensions were not significantly altered by substrates, but variety significantly influenced fruit length, diameter, and weight. The Vantage F1 Hybrid produced the longest (18.34 cm) and heaviest (177 g) fruits. The highest total yield was achieved with S4 (5.8 t ha^{-1}). Among varieties, Vantage F1 Hybrid (5.4 t ha^{-1}) and Bonofid F1 Hybrid (5.0 tha^{-1}) significantly outperformed MultiStar RZ (3.6 t ha^{-1}). Chemical analysis confirmed S4 possessed the most favorable nutrient profile, including elevated nitrogen (1.51%)), phosphorus (0.54%), and organic carbon (55.79%). In conclusion, combining substrate S4 with Vantage F1 Hybrid is recommended for optimizing high-quality greenhouse cucumber production in the dry zone of Sri Lanka.

Keywords: Cucumber; Dry zone; Organic substrates; Shade house; Soilless culture

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ID 122

Seasonal incidence of major pests and diseases in the *Attakkari* rice cultivar in northern Sri Lanka

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Abstract:
Attakkari, a traditional bold-grained rice cultivar favored by consumers in northern Sri Lanka, continues to be cultivated despite not being a recommended cultivar because of its cooking quality and tolerance to the flooding. Farmers frequently report yield losses due to pests and diseases; however, systematic regional assessments are limited. This study, evaluated the major pests and diseases affecting *Attakkari* over two growing seasons, *Yala* 2025 and *Maha* 2025/2026, across 53 farmer fields. A random sampling method was employed using 1 m × 1 m quadrats in the paddy fields. The incidence and severity of each pest and disease were assessed using the standard evaluation system for rice developed by IRRI, along with environmental parameters, including temperature, rainfall, and relative humidity (RH). During *Yala*, bacterial blight was severe in Mannar, with 80% incidence and a severity score of 9.0, following high temperatures (>32 °C) and rainfall of 42.5–56.7 mm recorded 2 weeks earlier. Leaf folder incidence reached a severity score of 9.0 in Mannar. Yellow stem borer showed moderate incidence with low severity, while brown spot was widespread at early growth stages. In *Maha*, fungal diseases were predominated. Brown spot affected all surveyed fields in Jaffna and Mullaitivu, with peak severity (9.0) at Oddusuddan following extreme rainfall and sustained RH. Leaf and panicle blast occurred only in Jaffna, with incidence up to 50% and severity up to 7.0 under cooler temperatures (<28 °C). Brown planthopper appeared exclusively in *Maha*, reaching 100% incidence at Vellankulam, Mannar. Correlation analysis revealed a positive association between bacterial blight and temperatures > 32 °C ($r = 0.68$, $\alpha = 0.05$), a negative association between blast and temperature ($r = -0.54$), and a strong correlation between brown spot and 30-day cumulative rainfall ($r = 0.82$). Sites with ≥ 10 consecutive days of RH > 85% exhibited 3.2-fold greater brown spot severity. These findings indicate the importance of continued multi-season evaluation and integrated pest and disease management strategies for sustainable cultivation of *Attakkari* rice.

Keywords: Attakkari; Bacterial blight; Brown spot; Climate correlation; Rice pests; Rice diseases

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Development of a starter culture for vinegar production using local isolates

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Abstract:
Industrial vinegar production uses a two-step fermentation process enhanced by starter cultures for efficiency. However, gradual loss of fermentation efficiency during long-term use is an issue faced by industry, especially those that depend on imported starter cultures. In this study, we explored the potential of developing a starter culture using locally isolated strains of yeast and acetic acid bacteria (AAB). For the isolation of yeast and AAB, three local fruits, banana (*Musa acuminata*), watermelon (*Citrullus lanatus*) and papaya (*Carica papaya*), and coconut water, which is widely used by the local vinegar industry were used. After confirming the fermentation potential of selected sugar sources with commercial baker's yeast, fruit pulps and coconut water were subjected to spontaneous fermentation for a period of 21 days. Yeasts were isolated after 4 days of fermentation on yeast potato dextrose agar (YPDA) while AAB were isolated after 14 days on glucose yeast extract calcium carbonate agar (GYC) medium. To select the most efficient yeast-AAB combination, fermentation was carried out using banana at 12% w/v reducing sugar content with all possible combinations of yeast and AAB with three replicates for each combination. During fermentation, pH and total titratable acidity (TTA) were measured at 4-day intervals for 21 days. Since all combinations gave the same level of TTA, yeast-AAB combination that gave stable pH between 2-3 was selected as the best combination. This combination was tentatively identified as *Pichia* spp. isolated from the spontaneous fermentation of coconut water and *Gluconobacter* spp. from the fermentation of papaya sugars. They were then grown in 1 L of YPDA and GYC media and cells were harvested by centrifugation followed by vacuum filtration and drying at controlled temperature. The finely ground cell powder yielded 2.0741 ± 0.0001 g L^{-1} *Pichia* and 0.2527 ± 0.0001 g L^{-1} yield of *Gluconobacter* with high purity and 10^8 CFU g^{-1} cell viability exceeding industrial benchmarks. This effort highlights the potential of developing starter cultures for industrial vinegar production using local isolates.

Keywords: Acetic acid bacteria; Starter cultures; yeast; Vinegar industry

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Effects of biochar and nitrogen on growth and yield of brinjal (*Solanum melongena* L.) under deficit irrigation: A study in the dry zone of Sri Lanka

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Abstract:
Brinjal (*Solanum melongena* L.) is an important vegetable crop widely cultivated in the dry zone of Sri Lanka, where its productivity is increasingly constrained by water scarcity, declining soil fertility, and increasing climatic variability. Improving resource-use efficiency through optimized irrigation practices, soil amendments, and nutrient management is therefore critical for achieving sustainable production systems. A field experiment was conducted at the Integrated Farm, University of Jaffna, during the *Yala* season of 2025 to evaluate the effects of deficit drip irrigation, biochar application, and varying nitrogen levels on the growth and yield of brinjal. The experiment was established in a factorial randomized complete block design with three replications. Treatments comprised two irrigation levels (75% and 100% of field capacity), three biochar treatments (peanut shell biochar, paddy husk biochar, and a non-amended control, each applied at 5 t ha^{-1}) and three nitrogen levels (50%, 75%, and 100% of the Department of Agriculture-recommended rate, Sri Lanka). Each experimental unit consisted of a 3.6 m × 2.4 m plots accommodating 16 plants. Data were collected on plant height, number of branches, number of leaves, leaf length, total yield, and marketable yield. Data were subjected to analysis of variance and treatment means were compared using Duncan's multiple range test at $P \leq 0.05$. The results showed that the interaction effects among irrigation, biochar and nitrogen treatments were not statistically significant. Irrigation treatments did not significantly affect most growth parameters; however, the 75% irrigation level produced higher total yield (15.01 ± 1.5 t ha^{-1}**)** and marketable yield (13.8 ± 0.67 t ha^{-1}), suggesting that mild deficit irrigation may enhance yield performance. Nitrogen showed a clear dose-response, with 100% nitrogen resulting in the highest plant height (87.4 ± 2.0 cm), leaf number (146.8 ± 1.9), leaf length (25.1 ± 0.45 cm), and branch number (14.1 ± 0.51), total yield (15.02 ± 1.9 t ha^{-1}) and marketable yield (13.34 ± 0.82 t ha^{-1}). The lack of significant effects from biochar treatment in the present study may be attributed to the short-term nature of biochar application under the tested field conditions.

Keywords: Biochar; Brinjal; Deficit irrigation; Dry zone; Nitrogen levels

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Biological control of *Halyomorpha halys* with egg parasitoids: Current status and perspectives

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Abstract:
The brown marmorated stink bug (*Halyomorpha halys*, BMSB) is a highly polyphagous pest native to East Asia that has become a major invasive species worldwide, causing severe economic losses in agricultural systems. Management strategies based largely on broad-spectrum insecticides have shown limited long-term effectiveness and raise serious environmental concerns. Consequently, biological control using egg parasitoids has emerged as a promising and sustainable alternative. This review synthesizes the current status of BMSB biological control by egg parasitoids, with particular emphasis on species belonging to the genera *Trissolcus* and *Anastatus*. Among these, *Trissolcus japonicus* and *Trissolcus mitsukurii* stand out due to their high parasitism rates, host specificity, and capacity to establish in both native and invaded regions. We summarize the current knowledge on the bioecology of these parasitoids and examine how biotic and abiotic factors influence their performance under laboratory and field conditions. Key challenges related to mass rearing, release strategies, and establishment are discussed. Finally, we highlight opportunities for integrating egg parasitoids into integrated pest management programs, emphasizing the research priorities needed to enhance biological control efficacy and reduce the economic and environmental impacts of BMSB infestations.

Keywords: *Anastatus*; Brown marmorated stink bug; Invasive species; Integrated pest management; *Trissolcus*

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ID 135

Spatial distribution of soil microbial biomass carbon and physicochemical properties in the Katupotha tank cascade system, Sri Lanka

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Abstract:
Soil microbial biomass carbon (MBC) is the carbon in soil microbial cells per unit of dry soil and plays an important role in maintaining soil health. Tank cascade system (TCS) consists of interconnected small tanks constructed by ancient civilizations to conserve rainwater and support humans, livestock, and ecosystems. Due to limited research on the spatial distribution of MBC and selected soil physiochemical properties in TCS, this research was conducted in Katupotha tank cascade system (KTCS) in Mihintale, Anuradhapura. Six small tanks, including Thammennawa, Miris Katukeliyawa, Katupotha, Alappankulama, Kandu Binduwewa, and Maha Kirindegama were selected. Random soil samples were collected (0-15 cm depth) using a stainless-steel auger (5 cm diameter) from five selected components: perahana, wewe kattakaduwa, gasgommana, wele kattakaduwa, and kiul ela from each tank during the *Yala* season. GPS coordinates were recorded using a Garmin eTrex 30 handheld GPS receiver. MBC was measured using the chloroform fumigation-extraction method. Using standard protocols, soil pH, electrical conductivity (EC), moisture content (MC), and bulk density (BD) were measured and mapped using ArcGIS 10.8 software. MBC% ranged from 0.0004% to 0.11674%. Soil pH ranged from 4.4 to 9, EC ranged from 7.05 to 5195.45 µS cm^{-1}; BD ranged from 0.08 to 1.41 g cm^{-3}, and MC ranged from 4% to 98%. Spatial variability of parameters was noted across KTCS. This study is important for sustainable TCS management. To support conservation and enhance ecosystem resilience in the dry zone TCS, further research should be conducted.

Keywords: Dry zone; Soil microbial biomass carbon; Soil physicochemical properties; Spatial distribution; Tank cascade system

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ID 136

Bio super phosphate® and conventional phosphorus fertilizer effects on banana under two agro-ecological zones

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Abstract:
This study evaluated the effectiveness of Bio Super Phosphate® (BSP; 25- 28% P_2O_5) as an alternative to conventional triple superphosphate (TSP) on the growth and yield performance of banana (*Musa* spp.) under two agro-ecological zones in Sri Lanka. Field experiments were conducted at the Faculty of Agriculture, University of Ruhuna (6.057124° N, 80.567242° E), representing the Low Country Wet Zone, and at a farmer field in Ranna, Hambantota District (6.0998602° N, 80.9208123° E), representing the Low Country Dry Zone. The experiments were arranged in a Randomized Complete Block Design with five treatments (T1–T5), five replicates. At the Faculty of Agriculture, T1 (TSP control), T2, T3, T4, and T5 received 50, 40, 60, 80, and 160 g plant^{-1}, respectively, as basal applications. At 2, 4, 6, and 8 months after planting, T1, T2, T3, T4, and T5 received 100, 80, 120, 160, and 320 g plant^{-1}, respectively, at each application. At Ranna, T1 (TSP control), T2, T3, T4, and T5 received 50, 40, 60, 80, and 160 g plant^{-1}, respectively, as basal applications. At 2, 4, 6, and 8 months after planting, T1, T2, T3, T4, and T5 received 80, 60, 80, 120, and 150 g plant^{-1}, respectively, at each application. Phosphorus was applied at different rates using BSP, while TSP was used as the control. Uniform nitrogen and potassium applications were maintained according to Department of Agriculture recommendations. Data were analyzed using ANOVA and Dunnett's test in SAS 9.1.3. Results showed no statistically significant differences ($p > 0.05$) among treatments for plant height, stem diameter, number of leaves/plant, bunch weight, hands/bunch, at both zones. Overall, BSP treatments produced growth and yield responses comparable to the TSP treatment for most parameters evaluated. Under the conditions of this study, BSP showed potential as an alternative phosphorus source for banana cultivation in Sri Lanka.

Keywords: Banana; Bio Super Phosphate; BSP; Phosphorus; Sustainable fertilization

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ID 137

Enhancing *Mesocomys* egg parasitoids' fitness: Temperature modulation during immature stage boosts reproduction and biocontrol capacity

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Abstract:
Temperature is a critical environmental factor influencing key physiological processes in insects, including reproduction, development, and sex determination. Parasitoid wasps are widely used as biological control agents, and understanding how temperature affects their performance under natural conditions is essential for improving pest management efficacy. *Mesocomys* (Hymenoptera: Eupelmidae) is an obligatory egg parasitoid and a major natural enemy of economically important forest pests, such as the Japanese giant silkworm, *Rinaca japonica* Moore. However, field studies show that temperature substantially influences the efficacy of this parasitoid, thereby affecting the overall success of biological control programs. Therefore, in this study, five constant temperature gradients (17, 20, 23, 26, and 29 °C) commonly encountered in natural environments were simulated to systematically evaluate the developmental performance of two *Mesocomys* species (*M. albitarsis* and *M. trabalae*). We focused on quantifying key thermal biological parameters, including developmental duration, developmental rate, developmental threshold temperature and effective accumulated temperature. Furthermore, the parasitic capacity of their F1 generation against both their commonly used mass-rearing alternative host, the Chinese oak silk moth, *Antheraea pernyi* (Guérin-Méneville) eggs, and the target host, the Japanese giant silkworm, *Rinaca japonica* Moore eggs, was assessed. On *A. pernyi* eggs, both *Mesocomys* had shorter development and faster rates with higher temperature. At 17–26 °C, *M. albitarsis* had stronger parasitism and stable female ratio (71.86%), while *M. trabalae's* female ratio increased with temperature. F_1 *M. albitarsis* had stably high female ratio (>71.88%) in 10-day oviposition (except day 1); *M. trabalae* had high ratio (>78.99%) on days 2–8 but declined after day 8 at 17–20 °C.On target host *R. japonica* eggs, *M. albitarsis* had significantly higher parasitism than *M. trabalae*; wasp species and temperature did not affect female ratio or emergence rate. Notably, *M. trabalae* failed to eclose at 29 °C on both hosts, exceeding its thermal tolerance limit. The findings provide a crucial theoretical foundation for optimizing artificial mass rearing temperatures and informing field release strategies to enhance their biocontrol efficacy.

Keywords: *Antheraea pernyi*; Biological control; Immature developmental temperature; Large-scale rearing; *Mesocomys* spp.; *Rinaca japonica*

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ID 142

Effects of different shade levels and fertilizer substrates on the growth of Azolla and water quality

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Abstract:
Azolla serves as an economical biofertilizer and high-protein livestock feed, however, its optimum cultivation is often constrained by inadequate light management and nutrient imbalances. This study aimed to identify the most efficient combination of fertilizer substrate and shade level to maximize Azolla yield while maintaining favorable water quality. The experiment was conducted using twelve treatments in a two-factor factorial completely randomized design with three replicates. The first factor consisted of three fertilizer combinations: poultry litter, poultry litter with single superphosphate (SSP), and a control without fertilizer substrate. The second factor included four shade levels: 0%, 50%, 60% and 70%. Over a period of 28 days, selected water quality parameters and Azolla fresh biomass were periodically measured. Results revealed that cultivating Azolla under 0% shade using poultry litter, either alone or combined with SSP produced significantly higher Azolla biomass at day 7 (213.51 ± 17.37 g, 213.29 ± 27.90 g) and day 14 (134.64 ± 13.03 g, 129.17 ± 19.30 g). This peak performance is attributed to high light intensity, which maximizes the photosynthetic activity required to fully exploit available nutrients. The minimum pH levels and nitrate concentrations were observed on day 14, followed by a minimum ammonium concentration on day 21 across all the treatments. Overall, a significant interaction among fertilizer substrate, shade level and time demonstrated that the combination of poultry litter (with or without SSP) under 0% shade was the most effective treatment. Therefore, this combination is recommended for maximizing Azolla biomass production under similar cultivation conditions.

Keywords: Fertilizer; Shade; Single superphosphate; Substrate; Water quality

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ID 144

Morphological variation in cinnamon (*Cinnamomum zeylanicum* Blume) seedlings as affected by distance from the pollen source of "Sri Gamunu"

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Abstract:
Cinnamon (*Cinnamomum zeylanicum*) is a naturally cross-pollinated species, and limited information is available regarding the influence of pollen source distance on seedling characteristics. Therefore, this study was conducted to investigate the effect of distance from the pollen source on initial growth and morphological variations in seedlings. Seeds were collected from two locations (Wathukolakanda and Walakannda) in Kirinda, Puhulwella area of Matara, at five distances: 0 m (center of the cultivation of var. Sri Gamunu) and 50 m, 100 m, 150 m, 200 m away from the boundary of Sri Gamunu cultivation. Seeds from each distance were tested separately. The experiments were arranged in a completely randomized design with 11 replicates (11 rows). Seeds from each distance were sown in rows in sand trays, with 10 seeds per row. Germination percentage, seedling height and root volume were recorded as initial growth parameters, while leaf shape, apex and base were assessed as morphological traits. Results indicated no significant differences in germination percentage, seedling height or root volume among seedlings from different distances. However, significant variations ($P \leq 0.05$) were observed in morphological traits with increasing distance from the pollen source at both locations. Broadly ovate leaf shape, acute leaf apex and sub-cordate leaf base were more prominent in the first two leaves of progeny seedlings closer to the pollen source of Sri Gamunu variety, and the occurrence of these traits declined with increasing distance. Therefore, the study concludes that proximity to the pollen source influences morphological expression, with a higher likelihood of obtaining seedlings resembling the Sri Gamunu variety within 100 m distance of the pollen source.

Keywords: Acute leaf apex; Cinnamon; Ovate leaf shape; Pollen source; Sri Gamunu variety; Sub-cordate leaf base

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ID 145

Rooting and sprouting responses of cinnamon (*Cinnamomum zeylanicum* Blume) cuttings to natural bio stimulants and indole-3-butyric acid

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Abstract:
Cinnamon is a major spice and an export crop in Sri Lanka, valued for its applications in the food, pharmaceutical and cosmetic industries. Traditionally, cinnamon is propagated through seeds, resulting in a prolonged nursery period and delayed harvesting. Although vegetative propagation offers advantages such as genetic uniformity and reduced nursery duration, its adoption remains limited due to poor rooting ability, limited planting material availability and low cutting establishment success. While natural bio-stimulants such as aloe vera gel, honey, and coconut water have been reported to enhance rooting in several plant species, their effectiveness in cinnamon propagation has received little scientific attention. Therefore, this study evaluated the effectiveness of selected natural bio-stimulants and a synthetic rooting hormone on rooting and sprouting performance of cinnamon cuttings. The experiment was conducted using semi-hard wood, pencil-thick cuttings. A completely randomized design with five replicates (10 cinnamon cuttings per replicate) was employed to evaluate five treatments: control (distilled water, few seconds), indole-3-butyric acid (IBA 0.2%, few seconds), aloe vera gel (original extraction, 20 minutes), honey (undiluted, 20 minutes), and coconut water (fresh extraction, 1 hour). Cuttings were dipped in treatment solutions, planted in polybags (5 x 8 inches) containing standard potting mixture and kept in propagator randomly. Data on survival percentage, percentage of cuttings with callus formation, rooting and sprouting, shoot length, and average number of roots per cutting were recorded 45 days after establishment of cuttings. Results indicated that no significant difference among treatments on the recorded parameters ($P > 0.05$). However, all the treatments demonstrated high survival and callus formation percentage exceeding 90%, with moderate rooting (50%) and sprouting (60%) of cinnamon cuttings 45 days after planting. Therefore, these findings suggest that both bio-stimulants and synthetic hormone treatments have potential to support vegetative propagation of cinnamon, though extending the experimental duration may improve rooting and sprouting outcomes.

Keywords: Aloe vera gel; Cinnamon; Coconut water; IBA; Vegetative propagation

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ID 148

Host age preference and performance of three brachypterous *Anastatus* parasitoids on *Riptortus pedestris* eggs reveal a female-biased candidate for managing soybean stay-green syndrome

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Abstract:
Riptortus pedestris (Fabricius) (Hemiptera: Alydidae) is a major pest of soybean, causing stay-green syndrome and significant losses in yield and quality. Though several parasitoids have been reported, their biological control potential is still limited due to low female progeny ratios and difficulties in mass rearing. To identify a parasitoid with high parasitism efficiency and strong mass production potential, we tested three brachypterous strains of *Anastatus* (Hymenoptera: Eupelmidae) (*A. gastropachae*, *A. meilingensis*-1, and *A. meilingensis*-2) for host age preference and performance on R. pedestris eggs of different ages (0-, 2-, 4-, and 6-day-old). All three parasitoids successfully parasitized host eggs across all age classes, with emergence rates exceeding 85% and minimal host-feeding activity. Parasitism rates were highest on 0-, 2-, and 4-day-old eggs. Among the tested parasitoids, *A. meilingensis*-2 consistently showed the highest parasitism levels and maintained a female progeny ratio above 60% on 2- and 4-day-old eggs, whereas the female ratio was below 10% for *A. meilingensis*-1 and zero for *A. gastropachae*. Moreover, individuals of A. *meilingensis*-2 emerging from *R. pedestris* eggs (i.e., F1 generation) retained the ability to parasitize the same host and produced a female ratio exceeding 75%. These results suggest that *A. meilingensis*-2 could be a potential biological control agent for the sustainable management of *R. pedestris* due to its high parasitism efficiency and favorable sex ratio.

Keywords: Egg parasitoids; Egg age; Host feeding; Host suitability; Female progeny ratio; Mass rearing

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ID 149

Performance of five egg parasitoids of the genus *Anastatus* on eggs of *Riptortus pedestris* of different ages

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Abstract:
Riptortus pedestris (Fabricius) (Hemiptera: Alydidae) is a widely distributed polyphagous pest associated with soybean stay-green syndrome, causing substantial yield losses across Asia. The continued reliance on chemical control remains problematic, highlighting the need for sustainable biological alternatives. Thus, in this study, we comparatively evaluated the parasitism performance, host-feeding behavior, developmental traits, and host-age preference of five egg parasitoids of the genus *Anastatus* (*A. dexingensis*, *A. fulloi*, *A. gansuensis*, *A. japonicus*, and *A. shichengensis*) on *R. pedestris* eggs of different ages (0-, 2-, 4-, and 6-day-old). All five parasitoid species successfully completed development on *R. pedestris* eggs, with offspring emergence rates exceeding 80% across all host ages. Parasitism and host-feeding were strongly influenced by host-egg age, with all species showing a clear preference for younger eggs, particularly those 0- and 2-day-old. *Anastatus dexingensis* and *A. japonicus* parasitized the highest number of host eggs (13.47 and 12.27 eggs, respectively), whereas the thelytokous *A. gansuensis* exhibited the strongest host-feeding activity (3.80 eggs) and produced exclusively female offspring. In contrast, the remaining four species exhibited strongly male-biased sex ratios when developing on *R. pedestris* eggs. Developmental duration generally increased with host-egg age, indicating a trade-off between host quality and parasitoid fitness. Overall, *A. dexingensis* and *A. japonicus* appear well suited for short-term suppression of *R. pedestris* through inundative releases, whereas the thelytokous *A. gansuensis* shows strong potential for long-term, sustainable population regulation. These findings provide a scientific basis for selecting effective *Anastatus* spp. and optimizing egg-stage biological control strategies against *R. pedestris*.

Keywords: Bean bug; Egg parasitoids; Host-age preference; Host suitability; Inoculative releases; Inundative releases; Soybean stay-green syndrome

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ID 150

Morphological characterization and diversity analysis of 34 *Ixora* accessions in Southern Sri Lanka

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Abstract:
The genus Ixora comprises evergreen ornamental shrubs valued for their diverse floral characteristics. However, its morphological diversity remains insufficiently documented. This study aimed to characterize morphological diversity among Ixora accessions and identify traits contributing to phenotypic variation. Thirty-four Ixora accessions, with 10 replicates per accession, were collected from the low-country wet zone of Southern Sri Lanka. Twenty-three morphological traits, comprising eight leaf and fifteen floral characteristics, were recorded at full bloom using IPGRI descriptors. Principal Component, correlation, and Ward's hierarchical cluster analyses were performed using R statistical software to characterize morphological diversity and group accessions based on morphological similarity. Substantial variation was observed in both leaf and floral traits. Mean leaf length ranged from 2.5–20.0 cm, mean leaf width from 0.8–7.0 cm, mean internodal length from 0.4–8.0 cm, and mean number of florets per cyme from 13–315. The first five principal components explained 76.8% of the total variance, with PC1 accounting for 30.90% and strongly associated with inflorescence diameter, inflorescence length, leaf length, and inflorescence width. PC2 explained 15.45% and was primarily associated with petal width and petal length. Inflorescence diameter and length showed a strong positive correlation (r = 1.00). Hierarchical clustering grouped the 34 accessions into three phenotypic clusters containing 18, 3, and 13 accessions, respectively. The observed morphological diversity provides a useful foundation for documenting Ixora diversity and identifying promising accessions for future selection in ornamental breeding.

Keywords: Genetic resources; Inflorescence traits; Ixora; Morphological characterization; Ornamental plants

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ID 152

Quantifying condensate recovery from split air conditioners in tropical institutional buildings

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Abstract:
Split-type air conditioning (AC) systems are increasingly prevalent in tropical institutional buildings due to their efficiency and user convenience; however, the condensate they generate is typically discarded as waste. This study investigates the potential for reclaiming AC condensate as a sustainable water resource, thereby contributing to institutional water resilience and reducing potable water demand. Newly installed, same-brand, 24,000 BTU h^{-1} non-inverter AC units were monitored under three operational scenarios, each cooled to 24 °C: (1) two units operating from 08:00 to 16:00 in a 150 m^3 office with 50 occupants and 50 laptops at 70% relative humidity (RH); (2) two units operating during the same hours in an unoccupied 150 m^3 space at 55% RH; and (3) a single unit running continuously in a 55 m^3 low-humidity space at 45% RH. Average hourly condensate yields per unit were 2250 mL, 1750 mL, and 220 mL, respectively, corresponding to normalised rates of 30 mL, 23 mL, and 4 mL per unit per m^3 per hour. These results demonstrate a relationship between indoor RH and condensate generation, with higher yields in occupied, humid environments. Water quality analysis revealed a pH of 5.0–5.5, indicating potential suitability for irrigation and other non-potable applications with appropriate treatment. Overall, AC condensate harvesting represents a practical, low-cost sustainability strategy for institutions in tropical climates, offering potential water savings and supporting broader resource recovery initiatives.

Keywords: Air conditioner condensate; Institutional sustainability; Relative humidity; Resource recovery; Water harvesting

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ID 153

Effects of GA_3 on fruit growth and parthenocarpy induction in spine gourd *(Momordica dioica)*

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Abstract:
Spine gourd (*Momordica dioica*) is a nutritionally important dioecious cucurbit valued for its edible fruits and medicinal properties. However, commercial cultivation of spine gourd remains limited due to its dioecious reproductive system, particularly the difficulty in distinguishing male and female plants prior to flowering and pollination-related constraints. This study evaluated the effects of gibberellic acid (GA_3) on fruit growth responses and the potential induction of parthenocarpy in an open-field experiment. Three GA_3 concentrations (50 ppm, 100 ppm, and 200 ppm) were tested alongside a control treatment. The results showed that GA_3 application produced significant improvements in fruit length, fruit width, and fruit weight; specifically, the 100-ppm concentration showed the best response for enhancing fruit width and fruit weight. At 8 days after the first GA_3 application, GA_3 at 100 ppm increased fruit width by 13% and weight by 21% compared to the control, while at 16 days after the first GA_3 application, both 100 ppm and 200 ppm treatments improved fruit weight by 25% compared to the control. Despite these significant improvements in yield potential and fruit size, the attempt to induce parthenocarpy was unsuccessful under the experimental conditions, as fruit development still relied on manual pollination. These findings highlight the potential of GA_3 as an effective agronomic strategy to enhance the commercial viability of this underutilized crop by improving certain fruit growth characteristics. Future research involving long-term field assessments, alternative hormone combinations and diverse environmental conditions is required to evaluate the potential induction of parthenocarpy and its implications for crop productivity.

Keywords: Cucurbitaceae; Gibberellic acid (GA_3); Parthenocarpy; Plant growth regulators; Spine gourd (*Momordica dioica*)

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ID 154

Development of a low-cost Arduino-based multi-sensor system for real-time monitoring of banana ripening under tropical conditions

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Abstract:
Banana ripening involves significant physiological and biochemical changes, and real-time monitoring is important for reducing postharvest losses and improving quality management under tropical conditions. Traditional ripeness assessment methods are often subjective, destructive, and unsuitable for continuous monitoring. Therefore, this study aimed to design and develop a low-cost Arduino-based multi-sensor system for real-time monitoring of banana ripening and to evaluate the relationship between ripening stages, storage duration, and volatile gas emissions under tropical laboratory conditions. The system was developed using a DHT11 sensor for temperature and relative humidity measurements, along with MQ-series gas sensors (MQ-3, MQ-4, and MQ-135) to detect alcohol-related volatile compounds, methane (CH_4), and ammonia (NH_3), respectively. A total of 30 *Musa acuminata* (Seeni banana) samples were monitored over a three-month period under tropical laboratory conditions, and ripening progression was evaluated using a standard peel color index (1–7 scale). Temperature (31–32 °C) and relative humidity (84–85%) remained relatively stable, while gas concentrations increased progressively during ripening. NH_3, CH_4 and alcohol concentrations ranged from 2.67–25.33, 4.330–18.67, and 4.67–34.00 ppm, respectively. Seeni bananas required 11-12 days to complete ripening. Regression analysis showed strong relationships between storage duration and gas emissions, with the highest R^2 observed for peel color (0.982). Correlation analysis confirmed significant associations between storage duration and all measured parameters, particularly peel color (r = 0.992) and alcohol concentration (r = 0.893). The developed system provides a practical non-destructive, and cost-effective approach for real-time banana ripening monitoring, with practical applications in postharvest handling and supply chain management in tropical environments.

Keywords: Arduino; Banana ripening; Non-destructive assessment; Postharvest technology; Real-time monitoring; Volatile organic compounds

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ID 155

Effect of semi–solid and liquid MS media with or without banana pulp on shoot proliferation and root development in *Vanilla planifolia* Andrews

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Abstract:
Conventional propagation of vanilla through stem cuttings is relatively slow and limits large-scale production, whereas micropropagation provides a rapid method for producing uniform planting materials. Therefore, this study evaluated the effect of culture medium type and growth regulator on *in vitro* shoot proliferation and root development of *V. planifolia*. The experiment was conducted at the Plant Tissue Culture Research Center, Department of Export Agriculture, Walpita, using a two-factor factorial completely randomized design with twenty replicates. Two culture media types, liquid and semi-solid MS media and two growth regulators, banana pulp and synthetic plant growth regulators (PGRs), were evaluated, resulting in four treatment combinations: liquid medium with banana homogenate, liquid medium with synthetic PGRs, semi-solid medium with banana homogenate, and semi-solid medium with synthetic PGRs. Nodal explants collected from healthy mother plants were initially established on hormone-free MS medium to minimize contamination and were subsequently transferred to the respective treatments. After three months of culture, shoot length, internodal length, root length, number of nodes, leaves, and roots were recorded. The results revealed that liquid MS medium supplemented with banana homogenate significantly enhanced both shoot and root development compared with other treatments ($P \leq 0.05$). The highest shoot length, node number, root number, and root length were observed in liquid medium containing banana pulp, whereas semi-solid medium supplemented with synthetic PGRs showed the lowest growth performance. The findings indicate that banana homogenate can serve as an effective, low-cost natural growth supplement, while liquid media improve nutrient availability and overall plant growth. Therefore, liquid MS medium supplemented with banana homogenate can be considered an effective, economical, and eco-friendly alternative for the effective *in vitro* propagation of *V. planifolia.*

Keywords: Banana homogenate; Liquid and semi-solid MS medium; Micropropagation; Synthetic plant growth regulators; *Vanilla planifolia*

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Influence of pollen dilution on pollination efficiency and seed yield in hybrid curry chili (*Capsicum annuum* L.) under protected conditions

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Abstract:
Hybrid seed production in *Capsicum annuum* L. largely depends on artificial pollination, particularly for achieving high yields and ensuring seed purity. However, asynchronous flowering and limited fresh pollen availability often reduce pollination efficiency and seed yield under protected cultivation conditions. Therefore, this study evaluated the effect of different pollen diluents on pollination success in hybrid curry chili under protected conditions at the Faculty of Agriculture, University of Ruhuna. Eleven treatments consisting of different pollen:diluent combinations were tested: T1–100% pollen (control), T2–1:1 pollen: talc, T3–1:2 pollen: talc, T4–1:1 pollen: wheat flour, T5–1:2 pollen: wheat flour, T6–1:1 pollen: glucose, T7–1:2 pollen: glucose, T8–1:1 pollen: sucrose, T9–1:2 pollen: sucrose, T10–1:1 pollen: agar, and T11–1:2 pollen: agar. The experiment was arranged in a completely randomized design with twelve replicates. Fruit set percentage was recorded 14 days after pollination, while the number of seeds per pod and dry seed weight per pod were measured at harvest. Data were analyzed using one-way ANOVA followed by Tukey's test at the 5% significance level. Results showed that pollen dilution significantly affected pollination success and seed production. Fruit set percentages above 80% were observed in T2, T6, T7, T8, and T9. Significantly higher seed numbers and dry seed weights per pod were recorded in T6, T8, and T9 treatments. The findings indicated that glucose and sucrose are effective pollen diluents for hybrid curry chili seed production. Glucose at a 1:1 ratio and sucrose at both 1:1 and 1:2 ratios, provide readily available energy, improve pollination efficiency while reducing dependence on fresh pollen.

Keywords: *Capsicum annuum*; Hybrid seed production; Pollen dilution; Pollination efficiency

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Assessment of agronomic performance and economic viability of a gherkin–yard-long bean sequential cropping system under pot culture conditions in the low country wet zone of Sri Lanka

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Abstract:
This study evaluated the agronomic performance and economic viability of a gherkin–yard-long bean (YLB) sequential cropping system under pot culture conditions in the low-country wet zone of Sri Lanka. The experiment used the gherkin variety Chandani F1 and the yard-long bean variety Gannoruwa A9 and was conducted over three consecutive cropping cycles using the same pots and growing media without replacement. In the first cycle, gherkin was cultivated with the recommended fertilizer package. In the second cycle, the system was divided into two: one set continued gherkin cultivation under the recommended fertilizer regime, while the other was planted with yard-long bean under three fertilizer levels (recommended level, 50% reduction, and no fertilizer). In the third cycle, gherkin was reintroduced to assess residual effects, with treatments including full and 50% reductions in nitrogen application. A completely randomized design with five treatments and five replicates was generated by combining the cycles. Growth and yield parameters were recorded across all cycles. Data were analyzed using one-way ANOVA at a 5% significance level, and means were separated using Duncan's multiple range test. Research findings showed a significant decline in yield and profitability under continuous gherkin monocropping, indicating limited sustainability. The inclusion of yard-long beans significantly improved system productivity and economic performance across cycles. No significant difference was observed between continuous full fertilization and the sequence where unfertilized YLB was followed by fully fertilized gherkin. Overall, the gherkin–YLB–gherkin system proved to be a more sustainable and economically viable option than continuous monocropping under controlled pot conditions.

Keywords: Crop rotation; Gherkin; Monocropping; Sustainability; Yard-long-bean

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ID 159

Soil and sediment compression from manually driven cores: A baseline study for blue carbon science in Sri Lanka

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Abstract:
Coring is a widely used technique for organic carbon analysis in coastal ecosystems, however, soil and sediment compression during sampling remains underexplored in tropical regions. This study investigated compression associated with a low-cost coring method using a 1 m metal core driven manually and by hammering, as an alternative to mechanized drilling. Sampling was conducted across four seagrass meadows (Dondra, Kalpitiya, Jaffna, and Batticaloa) and two saltmarsh ecosystems (Hambantota and Jaffna) in Sri Lanka (n = 72 cores; 12 per site). Compression was calculated from the difference between penetration depth and recovered core length, ranging from 12.5% to 68.33%. Seagrass sediments exhibited significantly greater mean compression (49.51% ± 4.66%) than saltmarsh soils (26.56% ± 2.41%) ($P < 0.05$, one-way ANOVA), with notable variation among seagrass sites but not between saltmarsh sites ($P > 0.05$, t-test). The highest compression occurred in Dondra (68.33%), while Batticaloa showed the lowest (12.5%). Coring depths of 0–25 cm, 26–50 cm, 51–75 cm, and 76–100 cm accounted for 6.94%, 41.67%, 31.94%, and 19.44% respectively, whereas recovery depths for the same intervals were 25%, 73.61%, 1.39%, and 0% respectively. Variability in coring depth was influenced by bedrock proximity, texture, grain size, moisture, and sediment composition, while recovery was strongly affected by compression. Overall, effective recovery in Sri Lankan coastal ecosystems was optimal at 26–50 cm. For deeper sampling (≥1 m), mechanized coring systems are recommended to minimize compression and improve recovery accuracy in blue carbon stock estimations, as reported in related literature.

Keywords: Coring; Organic carbon; Saltmarsh; Seagrass; Soil compression

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ID 165

The impact of Green Banking Adoption Practices (GBAP) on banking performance

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Abstract:
As the banking sector evolves in response to global trends and customer expectations, the integration of green practices has gained importance. Green Banking Adoption Practices (GBAP) refer to the integration of environmentally responsible strategies, such as eco-design, internal environmental management, green purchasing, investment recovery, and customer collaboration into banking operations. Despite its growing adoption, there remains limited empirical evidence linking GBAP to core banking performance in emerging economies, creating uncertainty regarding its return on investment. This study investigates the impact of GBAP on the performance of commercial banking institutions in Kandy district, Sri Lanka, specifically focusing on three key dimensions: environmental performance, financial performance, and operational performance. A quantitative research methodology was applied. The target population comprised 612 executive-level and higher-level staff across licensed commercial banks in the Kandy district. A sample of 237 employees (132 from public banks and 105 from private banks) was selected using a stratified sampling approach based on bank sector type, managerial hierarchy, and branch location. Data were collected through a structured questionnaire and analyzed using statistical tools, specifically Pearson correlation and simple linear regression analysis, to test three hypotheses related to each performance dimension. The results revealed a strong positive relationship between GBAP and environmental performance ($r = 0.744$, $P = 0.0001$), indicating that green banking practices contribute significantly to improving environmental outcomes such as waste reduction and efficient resource usage. The study also found that GBAP has a strong, significant impact on operational performance ($r = 0.652$, $P = 0.0001$), particularly in terms of efficiency gains, cost control, and improved internal processes. While the relationship between GBAP and financial performance was found to be moderate yet statistically significant ($r = 0.591$, $P = 0.0001$), it still confirms potential long-term financial benefits through efficiency improvements and reputational advantages. This research provides empirical evidence that GBAP accounts for 55.3% of the variance in environmental performance ($R^2 = 0.553$), 42.5% in operational performance ($R^2 = 0.425$), and 34.9% in financial performance ($R^2 = 0.349$), confirming its direct role in enhancing overall bank performance. It contributes to academic literature by offering insights from a developing country perspective and provides practical guidance for banking professionals and decision-makers on how green banking initiatives can align with institutional performance goals.

Keywords: Environmental performance; Financial performance; Green banking adoption practices (GBAP); Operational performance

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International Symposium on Agriculture and Environment (ISAE) 2026

Special Plenary Session

The Fertilizer Frontier: Navigating Change with Agriculture

Keynote Speech

Transforming Agriculture Through Soil Intelligence and Precision Nutrition

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Abstract:
Agriculture is entering a new era in which data-driven decision-making is becoming as important as fertiliser itself. While government fertiliser recommendations remain an essential scientific foundation, they are necessarily designed for average conditions. Modern farming requires recommendations that recognise the uniqueness of every field. This concept paper introduces Soil Intelligence, an integrated framework combining soil analysis, crop demand, water quality, growth stage, climate, yield targets and economics to produce field-specific nutrient programs. The objective is not to replace existing recommendations, but to refine them using evidence from individual fields/areas. The key take message is simple: every field is unique; therefore, every nutrient decision should be unique as well.

Two different farms may receive identical fertiliser recommendations yet produce very different yields. Differences in soil chemistry, soil biology, water quality, management history and yield potential explain much of this variation.

Traditional nutrient management follows a simple pathway: Crop → Government Recommendation → Standard Fertiliser → Every Farm. Although this approach is simple, proven and practical, but cannot account for field variability, nutrient reserves, previous applications or economic optimisation.

Three anonymised ALTSA soil reports illustrate substantial variation in soil pH, phosphorus, calcium, zinc and other nutrients between fields growing the same crop. Demonstrating the need for different fertiliser strategies.

The scientific foundation of the proposed framework is based on Liebig's Law of the minimum demonstrates that crop productivity is controlled by the least available essential nutrient rather than the nutrient supplied in the greatest quantity. This explains why increasing nitrogen application often fails to improve yield when zinc, boron or potassium is limiting. The 4R nutrient stewardship framework (right source, right rate, right time and right place) provides the operational basis for implementing this principle in modern agriculture.

Soil Intelligence extends conventional soil testing by integrating crop information, soil chemistry, irrigation water quality, growth stage, local climate, target yield and economic objectives to generates a tailor-made nutrition program for each field, thereby supporting better decisions and improved profitability.

A practical comparison using anonymised ALTSA reports demonstrates how a traditional balanced NPK recommendation differs from a precision recommendation that corrects zinc deficiency, adjusts soil pH, reduces unnecessary phosphorus and increases potassium where required. Expected outcomes include higher nutrient-use efficiency, lower fertiliser costs and improved yield.

Looking ahead nutrient management will increasingly combine laboratory data with remote sensing, drones, satellites, IoT sensors, artificial intelligence, machine learning and variable-rate

application technology to support real-time decision support systems capable of generating dynamic recommendations for individual management zones.

The next revolution in nutrient management will not come from applying more fertilizer but from applying knowledge. Soil testing provides information; soil intelligence transforms that information into profitable decisions. Government recommendations provide the foundation, but integrated field-specific decision-making represent the future of sustainable agriculture.

Keywords: Decision Support Systems; Nutrient Management; Precision Agriculture; Precision Nutrition; Soil Intelligence; Soil Testing

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International Symposium on Agriculture and Environment (ISAE) 2026

Young Graduates' Forum (YGF)

Oral Presentations

Keynote Speech

Publishing Scholarly Books with Springer Nature: Opportunities, Ethics, and Open Access

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Abstract:
This presentation provides an overview of Springer Nature and its role in advancing scholarly communication. It introduces the process of developing and publishing academic books with Springer Nature, from proposal submission and evaluation to manuscript development and publication. The session also highlights the importance of research integrity in scholarly publishing, discusses the opportunities and challenges associated with the use of artificial intelligence in research and publishing, and explores ethical considerations related to AI-generated content. In addition, the presentation examines the growing landscape of open access publishing and the various options available for publishing books and research outputs openly with Springer Nature to maximize their visibility, accessibility, and impact.

Keywords: Academic books; Artificial intelligence; Open access; Research integrity; Scholarly publishing; Springer Nature

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Impact of inoculation of *Trichoderma harzianum* and *Verticillium chlamydosporium* into potting mixture for controlling root-knot nematode in curry chili cultivation under protected- house condition

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Abstract:
Capsicum annuum L. (Curry chili) is an important vegetable crop cultivated under protected house conditions, but its yield is greatly diminished due to root-knot nematode infestations. Excessive dependency on chemical nematicides has raised concerns about environmental pollution, soil degradation and human health, highlighting the need to investigate ecologically safe alternatives. This study evaluated the effectiveness of *Trichoderma harzianum* and *Verticillium chlamydosporium* as biological control agents against root-knot nematode infestation of curry chili cultivation. This experiment was conducted from March to August 2025 in the protected house of the Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, using the curry chili variety Muriya F1. Treatments consisted of different inoculation dosages (100ml and 200ml) applied once a week for two, three and four consecutive weeks, together with an untreated control (without biocontrol agent), arranged in a Completely Randomized Design (CRD). The results showed that the treatments receiving 200 ml inoculum solution once a week for continuously three (T6) and four (T7) weeks respectively had better plant growth and yield with efficient root-knot incidence suppression compared with the untreated control. The results showed that the treated plants significantly enhanced their yield performance with an increase ranging from 4.6% to 19.62% over the control. Besides, the root-knot nematode population decreased by 91.67%, and root-knot incidence on roots decreased by 71.74% in treated plants. These findings reveal the potential of *T. harzianum* and *V. chlamydosporium* as an environmentally friendly biocontrol agent that not only reduces nematode injury but also increases the productivity of crops, offering a good alternative to chemical nematicides in protected *Capsicum annuum* cultivation.

Keywords: *Capsicum annuum;* Cocopeat media; Root-knot nematodes; *Trichoderma harzianum; Verticillium chlamydosporium;*

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Optimization of poultry litter–rice straw substrates for black soldier fly larvae production: impacts on growth, protein yield, and waste reduction

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Abstract:
Rising costs and environmental concerns associated with conventional protein feed ingredients have intensified interest in alternative sources such as black soldier fly larvae (BSFL). BSFL growth performance and nutrient levels are strongly influenced by the physicochemical properties of the rearing substrate. Effective use of poultry litter as a substrate for BSFL production requires adjustment of its physicochemical properties, particularly to optimize the C:N ratio, which is critical for larval growth and nutrient conversion. This study evaluated poultry litter (PL) and chopped rice straw (RS) mixtures as substrates for BSFL production. A completely randomized design was employed with seven PL:RS combinations (w/w) (100:0, 96:4, 92:8, 88:12, 84:16, 80:20, and 0:100), with food waste (FW) included as a control. Six-day-old larvae (n = 500) were introduced into trays containing 500 g of substrate and reared to the prepupal stage; each treatment was replicated six times. Substrate C:N ratios varied significantly ($P < 0.001$), ranging from 10.36 (PL100RS0) to 60.42 (PL0RS100), with PL80RS20 achieving a near-optimal ratio (15.6). Larvae reared on FW exhibited superior performance, with the highest survival rate (86.1%), larval weight (145.7 mg), and length (18.0 mm) by day 14. In contrast, PL100RS0 and RS100 resulted in reduced survival (63.5% and 24.4%, respectively). Among the PL–RS mixtures, PL80RS20 performed best, achieving 76.3% survival, 71.8 mg larval weight, and 14.2 mm length. Crude protein (CP) content differed significantly ($p < 0.001$), with PL80RS20 (38.9%) and PL100RS0 (38.4%) comparable to FW (38.7%). Total CP yield per 500 g substrate was highest for FW (10.1 g), followed by PL80RS20 (6.4 g). Waste reduction and bioconversion efficiency followed trends consistent with larval growth performance. These findings indicate that neither poultry litter nor rice straw alone provides suitable conditions for optimal BSFL development. However, the performance of the PL80RS20 mixture demonstrates the potential for converting poultry litter into insect protein. Further optimization of PL–RS substrate conditions is required to achieve growth performance and environmental efficiency comparable to food waste, thereby supporting sustainable waste-to-protein conversion systems.

Keywords: Bioconversion Efficiency; BSF; Growth; Poultry litter; Rice straw; Substrate

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Processing effects on the chemical composition of *Scutellaria baicalensis* (Huangqin) roots

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Abstract:
Scutellaria baicalensis Georgi, or Huangqin is an important traditional Chinese medicinal herb often used for treating conditions such as inflammation and fever due to its bioactive secondary metabolites. While the medicinal value of *S. baicalensis* is well known, there is a significant gap in understanding how post-harvest processing techniques affect the herb's chemical composition and functional characteristics. This study aimed to evaluate the effects of different processing methods on the phytochemical composition and antioxidant activities of *S. baicalensis* roots. Seven different processing methods were investigated, including sun-drying and artificial drying at 40 °C, 60 °C, and 80 °C, with and without prior steaming. Phytochemical profiling was conducted using High-Performance Liquid Chromatography coupled with tandem mass spectrometry (HPLC-MS/MS), while antioxidant activities were measured using DPPH and ABTS radical scavenging assays. The results showed that processing methods significantly influenced both chemical composition and antioxidant capacity. Artificial drying method at 80 °C (XQ80) resulted in the most favourable flavonoid profile and the highest antioxidant activity (DPPH: 0.12 ± 0.01 mg mL^{-1}; ABTS: 0.31 ± 0.02 mg mL^{-1}). Metabolomics analysis identified eight key compounds, including Wogonin, Chrysin and Pinocembrin, which were strongly associated with antioxidant activity based on VIP scores and IC_{50} correlations. These findings highlight the importance of processing conditions in optimizing the functional quality of *S. baicalensis* and support the development of standardized post-harvest protocols to ensure consistent therapeutic efficacy.

Keywords: Antioxidant Activity; Chemical Composition; Flavonoids; Post-harvest Processing; *Scutellaria baicalensis*

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Valorization of paddle-dried POME solid waste for potassium-rich organic liquid fertilizer production

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Abstract:
With escalating environmental problems, there is a growing demand for innovative approaches to sustainable resource recovery in the palm oil industry. The solid waste (palm extract) generated during the paddle-drying stage of palm oil mill effluent (POME) processing is a rich source of potassium and other nutrients essential for plant growth and development. This study aimed to develop a potassium-rich organic liquid fertilizer from palm extract and to evaluate the effects of the developed fertilizer on the growth performance of radish (*Raphanus sativus*). Palm extract was selected as the raw material due to its inherently high potassium content and abundant availability as a bulk solid waste generated from palm oil mills. The micro air-bubbling technique was used to separate the residual crude fat from the oil-in-water emulsion of the palm extract prior to fertilizer development. A crop experiment was conducted using a completely randomized design (CRD) with eight replicates to evaluate the effects of different concentrations of the developed liquid fertilizer. Fertilizer solutions were prepared by diluting the developed fertilizer extract with water at ratios of 1:5, 1:10, 1:15, 1:20, and 1:25 and were applied to a growth medium consisting of topsoil, sand, and compost in a 1:1:1 ratio. The observed growth parameters included leaf count, leaf length, root length, root diameter, fresh weight, and dry weight. The results showed that the concentration of the liquid fertilizer significantly affected the growth performance and yield of radish (*Raphanus sativus*) (ANOVA, $P < 0.05$). Among the tested treatments, the fertilizer diluted at a 1:20 ratio exhibited the most favorable growth response, with plant growth closely comparable to that of the standard chemical fertilizer (control) and more favorable than that observed with other dilution ratios. These findings support a sustainable solution to manage the solid waste generated in palm oil mills, as well as an efficient and sustainable radish cultivation technique.

Keywords: Organic liquid fertilizer; Palm oil milling effluent (POME); Sustainable resource regeneration

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Innovation capabilities in agricultural R&D institutes in Sri Lanka: Evaluating the performance and challenges

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Abstract:
The internal innovation capabilities of Sri Lankan Agricultural Research and Development Institutes (SLARDI) are insufficiently evaluated. This study presents an evaluation of the internal innovation capabilities of SLARDI, using a unique innovation capability assessment model known as the New Innovation Capability Assessment Model (NICAM). The model comprises an Innovation Capacity Index (ICI) and Contextualized Global Innovation Index (GII). The NICAM was generated through a primary survey administered to 32 institutional divisional heads, supported by secondary data. Data was analyzed using the entropy–weighted method, composite index, social network analysis, and the Generalized Additive Model (GAM). The results indicate considerable variation in innovative performance levels. Universities demonstrate a higher NICAM innovation performance score of 0.098 due to network centrality and intensive collaboration, whereas other institutions show a comparatively lower score of 0.015 despite adequate investment in innovation. GAM analysis further reveals that network strength, leadership style, and investment effectiveness positively influence innovation performance. Network analysis also highlights weak interdivisional connections among institutions. Key challenges identified include financial constraints, ineffective administration, and persistent skill gaps. Overall, these findings suggest that internal organizational factors play a critical role in innovation, and, therefore, NICAM has a strong potential to be scaled up to enhance organizational innovation performance.

Keywords: Innovation barriers; Innovation capabilities; Internal drivers of innovation; Internal innovation capacity; New innovation capability assessment model.

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Effects of water repellency levels on carbon dioxide emissions from soil incorporated with organic amendments

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Abstract:
Incorporation of organic amendments (OAs) into soil increases organic matter content (OM%) and carbon dioxide (CO_2) emissions while inducing water repellency (WR), which restricts spontaneous water penetration. The WR conditions limit OM decomposition and reduce subsequent CO_2 emissions. Temporal reductions in OM% due to decomposition can decrease both CO_2 emissions and WR levels because of the limited presence of organic substrates. However, the net effects of these temporal variations (OM% and WR) on CO_2 emissions in soil with OAs are still unclear. Therefore, this study aimed to determine the effects of WR levels on CO_2 emissions from soil incorporated with OAs. Surface Ultisols from Mapalana, Sri Lanka were amended with five types of air-dried and/or ground OAs (mahogany and casuarina litter, goat and cattle manure, and compost) at a rate of 15% (w/w) rate and incubated for 15 weeks in laboratory conditions. Carbon dioxide emissions (NaOH trapping), degree of WR (sessile drop contact angles; CAs), and OM% (Walkley-Black and Loss on Ignition methods) were measured weekly. Both OM% and CAs decreased temporally due to decomposition. Initially, CO_2 emissions peaked around day 21 and then gradually decreased until day 42. Thereafter, clear CO_2 emission pulses were observed despite continuously reduced OM%. A strong negative exponential correlation between these CO_2 pulses and the respective CAs ($R^2 = 0.81$) suggested that decreasing WR could improve improve water penetration and microbial access, thereby increasing CO_2 emissions. According to ANOVA, before day 42, only the effects of OM% was statistically significant, whereas thereafter, the effects of both OM% and CAs were statistically significant ($P < 0.05$). These findings revealed that soil WR can be considered a key factor regulating CO_2 emissions during the later decomposition period mainly due to its impact on soil moisture, in addition to OM availability.

Keywords: CO_2 emissions; Contact angle; Organic amendments; Organic matter; Water repellency

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Determination of the economically optimal ratoon cycle in sugarcane cultivation in Sevanagala, Sri Lanka

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Abstract:
The productivity and profitability of sugarcane cultivation heavily depend on ratoon crop performance, which is influenced by management practices. Understanding ratoon yield variability and replanting the crop at an optimum ratoon cycle are essential for enhancing the sustainability of the sugar industry. This study determined the economically optimal ratoon cycle of sugarcane variety SL 96 128 and assessed the ratoon management practices adopted by sugarcane farmers in Sevanagala. Farm-level yield data from 2014 to 2024 were used to determine the optimum ratoon cycle. Questionnaire survey data from 60 farmers were analysed to assess the adoption of ratoon management practices recommended by the Sugarcane Research Institute, Sri Lanka. Ordinary least squares regression analysis was used to examine ratoon yield variation, and optimum ratoon cycles were identified using a method developed based on the Cumulative Return on Investment (CROI) approach described by Keerthipala and Dharmawardene in 2000. Farmers' ratoon management practices were assessed based on adoption rates. The relationship between cane yield and ratoon cycles showed a notable declining trend under both rainfed and irrigated conditions. For variety SL 96 128, replanting after the 12th ratoon, or when cane yields fall below 64 t ha^{-1}, was found to be optimal for rainfed farms in Sevanagala. For irrigated farms, the 9th ratoon was the optimum ratoon cycle, with a break-even cane yield of 98 t ha^{-1}. Harvesting at ground level, simultaneous harvesting, timely weeding, applying fertilizer when the soil is moist, and gap filling were fully adopted. Mulching, covering applied fertilizer with soil, stubble shaving, earthing up, and soil loosening showed low adoption. Increasing farmer awareness, focused training, and affordable mechanization options are essential to enhance the adoption of low priority but agronomically beneficial practices, thereby improving ratoon crop productivity and sustainability.

Keywords: Management practices; Optimum ratoon cycle; Ratoon yields; Sevanagala; Sugarcane

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Modelling the combined effects of rainfall variability and land cover changes on landslide hazard: A case study of Ginigathhena, Central Province, Sri Lanka

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Abstract:
Landslides are among the most destructive natural hazards in Sri Lanka's wet zone, where changing rainfall patterns and land cover alterations significantly influence slope stability. This study investigates the combined effects of rainfall variability and land cover change on landslide occurrence in Ginigathhena, located in the Central Province of Sri Lanka, and develops an integrated logistic regression model for hazard prediction. The study utilizes a decade of multi-source data (2014–2024), including landslide inventory records comprising 79 documented events from the National Building Research Organization, daily rainfall records from the Department of Meteorology, and multi-temporal Landsat 9 satellite imagery (30 m resolution) obtained from the USGS Earth Explorer platform. Land cover dynamics were assessed using the Normalized Difference Vegetation Index (NDVI), with particular attention to vegetation change within a 200 m buffer surrounding documented landslide locations. Rainfall variability was analyzed using cumulative rainfall thresholds, including 3-day cumulative rainfall. The findings reveal that 94.93% of recorded landslide events occurred under 3-day cumulative rainfall exceeding 120 mm, indicating that this threshold is a useful predictor of landslide initiation. Additionally, vegetation cover within a 200 m buffer surrounding landslide-prone areas showed a consistent decline over the study period, which was significantly associated with increased landslide occurrence, highlighting the role of vegetation loss in enhancing slope instability. A binary logistic regression model (landslide/no landslide) was developed using 250 observations, with cumulative rainfall thresholds and vegetation cover change as key independent variables. The logistic regression model achieved a test accuracy of 90.91% (AUC-ROC = 0.765, PR-AUC = 0.579, recall = 60%, F1-score = 0.46), confirming the predictive relevance of rainfall and vegetation variables. The developed model provides a useful decision-support tool for landslide hazard assessment and can support early warning systems, land-use planning, and climate-resilient disaster risk management in Sri Lanka.

Keywords: Disaster risk reduction; Change; Land cover; Landslide susceptibility; Logistic regression; NDVI; Rainfall threshold

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Optimization of culture conditions for enhanced growth and sporulation of *Magnaporthe oryzae*

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Abstract:
Rice blast, caused by *Magnaporthe oryzae,* is a major threat to rice production worldwide. Reliable *in vitro* conidia production of this pathogen is essential for pathogenicity assays and resistance screening but is often limited by microenvironmental and nutritional factors. Therefore, this study aimed to optimize culture conditions for maximizing vegetative growth and conidia production. Effects of culture media type (oatmeal agar, cornmeal agar, rice straw agar, rice bran agar, and rice flour agar), nutrient strength (full and half), incubation temperature (25 °C and 28 °C), and light source (UV-A black light and white light) on fungal growth and sporulation were evaluated. The experiment was arranged in a completely randomized design with three replicates. Vegetative growth was assessed during the first 10 days under dark conditions, followed by sporulation after light exposure. Data were analyzed using multifactor analysis of variance. Results showed a significant three-way interaction among medium type, nutrient strength, and temperature for mycelial growth. The highest growth rates occurred on half-strength oatmeal agar at 25 °C (6.27 ± 0.10 mm day^{-1}) and half-strength cornmeal agar at 28 °C (6.15 ± 0.23 mm day^{-1}), indicating that reduced nutrient availability enhanced vegetative growth under specific temperatures. Sporulation was significantly influenced by media type, nutrient strength, temperature, and light source. Maximum conidial production was achieved on full-strength corn meal agar at 28 °C under continuous black light, producing approximately 3.26×10^5 conidia mL^{-1}. These findings provide a reliable protocol for the mass production of conidia of *Magnaporthe oryzae* for pathogenicity testing and resistance screening.

Keywords: Conidia production; Culture media; Pathogenicity testing; Resistance screening; Rice blast

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Financial literacy and financial inclusion among welfare-supported self-employed women: Evidence from Matara district, Sri Lanka

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Abstract:
This study examines the relationship between financial literacy (FL) and financial inclusion (FI) among self-employed women receiving welfare support in Matara District. The study aims to evaluate the current FL rate, examine the impact of FL on FI, and suggest policy recommendations to enhance FL and FI within this vulnerable group. A sample of 203 self-employed women supported by the '*Aswesuma*' program was selected from five Divisional Secretariat divisions using purposive and convenience sampling. Data were collected through pre-tested, structured questionnaires aligned with OECD financial literacy guidelines. FL scores were calculated using financial knowledge, financial attitude, and financial behavior, while FI scores reflected access, usage, and quality of financial services. FL scores were standardized and classified into low (23.6%), medium (47.3%), and high (29.1%) levels using z-scores. Applying the OECD/INFE threshold of ≥70% to define FL, only 15.8% of women were considered as financially literate overall. By dimension, 53.7% demonstrated adequate financial knowledge, 75.4% expressed a positive financial attitude, but none met the adequacy benchmark for financial behavior. Structural Equation Modeling (SEM) results identified financial knowledge as the strongest predictor of FL (β = 0.530), while financial behavior (β = 0.512) and financial attitude (β = 0.300) were the weakest areas requiring improvement. The study concludes that weak financial behavior remains a major barrier to inclusion. It recommends behavior focused financial education, sector specific training, integration of FL into welfare schemes, and improved digital finance skills. Future research should explore additional factors shaping financial inclusion among self-employed women supported by welfare programs.

Keywords: Financial behaviour; Self-employed women; Structural Equation Modelling; Welfare programs (Aswesuma); Welfare Support

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Climate-responsive digital twin-artificial neural network framework for thermal comfort prediction and energy optimization: Validation in Jaffna with framework application across selected Sri Lankan climatic zones

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Abstract:

The construction and operation of the building represent major sources of global carbon emissions and overall energy consumption. In tropical countries like Sri Lanka, climate-responsive and comfort-oriented design practices are not yet adequately prioritized. Conventional static approaches to building design and management overlook variations in occupant behaviour and regional climate fluctuations, limiting opportunities for energy optimization and thermal comfort. This study develops a Digital Twin–Artificial Neural Network (DT–ANN) framework for thermal comfort prediction and energy optimization. The framework was validated using a naturally ventilated building in Jaffna (hot-dry climate) based on field measurements and occupant survey data. Digital Twin energy simulations were additionally developed for representative buildings in Colombo (hot-humid) and Hawa Eliya (cool-highland) to demonstrate the framework's applicability across representative Sri Lankan climatic zones; however, field validation was conducted only for the Jaffna case study. Three-dimensional Digital Twin models were generated in Autodesk Revit software by combining architectural parameters, site-specific meteorological data, and occupant feedback. The research methodology utilized a dataset of 1,632 occupant survey responses collected from a representative naturally ventilated building in Jaffna. A feedforward ANN model with two hidden layers (64 and 32 neurons, respectively) was developed and trained using an 80:20 train-test split, with thermal comfort levels classified into three categories (cold, neutral, hot) based on the ASHRAE 7-point thermal sensation scale. Model validation was performed using an independent post-modification occupant survey dataset collected after implementation of passive envelope improvements in the Jaffna study building. These responses were not included in ANN model training, enabling independent validation of predictive performance. The ANN model attained 81% prediction accuracy (0.81), thereby confirming the reliability in the hot-dry context. Post-modification occupant feedback in Jaffna supported the robustness of the model. Digital Twin simulations indicated that the implemented passive envelope modifications reduced total annual energy consumption by 21.1% and cooling demand by 30.0% in the Jaffna case study. These energy savings were obtained from Digital Twin simulation scenarios rather than field-measured operational reductions. Consequently, the proposed DT–ANN framework demonstrated reliable thermal comfort prediction and substantial simulated energy savings in the validated Jaffna case while providing a transferable methodology for application to other Sri Lankan climatic regions. The framework supports Sustainable Development Goals 11 (sustainable cities) and 13 (climate action) and offers a scalable protocol for climate-responsive design in tropical regions.

Keywords: Artificial Neural Network; Building Energy Simulation; Digital Twin; Thermal Comfort; Tropical Climates

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Poster Presentations

Study on pathological findings in the lungs of African swine fever-infected pigs in Sri Lanka

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Abstract:
African swine fever (ASF) is a highly contagious hemorrhagic viral disease of swine caused by African swine fever virus (ASFV), whichbelongs to the family Asfarviridae, genus Asfivirus. The first outbreak of ASF in Sri Lanka in October 2024 resulted in high mortality, causing the pig population to decrease by 44.3% in 2025. Investigating the disease's pathology was imperative. This study was conducted to determine the pathological changes in lungs of African swine fever infected pigs in Sri Lanka and the role of macrophages in the development of such lesions. Lung samples from ASF-infected pigs (n = 30) and apparently healthy pigs (n = 30) were collected and analyzed for pathological changes (semi-quantitative analysis for of alveolar, bronchiolar and vascular changes and macrophage counts in bronchioles). A significant increase ($P < 0.05$) in macrophage counts in the peribronchiolar area was noted in the ASF-infected animals (33.52 ± 0.93) compared with the control group (0.18 ± 0.02). Semi-quantitative analysis of the tissue damage revealed that there is higher damage in the lungs of ASF-infected animals compared with the control group ($p<0.05$). Collagenolysis was observed in the test samples, indicating damage in the bronchial wall in the ASF infected animals although there were not any collagenolysis areas to the control group. In conclusion, the present study proposes ASF-induced bronchiolar damage is associated with macrophages and improves understanding of pathological changes in alveoli, bronchioles, and blood vessels, supporting disease diagnosis under local conditions.

Keywords: African swine fever; Collagenolysis; Histopathology; Macrophages; Swine

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Quality and consumer preference of butternut squash (*Cucurbita moschata*) puree incorporated non-fat drinking yoghurt

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Abstract:
Rising consumer demand for healthy foods has increased interest in non-fat yoghurt products, although fat reduction often leads to undesirable changes in texture, mouthfeel, and overall product quality. Butternut squash (*Cucurbita moschata*), a pumpkin variety, demonstrates considerable potential as a natural fat replacer due to its rich content of dietary fibre, pectin, and starch. This study developed a functional non-fat drinking yoghurt enriched with *C. moschata* puree and evaluated its quality characteristics and consumer acceptability. Six yoghurt formulations were prepared by incorporating *C. moschata* puree at levels of 0% (control), 2, 4, 6, 8, and 10% (w/w) into non-fat UHT cow milk; sugar (8%), gelatin (0.5%), and yoghurt starter culture (2%) were kept constant. Standard methods were used to assess the compositional and physicochemical properties. Sensory evaluation was conducted with 50 untrained panelists using 9-point hedonic scale and the Check-All-That-Apply (CATA) method. A completely randomized design with three replicates was used, and the data were analyzed using IBM SPSS (ver. 25) and XLSTAT (Win). Increasing puree levels resulted in increased percentages of total solids (19.18 ± 0.89 to 22.04 ± 3.17%), protein (3.62 ± 0.01 to 5.43 ± 0.05%) and carbohydrate (15.13 ± 0.90 to 16.56 ± 3.71%) in yoghurts. pH (4.27 ± 0.06) and titratable acidity (0.61 ± 0.03 to 0.66 ± 0.01% lactic acid) did not differ significantly ($P > 0.05$) among treatments and remained within the typical range for yoghurts. Colour analysis indicated a gradual decline in lightness (L^*) together with increased reddish ($+a^*$) yellow ($+b^*$) tone in the drinking yoghurt at higher puree inclusion levels, due to the presence of carotenoids. The overall sensory acceptability score was significantly ($P < 0.05$) higher at the 4% puree level and was considered optimal, as it achieved a harmonious balance of enhanced sweetness, pronounced milky flavour, and desirable texture according to CATA analysis, whereas higher inclusion levels led to lower acceptance, mainly due to changes in texture and flavour. The findings demonstrated that *C. moschata* puree can be successfully used to produce a nutritious, nutritious and acceptable non-fat drinking yoghurt while supporting value addition and reduction of post-harvest losses.

Keywords: Butternut squash; Check-All-That-Apply; Consumer preference; Drinking yoghurt

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Potential of T*richoderma harzianum* GenBank MZ423064.1 for sustainable mycoprotein production in the food and feed industry

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Abstract:
Fungal protein is gaining traction in the food and feed industries due to the rising demand for sustainable, nutrient-rich alternatives to conventional proteins. In this context, *Trichoderma harzianum* GenBank MZ423064.1, a newly isolated strain from the *Makandawa* Forest Reserve in Sri Lanka, was evaluated for its potential for mycoprotein production. This study aimed to optimize fermentation conditions for enhanced protein production while ensuring safety and functional properties. Aflatoxin production by *T. harzianum* GenBank MZ423064.1 was evaluated using LC-MS/MS, and no aflatoxin was detected (LOD: 1.6 μg kg^{-1}), supporting the safety of strain. Fermentation parameters, including carbon sources (glucose, maltose, sucrose, lactose, galactose, and soluble starch), nitrogen sources (peptone water, yeast extract, ammonium nitrate, and sodium nitrate), pH levels (4, 6, and 8), temperatures (22, 25, and 27 °C), stirring conditions, and incubation time (0-240 hours), were systematically optimized, and protein content was measured using the Kjeldahl method. Maximum extracellular protein production occurred at pH 6, and 27 ^{o}C using maltose and peptone, while optimal intracellular protein production occurred at pH 4 and 22 ^{o}C with soluble starch and ammonium nitrate. Static conditions with 168 hours of fermentation were found to be optimal in both cases. Furthermore, the strain exhibited antibacterial activity against *Bacillus subtilis* (ATCC 6633), *Escherichia coli* (ATCC 8739), *Salmonella* (ATCC 14028) and *Staphylococcus aureus* (ATCC 6538), with the highest inhibition observed against *B. subtilis*. These findings highlight the potential of *T. harzianum* GenBank MZ423064.1 as an efficient source of mycoprotein with potential functional properties, supporting further investigation of its application in food and feed industries.

Keywords: Antibacterial activity; Fermentation optimization; Mycoprotein*; Tricoderma harzianum*; Sustainable protein

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Separation and purification of flavonoids from *Abelmoschus manihot* flowers using D101 resin

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Abstract:
Abelmoschus manihot (L.) Medicus, commonly known as a yellow marshmallow or Huang Shu Kui (HSK) in China, is an annual or perennial plant belonging to the family Malvaceae. With growing recognition of its potential therapeutic properties, there is a pressing need for the development of advanced purification techniques aimed at the isolation and enrichment of flavonoids. This study aimed to develop an efficient method for the separation and purification of flavonoids from the flowers of *A. Manihot*. Initially, the crude ethanol extract was obtained by refluxing the plant material twice with 70% aqueous ethanol. Then crude ethanol extract was analyzed via ultra-high-performance liquid chromatography coupled with quadrupole time of flight tandem mass Spectrometry (UPLC-Q-TOF-MS/MS) in combination with Global Natural Products Social (GNPS) molecular networking. This analysis identified 19 distinct flavonoid compounds. Subsequently, the extract was subjected to fractionation using D101 macroporous resin with gradient ethanol solutions (10, 30, 50, and 70%), which revealed that the 30% and 50% ethanol elution fractions exhibited the highest concentrations of flavonoids. Further purification of these target fractions was achieved through high-speed counter current chromatography (HSCCC) with optimized solvent systems. This multi-step purification process successfully isolated six flavonoid compounds: Kaempferol, Isorhamnetin, Isoquercitrin, Rutin, Myricetin, and Quercetin, as determined by UPLC-Q-TOF-MS/MS analysis. Among them, Kaempferol and Isorhamnetin were isolated for the first time from *A. manihot* flower by D101 resin along with the High-Speed Counter Current Chromatography (HSCCC).

Keywords: *Abelmoschus manihot*; D101 resin; HSCCC; Flavonoids

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Assessing export readiness of the small and medium enterprises in the agriculture sector in Sri Lanka

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Abstract:
This study assesses the level of export readiness of small and medium enterprises (SMEs) in the agriculture sector in Sri Lanka by constructing an export readiness index (ERI). SMEs in the agriculture sector make a major contribution to export revenue, employment creation, and rural economic development. However, many of them encounter difficulties related to entering and sustaining their presence in international markets due to limited export readiness. Primary data were collected using a structured questionnaire survey 90 purposively selected SME exporters in the agriculture sector in Sri Lanka. Secondary data were gathered from the EDB database. Descriptive statistics, the Wilcoxon signed-rank test, and Spearman's correlation analysis were carried out using IBM SPSS Statistics and Microsoft Excel. This research examined the relationships of product factors, organizational, technical and operational factors with the export readiness of SMEs. Results showed that all three categories had significant positive relationships with export readiness. SMEs performed well in terms of product quality, product differentiation, management support, and strategic planning, whereas technical and operational factors, including logistics, digital marketing, and staff training needed to be improvement. Using scores derived from the entropy weighting method, the ERI categorized SMEs into high, medium, and low readiness levels, thereby allowing more effective segmentation of exporters for targeted policies, training, and marketing programs. Furthermore, the study recommendation for SMEs and the EDB to enhance agricultural exports from Sri Lanka.

Keywords: Agricultural SMEs; Export development board (EDB); Export readiness; Export readiness index (ERI); Sri Lanka

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The impact of exchange rate movements on coconut kernel-based product exports in Sri Lanka

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Abstract:
The sudden fluctuation of the exchange rate has been a critical macroeconomic challenge in the Sri Lankan coconut industry, leading to export instability. This study investigated the impact of real effective exchange rate (REER) fluctuations on exports of coconut kernel-based products, such as coconut milk, coconut cream, coconut milk powder, and virgin coconut oil, while examining exporters' awareness and adoption of risk-management practices. This empirical investigation was based on secondary data analysis over the period of 2014 to 2024 and employed augmented dickey-fuller test, johansen cointegration, vector autoregressive model, granger causality tests, and impulse response function to identify short-run dynamic impacts. The results revealed that REER had a significant short-term negative impact on milk powder and virgin oil, although the impact on coconut milk powder become positive after a four-month lag. In contrast, coconut cream and coconut milk exhibited no statistically significant response to REER movements, suggesting relatively inelasticity and strong global demand. A survey of 80 purposively selected exporters showed high awareness of exchange rate risk, with exporter experience, firm size, and foreign market dependence significantly influencing risk perception. Agreement-based contracts, particularly forward agreements, emerged as the most widely practiced hedging tool for mitigating currency exposure. The study concluded that sudden exchange-rate movements affected Sri Lanka's coconut export sector in uneven and product-specific ways, underscoring the need for strengthened institutional support. Establishing a dedicated government-led currency risk management unit and promoting wider adoption of financial hedging instruments would enhance resilience and competitiveness in the coconut export industry.

Keywords: Coconut exportation; Real effective exchange rate; Risk management

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Public perception and communication effectiveness related to Central Bank of Sri Lanka: Trust and institutional credibility in the western province

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Abstract:
This study evaluates public perception and trust towards the Central Bank of Sri Lanka (CBSL), with emphasis on the effectiveness of its communication strategies under the current regulatory framework. The CBSL was recently empowered through the Central Bank Act No. 16 of 2023, ensuring transparency and accountability. In this context, the general public has emerged as a critical stakeholder segment to whom the Central Bank must be accountable. However, CBSL lacks a clear strategy for effectively engaging this non-expert community. To address this gap, an exploratory research design was adopted, using stratified sampling techniques. Data were collected from 400 respondents across the Western Province through a structured questionnaire, supplemented by qualitative insights from interviews. Both qualitative and quantitative analysis were conducted using R 4.5.1. The findings indicate that general public holds significantly positive perceptions and trust in CBSL (P = 0.001). Furthermore, Spearman's correlation analysis revealed a significant positive relationship between these two variables (P = 0.001). Ordinal logistic regression analysis confirms that perception was a significant predictor of trust, with variations in trust levels observed across demographics characteristics. This study highlights the importance of strengthening CBSL's communication as a key factor with public trust and perception. Communication effectiveness assessed using exploratory factor analysis, revealed gaps in clarity, transparency, and language simplicity despite its perceived usefulness. Furthermore, SEM suggests sequential pathway from communication effectiveness → perception → usefulness → trust → satisfaction. Overall, this study provides evidence-based insights for CBSL to strengthen institutional credibility and public trust through more effective communication strategies.

Keywords: Central Bank of Sri Lanka; Communication effectiveness; Public perception; Trust; Institutional credibility

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Adoption and effectiveness of drip irrigation systems among smallholder chili farmers in *Vavuniya* District: a case study of the Agriculture Sector Modernization Project

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Abstract:
Drip irrigation has been widely recognized as a climate-smart agricultural practice to improve water use efficiency and crop productivity in water-scarce regions. However, its continued use among smallholder farmers remains a challenge despite government support programs. Accordingly, this study assessed the adoption and effectiveness of drip irrigation among smallholder chili farmers in the *Vavuniya* District under the Agriculture Sector Modernization Project (ASMP). Primary data were collected using a pre-tested structured questionnaire from 80 chili farmers in four purposively selected Grama Niladhari divisions in the *Omanthai* area with 20 farmers from each division selected through simple random sampling. The collected data were analyzed through descriptive statistics and Partial Least Squares Structural Equation Modeling. The results revealed that perceived usefulness significantly influenced farmers' attitudes toward drip irrigation ($\beta = 0.521$, $P < 0.05$), while perceived ease of use positively affected their intention to continue using the technology ($\beta = 0.463$, $P < 0.05$). The adoption of drip irrigation improved farm performance resulting in 65% increase in chili yield, more than a 100% increase in seasonal income, a 69% reduction in water use, and a 51% reduction in labor requirements. Despite these benefits, high maintenance costs and limited technical knowledge were identified as major barriers to the continued use of drip irrigation. The study highlights the importance of continuous technical support, farmer training, and affordable maintenance services to ensure the long-term sustainability of drip irrigation systems. The findings also provide useful insights for policymakers and agricultural development agencies to strengthen climate-smart agriculture through improved extension services, capacity building, and improved access to drip irrigation technologies.

Keywords: Agricultural modernization; Chili cultivation; Drip irrigation; Smallholder farmers; Technology adoption

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Export competitiveness and exporter constraints in Sri Lanka's coconut sector

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Abstract:
Exporter-level constraints play a critical role in shaping export performance and competitiveness, particularly in developing economies. This study assesses the export competitiveness and market potential of nine coconut kernel-based products in Sri Lanka, with particular emphasis on the constraints faced by exporters and their policy implications. Primary data were collected through a structured questionnaire using Likert-scale measures among coconut exporters to identify key challenges affecting export performance and market expansion. These insights were complemented by secondary data analysis using the revealed symmetric comparative advantage index and the autoregressive integrated moving average model over the period 2005–2024. The findings reveal that exporters face significant constraints, including high export costs, supply chain instability, exchange rate volatility, regulatory barriers, logistical inefficiencies, and limited capacity for product diversification. These challenges directly undermine competitiveness and restrict market expansion. Consistent with these findings, secondary analysis indicates that while desiccated coconut remains highly competitive, it shows a declining trend. In contrast, value-added products such as virgin coconut oil, coconut milk powder, liquid coconut milk, coconut cream, and coconut flour demonstrate strong and increasing levels of competitiveness, driven by growing global demand for health-oriented and plant-based products. The results highlight several critical policy priorities. Addressing cost inefficiencies, improving trade facilitation, strengthening raw material supply systems, and enhancing financial risk management are essential. Furthermore, promoting value addition, investing in innovation, improving logistics infrastructure, and expanding into new markets are key to sustaining long-term growth. Overall, a coordinated policy framework is required to enhance resilience, competitiveness, and diversification in Sri Lanka's coconut export sector.

Keywords: Export barriers; Market diversification; Export competitiveness; Likert scale; Value addition

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Determination of hydraulic properties and the water repellency index in sandy soils

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Abstract:
Soil water repellency (SWR) is a phenomenon in sandy soils that restricts water infiltration, reduces soil moisture availability, and disrupts uniform wetting patterns. It is often caused by organic coatings on soil particles. The water repellency index (RI) is one of the parameters used in estimate the magnitude of SWR, and it explains the sorptivity of water in soil compared with that of a completely wetting liquid such as an alcohol. Generally, ethanol has been used as the completely wetting liquid to measure the RI, but its environmental impact and volatility have prompt the evaluation of alternative alcohols. This study aims to assess the efficiency and possibility of using other short-chain alcohols to estimate RI, using butanol and 2-propanol as alternative alcohols with a series of water-repellent sandy soils. Water-repellent and wettable coastal dune sands were collected from the Hambantota District in Sri Lanka under a *Casuarina equisetifolia* shelterbelt. A series of 12 soil mixtures with different repellency levels was prepared. Sorptivity measurements were obtained using a mini disk infiltrometer with water, ethanol, butanol, and 2-propanol. Statistical analyses were performed to evaluate the correlations between conventional ethanol-based RI and values derived from butanol and 2-propanol. Both showed strong, significant correlations with the ethanol-based RI (butanol: $R^2 = 0.97$; 2-propanol: $R^2 = 0.91$; $P < 0.05$), confirming their suitability as reliable alternatives for RI estimation and highlighting the influence of SWR on hydraulic behavior.

Keywords: Contact angle; Infiltration rate; Soil water repellency; Sorptivity; Water repellency index

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Effects of water repellency levels induced by organic amendments on water stability and carbon retention of model soil aggregates

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Abstract:
Global population growth has increased the demand for food, leading to a rising need for sustainable approaches to food production. Container gardening in urban areas is a self-sustaining growing method that is attracting increasing interest. To address issues such as the rapid decomposition of organic matter (OM) in potting media, developing a sustainable, long-lasting, aggregated potting medium would be useful. This study examined the impacts of water repellency (WR) induced by organic amendments (OAs) of varying WR levels on water stability (WS) and carbon retention (CR) of model aggregates developed as a potting medium. Soil was amended with six OAs: plant-based (gliricidia, mahogani, and casuarina leaf material) and animal-based (goat and cattle manure and compost). Aggregates were prepared by mixing 85% soil with 15% OAs. Prepared aggregates were incubated under laboratory conditions for 15 weeks. The WR was measured using the water drop penetration time and sessile drop method, and WS of aggregates was determined using wet sieving. The OM content was determined using the loss-on-ignition and the Walkley-Black methods. Measurements were recorded at weekly intervals. Among the OAs, plant-based OAs showed the highest WR, and the WR of aggregates decreased over time. WS was about 95-100% in most aggregates, compared to 80% in the control without OAs. Compost had the lowest WS at 65-80%. Plant-based OAs showed the highest CR at 82-92%, while compost showed a CR of 43%. WR had a moderate positive correlation with WS and a weak positive correlation with CR. Overall, WR induced by OAs improved WS and CR in aggregates.

Keywords: Carbon retention; Organic amendments; Potting media; Water repellency; Water stability

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UAV-based multispectral indices for non-destructive polyphenol estimation in fresh tea leaves (*Camellia sinensis*)

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Abstract:
Polyphenols in tea (*Camellia sinensis*) are critical determinants of quality, flavour, and health benefits. Conventional assessment methods, including sensory evaluation and chemical analysis, are time-consuming, destructive, and require specialized expertise. This study evaluated the potential of UAV-based multispectral imaging to estimate polyphenol content in fresh tea leaves. Fifty georeferenced leaf samples were collected from a single-cultivar TRI 4049 plantation at Moragalla Tea Estate, Galle, Sri Lanka. Multispectral images were acquired using a DJI Phantom 4 Multispectral drone at a flight altitude of 20 m, producing high-resolution imagery (approximately 1 cm ground sampling distance) under clear-sky conditions between 10:00 am and 2:00 pm, using blue, green, red, red-edge, and near-infrared bands. Polyphenol content was quantified using the Folin-Ciocalteu method. Vegetation indices were derived and evaluated using linear regression analysis. Among all tested indices (NDVI, NDRE, CIG, SAVI and GNDVI), GNDVI (R^2 = 0.763, RMSE = 3.34) was identified as the most reliable predictor. The strong performance of GNDVI is likely due to its sensitivity to chlorophyll and nitrogen status, which are closely associated with polyphenol accumulation. UAV-based multispectral imaging offers a rapid, non-destructive approach to monitoring tea quality, supporting improved harvesting and management decisions. The findings are limited to a single cultivar and a single study location. Future work should integrate multi-temporal data and advanced modeling techniques.

Keywords: Multispectral imaging; Tea polyphenol content; UAV remote sensing; Vegetation indices

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Design and development of an AI-based autonomous robotic system for papaya latex extraction

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Abstract:
Papaya (*Carica papaya* L.) is an economically important tropical crop valued for its latex, which contains the proteolytic enzymes papain and chymopapain which are widely used in the food, cosmetic, and pharmaceutical industries. In Sri Lanka, papaya latex extraction is predominantly performed manually, requiring skilled labor and early morning harvesting. These practices are labor-intensive, time-consuming, and increasingly unsustainable due to rising labor costs and workforce shortages. Therefore, this study developed and evaluated an AI-enabled autonomous robotic system integrating computer vision and precision scraping for automated papaya latex extraction. The developed system integrates an ESP32-CAM for real-time image acquisition, an Edge Impulse-trained AI model for fruit maturity detection, and a robotic arm mounted on a linear motion platform controlled by an Arduino microcontroller. A custom-designed scraping tool maintained a target incision depth of 2 mm and 1 cm and a spacing between incisions, ensuring uniform latex extraction. The AI model achieved a training accuracy of 96.2%, a validation accuracy of 92.1%, and an F1 score of 0.89. Prediction confidence scores ranged from 0.60 to 0.99, with a classification threshold of 0.65 for reliable maturity identification. The highest fruit detection accuracy (92%) was achieved at a camera-to-fruit distance of 20 cm. Mechanical evaluation of 10 fruits demonstrated that the robotic system achieved incision depths (1.85 ± 0.24 mm) that were significantly closer to the target depth range of 1.5–2.0 mm than those obtained by manual extraction (3.60 ± 0.70 mm; $P < 0.001$). The robotic system produced a significantly higher latex yield (47.2 ± 3.99 mL) than manual extraction (37.3 ± 3.23 mL), while maintaining more consistent scraping times (6.17–8.90 s). These findings demonstrate that AI-based vision and robotic control can effectively automate papaya latex extraction, improve yield, consistency, and operational efficiency while offer a scalable solution for agricultural automation in Sri Lanka.

Keywords: Agricultural automation; Autonomous robotic hand; Computer vision; Edge Impulse; ESP32-CAM; Fruit maturity detection; Papaya latex extraction

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Integrating agrivoltaic systems in tea cultivation: Effects of shading and LED supplementation on growth, yield and quality

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Abstract:
Rising renewable energy demands and the widespread use of agricultural land have highlighted the importance of integrated land-use strategies such as agrivoltaics. While agrivoltaic systems have shown considerable potential in diverse agricultural settings, their effects on perennial plantation crops, particularly tea, remain underexplored, especially under tropical climatic conditions. This study evaluated the impact of agrivoltaic shading and blue-red LED grow light supplementation on the growth, yield, and quality of tea plants cultivated in Sri Lanka. A six-month field experiment was conducted in Hantana, Kandy, using a randomized complete block design with three treatments: tea grown under agrivoltaic panels without light supplementation, tea grown under agrivoltaic panels with LED supplementation, and conventional open-field tea cultivation with each treatment replicated three times. Statistical analysis was performed using ANOVA to determine significant differences among treatments. Key growth and productivity parameters, including yield, shoot density, and leaf area, were assessed, along with selected biochemical quality indicators such as polyphenol and total catechin contents. The results indicated that, compared with traditional open-field tea cultivation, yield decreased by 35.35% under agrivoltaic shading and 30.83% with LED supplementation, while shoot density declined by 39.34% and 34.94%, respectively. Leaf area was minimally affected with reductions of 4.92% and 2.63% respectively. In contrast, the polyphenol content did not differ significantly between tea cultivated under agrivoltaic panels without LED supplementation and conventional open-field conditions, whereas total catechin content was significantly higher under open-field cultivation. Caffeine and epigallocatechin gallate concentrations were generally higher in tea grown under the agrivoltaic system with LED supplementation, suggesting that modified light environments may influence specific biochemical pathways associated with secondary metabolite accumulation. This study demonstrates that agrivoltaic systems, when integrated with appropriate supplementary light management strategies, represent a promising technology for tea cultivation. With further optimization, such systems could enhance land-use efficiency while supporting sustainable tea production by enabling the simultaneous generation of renewable energy and agricultural production.

Keywords: Agrivoltaics; LED grow light supplementation; Photovoltaic shading; Sustainable land use

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Integrating UAV multispectral vegetation indices with machine learning for accurate block-level tea yield forecasting in the Low Country of Sri Lanka

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Abstract:
Accurate tea yield forecasting is critical for precision plantation management. It enables efficient harvest scheduling and resource allocation, particularly in Low Country tea-growing regions of Sri Lanka. To address this challenge, UAV-derived multispectral vegetation indices were integrated with machine learning models to develop an accurate framework for block-level tea yield forecasting in Low Country tea plantations. Multispectral UAV imagery and corresponding block-level fresh tea yield data were acquired from nine tea plantation blocks over four consecutive harvest cycles at the Moragalla Tea Estate, Imaduwa, Sri Lanka. Vegetation indices derived from multispectral UAV imagery, including NDVI, SAVI, EVI, TVI, and VARI, were used as input features for six machine learning models: RF, XGBoost, SVM, ANN, DT, and LR. The models were trained and tested using block-level fresh tea yield observations, and model performance was subsequently evaluated. The dataset was randomly divided into training (70%) and testing (30%) sets using a random seed (set.seed(123)) to ensure reproducibility. The training data were used to train machine learning models, and the models were evaluated on the independent testing data. Model performance was assessed using the coefficient of determination (R^2) and the root mean square error (RMSE). The predictive approach was evaluated using vegetation indices derived from UAV images captured immediately before harvest. The NDVI-based XGBoost model produced the highest predictive performance among all tested models (R^2 = 0.78, RMSE = 27.78 kg/block). The superior performance of the NDVI-based models highlights the effectiveness of UAV-derived spectral information for improving tea yield forecasting. These findings demonstrate the potential of machine-learning-driven approaches to enhance precision management in Low Country tea plantations.

Keywords: Machine learning; Multispectral imaging; Precision agriculture; Tea yield forecasting; Unmanned aerial vehicle (UAV); Vegetation indices

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Quantifying blue carbon stocks in reef–lagoon seagrass meadows of Adukkuparu, Trincomalee, Sri Lanka: Insights and field-based challenges

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Abstract:
Seagrass meadows are significant carbon sinks, storing substantial amounts of carbon in their sediments and thereby contributing to climate change mitigation. Despite their ecological importance, blue carbon stocks in South Asian reef–lagoon seagrass ecosystems remain inadequately quantified. Therefore, this study aimed to quantify organic carbon stocks in the seagrass beds along the northeast coast of Sri Lanka and document the key field–based challenges. Vegetation and soil to a depth of 100 cm were sampled at two sites within the Adukkuparu area of Trincomalee District. Sediment organic carbon stocks in each 5 cm interval were estimated using the loss–on–ignition method with a carbon conversion factor. The mean total sediment carbon stock was 79.86 ± 29.53 Mg C ha^{-1} down to a depth of 100 cm. Biomass carbon stock of the three seagrass species was 0.06 ± 0.03 Mg C ha^{-1} for *Thalassia hemprichii*, 0.11 ± 0.07 Mg C ha^{-1} for *Cymodocea rotundata*, and 0.07 ± 0.04 Mg C ha^{-1} for *Oceana serrulata*. The findings of this study provide valuable information for regional carbon assessments in reef–lagoon seagrass ecosystems and for assessing their potential role in climate change mitigation. Sediment collection to a depth of 100 cm was substantially hindered by the hard substrate, highlighting the need for a specialized methodological framework for blue carbon studies in reef–lagoon environments.

Keywords: Blue carbon; Reef–lagoon ecosystem; Sediment organic carbon; Seagrass meadows; Sri Lanka

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Development of an efficient *in vitro* propagation protocol for large-scale multiplication and conservation of *Salacia reticulata* (Kothalahimbutu)

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Abstract:
Salacia reticulata (Kothalahimbutu) is an important medicinal plant. Its large-scale cultivation is limited by low efficiency of conventional propagation methods. This study aimed to develop an optimized *in vitro* micropropagation protocol. A total of 210 nodal segments were surface sterilized with 15% Clorox solution for 10 minutes and cultured on full-strength Murashige and Skoog (MS), half-strength MS (½ MS), and Woody Plant Medium (WPM). Among the tested media, WPM resulted in the highest explant survival rate (89%), which was significantly higher compared with other media treatments ($P < 0.05$). Since tissue browning due to phenolic oxidation was a major challenge during explant establishment, the effects of ascorbic acid and citric acid (50, 100, and 150 mg L^{-1}) were evaluated. Supplementation with 100 mg L^{-1} ascorbic acid effectively reduced browning and significantly improved explant establishment ($P < 0.05$). Successfully established explants were transferred to WPM supplemented with different cytokinin–auxin combinations for shoot proliferation: T1 (1.5 mg L^{-1} BAP + 0.5 mg L^{-1} IBA), T2 (1.5 mg L^{-1} BAP + 0.5 mg L^{-1} IBA + 1.0 mg L^{-1} kinetin), T3 (2.0 mg L^{-1} BAP + 0.5 mg L^{-1} IBA), and T4 (2.0 mg L^{-1} BAP + 0.5 mg L^{-1} IBA + 1.0 mg L^{-1} kinetin). Among these treatments, T2 showed the highest shoot multiplication response ($P < 0.05$), producing approximately 10 shoots per explant with a maximum shoot height of 5.3 cm after 10 weeks of culture. The regenerated shoots were subsequently transferred to rooting media containing different concentrations of IBA (0.5, 1.0, 1.5, and 2.0 mg L^{-1}) supplemented with 0.1 mg L^{-1} BAP, and rooting experiments are currently in progress to determine the optimum concentration for root induction. The completed experiments were analyzed using a completely randomized design, and treatment means were compared using duncan's multiple range test with SAS statistical software. The optimized protocol developed in this study provides an efficient approach for rapid multiplication, commercial propagation, and *ex situ* conservation of *S. reticulata*.

Keywords: Kothalahimbutu; Medicinal plants; Nodal culture; *Salacia reticulata*; WPM

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Optimization of an *in vitro* propagation protocol for efficient mass production of *Murraya koenigii* (l.) Spreng. plantlets

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Abstract:
Murraya koenigii (L.) Spreng. (curry leaf) is an important medicinal and aromatic plant widely valued for its nutritional and therapeutic properties. However, conventional propagation methods limit the large-scale production of uniform and healthy planting material. This study aimed to develop an efficient *in vitro* propagation protocol for rapid multiplication of *M. koenigii* using previously established nodal explants cultured on Murashige and Skoog (MS) medium. Shoot proliferation was evaluated using MS medium supplemented with different concentrations of 6-benzylaminopurine (BAP; 2.0, 2.5, and 3.0 mg L^{-1}) combined with 0.5 mg L^{-1} α-naphthaleneacetic acid (NAA) in a completely randomized design with 20 replicates. After eight weeks of culture, BAP concentrations of 2.5 and 3.0 mg L^{-1} significantly enhanced shoot multiplication compared with that at 2.0 mg L^{-1} BAP ($P < 0.05$), while no significant difference was observed between the two higher concentrations ($P > 0.05$). Considering resource efficiency and practical applicability, MS medium supplemented with 2.5 mg L^{-1} BAP and 0.5 mg L^{-1} NAA was selected as the optimal treatment for shoot multiplication. Proliferated shoots were subsequently evaluated for rooting response under nine different rooting treatments consisting of full-strength and half-strength MS media supplemented with varying concentrations of indole-3-butyric acid (IBA) and indole-3-acetic acid (IAA), with or without activated charcoal. The addition of activated charcoal significantly improved root induction and development ($P < 0.05$). Among the tested treatments, T5 (full-strength MS + 0.75 mg L^{-1} IBA + 0.25 mg L^{-1} IAA) and T8 (half-strength MS + 0.75 mg L^{-1} IBA + 0.25 mg L^{-1} IAA) produced the highest number of roots and greatest root lengths, with no significant difference between them ($P > 0.05$). Considering cost-effectiveness and commercial feasibility, T8 was selected as the optimal rooting treatment. The optimized regeneration protocol provides an efficient and reproducible system for the rapid multiplication and large-scale production of elite *M. koenigii* planting materials, thereby contributing to the commercial cultivation and conservation of this valuable medicinal plant.

Keywords: Curry leaf; *In vitro* regeneration; *Murraya koenigii*; Micropropagation; Nodal culture

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Enhancing efficiency and yield of *Schizophyllum commune* through electric and acoustic stimulation

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Abstract:
Commercial cultivation of S*chizophyllum commune* Fr., a cosmopolitan edible and medicinal macrofungus with documented bioactive properties, is constrained by inconsistent fruiting body development and suboptimal yields. This study evaluated the efficacy of selected physical stimulation techniques, including mild electrical stimulation, acoustic stimulation, and different light qualities, on the mycelial growth kinetics, fruiting body morphology, and yield parameters of S. *commune* under controlled cultivation conditions. Treatments comprised individual applications of mild electrical stimulation (12 V DC), acoustic stimulation (75 dB), and narrow-spectrum illumination (blue and white LEDs at 1500 lux), alongside combined electrical stimulation at graduated voltages (12V, 16V, and 20V DC) paired with acoustic stimulation (75dB). An untreated control was also included. Key response variables included mycelial colonization rate, time to pinhead emergence, time to first harvest, pileus diameter, total fresh yield, and biological efficiency. Physical stimulation significantly influenced all growth and yield parameters relative to control. Individually, the 12 V electrical stimulation was the most effective treatment, achieving the fastest colonization rate (1.096 cm day^{-1}), the shortest time to first harvest (25.6 days), the largest pileus diameter (3.47 cm), the highest individual yield (2.82 g), and the highest biological efficiency (1.67%). Acoustic treatment alone accelerated pinhead emergence to 2.2 days. The synergistic combination of a 12 V electrical stimulation with 75dB acoustic stimulation produced the highest overall yield (3.195 g) and a biological efficiency of 1.28%. These findings demonstrate that targeted physical stimulation can substantially enhance *S. commune* cultivation efficiency. Future research should focus on underlying physiological, molecular mechanisms, refining application parameters, and validating outcomes under commercial production conditions.

Keywords: Acoustic stimulation; Biological efficiency; Fruiting body development; Mycelial colonization

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Comparative efficacy of six Sri Lankan cinnamon bark hydrosols in controlling post-harvest anthracnose of banana (var. Ambul)

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Abstract:
Banana anthracnose caused by *Colletotrichum musae,* is one of the major post-harvest diseases affecting banana fruits and reducing their quality and shelf life. This study was conducted to evaluate the antifungal activity of cinnamon bark hydrosols obtained from six Sri Lankan cinnamon accessions (66B, 64B, 60B, 59B, 58B, and 49B) under *in vitro* and *in vivo* conditions. The study aimed to compare the antifungal efficacy of different cinnamon accessions, identify the most effective hydrosol concentration for disease control, and evaluate the effect of treatments on banana fruit quality. *Colletotrichum musae* was isolated from infected banana fruits and cultured on potato dextrose agar. The *in vitro* antifungal activity was tested using hydrosol concentrations of 5.66%, 9.09%, and 12.28%. Inhibition of radial mycelial growth was recorded and analyzed using two-way ANOVA under a completely randomized design with four replicates. Spore germination was evaluated under 50% and 100% hydrosol treatments using a factorial completely randomized design with six replicates, and the data were analysed using the Friedman test. For the *in vivo* experiment, artificially inoculated 'Ambul' banana fruits at the colour breaking stage were treated with selected cinnamon bark hydrosols and stored under ambient conditions (27 °C). Fruits were treated with 50% and 100% hydrosol solutions, and lesion diameter was measured on the 5th, 6th, and 7th days after treatment to assess disease development. The data were analysed using repeated-measures ANOVA. Organoleptic and physicochemical properties of treated and untreated banana fruits were also evaluated. Among the tested accessions, hydrosol from accession 66B at 9.09% concentration showed the highest inhibition of mycelial growth and spore germination of *C. musae*. The i*n vivo* results showed that the 50% hydrosol treatment significantly reduced lesion development ($P < 0.05$) without causing visible damage to the banana peel. In addition, treatment with hydrosol from accession 66B did not significantly affect ($P > 0.05$) the organoleptic or physicochemical properties of 'Ambul' banana fruits compared with the untreated control. The results of this study indicate that cinnamon bark hydrosol obtained from accession 66B has potential as an eco-friendly method for controlling post-harvest anthracnose of banana while maintaining fruit quality.

Keywords: Anthracnose; Banana; Cinnamon bark hydrosol; *Colletotrichum musae*; post-harvest management

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International Symposium on Agriculture and Environment (ISAE) 2026

Three-Minute Industrial Training Session (3MIT)

Keynote Speech

Agriculture in the Age of AI: How Young Professionals Can Drive Innovation, Sustainability, and Meaningful Impact

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Agriculture remains one of the most important sectors of Sri Lanka's economy, supporting rural livelihoods, strengthening food security, and contributing to national development. However, despite its significance, the sector continues to face persistent challenges. Farmers struggle with unpredictable weather patterns, climate-related disasters, rising production costs, limited access to timely information, post-harvest losses, market inefficiencies, and declining interest among younger generations. As these challenges continue to grow, the need for innovative and sustainable solutions has never been greater.

At the same time, Sri Lanka is experiencing an unprecedented opportunity. Advances in artificial intelligence, data analytics, satellite technologies, digital platforms, and automation are transforming industries across the world. In agriculture, these technologies are enabling more accurate decision-making, improving resource efficiency, supporting climate adaptation, and helping farmers become more productive and resilient. What was once accessible only to governments, research institutions, and large corporations is now increasingly available to students, researchers, entrepreneurs, and young professionals.

The future of agriculture in Sri Lanka will not be determined solely by new technologies. It will be shaped by the people who choose to apply those technologies to solve real-world challenges. Whether it is reducing post-harvest losses, improving farmer incomes, predicting crop diseases, optimizing irrigation, connecting farmers to markets, or strengthening climate resilience, opportunities for innovation exist throughout the agricultural value chain. The challenge for the next generation is to identify these opportunities and transform them into practical solutions that create meaningful impact.

Sri Lanka's recent history also demonstrates an important lesson for the next generation: some of the greatest opportunities emerge during periods of uncertainty and disruption. Economic crises, climate-related disasters, supply chain disruptions, food shortages, and resource constraints have exposed vulnerabilities within the agricultural sector, but they have also highlighted areas where innovation is needed most. Challenges such as fertilizer shortages, water scarcity, market inefficiencies, labour constraints, and extreme weather events should not be viewed solely as risks. They should be viewed as signals pointing towards opportunities for new ideas, technologies, business models, and research. Many of the world's most successful innovations were born in response to a problem that demanded a different way of thinking. For young professionals, the ability to identify opportunities hidden within challenges will be a critical skill in the age of AI. Those who learn to observe problems closely, understand their root causes, and apply emerging technologies creatively will not only build successful careers but also contribute to transforming Sri Lanka's agricultural sector into one that is more productive, resilient, sustainable, and globally competitive.

Drawing on experiences from digital agriculture initiatives such as Govi Mithuru, one of Sri Lanka's largest agricultural advisory platforms, as well as broader work in digital innovation, sustainability, and inclusion, this keynote will explore how technology can be used to empower communities, improve livelihoods, and accelerate sustainable development. It will demonstrate

how simple ideas, when combined with technology and a clear understanding of real-world problems, can create solutions that benefit thousands of people.

Many of the most impactful innovations do not begin in laboratories or boardrooms. They begin with someone observing a problem, asking questions, and taking action. In a world where AI can generate answers in seconds, the real differentiator is the ability to ask better questions, identify overlooked opportunities, and connect knowledge across disciplines. Sri Lanka's agricultural transformation will require more than technology. It will require a new generation of innovators, researchers, entrepreneurs, and changemakers who are willing to step beyond traditional career paths and apply their skills where they are needed most. The future of agriculture is no longer limited to farming alone. It encompasses data science, sustainability, climate action, entrepreneurship, product innovation, artificial intelligence, and digital transformation.

The next breakthrough that improves the lives of Sri Lankan farmers may not come from a multinational corporation or a research institution. It may come from a student sitting in the audience today who observes a challenge, embraces an opportunity, and chooses to act.

The key message for young professionals is simple: Observe everything. Stay curious. Take every opportunity. In the age of AI, success will not be defined by access to technology, but by the ability to observe challenges, recognize opportunities, and act with purpose. Every challenge in agriculture presents an opportunity for innovation. Young professionals who remain curious, embrace lifelong learning, and step beyond their comfort zones can transform risks into opportunities and ideas into meaningful impact for Sri Lankan agriculture.

Keywords: Agriculture; Artificial Intelligence; Digital Agriculture; Innovation; Sustainability; Sri Lanka; Youth Leadership

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AmSafe Bridport (Pvt) Ltd

A.R.A. Rodrigo

AmSafe Bridport (Pvt) Ltd is a global leader in engineered textile solutions for the aerospace and defense industries. Industrial training was taken in the Sales Department's Cargo Team, providing hands-on experience with the Syteline ERP system for order management, shipment forecasting, and coordination between production and logistics into manufacturing process of airframe and fire protection products. The training enhanced professional communication, problem-solving, and data management skills, while involvement in weekly shipment tracking and material availability reporting contributed to improve operational efficiency. The experience also provided a comprehensive understanding of global supply chain operations and the stringent safety standards applicable to the aviation sector.

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Amsafe Bridport (Pvt) Ltd

K.L.B. Nipunika

Industrial training was undertaken in the Sales Administration Department of Amsafe Bridport Pvt Ltd, a global manufacturer of aerospace safety equipmentproviding an opportunity to apply agribusiness knowledge within the aerospace sector. During the training support was to sales managers in documentation and forecasting activities for international clients, including Airbus partners. Customer interactions enhanced communication and professional language skills, while broadening knowledge of international trade, niche market and the economic significance of foreign direct investment. Participation in a corporate social responsibility CSR project, and the developed of an Excel-based tracking system further strengthened data management and analytical skills. The successful completion of the training also resulted in an offer of permanent employment as a Sales Administration Executive.

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Noyon Lanka (Pvt) Ltd

W.T. Dinuprabha

Noyon is a world-leading warp-knitted lace manufacturing company belonging to MAS Holdings. I did my internship in the Human Resources department's Sustainability team. I gained knowledge of environmental sustainability, including circular economy practices in production and waste management, and maintained the GRS Standard within the company by conducting employee training. I worked with ISO 140001; the company won one Merit Award from NCPC and one Gold Award from SLAAQP. For this, the company's top management praised my contribution. I enhanced my soft skills through event compering, and finally, I earned recognition from the CEO as Noyon's compering lady.

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CAP Organic (Pvt) Ltd

A.W.S. Madhumali

I completed my industrial training at CAP Organic (Pvt) Ltd, a well-recognized organic beverage processing company in Sri Lanka. During this training period, I gained hands-on experience in production operations, quality control procedures, inventory management, and factory documentation systems. I was involved in inspecting products, identifying and removing damaged items, managing semi-finished stock, and updating Excel records to maintain accurate data. I also assisted with labeling, sampling, and stock transfers while ensuring proper documentation and traceability. In addition, I supported internal activities such as organizing employee training programs and preparing operational reports related to fuel usage, refreshment costs, and stock movements. Beyond technical knowledge, this internship provided me with valuable experience by teaching me responsibility, workplace discipline, adaptability, and professional ethics. Through these responsibilities, I developed teamwork, communication, and problem-solving skills while gaining a clear understanding of factory workflow, quality standards, and cost-control practices. This industrial training strengthened my professional confidence and prepared me for a successful career in the agribusiness and food-processing industries.

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Pelwatte Dairy Industries Ltd

A.D. Samarawickrama

I completed my industrial training at Pelwatte Dairy Industries (Pvt) Ltd. in the Quality Assurance Department. During this period, I conducted two major projects: a root cause analysis (RCA) of contaminated set yoghurt using the fishbone, 6M, and 6 Why methods, and development of a HACCP plan following its seven principles. I gained hands-on experience in microbiological and chemical testing, ISO 22000 and FSSC 22000 documentation, Halal audits, and internal audits. Additionally, I developed practical skills in data analysis, critical thinking, problem-solving, teamwork, and communication while gaining comprehensive knowledge of dairy processing, utility systems, laboratory practices, and overall quality management systems.

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Ceylon Grain Elevators PLC

S.A.R. Kavindhya

Ceylon Grain Elevators PLC (CGE) is a leading feed manufacturing and poultry business in Sri Lanka. I had the opportunity to train in the microbiology laboratory, Chemical laboratory and postmortem laboratory. I gained experience in microbiological testing in poultry production, chemical testing in the feed manufacturing and poultry disease identification for the health optimization and economic sustainability of the production system. I was able to understand the complexity of practical work, the importance of teamwork in meeting deadlines and developing up my personality to face challenges. They were satisfied with my work and appreciated my contributions as an intern.

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CIC Agribusiness Unit (CIC Seed Farm, Pelwehera)

R.A.D.Y. Ranaweera

CIC Seed Farm, Pelwehera, is a leading agricultural service and input supply enterprise. I worked across the seed paddy processing unit, rice and vegetable R&D units, vegetable seed processing unit, soil, plant and water analytical laboratory, seed testing laboratory, highland project, and quality banana division. I gained hands-on experience in hybrid and breeder seed production procedures, rice quality testing, poly-tunnel cultivation, integrated pest management, and field-to-packhouse operations of TEJC mango, Cavendish banana, and hybrid coconut. Additionally, I strengthened my skills in labor supervision, adaptability, and problem-solving, and presented innovative proposals on banana-waste liquid fertilizer production and thrips management strategies for chili cultivation.

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Guizhou University, Guiyang, China

K.A.K. Dilrangi

During my internship at Guizhou University, China, I specialized in plant disease diagnosis within the laboratory of Plant Pathology and the State Key Laboratory of Green Pesticides. I managed a complete scientific workflow, from field sampling and pathogen isolation to molecular identification using PCR and phylogenetic analysis. Notably, I identified a novel disease-causing variety within the *Nigrospora* species. Beyond the lab, I engaged with global research trends at the 5th International Conference on Mountainous Agriculture. My technical contributions were highly valued, and I was subsequently invited to pursue doctoral studies, marking an important step in my career in global agricultural research.

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Board of Investment – Katunayake: Environment Management Department

N.W.M.E.S. Navarathne

The Board of Investment (BOI) of Katunayake is the first and largest export processing zone in Sri Lanka. I hadthe opportunity to train in the Environmental Management Department. I gained practical experience in wastewater and drinking water quality assessment, waste management practices, and working environment monitoring within industrial settings.I also participated in factory inspections, and report preparation. I developed communication skills by working closely with staff members and employees. I also faced some difficulties in laboratory due to the technical complexity of the work. However, I gained hands-on experiences while enhancing the department's ability to assess environmental compliance.

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Weehena Farms

P.H.H.K. Hewage

Weehena Farms is a well-recognized enterprise committed to high-quality production standards in the Sri Lankan poultry industry. During my internship program, I was involved with Quality Department. I gained practical experience in poultry production, waste disposal, audit compliance activities, test sample collection, maintaining quality-related documents, safety training and employee welfare programs. In addition, I developed teamwork skills and the ability to work in dynamic environments by handling conflict situations. As a further improvement, I proposed the establishment of a hatchery unit which is highly needed for the company's future developmens. This hard work provided me with an opportunity to contribute to the organization.

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Synapse Solutions (Pvt) Ltd

H.M.S. Kavinda

This internship was carried out at Synapse Solutions (Pvt) LTD, an innovative technology company specializing in telecommunications, enterprise systems, SaaS platforms, and automation solutions. I joined as a Software Engineer Intern and gained hands-on experience in real-world software development using Java Spring Boot, Angular, MySQL, and Linux environments. My responsibilities included developing backend services for PBX software, building responsive UI components, integrating APIs, performing production updates, and managing servers. I collaborated with senior developers and participated in client meetings, strengthening my communication and teamwork skills. This experience enhanced my problem-solving ability, adaptability, time management, and professional responsibility while contributing to system stability, performance optimization, and documentation within an enterprise environment.

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Sri Lanka Institute of Nanotechnology (SLINTEC)

A.A.P.M. Amarasinghe

Sri Lanka Institute of Nanotechnology (SLINTEC) is a leading national R&D center in nanotechnology, where I trained in its agriculture section. I gained laboratory experience by contributing to research projects on improving vegetable crispiness, seed priming, granular fertilizer formulation and biochar modification. Meanwhile, I gained experience with advanced analytical equipment including FTIR, BET analyzer, SEM, UV-Vis spectrophotometry etc. By developing teamwork, I worked in a multidisciplinary research environment and strengthened my professional ethics by maintaining research data confidential. Furthermore, I proposed a sustainable, climate-resilient crop improvement project, which impressed the research team and allowed me to initiate it as a novel side project.

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Unilever Sri Lanka

A.D. Liyanage

I completed my internship at Unilever Sri Lanka, a leading multinational FMCG company, as a Customer Strategy & Planning Intern in the Skin Cleansing category. During this time, I worked closely with globally recognized brands such as Lifebuoy, Lux, Pears, Rexona, and Dove. I gained valuable experience in market analysis, demand forecasting, promotional planning, and channel strategy execution. Working in a dynamic, fast-paced corporate environment allowed me to strengthen my teamwork, communication, and analytical skills. This internship gave me deep insights into customer behavior and brand growth, shaping my professional development and inspiring my passion for a long-term career in the FMCG industry.

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Ceylon Biscuits Limited (Pvt.) Ltd

P.B.S.N.M.M.H.C. Kumarihami

Ceylon Biscuits Limited is one of the leading food manufacturers in Sri Lanka, best known for its Munchee products. I completed my industrial training in the Quality Assurance Department of CBL, where I gained practical knowledge of biscuit manufacturing and quality assurance processes. I was involved in sensory data recording, shelf-life studies, microbiological record keeping, water quality analysis, raw material inspection, and packaging assessment during the training. I also conducted a project on "Food Safety and Quality Culture Assessment" to assess employees' knowledge and practices related to food safety and quality culture. This training improved my understanding of food quality systems, teamwork, and industrial operations.

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Switz Lanka (Pvt) Ltd

H.M.N.Y. Wickramasinghe

Switz Lanka (Pvt) Ltd, the producer of Happy Hen eggs, is a leading egg-producing company in Sri Lanka. I got the opportunity to work in brooder cages, open- and closed- house layer cages. I was responsible for assisting with feeding and watering management during brooder and grower periods, supporting vaccination programmes, operating the control panel of closed house cages, waste management, and participating in post-mortem training while supporting overall labor management and daily farm operations. I developed skills in labor management, teamwork, and effective communication while supervising daily farm operations. I also improved my abilities in data recording, problem-solving, and decision-making under real working conditions, preparing me for future work in the animal science and agriculture fields.

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Naresuan University, Thailand

K. Keerthana

I undertook a research internship at the Department of Electrical and Computer Engineering, Naresuan University, to investigate hydrogen deployment pathways. I conducted a systematic literature review of national energy statistics, the Thailand Power Development Plan, hydrogen roadmaps, and peer-reviewed studies to identify structural barriers and policy misalignments. The review formed the basis of a journal manuscript submitted for publication. I also contributed to co-developing an AI- and MATLAB-based model to analyze determinants of industrial hydrogen adoption. The research extended beyond the internship and continues as an active collaboration, contributing rigorous and policy-relevant insights to hydrogen governance and sustainable energy transformation.

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Graduate Associate Professionals (Pvt) Ltd

Vigneswaran Nirthani

The industrial training was undertaken Graduate Associate Professionals (Pvt) Ltd., where I was attached to the Research and Development Division. My role encompassed conference and event coordination, research writing and documentation, innovation and special projects, and digital platforms and data management, providing broad interdisciplinary exposure. A notable achievement was serving as the coordinator of the InnoJet International Entrepreneurship and Innovation Competition 2025, conducted in parallel with the Kandy Conference, where I managed end-to-end planning, budgeting, partner coordination, and execution. This training strengthened my research, leadership, and project management skills, enhanced my exposure to international collaboration, and established a strong foundation for a research-oriented career in sustainability and innovation.

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Graduate Associate Professionals (Pvt) Ltd

M.P.S. Samadhi

Graduate Associate Professionals (Pvt) Ltd, the core of “gap headquarters”, is a research and consultancy hub located in the heart of Colombo 07. During my industrial training in the Research and Development Department, I engaged in diverse professional activities that strengthened both my technical and interpersonal competencies. Contributing to international conferences and workshops enhanced my coordination and research communication skills while working with academics and professionals. Editorial contributions, literature reviews, and digital outreach activities sharpened my analytical thinking and creativity. My commitment and adaptability were highly appreciated, enabling me to grow into a confident young professional capable of performing effectively in any professional environment.

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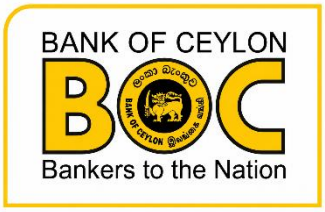

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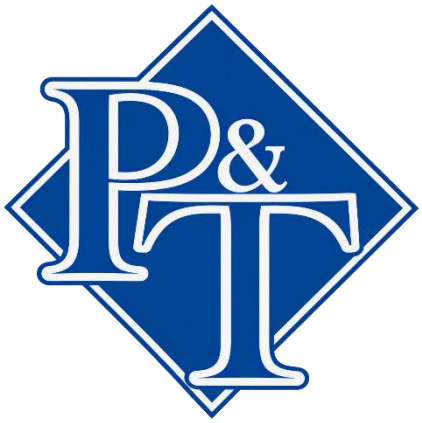

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