

BOOK OF ABSTRACTS

10TH INTERNATIONAL AGRICULTURE CONGRESS

IN CONJUNCTION WITH 25TH ASIAN
ASSOCIATION OF AGRICULTURE
COLLEGES & UNIVERSITIES BIENNIAL
CONFERENCE (AAACU25)

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Welcome to the 10th International Agriculture Congress (IAC10) and 25th Asian Association of Agricultural Colleges and Universities Biennial Conference (AAACU25)

Climate stress, disease pressure, and rising demand are placing new pressure on food production, and many existing approaches are struggling to keep pace. This conference brings together researchers, practitioners, and policymakers to address a practical question: how do we build farming systems that stay productive under these pressures?

The abstracts in this book approach that question from many directions. Rice breeders map QTLs for bacterial blight resistance. Engineers test IoT-controlled nutrient dosing for hydroponic farms and drones for precision spraying. Postharvest scientists examine melatonin treatment to extend the shelf life of Carabao mango. Extension researchers study how smallholders adopt digital tools and how policy can move innovations from the laboratory to the field. Other papers cover salt-tolerant rice varieties, copper nanoparticles synthesized from plant waste, animal genetic resource banking, and enterprise models for free-range poultry.

The crops, countries, and methods differ. The concern is the same: how to maintain agricultural production and food supply under harder conditions.

This year's theme, *Frontier Technologies for Agriculture Resilience and Food Security*, names that concern. The papers collected here show these technologies under test: field trials, genetic mapping, feasibility studies, and pilot enterprises, measured against real soil, weather, and market conditions.

Over the next three days, Melaka hosts researchers from Malaysia, the Philippines, Nigeria, Pakistan, China, Indonesia, Japan, Australia, and beyond. Read across the sections and the connections show themselves: a saline-soil rice trial in the Philippines speaks to biofertilizer research on rice in Malaysia, feed-formulation work in the Philippines to crop and livestock systems elsewhere. Agricultural research crosses borders. This conference gives researchers a chance to compare methods, results, and problems in person.

Thank you for bringing your work to IAC10 and AACU25 2026. Read beyond your own field, meet researchers working on different problems, and find at least one paper that changes how you approach your own. Welcome to the congress and to the historical city of Melaka.

Assoc. Prof. Dr. Christopher Teh Boon Sung, Chairperson of S & T Committee
3 Sep. 2026

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Economic Crisis and Food Security

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Abstract

Economic crises have repeatedly exposed weaknesses in national and global food systems. In Malaysia, the 1985–1986 recession, precipitated partly by falling commodity prices and export earnings, adversely affected employment and household incomes, although policy discussions at the time focused primarily on poverty and economic recovery rather than food security. The 1997–1998 Asian Financial Crisis demonstrated how currency depreciation, unemployment and declining purchasing power could affect food access and affordability. Malaysia was adversely affected, but Indonesia experienced a much deeper contraction, more severe food-price inflation and a sharper increase in poverty, while Thailand and South Korea recovered at different rates because of differences in economic structures and policy responses. Subsequent crises became increasingly global in their reach. The 2007–2008 food and fuel price crisis raised the cost of staple foods across Asia, Africa and the Middle East, particularly affecting poor urban households and food-importing countries. The COVID-19 pandemic disrupted agricultural production, labor mobility, logistics and household incomes worldwide, even where aggregate food supplies remained sufficient. The commodity-price shock following the Russia–Ukraine conflict further increased the prices of grain, fertilizer, animal feed and energy, placing additional pressure on food-importing countries in Africa, Asia and the Middle East. These experiences show that economic crises affect food security through multiple channels, including income and employment losses, exchange-rate depreciation, international price transmission, trade restrictions, rising production costs and reduced government fiscal capacity. Their effects are also uneven: low-income households spend a larger proportion of their income on food, while import-dependent countries are more exposed to currency and international market shocks. The discussion is structured around the four dimensions of food security, availability, accessibility, affordability, and stability, and distinguishes between immediate crisis responses and longer-term resilience strategies. Short-term measures such as targeted income assistance, food subsidies, price stabilization, emergency reserves and the maintenance of trade flows can protect vulnerable consumers. However, these interventions must be complemented by sustained investment in agricultural research and development, technology adoption, infrastructure and skills to improve productivity, technical efficiency and output. Diversified production and import sources, stronger regional cooperation and more resilient supply chains are also required. Productivity growth must be environmentally sustainable through efficient use of land, water, energy and agricultural inputs, protection of soil and ecosystems, and adoption of climate-resilient technologies. Food security should therefore be integrated into both macroeconomic crisis management and long-term sustainable development.

Keywords: economic crises, food security, food affordability, agricultural resilience

Sustainable Management in Oil Palm Plantation Field with Greenhouse Gas Emissions and Soil Fertility

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Abstract

Malaysia remains one of the world's major palm oil producing countries, with more than 5.7 million hectares under oil palm cultivation. However, the environmental sustainability of oil palm production, particularly greenhouse gas (GHG) emissions, has received increasing attention. Within an oil palm field, different management zones, including the weeded circle, frond heap and harvest path, create distinct soil physicochemical conditions. The distribution of soil solids, water and air phases, together with differences in soil pH, nutrient availability, organic matter inputs, root distribution and fertilisation practices, can influence soil processes and consequently GHG emissions. Higher GHG emissions were generally observed in areas receiving greater organic matter inputs, particularly the frond heap and weeded circle. In addition to in-field organic residues, oil palm processing generates substantial quantities of agricultural waste, particularly empty fruit bunches (EFB). Although EFB may contribute to GHG emissions when decomposed under plantation conditions, it also contains valuable nutrients, particularly potassium, which can potentially be recovered for agricultural use. In a long-term field experiment using 1 m³ acrylic chambers to evaluate GHG emissions from EFB placed in an oil palm plantation, integrated GHG emissions expressed as global warming potential were 23 times higher during the wet season than during the dry season. This was largely associated with enhanced CH₄ production under anaerobic conditions and fungal denitrification associated with EFB. An alternative approach to EFB management is the utilisation of EFB washing water, a nutrient-rich by-product generated during the production of carbon-neutral EFB pellets, as a source of moisture and plant nutrients in oil palm fields. Field application of EFB washing water increased soil pH, electrical conductivity, total carbon and dissolved organic carbon in deeper soil layers. In a long-term field trial, EFB washing water was subsequently applied through trenches between oil palm trees, with tap water used as the control. The application of EFB washing water enhanced soil microbial biomass, maintained soil structure at greater depths and stimulated active carbon cycling, as indicated by lower CO₂ release and higher soil ATP contents compared with the control. Although the increase in fresh fruit bunch yield was not statistically significant, the treatment showed potential to minimise yield decline during dry periods. Overall, organic matter accumulated within oil palm fields, whether derived from cut fronds or EFB, can contribute to GHG emissions under favourable decomposition conditions. Sustainable plant residue management is essential to minimise environmental impacts while recovering and returning valuable nutrients to the soils. The utilisation of EFB washing water represents a promising circular approach that recycles nutrients, improves soil fertility and may reduce GHG emissions associated with conventional EFB management, while supporting soil biological activity and oil palm productivity.

Keywords: oil palm, empty fruit bunch, greenhouse gas, soil fertility, liquid fertilizer

Soil at the Centre of Energy Crisis and Net Zero Agriculture

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Abstract

Modern agriculture is built on an increasingly fragile relationship between food, energy and soil. Synthetic nitrogen fertilizer, produced largely through the fossil-energy-intensive Haber–Bosch process, has been fundamental to the extraordinary growth in global food production. Yet this achievement has created a structural dependency: fertilizer production, farm machinery and freight are all closely tied to fossil energy and concentrated global supply chains. Recent disruptions associated with the 2026 Strait of Hormuz crisis demonstrate how rapidly an energy shock can become a fertilizer shock and, ultimately, a food-security shock.

Soil is often treated as a passive medium within this system, but it should instead be viewed as the central buffer linking energy security, food production and net-zero agriculture. Only around 30–60% of fertilizer nitrogen is typically recovered by crops, while the remainder is retained in soil or lost. At the same time, long-term dependence on external fertilizer has often been accompanied by declining soil organic matter, weakening the internal nutrient reserves that once helped agricultural systems withstand shortages.

Building soil organic matter therefore has value well beyond carbon sequestration. Particulate organic matter provides relatively rapid nutrient cycling, while mineral-associated organic matter acts as a more persistent store of carbon and nitrogen. Improved soil organic matter can consequently generate several simultaneous returns: greater nitrogen-use efficiency, lower dependence on purchased fertilizer, enhanced resilience to supply shocks and reduced greenhouse-gas emissions.

Net-zero agriculture should therefore not be framed simply as replacing fossil fuels with renewable energy while maintaining the existing production system. A more resilient transition requires progressive restructuring of nitrogen and energy flows. Immediate measures include mapping exposure to fertilizer shortages, improving nitrogen rate, timing and placement, sensing crop and soil demand, and protecting soil organic matter. Longer-term transformation requires greater biological nitrogen fixation through legumes, circular use of manure and recovered nutrients, renewable farm energy, green ammonia and emerging decentralized fertilizer technologies.

The ultimate goal is no longer maximum yield supported by maximum external input, but a food system that simultaneously delivers yield, nutritional quality, profitability, soil function, lower nitrogen loss and reduced fossil-N dependence. Soil must therefore move from the margins of energy and climate policy to the center of agricultural transformation. Net zero will be most durable when agriculture treats soil carbon and nutrient cycling not merely as environmental outcomes, but as strategic infrastructure for food, energy and economic resilience.

Keywords: soil carbon, climate change, nutrient use efficiency, regenerative agriculture

Livestock Greenhouse Inventory and Mitigation Research in the Philippines

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Abstract

The establishment of a collaborative research facility intended to improve greenhouse gas inventory and mitigation research in the Philippines represents a critical step toward advancing the climate-smart livestock industry. This initiative combines the refinement of the national inventory on greenhouse gas for livestock with direct experimental measurements of emissions across different livestock species, creating an integrated platform for research, monitoring, and mitigation. Using the IPCC Tier 2 method, cattle-related GHG emissions were recalculated to provide more accurate estimates than those derived from the Tier 1 approach. The Tier 2 method incorporates detailed information on animal type, productivity, and production systems, utilizing livestock population data from government agencies and performance data gathered in collaboration with 20 state colleges and universities. Results showed that cattle-related GHG emissions have increased substantially over the past three decades, with enteric fermentation contributing more than 70% of total emissions. These findings highlight the need for more accurate country-specific data and targeted mitigation strategies. To address this need, the UPLB headbox respiration facility was used to establish a methane conversion factor (Y_m) appropriate for Philippine production conditions, while the Greenfeed system was used to quantify methane and carbon dioxide emissions, with initial trials demonstrating differences in emissions among cattle fed with regionally relevant diets. Complementing this effort, feeding trials were also conducted at the Philippine Carabao Center using a polytunnel-based methane measurement system to evaluate locally available forage resources and feed technologies as mitigation strategies in buffaloes. Beyond emission monitoring, these facilities also support the determination of caloric and nutrient biological values of feedstuffs. In vitro and in situ digestibility studies further enable the indirect nutrient values determination and screening for methane-mitigating compounds. Collectively, these efforts can establish a national hub for the integration of metabolic research and emission monitoring, which will provide an improved baseline for identifying emission hotspots, effective mitigation strategies, and better nutrition management. This integrated approach strengthens the scientific foundation for sustainable livestock production systems in the Philippines.

Keywords: climate-smart livestock, greenhouse gas inventory, enteric methane, methane mitigation, sustainable livestock production

Climate Smart and Resilient Small Ruminants

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Abstract

Small ruminants (sheep and goats) are critical and growing contributors to global food security, fibre production and rural livelihoods, particularly in developing regions. However, climate variability, characterized by altered rainfall patterns, temperature extremes and increased frequency of drought and severe weather events, poses multifaceted threats to small ruminant production systems. These climate stressors directly compromise animal productivity (meat, milk, fibre yield), reproduction, and health whilst indirectly affecting feed and water availability, land suitability, and disease and parasite burden. Small ruminants, given their adaptability, are particularly suited to future changing climatic conditions. Compared to cattle, small ruminants mature early and have short gestations with high rates of multiples, are well adapted to harsh environments, can consume low quality forage not suitable for larger animals, are more drought tolerant, require lower initial investment costs and have rapid returns which mitigates risk, provide food security (particularly in marginal areas) and reduce poverty, produce less GHG, help control weeds and overall contribute valuable macro and micro nutrients into the human food chain. This makes small ruminants ideal candidates for future industry growth under climate constrained environments. Climate smart agriculture for small ruminants integrates three primary approaches: adaptation, mitigation and productivity enhancement. Adaptation strategies include genetic selection for tolerance traits (heat tolerance, water use efficiency, and disease resistance), improved grazing management and diversification of feed sources. Mitigation measures, including optimized feeding and improved manure management, can reduce methane emissions without impacting productivity. Diversification can also contribute to resilient systems by integration of crop-livestock systems, agroforestry and water harvesting infrastructure. Despite small ruminants facing similar challenges as larger livestock, published research in small ruminant production systems is limited. This knowledge gap hinders sustainable development and technology adoption in this sector. Scalable and sustainable small ruminant growth requires research and collaboration across multiple domains. Future research needs to engage local producers and groups, focus on genetics and selecting for efficiency and genetic resilience including characterizing and potentially exploiting tolerant indigenous breeds, examining technology and data acquisition, precision nutrition and nutritional interventions, understanding nutrient partitioning and metabolism, rearing young stock as well as research and development of education and extension systems and practices. This presentation will synthesize evidence on climate smart small ruminant production, identify critical research gaps and propose future research directions; demonstrating how scaling resilient sustainable small ruminant production systems can enhance food security and improve rural incomes that can contribute to global climate mitigation goals.

Keywords: small ruminants, sheep, goats, sustainability, resilience, adaptation

Spectroscopic / Imaging / Data Science Applications in Smart Agriculture

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Abstract

Because the quality attributes of agricultural, food, and forest products are rarely uniform, smart agriculture requires non-destructive, rapid, and objective evaluation methods that can be deployed from the laboratory to the field and the production line. Near-infrared spectroscopy (NIRS), based on the reflected or transmitted absorbance of electromagnetic energy in the range 800–2500 nm, has long been used for the non-destructive measurement of organic materials, since the NIR absorption is attributed mainly to overtones and combinations of vibrational bands involving C-H, O-H, and N-H. When this spectroscopic principle is extended into the spatial domain through hyperspectral and multispectral imaging, and coupled with chemometrics and machine/deep learning, it becomes a powerful data science tool for visualizing and predicting the internal quality, composition, and physical properties of biological materials at pixel-level resolution. This presentation introduces our recent scientific and technical efforts that combine spectroscopy, imaging, and data science for smart agriculture applications. First, a fast online NIR spectroscopic system operating at 120 m/min was developed to simultaneously predict the stiffness (modulus of elasticity) and moisture content of wooden veneer, achieving prediction errors as low as 0.9 GPa and 0.6%, respectively, demonstrating the feasibility of real-time, on-line quality monitoring on a production line. Second, near-infrared hyperspectral imaging (NIR-HSI) was coupled with a heat and mass transfer simulation to visualize, for the first time, the three-dimensional distribution of moisture within biological materials, providing a means to validate and refine drying and processing models. Third, a cognitive spectroscopy approach combining NIR-HSI with convolutional neural networks (CNN) was applied to species/variety identification from hyperspectral images, attaining 90.5% identification accuracy and clearly outperforming conventional visible-imaging techniques. Taken together, these studies show that basic spectroscopic research, when integrated with big-data information technology and spectral imaging, is continuously improving material analysis performance. Portable and low-cost devices are also being designed to enable remote, in-field analysis. Future advancements are expected to expand these spectroscopic, imaging, and data science applications across even more domains of smart agriculture, supporting online or at-line quality monitoring from farm to factory.

Keywords: near-infrared spectroscopy, hyperspectral imaging, chemometrics, deep learning, smart agriculture

Artificial Intelligence in Agri-biotechnology: From Data to Designed Biology

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Abstract

Artificial intelligence (AI) is becoming a critical computational layer linking data-intensive agriculture with molecular and quantitative crop improvement. The urgency is clear: the global population is projected to approach 9.7 billion by 2050, while agriculture may need to produce approximately 50% more food, feed and fibre than in 2012, under increasing pressure on land, water and climate resources. Against this backdrop, modern agriculture is shifting from merely collecting data toward integrating heterogeneous information for prediction, prescription and increasingly biological design. This presentation positions agricultural performance within a genotype $\times$ environment $\times$ management ($G \times E \times M$) framework, in which AI can model complex, nonlinear relationships between genetic potential, environmental exposure, management interventions and phenotype. The focus then shifts to agri-biotechnology, where genomics, transcriptomics, proteomics, metabolomics, phenomics and enviromics generate high-dimensional datasets that require computational integration. Machine learning and deep learning can integrate genome-wide markers, multi-omics profiles, high-throughput imaging and environmental covariates to support genomic prediction, trait–gene association, biomarker discovery and $G \times E$ prediction. A particularly important application is genomic selection, where genome-wide marker information is used to predict breeding values before complete phenotypic evaluation. The potential impact is measurable: simulation work in rice has shown that reducing the breeding cycle from 3 years to 2 years through genomic prediction could increase medium-term genetic gain by up to 27%. In cassava, conventional phenotypic selection cycles of 4–6 years have been estimated to potentially fall to about 2 years with genomic selection. Complementary approaches such as speed breeding can shorten generation length by approximately 2.5- to 5-fold, further increasing genetic gain per unit time when integrated with genomics. AI also expands biotechnology from prediction toward design. Computer vision can transform RGB, multispectral, thermal and LiDAR observations into quantitative phenotypes, linking millions of image pixels to biologically meaningful traits. AI-assisted CRISPR workflows can prioritize candidate genes, guide-RNA designs and potential off-targets before molecular and field validation, while machine-learning approaches in proteomics can improve peptide interpretation and biomarker discovery. Collectively, these developments are shifting crop improvement from a largely sequential process toward iterative design–build–test–learn cycles. The emerging frontier is an AI-enabled crop digital twin integrating genome, phenotype, environment and management to ask *what-if* questions before committing resources to biological experiments. The ultimate value of these technologies, however, will depend on representative datasets, biological validation, model interpretability, biosafety, governance and equitable access. AI therefore does not diminish the importance of biology; it provides the computational capacity to move agri-biotechnology from observing biology, to predicting biology, and increasingly, to designing biology.

Keywords: artificial intelligence, agri-biotechnology, genomic selection, precision phenotyping, crop digital twins

Squid (*Loligo* sp.) Impacts In Avoid Pathogenic Bacteria And Stimulating Health in Whiteleg Shrimp (*Litopenaeus vannamei*) Aquaculture

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Abstract

Squid (*Loligo* sp.) ink is a waste product from the seafood industry, inexpensive, effective, and applicable. The advantages of squid ink include increasing the nutritional value of feed, inhibiting biofilm formation, quorum sensing, and the growth of pathogenic bacteria in fish and shrimp farming due to its content of betaine, cinnamic acid, choline, and 2-piperidinone. Squid ink extract can also act as an immunostimulant for white shrimp (*Litopenaeus vannamei*). One of the diseases that attacks whiteleg shrimp (*L. vannamei*) aquaculture in Indonesia is Acute Hepatopancreatic Necrosis Disease (AHPND) caused by *Vibrio parahaemolyticus* carrying the *Pir-A* and *Pir-B* genes. The purpose of this study was to determine the impact of squid ink extract on the occurrence of *Vibrio* sp. attacks in whiteleg shrimp ponds. This study was conducted in shrimp ponds in Negara District, Jembrana Regency, Bali Province, Indonesia, consisting of treatment ponds and control ponds with an area of 700–800 m² and a stocking density of 125 individuals/m². Squid ink extract was given to the treatment pond at a dose of 500 mg/kg mixed with feed once a day. This study used a descriptive experimental method. The identification process began with bacterial extraction, followed by quantitative testing and PCR amplification, which were then visualized through DNA bands from electrophoresis. The amount of *V. parahaemolyticus* in the hepatopancreas of whiteleg shrimp was carried out using the spread plate method. The initial stocking density of fry was 100,000 per pond and water sampling was carried out four times, i.e. at DOC 20, DOC 35, DOC 50, and DOC 65 with an interval of 14 days. The results of the study concluded that the administration of squid ink extract through feed was able to suppress the presence of *V. parahaemolyticus* bacteria in the hepatopancreas of whiteleg shrimp. Where in the treatment pond the density ranged from 2.5×10^3 to 9×10^7 CFU/mL, and 3.4×10^3 to 3.1×10^8 CFU/mL in the control pond. *V. parahaemolyticus* were identified as containing the *Pir-A* and *Pir-B* genes in the hepatopancreas of whiteleg shrimp (*L. vannamei*). The administration of squid ink extract worked effectively in reducing the population density of *Vibrio* sp.

Keywords: Squid, *Litopenaeus vannamei*, Immunity, *Vibrio parahaemolyticus*, Anti-bacteria

Innovations and Sustainable Strategies for a Resilient Malaysian Blue Economy

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Abstract

The global blue economy plays an increasingly important role in supporting food security, economic growth, employment, and human well-being while emphasizing the sustainable use and protection of aquatic ecosystems. Within this global context, Malaysia has significant opportunities to harness its extensive marine and coastal resources to generate economic value, strengthen food security, create employment, and improve the well-being of coastal communities. This presentation provides an overview of the global blue economy before examining the key challenges and practical pathways for building a resilient Malaysian blue economy, with particular emphasis on fisheries and aquaculture. Available evidence shows that Malaysia's blue economy contributed an estimated RM138 billion, or 8.4% of gross domestic product, in 2024 and is projected to reach RM1.07 trillion, or 27%, by 2040, while employment could increase from approximately 650,000 to 2.65 million workers. Aquaculture for example now accounts for 60% of aquatic animal production, with Asia producing approximately 90% of output. However, progress is constrained by unsustainable fishing, water pollution, climate-related coastal vulnerability, aquatic animal diseases, antimicrobial resistance, inconsistent seed and stock quality, and rising operating costs. The presentation highlights circular aquaculture approaches—including integrated multi-trophic aquaculture, recirculating aquaculture systems, and biofloc technology—as strategies for improving resource efficiency, recycling nutrients, reducing waste, and strengthening production resilience. The use of microalgae, seaweeds, and their associated microorganisms for quorum sensing inhibition also offers a non-antibiotic approach to disease management. Innovations can also be co-developed, validated, and scaled through a quadruple-helix partnership involving universities, industry, government, and communities. A resilient Malaysian blue economy therefore requires innovation to be integrated with environmental sustainability, inclusive community participation, collaborative governance, and pathways that translate research into investable and scalable solutions.

Keywords: blue economy, circular aquaculture, integrated multi-trophic aquaculture, aquatic animal health, quadruple helix

Unveiling the Genetic Choreography of Chili Anthracnose Resistance: Leveraging Molecular Foundations for the Digital Breeding Era

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Abstract

Chili anthracnose, driven by the complex interaction between *Capsicum* spp. and various *Colletotrichum* species, remains a formidable global challenge that defies conventional breeding. This plenary session reflects on decades of research that unravelled the "biological ground truth" of this disease, shifting the paradigm from a static view of resistance to a dynamic Genotype x Stage x Pathotype interaction model. A landmark highlight of our work is the discovery of stage-specific resistance, where genetic control in chili fruit is uncoupled and independently regulated during green and red maturity stages. Crucially, we demonstrate that a variety's defensive success is not only stage-dependent but also highly specific to the pathotypes identified through host differential reactions. This intricate genetic choreography explains why "one-size-fits-all" resistance often fails in the open field, where diverse pathogen populations and fruit maturity levels converge. As we enter the era of Digital Transformation, these molecular foundations must serve as the core logic for Digital Phenotyping. To be truly effective in Precision Field Farming, high-throughput sensors and AI models must be "biologically calibrated" to recognize these invisible transitions between resistance and susceptibility across different fruit stages and pathogen profiles. By integrating our molecular legacy with digital innovation, we can finally architect resilient chili cultivars—ensuring that the future of digital agriculture is not only data-driven but biologically profound. "The art of science is to make the complex appear simple and the invisible, visible."

Keywords: stage-specific resistance, host-pathogen interaction, digital phenotyping, pathotype diversity

Morpho-Physiological and Growth Performance of Aerobic Rice (MR219-9) in Competition with Weed (*Eleusine indica*) as Influenced by Biofertilizer

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Abstract

The experiment was conducted at Universiti Putra Malaysia (UPM) to evaluate the morpho-physiological and growth performance of aerobic rice in competition with weeds as influenced by biofertilizer. It consisted of five biofertilizer treatments (control: chemical fertilizer recommended rate (CFRR) 100% (150 N; 60 P₂O₅; 60 K₂O kg ha⁻¹), biofertilizer 1 ton + 75% CFRR, biofertilizer 2 tons + 50% CFRR, biofertilizer 3 tons + 25% CFRR and biofertilizer 4 tons ha⁻¹) and five crop:weed mixture ratios (Crop100: Weed0, Crop75: Weed25, Crop50:Weed50, Crop25:Weed75 and Crop0:Weed100) in a replacement-series model. The results revealed that rice and weed plant biomass pot⁻¹ were higher in biofertilizer 1 ton + 75% CFRR, rice photosynthesis and transpiration rate were higher in biofertilizer 4 tons ha⁻¹, rice chlorophyll-a, chlorophyll-b, total chlorophyll, actual chlorophyll and weed plant height, leaf area and plant biomass plant⁻¹ were higher in CFRR 100%, weed photosynthesis and transpiration rate were higher in biofertilizer 2 tons + 50% CFRR. Rice plant height, leaf area, biomass plant⁻¹, chlorophyll-a, chlorophyll-b, total chlorophyll, actual chlorophyll and photosynthesis were higher in Crop25:Weed75 mixture ratio, plant biomass pot⁻¹ was higher in Crop100:Weed0 mixture ratio, transpiration rate was higher in Crop50:Weed50 mixture ratio while weed biomass pot⁻¹, photosynthesis and transpiration rate were higher in Crop0:Weed100 mixture ratio. These results imply that application of biofertilizer 1 ton + 75% CFRR enhances biomass accumulation of aerobic rice while the superior effect of Crop25:Weed75 mixture ratio indicated that 'MR219-9' was a stronger competitor than *Eleusine indica*.

Keywords: aerobic rice, biofertilizer, competition, performance, weed

Assessing Risk of UAV Spraying Drift in Indoor UAV Laboratory

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Abstract

Unmanned aerial vehicles (UAVs) are currently favored for use in aerial spraying in agricultural practices. Spray drift, or the movement of sprayed particles away from their intended target region, may reduce spraying effectiveness, increase costs and potentially be hazardous to people, animals, and the environment. The purpose of this study is to observe the effects of flying height, flight speed, wind speed and spray type in spraying drift distribution patterns. The experiment is conducted using a hexacopter UAV with a 16-liter payload in the Indoor UAV Laboratory, UPM. A total of 25 water-sensitive papers were placed at the testbed sampling points to capture the spraying pattern for each test. The study indicated that UAV speed has a substantial impact on spray coverage (%) at the area of interest. From the results, the use of boom sprayer flying at a height of 2.5 meters, at a speed of 2 meters per second, and under low wind speed conditions produces the best spraying uniformity and the least drift. In conclusion, the experiment demonstrated that flying height, flight speed, wind speed, and spray type all contribute to the spraying drift pattern.

Keywords: Unmanned Aerial Vehicles, aerial spraying, spraying drift

Genetic Mapping of Bacterial Panicle Blight QTLs in Rice Using F2 Population

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Abstract

Over 3.5 billion people rely on rice as one of their most important staple foods; it has been one of the most significant crops in the globe for centuries. However, the incidence of pest and diseases cause a lot of damage to the crop thereby affecting rice production on global scale. Most commercial cultivars of rice (*Oryza sativa* L.) are susceptible to bacterial panicle blight (BPB). BPB is a devastating bacterial disease causing significant losses in grain yield and milling quality. There are limited sources of genetic resistance adapted to Malaysia's growing conditions and no commercial cultivar of rice is currently available in Malaysia with a high level of BPB resistance. Bacterial panicle blight resistance has been reported to be quantitative in nature. A population of F2 progeny lines derived from a cross between two Malaysian commercial rice cultivars, MR 219 (BPB susceptible) and MR 220 CL1 (BPB resistant) was used to map BPB resistance QTLs. Progenies were evaluated for disease reactions in a replicated trials using CRD and the data was analyzed with SAS. Genotyping was done with 201 simple sequence repeat (SSR) markers in the laboratory. Two significant (logarithm of odds ratio > 2.5) quantitative loci (QTLs) were identified for BPB resistance, with individual effect explaining 9.7 and 40.3% of the total phenotypic variance in the F2:3 progenies respectively. QTL (qBPB-9) was detected between RM201 and RM316 on chromosome 9 while QTL qBPB-10 was detected between RM590 and RM228 on chromosome 10. Bulk segregant analysis (BSA) was used as an alternative method to map the QTLs. Consistent result across the two methods indicate the stability of the identified QTLs and their potential for improving rice BPB resistance using marker-assisted selection (MAS).

Keywords: *Oryza sativa*, QTL, bacterial panicle blight, bulk segregant analysis

Determinants of Willingness to Pay for Seaweed-Based Biofertilizer Among Urban Gardeners

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Abstract

Population growth in Malaysia has increased the demand for food, especially in urban areas. To meet this need, chemical fertilizers are widely used in urban agriculture because they boost crop growth and yield. However, their continuous use can cause negative impacts such as soil acidity, water pollution, and deterioration of soil structure. As a result, sustainable alternatives like biofertilizers are gaining attention due to their environmental and health benefits. One potential innovation is seaweed-based biofertilizer, which has various agronomic benefits and abundant resources in Malaysia. Despite proven effectiveness, its market demand remains uncertain. Therefore, this study aims to determine market potential by examining urban gardeners' willingness to pay (WTP) for seaweed-based biofertilizer attributes and other factors that can influence WTP. Urban gardeners are selected as they operate on a small scale with lower input costs and risks compared to farmers, making them more suitable for introducing new products. Primary data was collected from 160 urban farmers in the Klang Valley through a face-to-face survey using the Discrete Choice Experiment (DCE) questionnaire. This study applies basic and interaction models using Mixed Logit (MXL). Results for the basic model shows a positive WTP towards seaweed-based biofertilizers that had certification, nutrient labels, and pellet form. Certification from authoritative bodies is found as the most preferred attribute, reflected by the highest estimated WTP of RM30.80. The interaction model shows that income and gender positively influence WTP. These findings provide useful insights for producers to develop effective strategies to ensure successful market adoption of biofertilizers.

Keywords: seaweed-based biofertilizer, sustainable agriculture, biofertilizer's attributes, willingness to pay (WTP), urban gardeners' preferences

Multicarbohydase-phytase Complex Supplementation of Broiler Diets with Reduced Metabolizable Energy, Digestible Amino Acids and Minerals

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Abstract

This study was conducted to assess the effects of multicarbohydase (MCE)-phytase supplementation in a corn-soybean meal-based diet with reduced apparent metabolizable energy (AME), digestible amino acids (DAA), and minerals (Ca and P) on the growth performance, carcass yield, and economics of broiler chickens. A total of 480-day-old mixed sex broiler chicks (Cobb 500) were randomly assigned to four diets with 10 replicates of 12 broilers each namely: standard broiler diet (SBD, positive control), Negative control 1 (NC1, reduced AME by 75 kcal/kg, DAA by 2.5%, Ca and P by 0.20%) + MCE-phytase (0.01%), Negative control 2 (NC2, reduced AME by 100 kcal/kg, DAA by 5%, Ca by 0.25% and P by 0.20%) + MCE-phytase (0.01%), and NC2 + xylanase-phytase (XP- 0.05% and 0.01%, respectively). The bodyweight and feed intake were recorded for each feeding period (10, 25, 31 d), and production performance was calculated. At 31 days old, two broilers per replicate were taken randomly for carcass yield evaluation. The economics of feeding was calculated using income over feed cost (IOFC). The diet with XP elicited inferior performance ($P < 0.01$) compared to any of its counterparts. There were no evident differences in carcass yield associated with the diets. The broiler production index (BPI) was superior ($P < 0.01$) for the broilers fed SBD than their counterparts, except for broilers fed the NC1+MCE-phytase, which was statistically similar. The IOFC from the diets with MCE-phytase was comparable to SBD, but higher ($P < 0.01$) than the diet with XP. The findings demonstrated the efficacy of the MCE-phytase as a supplement to a diet with reductions in energy and nutrient contents.

Keywords: broilers, carbohydrase, digestible amino acids, minerals, phytase

Morphological Characterization of Selected Ube (*Dioscorea alata* L.) Accessions from the Visayas Region in the Philippines

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Abstract

Ube (*Dioscorea alata* L.) is a staple crop grown and used for food in the Philippines, holding cultural and economic significance. Currently, no published studies have reported intensive morphological characterization of *D. alata* accessions in the Visayas region. This study aimed to characterize 115 *D. alata* accessions collected from the Visayas region using standard descriptors to assess morphological variability. The accessions were characterized using a total of 126 descriptors for yams (*Dioscorea spp.*) provided by the International Plant Genetic Resources Institute (1997). Descriptive statistics showed high variability in traits such as sprouting, leaf measurement at length 3, number of internodes to first branching, internode number to fully expanded leaf, stem length, number of stems, branching, leaf number, tuber width, leaf measurement at width 2, days to emerge, internode length, and leaf measurement at length 2. Principal Component Analysis (PCA) revealed that the first three PCs explained about 49.20% of the variance, and the traits that contributed most to the total variation are stem length, internode number to fully expanded leaf, leaf measurement at length 2, leaf measurement at length 3, leaf measurement at width 2, and sprouting. The PCA scatter plot displays two distinct clusters, primarily separated along PC1, which accounts for 22.5% of the total variation. Cluster analysis grouped the accessions into five main clusters using a 0.5 dissimilarity coefficient, indicating genetic variability and suggesting a broad genetic base. The findings of this study could be vital for future breeding programs and in the conservation, management, and utilization of genetic resources.

Keywords: *Dioscorea alata*, morphological characterization, variability, genetic resources, Visayas, Philippines

Technology-Enabled Prosperity Partnerships: A Multi-Sectoral Extension Model for Agricultural Resilience and Food Security

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Abstract

In response to the growing need for resilient agricultural systems and sustainable food security, aligned with the United Nations Sustainable Development Goals (SDGs), the University of Eastern Philippines (UEP) advances the Prosperity-Partnership Caravan as an integrative, technology-enabled extension model for rural development. This study examines how multi-sectoral collaboration, supported by emerging coordination and information systems, can strengthen agricultural resilience and improve food security outcomes in Northern Samar. Specifically, the study aims to: (1) assess how strategic partnerships enhance the delivery of agriculture-related services and innovations; (2) identify socio-economic and institutional factors that influence the adoption of resilient and food-secure practices; and (3) develop a scalable, technology-informed framework for implementing partnership-driven community interventions in vulnerable regions. Using a co-management and participatory approach, the initiative integrates stakeholder consultations, formalized partnerships, resource-sharing mechanisms, and feedback systems enhanced by data-driven monitoring and coordination tools. The caravan engaged ten stakeholder categories, including 16 national government agencies, 24 local government units (LGUs), 12 civil society organizations (CSOs), and 13 private sector partners. These collaborations facilitated the delivery of agricultural support services, capacity-building activities, and food security interventions across 569 barangays, reaching 220 schools, 84,000 families, and over 639,000 individuals. Findings highlight that success was driven by coordinated mobilization, real-time information exchange, and the convergence of services targeting agriculture productivity, livelihood diversification, and community-based food systems. The study demonstrates that embedding frontier approaches—such as digital coordination platforms, integrated monitoring systems, and multi-sector innovation networks—within extension programs enhances their scalability and impact. This research contributes a replicable model that bridges academic research, technological integration, and community engagement, offering a pathway for strengthening agriculture resilience and advancing inclusive, sustainable food security in marginalized regions.

Keywords: agricultural resilience, food security, multi-sectoral collaboration, digital coordination systems, sustainable development

Influence of Dietary Vitamin E and Selenium to the Laying Performance, Egg Quality and Carcass Characteristics of Japanese Quails (*Coturnix coturnix japonica*) Under Heat Stress (34°C)

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Abstract

Heat stress brought about by climate change negatively impacts the performance of quails, which may be solved by dietary manipulations. Hence, this study aims to evaluate the influence of vitamin E and selenium on the laying performance, egg quality, and carcass characteristics under ambient (27 °C) and heat stress (34 °C) temperatures. Two hundred forty (240) laying quails with 30 birds/treatment combinations were randomly assigned into 8 treatment combinations following a 2 (vitamin E at 0 and 250 mg/kg of feeds) x 2 (selenium at 0 and 0.30 mg/kg of feeds) factorial design and were raised for 6 weeks. The interaction of temperature and supplementation of selenium and vitamin E significantly ($P < 0.05$) decreased body weight gain, feed consumption, yolk weight, dressing percentage, and increased mortality rate. Furthermore, selenium and vitamin E significantly ($P < 0.05$) increased body weight gain, yolk color, shell percentage, and decreased mortality rate, albumen weight, and dressing percentage. Supplementation of selenium and vitamin E did not significantly ($P > 0.05$) affect the egg production, egg weight, shape index, shell thickness, shell percentage, albumen weight, and giblets percentage of quail layers under heat stress. Heat stress alone, on the other hand, impaired the feed consumption ($P < 0.00$), feed conversion ratio ($P < 0.00$), egg production ($P < 0.00$), egg yolk color ($P < 0.01$), and dressing percentage ($P < 0.00$). Thus, heat stress negatively influenced quail performance and carcass traits, while dietary supplementation with vitamin E and selenium demonstrated potential in mitigating some of these adverse effects. This suggests that nutritional manipulation can serve as a practical and cost-effective strategy for small-scale farmers who lack access to controlled housing systems to sustain quail productivity under elevated ambient temperatures.

Keywords: heat stress, vitamin E, selenium, Japanese quail

The Policy Logic of Integrating Smallholder Farmers into Modern Agriculture: A Grounded Theory Analysis of China's 2026 Central Document No. 1

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Abstract

The 2026 Central Document No. 1 is the latest guiding framework issued by the Chinese government to advance the modernization of China's agriculture. Utilizing grounded theory for a three-level coding of the policy text, this study deconstructs the underlying policy logic through a "Condition—Action—Outcome" framework. Research findings indicate that: First, at the condition level, the supportive foundation for policy integration is driven by both institutional safeguards and factor supply, which jointly establish the institutional environment and resource base for subsequent actions. Second, at the action level, policy practices comprise a synergy between developmental integration and protective integration. Specifically, developmental integration—leveraging the confluence of organizational, technological, and market integration—aims to facilitate "effective market" functions and stimulate smallholders' endogenous motivation. Conversely, protective integration—anchored by dynamic monitoring and collaborative assistance—aims to exercise the "active government" role to preempt survival crises. Third, at the outcome level, policy effectiveness converges on the modernization of management entities and modernization of production-marketing systems. The former manifests as individual resilience enhancement and solidified organizational linkages, representing the modernization of micro-level entities; the latter is characterized by optimized production supply improvement and market value realization, reflecting structural upgrades across the industrial chain. Consequently, through the systematic adjustment of production relations and productive forces, the Chinese government has constructed a "Chinese Paradigm" for the organic integration of smallholder farmers into modern agriculture.

Keywords: Central Document No.1, smallholder farmers, modern agriculture, organic integration, grounded theory

Post-Pandemic Realignment: Comparing Product–Market Fit of Indonesia’s Ornamental Plant Exports to Japan and China

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Abstract

Amid global uncertainty, market insight is crucial for building resilience in agribusiness exports through a strategic understanding of evolving trade structures. This study evaluates such transformations by analyzing the product–market alignment of Indonesia’s ornamental plant exports, comparing pre-pandemic (2016-2018) and post-pandemic (2022-2024) trade profiles in Japan and China. Using market share, Trade Intensity Index (TII), and market fit, this study evaluates how the export orientation of ornamental foliage plants (HS 0602) and cut flowers (HS 0603) adapts to international dynamics. The market share and TII of HS 0602 weaken in Japan but increase sharply in China, while HS 0603 displays the opposite pattern, with consistent strengthening in Japan and weakening in China. Results reveal a marked structural shift. Pre-pandemic, Japan showed a poor fit due to a mismatch between Indonesia’s foliage-heavy portfolio (58.93%) and Japan’s cut flower preference (76.56%). Post-pandemic, this transformed into a good fit as HS 0603 penetration into Japan rose to 58.22%. Conversely, China became a paradoxical poor fit; despite Indonesia’s deepening foliage specialization (64.87%), China’s demand pivoted toward cut flowers (59.28%). These findings imply that relying on historical dominance without monitoring structural shifts creates export vulnerability. Strategic recommendations focus on market diversification and product mix optimization to align with shifting global demand. These findings provide a baseline for exporters to appropriately adjust product orientation in the face of global market uncertainty.

Keywords: export resilience, market dynamics, market fit, ornamental plants, post-pandemic

Development of Automated Greenhouse- Type Solar Seaweed Dryer

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Abstract

Red seaweed cultivated in the Philippines is a rich source of carrageenan which is widely used in food products as a binding, gelling, and thickening agent. The Automated Greenhouse-Type Solar Seaweeds Dryer was developed to reduce drying time and improve product quality, particularly during the wet season. It is made of a bent-arc galvanized iron (GI) pipe frame and covered with a 200-micron UV-clear plastic film. It harnesses solar energy through panels connected to a charge controller and batteries. These power exhaust fans, lighting system, and the Arduino microcontroller. Through sensors, it automatically regulates temperature and humidity inside, maintaining optimal drying conditions. Inside the chamber, seaweeds are suspended on hanging poles, ensuring even drying in a controlled environment. During dry months, seaweeds can be dried in two to three days, comparable to traditional methods that use elevated platforms or hanging poles. In the wet season, drying time is reduced from the conventional five to eight days to only four to five days. This protects seaweeds from contaminants, dirt, and foreign objects, resulting in consistently higher-quality dried products. This addresses one of the challenges faced by seaweed farmers: unpredictable weather. Rain during drying often compromises quality, lowering carrageenan content and reducing market value.

Keywords: automated solar seaweeds dryer, seaweeds dryer

Integrated Nutrient Management for Sustainable Production: Optimizing Rice Yield with Locally Developed Bradyrhizobium-Based Biofertilizer

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Abstract

The injudicious application of synthetic fertilizers for conventional rice production leads to soil fertility decline which affects crop productivity. Integrating locally isolated biofertilizers with reduced amounts of synthetic fertilizers offers a promising strategy to reduce chemical inputs while maintaining soil and crop productivity. This study evaluated the effects of combining six strains of indigenous bradyrhizobia—originally isolated from legumes—as biofertilizer with synthetic fertilizer on growth and yield response of rice and its effect on soil organic matter (SOM) through a three-year field experiment (2022–2024). Using five treatments with 25-50% reduction in synthetic fertilizer combined with 2-4 kg of biofertilizer, linear regression and correlation tests were performed. Rice yield responses varied among the treatments as SOM increased. Among the treatments, the combination of 2 kg biofertilizer with 25% reduced NPK showed the highest average yield with the highest SOM concentration, indicating the role of SOM for crop productivity. The other combinations also showed positive yield response with improved SOM compared to the control (recommended rate of synthetic fertilizers). These results indicate that while Bradyrhizobium strains are typically used as inoculants for legumes, they can be used successfully in association with non-legume crops which likely due to their capabilities as plant growth promoting rhizobacteria (PGPR). The findings highlight that integrating biofertilizers in conventional rice production appears to be a viable strategy for reducing chemical fertilizer dependence, improving soil health, sustaining crop yield, and minimizing cost of production.

Keywords: Bradyrhizobium, INM, PGPR, soil organic matter

Deciphering the Genetic and Molecular Basis of Bacterial Leaf Blight Resistance in Wild Rice *Oryza rufipogon*

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Abstract

Rice (*Oryza sativa* L.) production is severely constrained by bacterial leaf blight (BLB) caused by *Xanthomonas oryzae* pv. *oryzae* (*Xoo*). Wild rice species such as *Oryza rufipogon* represent valuable reservoirs of BLB resistance genes for rice improvement. This study aimed to identify BLB-resistant *O. rufipogon* accessions, characterize their resistance genes, and elucidate the molecular mechanisms underlying host response to *Xoo* infection. A total of 112 accessions were screened with an *Xoo* strain UPMSB1 via leaf clipping method under greenhouse conditions, in which six and seventeen accessions were identified as resistant and moderately resistant, respectively. These accessions were subsequently genotyped using BLB resistance gene-specific markers including *Xa4*, *xa5*, *Xa11*, *Xa21*, *Xa23*, *Xa27*, *Xa32*(t), *Xa33*(t), *Xa35*(t), *Xa43*(t), and *Xa47*(t). Marker analysis confirmed the presence of these resistance genes among resistant accessions. From the phenotypic screening, one resistant (IRGC93216) and one susceptible (IRGC104750) accession were selected for comparative RNA-seq analysis before and after *Xoo* inoculation. Comparative transcriptomic analysis revealed 9,995, 7,459, and 13,250 differential expressed genes (DEGs) in resistant control (RC) vs resistant inoculated (RI), susceptible control (SC) vs susceptible inoculated (SI), and RI vs SI contrasts, respectively. Functional enrichment showed that resistance in IRGC93216 was associated with plant-pathogen interaction, Mitogen-Activated Protein Kinase MAPK signaling, glutathione metabolism, protein processing and export, ABC transporters, and fatty acid metabolism. These findings indicate coordinated immune signalling and defense responses in resistant accession. The identified resistant accessions and molecular insights provide valuable resources for the development of BLB-resistant rice varieties and support the strategic utilization of wild genetic diversity in breeding programs.

Keywords: Rice, *Oryza rufipogon*, bacterial leaf blight, resistance genes, RNA-seq

Nutritive Value and Economic Feasibility of Lawlaw (*Sardinella lemuru*), Bolinao (*Neostethus thessa*), and Silag (*Anchoa mitchilli*) as Protein Sources for Swine and Poultry

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Abstract

This study evaluated the nutritive value and economic feasibility of lawlaw (*Sardinella lemuru*), bolinao (*Neostethus thessa*), and silag (*Anchoa mitchilli*) as alternative protein sources for poultry feed. Fish samples collected from Sorsogon landing sites were processed into fish meal using oven-drying (105 °C) for 8 and 10 hours. Proximate composition (crude protein, crude fat, moisture, ash, calcium, and phosphorus) was determined using standard analytical methods. True metabolizable protein (TMP) was assessed through a digestibility trial with 20 broiler chickens using the Sibbald method. Economic feasibility was evaluated based on production cost and protein cost efficiency. Significant differences ($p \leq 0.01$) were observed among treatments. Silag (68.03–70.00%) and bolinao (67.31–69.57%) exhibited higher crude protein than commercial fish meal (56.83%) and lawlaw (45.63–45.74%). Lawlaw had the highest crude fat content (17.71–17.84%), while silag showed superior mineral composition. Extended drying (10 hours) improved nutrient stability and reduced moisture content. TMP values were significantly higher in bolinao (68.02%) and silag (66.66%), with corresponding coefficients of 97.77% and 95.22%, compared to lawlaw (36.38% TMP; 79.54%) ($p < 0.01$). Locally produced fish meals were more cost-effective than commercial fish meal (₱249/kg). Lawlaw had the lowest production cost (₱144.16–154.02/kg), whereas bolinao and silag demonstrated greater protein cost efficiency (₱233.00–265.81/kg protein) compared to commercial fish meal (₱438.15/kg protein). These findings indicate that the evaluated species are viable, cost-efficient alternatives to conventional fish meal, with potential to enhance feed resource utilization and support sustainable poultry production.

Keywords: fish meal, proximate composition, economic feasibility, coefficient of TMP, true metabolizable protein

Morphophysiological and Molecular Characterization of Wild Rice (*Oryza rufipogon*) Accessions for Drought Tolerance

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Abstract

Drought is a major environmental constraint that significantly reduces rice growth and productivity, ultimately affecting global food security. This study aimed to identify drought-tolerant wild rice (*Oryza rufipogon*) accessions using polyethylene glycol (PEG-6000) simulation at the seedling stage and to evaluate associated simple sequence repeat (SSR) markers. A total of 20 accessions from diverse geographical origins, along with a drought-tolerant check (IRGC 636) and a susceptible variety (MR303), were screened under controlled hydroponic conditions in a growth chamber using a Completely Randomized Design with three replications. Drought stress was simulated using PEG-6000 to impose four osmotic potentials (0%, 10%, 15%, and 20% PEG, corresponding to approximately -0.05, -0.19, -0.36, and -0.58 MPa, respectively). Seedling responses were evaluated based on morphological and physiological traits and scored using the Standard Evaluation System (SES, IRRI, 2002). Based on phenotypic performance, three accessions were classified as drought-tolerant (IRGC 104409, IRGC 104457, and IRGC 105616) and seven as moderately tolerant (IRGC 104474, IRGC 104870, IRGC 105832, IRGC 105901, IRGC 106086, IRGC 106106, and IRGC 106416). Four and six accessions were identified as moderately susceptible and susceptible, respectively. Data were analyzed using two-way analysis of variance (ANOVA) in R, and treatment means were compared using the least significant difference (LSD) test at the 5% significance level. SSR analysis using drought-associated markers RM38 and RM279 revealed that RM38 identified three accessions sharing similar allele profiles with the tolerant check variety, IRGC 636. These results suggest the presence of useful drought-tolerant alleles within the evaluated germplasm. The identified accessions may serve as potential donors in breeding programs aimed at improving drought tolerance in rice. Further validation using additional drought-associated markers is recommended to support marker-assisted selection.

Keywords: wild rice, PEG-6000, drought, seedling stage, SSR markers

Optimizing Crop Rotations for Effective Physical Control of Purple Nutsedge in the Cotton-Wheat Cropping System

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Abstract

Purple nutsedge (*Cyperus rotundus* L.) is a persistent perennial weed that severely reduces productivity in cotton-based systems through rapid vegetative spread and prolific tuber formation. A three-year field study was conducted in southern Punjab, Pakistan, to determine the effectiveness of crop rotations, dry-out periods, and herbicide application for its control under a cotton-wheat system. The experiment followed a randomized complete block design with split-plot arrangement and four replications. Crop sequences included cotton, maize, sunflower, and mungbean with strategically managed dry-out periods in time spaces. Weed check and weed control treatments were also included. Results showed that integrated treatments significantly suppressed purple nutsedge density, shoot biomass, and tuber production compared with untreated continuous cotton. Among all systems, sunflower-based rotations produced the greatest weed suppression, recording the lowest shoot density and underground tuber population throughout the study, followed by maize and mungbean rotations. Continuous cotton maintained the highest infestation across all years. Repeated dry-out periods through periodic tillage substantially reduced tuber viability and limited subsequent weed emergence. In the third-year cotton crop, fields previously rotated with sunflower and maize produced superior cotton growth and yield relative to continuous cotton, indicating strong residual benefits of crop diversification and reduced weed pressure. Herbicide-treated plots consistently outperformed non-treated plots by further lowering weed biomass and improving crop performance. Overall, the study demonstrates that sunflower- and maize-based rotations combined with dry-out tillage and selective herbicide use provide an effective, sustainable, and practical strategy for long-term management of purple nutsedge in cotton-wheat production systems.

Keywords: purple nutsedge, crop rotation, cotton-wheat system, weed suppression, integrated weed management

Antioxidant Activity and Nutritional Profiling of Selected Underutilized Myrtaceae Fruits in Peninsular Malaysia

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Abstract

The Myrtaceae family encompasses a diverse range of genera and species, many of which are of notable ecological and economic importance. Despite this, many fruits within the family remain underutilized, largely due to limited scientific research, particularly regarding their phytochemical composition and nutritional profiles. This study aimed to investigate the nutritional composition and bioactivity of three underutilized fruits from the Myrtaceae family: *Syzygium cumini* (Jambu Arang), *Syzygium claviflorum* (Remuyu), and *Rhodomyrtus tomentosa* (Kemunting). Mineral content, including N, P, Mg, Ca, Zn, and Fe, were determined by wet ashing method. Phytochemical profiling was conducted through the Folin–Ciocalteu assay for total phenolic content (TPC) and the aluminium chloride colorimetric assay for total flavonoid content (TFC). Antioxidant activity was assessed using aqueous extracts evaluated by FRAP and DPPH assays, while Vitamin C content was estimated via titration. As the results, *Syzygium cumini* exhibited the highest available Mg concentration (2.05 ± 0.10 g/kg) but the lowest levels of N (1.70 ± 0.33 g/kg), Zn (0.06 ± 0.01 g/kg), and Fe (0.01 ± 0.00 g/kg). In contrast, *Syzygium claviflorum* has highest P (3.31 ± 0.09 g/kg), K (34.41 ± 1.20 g/kg), and Zn (0.73 ± 0.02 g/kg). *Rhodomyrtus tomentosa* demonstrated the highest N (2.53 ± 1.49 g/kg) and Ca concentration (1.51 ± 0.12 g/kg), but comparatively lower P (2.84 ± 0.01 g/kg), K (5.82 ± 0.24 g/kg), and Mg (0.71 ± 0.01 g/kg). *Rhodomyrtus tomentosa* has the highest total phenolic content (TPC) (5.83 ± 0.89 mg GAE/g), total flavonoid content (TFC) (1.29 ± 0.03 mg QE/g), and FRAP values (294.21 ± 4.58 mM Fe²⁺/g). Conversely, *Syzygium cumini* recorded the lowest TPC (1.89 ± 0.02 mg GAE/g) and TFC (0.72 ± 0.01 mg QE/g) but showed the highest DPPH radical scavenging activity ($93.54 \pm 0.047\%$). In comparison, *Syzygium claviflorum* showed the lowest DPPH radical scavenging activity ($89.40 \pm 0.80\%$) and FRAP value (226.86 ± 6.47 mM Fe²⁺/g). Vitamin C estimation further emphasized *Syzygium cumini* as having the highest content at 63.84 ± 5.10 mg/100 g, and the lowest is *Syzygium claviflorum* at 5.57 ± 0.53 mg/100 g. Overall, these findings underscore the nutritional and phytochemical potential of underutilized myrtaceae fruits in Malaysia and highlight their value as sources of minerals, antioxidants, and bioactive compounds.

Keywords: underutilized fruit, myrtaceae fruit, aqueous extraction, nutritional profiling, phytochemical

Determination of Critical Nitrogen, Phosphorus, and Potassium Levels for Optimizing Fertilization of Hybrid Coconut Seedlings

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Abstract

This study evaluated the critical nutrient concentrations (CNCs) of nitrogen (N), phosphorus (P), and potassium (K) in hybrid coconuts to optimize fertilization strategies for improved growth and nutrient uptake. Screenhouse pot trials and field experiments were conducted using varying levels of N, P, and K fertilizers. Soil and plant analyses revealed that nutrient application significantly influenced soil properties, nutrient availability, and growth performance of hybrid coconut seedlings. Results showed that soil nitrogen content increased with higher N application, while phosphorus treatments improved available P and soil conditions, particularly at moderate rates. Potassium application had limited effects on tissue K concentration, indicating sufficient native soil K levels. Plant tissue analysis demonstrated optimum nutrient uptake at specific fertilizer levels, with excessive application resulting in reduced uptake efficiency. Growth parameters such as plant height, leaf production, and base diameter were enhanced by balanced fertilization, particularly under moderate N and P treatments. Field trials further confirmed improved leaf production following fertilizer application. The findings highlight the importance of identifying critical nutrient thresholds to develop efficient and sustainable fertilization programs for hybrid coconut production.

Keywords: hybrid coconut, critical nutrient level, fertilization, optimization, yield

Morphology and Phylogenetic Studies on the Genetic Diversity and Origin of Philippine Red Junglefowl

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Abstract

Red Junglefowl (RJF), the ancestor of modern domestic chickens, is widely distributed in the Philippines, yet its genetic diversity and subspecies classification remain poorly understood. This study investigated Philippine (PH) RJFs from Luzon, Visayas, and Mindanao using mitochondrial DNA (mtDNA) D-loop analysis and detailed morphological assessment. A total of 55 RJFs were genetically analyzed, while 34 individuals (29 males and 5 females) were evaluated using qualitative and quantitative morphology parameters. Morphological assessment identified black/slate gray shank color and white to whitish-red earlobes as the most reliable RJF indicators. Male RJFs commonly exhibited eclipse plumage, while females showed rust red to yellow mantle coloration associated with the *e+* allele. Spur length (2.23 ± 0.87 cm) and body length (34.31 ± 3.47 cm) were also identified as useful morphometric indices. In contrast, yellow shank color was strongly associated with hybridization or introgression with domestic chickens. These findings also demonstrated that earlobe color alone is not a reliable basis for RJF subspecies identification. Genetic analysis revealed multiple maternal origins based on haplogroup D, E, and Y classifications. Phylogenetic and network analyses showed haplotype sharing between PH RJFs and other Asian RJFs, particularly Indonesian populations, indicating common maternal ancestry. High genetic diversity was observed, with 81.23% of molecular variation occurring within populations. Molecular evidence further confirmed the coexistence of *Gallus gallus gallus* and *Gallus gallus bankiva* subspecies in the Philippines. Furthermore, these findings support wild chicken biodiversity conservation, sustainable production for food security, and climate resilience, contributing to SDGs 2, 13, and 15.

Keywords: genetic diversity, morphology, mtDNA D-loop, phylogenetics, Red Junglefowl

Strengthening Local System Resilience through Disaster Preparedness and Risk Management Strategies: The Case of a Coastal Town in Northern Samar, Philippines

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Abstract

Coastal communities in the Philippines are increasingly exposed to disaster-related risks that require strong local preparedness, effective risk communication, and inclusive disaster risk reduction and management systems. Allen, Northern Samar, as a coastal municipality, is vulnerable to typhoons, flooding, erosion, and other hazards that may affect community safety and local resilience. This study aimed to assess the disaster preparedness and risk management strategies in selected coastal barangays of Allen, Northern Samar, with emphasis on residents' awareness, preparedness, experiences, and perceived effectiveness of disaster risk reduction and management practices. It also sought to generate institutional and operational insights from barangay officials, Municipal Disaster Risk Reduction and Management Office (MDRRMO) personnel, and DRRM focal persons as key informants. Using a descriptive research design, the study employed survey questionnaires among selected residents and key informant interviews to gather data on DRRM strategies, preparedness practices, implementation mechanisms, available resources, coordination processes, and challenges in disaster risk management. The findings showed that residents perceived the disaster risk reduction and management strategies in Allen as adequately implemented, particularly in information dissemination, hazard awareness, and disaster preparedness planning. The assessment of risk reduction management strategies yielded a grand mean of 2.90, interpreted as adequately implemented, while disaster preparedness obtained a grand mean of 3.66, interpreted as highly prepared. Key areas of preparedness included understanding warning messages, monitoring official advisories, securing important documents, preparing basic emergency supplies, and recognizing disaster risks in their communities. However, both survey responses and key informant interviews revealed continuing gaps, including lack of equipment and machinery for risk reduction, which ranked first among the identified problems, limited seriousness toward disaster drills, unequal relief distribution, insufficient funds for DRRM-related trainings, limited facilities for vulnerable groups, and coordination challenges during disaster response. The study concludes that while disaster preparedness and risk management strategies in Allen are generally in place, local system resilience remains constrained by resource, training, coordination, and participation gaps. The findings imply the need for an intervention program focused on DRRM equipment provision, disaster risk literacy, regular and structured simulation drills, inclusive relief distribution, increased training funds, strengthened institutional coordination, and improved support for vulnerable sectors. Strengthening local resilience therefore requires not only institutional preparedness but also community-centered, inclusive, and participatory risk management practices.

Keywords: disaster preparedness, risk management, local system resilience, DRRM, coastal community

Market Readiness and Adoption Intention of Seaweed-Based Foliar Fertilizer Among Seaweed Producers in the Philippines

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Abstract

Seaweed-based foliar fertilizer has emerged as a potential climate-resilient and sustainable agricultural input in the Philippines. This study assessed the market readiness and adoption intention of seaweed-based foliar fertilizer among seaweed producers. Specifically, it examined respondents' production characteristics, awareness, market participation, perceived opportunities and constraints, willingness to participate, and factors influencing intention to use the technology. Data were collected through a structured survey and analyzed using descriptive statistics, composite scoring, correlation, and regression analyses. Results showed that respondents generally had positive perceptions of seaweed-based foliar fertilizer, particularly its potential to improve livelihoods and support sustainable agriculture. Intention to use obtained the highest composite mean score, indicating a strong interest in adoption, especially when supported by training, extension services, and assured markets. Perceived market opportunities demonstrated the strongest positive association with intention to use, while financial risks and logistical constraints influenced adoption decisions. Major constraints identified included low product prices, inadequate drying and storage facilities, and limited technical support. The findings suggest that seaweed producers are generally receptive to seaweed-based foliar fertilizer as a value-added agricultural innovation. However, successful adoption depends on strengthening technical support, infrastructure, and market-linkage mechanisms to improve participation in sustainable bio-input systems.

Keywords: seaweed-based foliar fertilizer, market readiness, adoption intention, sustainable agriculture, Philippines

Enhancing Food Security in the Uplands: A Case among Women Farmers in an Economically Challenged Community in Southern Philippines

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Abstract

Rural poverty is still a critical problem facing the Philippines. The Science and Technology Community-Based Program for Inclusive Development through Community-Based Livelihood Improvement for Bukidnon aimed at demonstrating a technology transfer modality focusing on a disadvantaged community leading towards inclusive development through sustainable and resilient community-based livelihoods. The project was implemented among the 33 members of the Kiharong Women's Association in Brgy. Kiharong, a small community in Maramag, Bukidnon with high poverty incidence and low food threshold level. The project implemented livelihood interventions in organic vegetable production, mushroom production, and goat production through participatory extension approaches and social engagements. It forged partnerships with people, government and non-government organizations, allowing access of rural women to agricultural resources, which hastened adoption of technologies. The facilitated extension services enhanced the knowledge in farming and significantly improved the social bond between and among the women farmers. The communal and home gardens provided food, generated additional income, and improved the food availability, accessibility and utilization in the households during the pandemic. The income obtained from the home gardens contributed to food security and alleviated poverty in the women's households. The outputs and outcomes of the project in terms of products, knowledge, income, social capital, food security and poverty alleviation manifested huge potential for direct social, economic and environmental impact of the livelihood interventions in a geographically, economically, and socially disadvantaged community.

Keywords: poverty alleviation, gender and development, social capital, livelihood improvement, participatory development

Multivariate Analysis and Extreme Phenotype Selection for Seed and Fiber Yield Traits in Kenaf

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Abstract

Kenaf (*Hibiscus cannabinus* L.) is an economically important bast fiber crop with expanding industrial applications. However, genetic improvement of seed and fiber yield is constrained by the complex inheritance of quantitative traits and the high cost of large-scale genotyping. This study employed multivariate statistical analysis to characterize phenotypic variation and identify contrasting individuals for selective genotyping as a cost-effective strategy for genomics-assisted breeding. A total of 330 F2 individuals derived from a cross between HC-95 and KBL-51 were phenotypically characterized for ten agronomic traits, including six fiber yield traits (plant height, stem diameter, fresh biomass weight, fresh stem weight, dry fiber weight, and dry core weight) and four seed yield traits (days to first flowering, number of branches, number of fruits per plant, and number of seeds per fruit). Phenotypic relationships were evaluated using correlation analysis, followed by principal component analysis (PCA) to summarize multivariate variation and identify contrasting phenotypes. Correlation analysis revealed strong positive associations among fiber yield traits and positive relationships between fiber and seed yield components, indicating that superior fiber-producing genotypes also tend to exhibit enhanced seed yield performance. PCA indicated that the first two principal components explained 57.31% and 14.55% of the total phenotypic variation, respectively. Based on PC1 scores, the top and bottom 15% of individuals were selected through an extreme phenotype selection approach, resulting in a subset of 100 F2 individuals for selective genotyping. The findings demonstrate that multivariate analysis effectively captures phenotypic variation and facilitates the identification of representative extreme phenotypes, thereby substantially reducing genotyping costs. This strategy provides an efficient and cost-effective framework for downstream genomic analyses, molecular marker development, and genomics-assisted breeding in kenaf.

Keywords: kenaf (*Hibiscus cannabinus* L.), multivariate analysis, principal component analysis, selective genotyping, genomics-assisted breeding

Economic Analysis of Tilapia Production in the Central Region of Peninsular Malaysia: Preliminary Findings

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Abstract

Tilapia aquaculture plays an important role in contributing significantly to national food security, rural livelihoods, employment generation, and income diversification. However, rising feed costs, unstable market prices, disease outbreaks, and inefficiencies in farm operations have raised concerns about the profitability and long-term sustainability of tilapia farming. Furthermore, empirical evidence on the financial feasibility and economic performance of commercial tilapia farms in Peninsular Malaysia remains limited, particularly at the farm level. This study therefore aims to evaluate the economic performance, profitability, and financial feasibility of tilapia production in the Central Region of Peninsular Malaysia. Primary data were collected through structured interviews with 50 tilapia farmers in Selangor and Negeri Sembilan. The study employs Cost-Benefit Analysis (CBA) to assess financial viability using four widely accepted investment appraisal indicators: Net Present Value (NPV), Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR), and Payback Period (PBP). The results presented in this paper are based on preliminary findings. The preliminary findings indicate that the average initial capital investment was approximately RM220,000 per farm, while the estimated annual gross revenue and operating cost were RM455,000 and RM338,500, respectively. Feed expenditure represented the largest operating cost, accounting for approximately RM210,000, or 62% of the total annual operating cost. Consequently, the estimated average annual net income was RM116,500 per farm. Based on a five-year project horizon and a discount rate of 10%, the estimated NPV was RM118,450, the BCR was 1.24, and the IRR reached 21.8%, with an average payback period of approximately 3.4 years. These indicators suggest that tilapia farming is financially feasible and economically attractive under efficient production and management practices. The analysis further indicates that farm size, feed conversion efficiency, farming experience, and access to extension services are important determinants of farm profitability, whereas increasing feed prices, disease outbreaks, and market price volatility remain the primary constraints affecting financial performance. Overall, the findings highlight the economic potential of tilapia farming in the Central Region of Peninsular Malaysia and underscore the importance of improving feed efficiency, strengthening technical extension services, promoting modern aquaculture technologies, and expanding access to affordable financing to enhance the resilience, competitiveness, and long-term sustainability of Malaysia's tilapia industry.

Keywords: aquaculture economics, cost-benefit, feasibility, tilapia, viability

Genomic Basis and Fitness Costs of Cefuroxime Resistance in *Staphylococcus aureus* from Bovine Mastitis

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Abstract

Bovine mastitis caused by *Staphylococcus aureus* is a major infectious disease affecting dairy cattle in Taiwan. Frequent antibiotic use in dairy farms has accelerated the emergence of antimicrobial resistance and resistance-associated mutations. To investigate the mechanisms and biological consequences of β -lactam resistance, this study combined whole-genome sequencing (WGS) with an *in vivo* murine infection model to evaluate resistance development, resistance reversion, and fitness costs in *S. aureus*. Resistant derivatives were generated through continuous *in vitro* exposure to ampicillin, cefapirin, cefuroxime, and cefquinome using the susceptible strain *S. aureus* subsp. aureus ATCC 25923. Resistant strains showed markedly increased minimum inhibitory concentrations (MICs), whereas partial reversibility of resistance occurred after removal of antibiotic selective pressure. WGS analysis identified mutations in genes encoding penicillin-binding proteins, ABC transporters, cell wall-active antibiotic response proteins, cyclic-di-AMP phosphodiesterase, and two-component regulatory system sensor histidine kinases. Most clinical bovine mastitis isolates possessed identical or closely related resistance-associated mutations. Cefuroxime-resistant strains selected at different passages (CFX10, CFX20, and CFX30) were further evaluated in mice. Highly resistant isolates, particularly CFX30, exhibited significantly reduced bacterial colonization in the liver, spleen, and kidneys, indicating reduced *in vivo* fitness. Despite lower bacterial burdens, resistant strains induced strong immune activation with increased expression of IFN- γ , IL-1 β , IL-2, IL-4, and TNF- α . These findings demonstrate a trade-off between β -lactam resistance and virulence in *S. aureus*, providing insights into resistance evolution and its implications for antimicrobial treatment strategies.

Keywords: *Staphylococcus aureus*, β -lactam resistance, whole-genome sequencing, fitness cost

Establishing a Viable Enterprise Using Free-Range Chicken Production Technology in Bataan

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Abstract

The study aims to establish a viable enterprise for 2 years, funded by DA-ACEF, to increase the production of F1 free-range chicken, increase adoption of the technology developed by Tarlac Agricultural University, and enhance beneficiaries' capacity. A total of six technology packages at both on-station and on-farm sites, including FRC housing, FRC breeding, FRC brooding, FRC ranging, FRC feeding, and FRC health management. BPSU supported farmers from different cooperatives: 2 females and 2 males (on-farm) located in Tuyoy, Balanga City, and Gabon, Abucay, and one (on-site) in BPSU, with a breeder house, 114 breeders, feeds, madre de agua plants, incubators, and training. Both sites were 100% adopted the developed technologies and improved practices focused on breeder, grower house, brooding, ranging area, feeds, alternative feeds, concoctions, and eggshell calphos. The on-site produced fertilized and unfertilized eggs, hardened chicks, and growers and layers as a payback scheme for "passing the gift" for the second batch of beneficiaries. The first and second batches of beneficiaries attended a total of three training sessions. Production performance of free-range chickens from both on-station and on-farm sites was analyzed using the Statistical Tool T-Test: Two-sample assuming equal variances. Significant results were obtained for average egg production and mortality rate ($P < 0.05$). On-station and on-farm sites showed no significant differences in average egg sales, feed consumption, or feed cost ($P > 0.05$). Financial analysis assumptions for the selling price per tray are Php 230-250, Average Annual Sales Volume of Php 519, 661.01, Annual Net Income is Php 185, 921.70, Investment cost is Php 401, 901.00, and ROI is 2.16 years with a rate of return on capital of 55.71% per station. In conclusion, the project increased free-range chicken production in the community, adopted technology, and capacitated farmer beneficiaries. The sustainability plan for the project implemented a payback scheme to fully utilize stocks and inputs and achieve a positive return for free-range chicken growers.

Keywords: free-range chicken, madre de agua, incubator, on-farm, on-site

The Competitiveness of Small-Scale Swine Farmers in Mekong Delta, Vietnam

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Abstract

This research aimed to: (1) determine the social demographic characteristics and analyze their effects on innovation capacity, as well as determine the perceptions toward competitiveness and government policy support and analyze the effects of these indicators on farm productivity; and (2) analyze the effects of innovation capacity and productivity of small swine farmers on competitiveness. The survey was conducted from January 2024 to July 2024 in the Mekong Delta, covering three provinces. Several linear measurement methods were employed to assess the physical and management-related parameters that may influence production efficiency and competitiveness among smallholder pig farmers. The data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, and statistical tests were performed to evaluate relationships and differences among variables, ensuring a systematic and objective interpretation of the research findings. Because the population of small-scale farmers was large and exact data were unavailable, this study applied non-probability sampling. The number of respondents in each province was determined by quota sampling (90 respondents per province), for a total of 270 respondents. A random sampling method was used to select respondents at the small-scale farm level. Small-scale farms were selected to ensure that farmers had basic knowledge of trading and producing swine and that swine production was one of their main occupations. The results showed that farmers displayed positive perceptions toward innovation, such as adopting automatic feeders or drinkers, and recognized its contribution to competitiveness, although production efficiency remained moderate. Regression analyses showed that education level, herd size, and training participation had positive effects on innovation and competitiveness, whereas experience and market distance negatively influenced farm performance. For productivity, only main occupation and experience had significant negative impacts, indicating that full-time and long-experienced farmers tended to rely on traditional methods. Innovation was found to significantly enhance farm competitiveness, while production efficiency alone had no direct effect. The study highlights that innovation adoption, capacity building, and effective policy are essential for strengthening the sustainability and competitiveness of smallholder pig farms in the Mekong Delta.

Keywords: Mekong Delta, swine production, competitiveness, Vietnam

Proximate Analysis of Selected Forage Crops as Potential Food Supplement for Markaduke Native Pigs

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Abstract

The rising cost of commercial feeds poses a significant challenge to native pig farmers in Romblon, emphasizing the need for affordable and locally available feed alternatives. This study assesses the proximate composition of selected forage crops and agricultural by-products to determine their potential as supplementary feeds for native pigs. Commonly used feed resources were collected from various locations in Romblon and analyzed at the University of the Philippines Los Baños, Institute of Plant Breeding-Analytical Services Laboratory (UPLB-IPB-ASL) for crude protein, crude fiber, crude fat, ash, and moisture content. Results revealed considerable variation in nutritional composition. Leaves of mulberry, malunggay, and Madre de Agua showed high crude protein content, indicating their suitability as protein-rich feed components. Banana and ipil-ipil leaves exhibited elevated crude fiber levels, which may promote digestive health but require balanced inclusion to avoid reduced nutrient absorption. Sapal ng niyog (coconut residue) and seaweeds had the highest crude fat and ash contents, respectively, suggesting their potential as sources of energy and minerals. Based on the availability and nutritional profile of these feed materials, a 60:40 ration of commercial feed-to-forage and agricultural by-products can adequately meet the crude protein requirements for different stages of pig development. These findings provide a scientific basis for the utilization of locally sourced feed ingredients, promoting sustainability, cost efficiency, and improved productivity in native pig production in Romblon.

Keywords: agricultural by-products, feed formulation, forage crops, native pig, proximate composition

Safeguarding Animal Genetic Resources for Climate Change Adaptation through the Philippine National Livestock Cryobank

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Abstract

The cryobank or *ex-situ* conservation safeguards animal genetic resources, preventing economic losses and maintaining genetic diversity essential for livestock resilience amid climate change. By acting as a biological vault for livestock germplasm, the cryobank aims to support sustainable and adaptive animal production system. The Philippine livestock cryobank was established in 2012, initially focusing on water buffalo genetic resources, and has subsequently expanded to conserve other livestock species. Its strategic operation and management involve the systematic collection of animal genetic resources (AnGR), molecular characterization, cryopreservation, data banking, information dissemination, and the facilitation of access to and utilization of conserved genetic materials for research, breeding, and conservation purposes. Building on these efforts, as of May 2026, about 431,518 samples from five types of genetic materials (accession units) are preserved in the Cryobank, including water buffaloes (88.85%), cattle (7.20%), swine (0.82%), goat (0.65%), and sheep (0.003%). Semen (97.05%), DNA (0.26%), blood (2.68%), and oocytes (0.008%) are mainly stored in the cryobank. DNA profiles established using informative genetic markers, including mitochondrial DNA, Y chromosomes, and microsatellites, confirm species identification and delineation of various breeds and hybrids of buffalo, cattle, goat, and swine. This is helpful to establish genetic information as DNA references for livestock research and strategic conservation. Optimized protocols for producing frozen semen from swine, cattle, and goats have shown improved motility and viability of locally produced frozen semen, implying reserved genetics for future utilization in producing cryo-biological animals in the Philippine animal production systems. Future initiatives will focus on the collection and preservation of a wider range of livestock breeds, particularly those possessing adaptive and climate-resilient traits. These efforts will be complemented by continuous monitoring and the adoption of innovative *ex situ* cryoconservation technologies to strengthen and support the *in-situ* conservation of indigenous and locally adapted breeds.

Keywords: conservation, cryopreservation, genetic diversity, livestock biotechnology, semen

Advancing Intelligent Well-Being Agriculture through Curriculum and Research Integration: An Administrative Framework for Agricultural Resilience and Food Security at Maejo University

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Abstract

Agricultural universities play an increasingly important role in developing human capital, knowledge, and frontier technologies to address climate change, agricultural vulnerability, and food insecurity. From an institutional administration perspective, Maejo University (MJU) has positioned Intelligent Well-Being Agriculture (IWA) as a strategic framework for integrating curriculum development, research, innovation, entrepreneurship, and stakeholder engagement into a university-wide agricultural innovation ecosystem. This study aims to examine MJU's administrative approach to developing curricula and research systems that support agricultural resilience and food security through IWA. A strategic institutional case-study approach was employed through analysis of university development policies, academic and research frameworks, innovation pathways, capacity-development plans, and multi-sector partnership mechanisms. The administrative framework connects curriculum and research development across smart agriculture, artificial intelligence and digital technologies, agricultural biotechnology, food processing and future food, Bio-Circular-Green Economy applications, carbon neutrality, and climate and food-security analytics. Curriculum transformation emphasizes interdisciplinary, modular, and future-oriented learning, including postgraduate micro-credentials addressing food security amid climate change, spatio-temporal analytics, risk assessment, environmental leadership, and carbon-neutral food systems. Concurrently, research administration links academic inquiry and technology development through Technology Readiness Levels (TRLs 1-9), intellectual property management, incubation, acceleration, business validation, investment, and market deployment, strengthening pathways from university research to practical applications for farmers, communities, industry, and society. Institutional capability assessment further identified strategic development from the 2025 baseline toward 2028 targets, including strategy and organizational structure from level 2 to 5, knowledge capacity from 1 to 4, infrastructure from 1 to 5, networks from 1 to 4, and services from 1 to 4 on a five-level capability scale. The findings demonstrate that university administration can function as an integrating mechanism connecting curriculum, research, frontier technologies, entrepreneurship, and multi-sector collaboration. The MJU model illustrates how strategically aligning academic programs and research ecosystems under IWA can strengthen future agricultural competencies, accelerate technology translation, enhance community and industry engagement, and contribute to resilient, sustainable, and food-secure agricultural systems.

Keywords: Intelligent Well-Being Agriculture, curriculum development, research and innovation, agricultural resilience, food security

Growth Responses of a Newly Developed Mutant *Zoysia japonica* under Different Shade Percentages and Times

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Abstract

It has been estimated that up to 25% of cultivated turfgrasses experience abiotic stress due to shading effects. Hence, a newly developed mutant *Zoysia japonica* was evaluated for its growth response to different shading levels and times. The experiment was arranged in a nested design with four replications. The shading percentages consisted of 0% (control), 30% (one-layer black netting), 50% (two-layer black netting), and 70% (three-layer black netting). The shading duration was six hours, comprising early shade (8:00 a.m. to 2:00 p.m.) and late shade (12:00 p.m. to 6:00 p.m.). Each treatment comprised a 1 m × 7 m frame arranged with a 0.5 m gap between treatments and a frame height of 0.5 m. Light intensity for each treatment was measured. Lime (dolomite) and phosphorus fertilizer (CIRP) were added at a rate of 1,000 kg ha⁻¹ each. Compound NPK fertilizer (15-15-15) was applied at two-week intervals at the rate of 0.5 kg N per 100 m² per month from four weeks after planting. Different shade levels showed significant differences ($P < 0.05$) in all measured parameters. Interestingly, early and late shade showed indifferent growth responses. Plant height (mm), leaf length (mm), stolon internode length (mm), and stem internode length (mm) increased with increasing shade level. All root growth parameters, namely root volume (cm³), root length (mm), root fresh weight (g per 100 cm²), and root dry weight (g per 100 cm²), displayed a significant reduction with increasing shade level. Markedly, shoot density per m², number of leaves per m², shoot fresh weight (g per 100 cm²), shoot dry weight (g per 100 cm²), and stem thickness (mm) also exhibited a progressive decline as shade level increased. The highest leaf width (mm) was observed at 0% shade, while the lowest was at 70% shade. Turf quality was negatively affected by increasing shade levels. Physiological parameters, namely net photosynthesis ($\mu\text{mol m}^{-2} \text{s}^{-1}$), stomatal conductance ($\text{mol m}^{-2} \text{s}^{-1}$), and transpiration rate ($\text{mol m}^{-2} \text{s}^{-1}$), were reduced with increasing shade level, while intercellular CO₂ concentration ($\mu\text{mol mol}^{-1}$) was positively influenced by greater shade intensity. Total chlorophyll, SPAD value, and chlorophyll b increased, while chlorophyll a was reduced with increasing shade level. The findings demonstrate that mutant *Zoysia japonica* exhibits morphological and physiological adjustments to shade stress, but increasing shade intensity adversely affects morphology, growth, and photosynthetic efficiency regardless of shade time. These results provide valuable information for the selection and management of mutant *Zoysia japonica* in turf areas with limited light conditions.

Keywords: mutant *Zoysia japonica*, shading effect, growth responses, net photosynthesis, stomatal conductance

Development of a Precision Fertigation System for Greenhouse Rock Melon (*Cucumis melo* L.) Based on Crop Water Requirements

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Abstract

Greenhouse rock melon (*Cucumis melo* L.) production requires precise irrigation management to optimize water use efficiency while maintaining crop productivity. Conventional fertigation systems typically operate on fixed schedules that may not reflect actual crop water requirements (CWR), while historical weather data may not adequately capture real-time greenhouse microclimatic fluctuations. Therefore, this study developed an Internet of Things (IoT)-based precision fertigation system that integrates real-time climatic data for adaptive irrigation scheduling in greenhouse rock melon cultivation. An on-site weather station was installed at the Greenhouse Complex, Faculty of Agriculture, Universiti Putra Malaysia to continuously monitor environmental parameters such as temperature, relative humidity, solar radiation, and wind speed. These data were used to estimate crop water requirements through the FAO Penman–Monteith method, together with FAO crop coefficient (K_c) values. The calculated CWR was subsequently translated into irrigation schedules and programmed into an IoT platform, enabling automated and dynamic fertigation management that responds to changing climatic conditions in real time. The system was evaluated through a greenhouse experiment with three irrigation treatments: conventional time-based fertigation following Department of Agriculture (DOA) recommendations (T1), historical weather data-based CWR fertigation (T2), and on-site weather data-based CWR fertigation (T3). Analysis of variance showed significant treatment effects on water consumption ($F = 28.165$, $P < 0.001$) and fruit weight ($F = 19.741$, $P < 0.001$). Seasonal water consumption was highest in T1 (16.40 L polybag⁻¹), followed by T2 (4.64 L polybag⁻¹) and T3 (3.62 L polybag⁻¹), corresponding to water savings of 71.7% and 77.9%, respectively. Mean fruit weight differed significantly among treatments, with T1 producing the highest fruit weight (1.168 kg), followed by T2 (0.893 kg) and T3 (0.731 kg). Nevertheless, water productivity was substantially greater under CWR-based fertigation, increasing from 0.071 kg L⁻¹ in T1 to 0.193 kg L⁻¹ in T2 and 0.202 kg L⁻¹ in T3, respectively. In addition, conventional fertigation resulted in greater nutrient solution leaching, algae growth, root-zone saturation, and less uniform fruit development, whereas CWR-based treatments maintained more favorable root-zone conditions and produced fruits with higher soluble solids content (10 °Brix) than T1 (9 °Brix). These findings demonstrate that integrating real-time weather monitoring and CWR estimation into an IoT-based precision fertigation system can significantly reduce irrigation water use, improve water productivity, and support sustainable greenhouse rock melon production.

Keywords: precision fertigation, crop water requirements, internet of things, greenhouse cultivation, rock melon

Production Performance and Egg Physicochemical Properties of Layer Chicken Influenced by *Neurospora crassa* Biomass as a Functional Feed Additive

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Abstract

The increasing restrictions on synthetic feed additives and the growing demand for sustainable poultry production necessitate exploring natural alternatives to enhance laying hen performance and egg quality. This study evaluated the effects of *Neurospora crassa* biomass supplementation on production performance, egg physicochemical properties, amino acid profile, and economic viability of laying hens. A total of 80 ready-to-lay white leghorn hens (22 weeks old) were randomly assigned to four dietary treatments (0%, 0.5%, 1%, and 2% *N. crassa*) in a Completely Randomized Design over five weeks. Parameters measured included body weight, feed intake, egg production, egg quality traits, amino acid composition, and pH. Data were analyzed using analysis of variance in RStudio with Tukey's test for mean comparison. Results showed that supplementation significantly improved final body weight ($p < 0.0001$) and body weight change ($p = 0.0003$), with the highest values observed at 2% inclusion. Weekly egg weight increased significantly from Week 2 to Week 5 ($p < 0.001$), and feed intake showed significance in Week 5. Non-significant results were observed in initial body weight, hen-day egg production, and hen-housed egg production. Egg quality traits indicated enhanced nutrient deposition at higher supplementation levels. Moreover, supplementation with *N. crassa* biomass improved the amino acid composition of whole eggs, particularly lysine, threonine, leucine, glutamic acid, and aspartic acid, indicating enhanced nutritional quality of eggs. These findings indicate that *N. crassa* biomass is a promising natural feed additive that can improve growth performance and egg quality without adversely affecting production efficiency.

Keywords: amino acid, corn cob, fungi, egg quality, production

Exogenous Naphthaleneacetic Acid and Benzyladenine Enhance Ethyl p-Methoxycinnamate Accumulation in *Kaempferia galanga* L.

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Abstract

Kencur is an important medicinal plant that contains ethyl p-methoxycinnamate (EPMC) as its main bioactive compound. This study aimed to investigate the effect of naphthaleneacetic acid (NAA) and benzyladenine (BA) application on the content and yield of EPMC in kencur rhizomes. The experiment was conducted at the Agro Techno Park Experimental Garden, Universitas Brawijaya, Malang, using a factorial randomized block design (RBD) with two factors: NAA concentration (10, 20, 30 ppm) and BA concentration (0, 10, 20, 30 ppm). The main parameters observed included EPMC content and yield at 6 and 8 months after planting (MAP). The results showed that the combination of NAA 30 ppm + BA 30 ppm had the most significant effect, with EPMC content reaching 2.649% at 6 MAP and 5.936% at 8 MAP, and EPMC yield of 139.5 kg ha⁻¹ and 637.7 kg ha⁻¹ at the respective harvest times. Correlation and PCA analysis revealed that rhizome weight was closely associated with EPMC accumulation. Overall, the application of NAA and BA, particularly at higher doses and harvest at 8 MAP, effectively improved the quality and productivity of kencur bioactives. These findings have implications for the development of quality-oriented kencur cultivation technology to support the phytopharmaceutical industry.

Keywords: BA, EPMC, Kencur, NAA

Identification and Phytotoxicity Assessment of Soil Allelochemicals under Different Pine-Coffee Agroforestry Management Systems Using a Bioindicator

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Abstract

Pine-based agroforestry is widely promoted to support coffee production but often requires substantial management inputs to mitigate environmental stresses. As coffee is a perennial crop with only one major harvest cycle annually, integrating horticultural crops could improve land productivity and farmers' income. Nevertheless, the accumulation of allelopathic compounds in pine-coffee agroforestry soils may constrain the successful establishment of intercrops. This study evaluated the toxicity potential of allelochemicals in soils under different coffee cultivation intensities by assessing their effects on tomato growth as a bioindicator species. The experiment was conducted from November 2024 to March 2025 in Malang Regency, East Java, Indonesia, using a randomized complete block design with five treatments and five replications. Soil collected from agroforestry systems representing low (LC), medium (MC), high (HC), and best management practice (BMP) coffee cultivation intensities was used as tomato growth media and compared with soil from a non-agroforestry site. Vegetative growth, biomass accumulation, nutrient uptake, and yield components were evaluated. The results showed that soil from the lowest coffee cultivation intensity exhibited the lowest toxicity potential, producing vegetative growth comparable to non-agroforestry soil. In contrast, soil from the most intensively managed coffee system significantly reduced tomato productivity, decreasing fruit number and fruit weight by up to 72.14% and 73.99%, respectively. These findings indicate that increasing coffee cultivation intensity may enhance the accumulation of allelopathic compounds, thereby reducing the suitability of agroforestry soils for horticultural crop integration. Considering allelopathic soil toxicity is therefore essential when developing sustainable diversification strategies in pine-based coffee agroforestry systems.

Keywords: allelopathy, agroforestry, soil toxicity, terpenoid compounds

Soil CO₂ Flux Dynamics across Oil Palm Developmental Stages and Management Zones on a Selected Oil Palm Plantation in Peninsular Malaysia

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Abstract

Soil carbon dioxide (CO₂) flux represents a major component of the terrestrial carbon cycle and contributes substantially to greenhouse gas emissions from oil palm ecosystems. However, direct comparisons of soil CO₂ flux between peat and mineral soils across different plantation developmental stages and management zones remain limited. This study evaluated soil CO₂ flux dynamics in peat and mineral soil oil palm plantations representing different plantation developmental stages and management zones. Monthly field measurements were conducted at study sites in Bagan Datuk, Perak (peat), comprising replanting, young, and mature plantations, and Bukit Lawiang, Kluang (mineral), representing a mature plantation, using a portable infrared gas analyzer. Soil CO₂ flux was measured simultaneously with soil temperature, soil moisture, and other environmental factors across four management zones: weeded circle, harvesting path, inter row, and frond pile. Data were analyzed using General Linear Models (GLM) and correlation analysis. Soil type significantly influenced soil CO₂ flux, with peat soils exhibiting approximately 23% higher flux than mineral soils. Among management zones, the weeded circle recorded the highest average soil CO₂ flux, whereas the frond pile zone exhibited the lowest emissions in both peat and mineral soils. Correlation analysis revealed that the environmental controls on soil CO₂ flux varied across plantation development stages. In mature peat plantations, soil CO₂ flux was negatively correlated with soil moisture content ($r = -0.255$, $p < 0.001$) and relative humidity ($r = -0.095$, $p < 0.05$), but positively correlated with soil temperature ($r = 0.156$, $p < 0.001$). In young peat plantations, only soil temperature showed a significant positive relationship with soil CO₂ flux ($r = 0.159$, $p < 0.05$), while other environmental variables were not significant. In replanted peat plantations, stronger relationships were observed, with soil CO₂ flux negatively correlated with soil moisture content ($r = -0.285$, $p < 0.001$) and relative humidity ($r = -0.229$, $p < 0.01$), and positively correlated with soil temperature ($r = 0.353$, $p < 0.001$). These findings highlight the importance of incorporating plantation age, management zone characteristics, and environmental controls into greenhouse gas mitigation strategies for sustainable oil palm management.

Keywords: carbon dynamics, oil palm, environmental factors

Oil Palm Ecohydrology: Sap Flow Dynamics and Evapotranspiration Scaling on Tropical Peat Soil

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Abstract

Accurate quantification of crop water use is vital for optimizing agroecosystem management and mitigating climate change impacts in sensitive tropical landscapes. This study investigates the seasonal variation of oil palm (*Elaeis guineensis*) water use and its relationship with productivity on tropical peat soils. To achieve precise in-field evaluations, thermal dissipation probes (TDP) were implanted into the leaf petioles of mature oil palms to monitor sap flux densities. Based on these high-resolution sap flow measurements, oil palm stand transpiration (E_s) was determined to range between 1.57 and 1.78 mm day⁻¹. This is significantly lower than the broader ecosystem evapotranspiration (ET) values of 5.5 to 6.0 mm day⁻¹ previously reported in the literature, highlighting the distinct ecohydrological contributions of the overstory versus the understory and soil components. Furthermore, our findings reveal a clear socio-ecological trade-off: high-yielding, intensively fertilized plantations exhibit the highest transpiration rates, emphasizing a direct link between intensive management and elevated agricultural water demand. Ultimately, high-resolution sap flow monitoring proves to be a critical diagnostic tool for precision irrigation, stress mitigation, and sustainable oil palm cultivation within tropical peatlands.

Keywords: sap flow, water use efficiency, stand transpiration, tropical peatland

Performance of a Low-cost Drum Carbonizer for Mahogany and Bamboo Feedstocks: An Initiative towards Converting University Biodegradable Waste to Biochar

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Abstract

Biodegradable waste constitutes over 50.8% of solid waste streams at Tarlac Agricultural University. Given this share of generated biodegradable waste, this study evaluated a low-cost, 200-L drum-type carbonizer for producing biochar from three abundant feedstocks: mahogany shell, mahogany leaves, and bamboo. The carbonizer was fabricated from locally available materials for only USD 32.50 and operated in 3-hour batches using seasoned firewood (25-30 kg batch⁻¹; 15.5 MJ kg⁻¹ energy input) also available at the university. Performance evaluation of the 200-L drum-type carbonizer revealed a biochar yield of 39.33% from bamboo, 36% from mahogany shell, and 26% from mahogany leaves. The carbonizer operates at a specific energy requirement of 0.54 MJ/kg, a fuel consumption rate of 8.56 MJ/hr, an operating time of 3.3 hours, and total energy consumption of 502 MJ. Results confirmed that the 200-L drum-type carbonizer is a reliable unit for small-scale biochar production. Proximate analysis revealed high volatile matter ranging from 66.6-93.1% and low fixed carbon content ranging from 3.5-13.6%, indicating incomplete, low-temperature pyrolysis, and higher heating values ranging from 17.1 to 18.4 MJ kg⁻¹, lower than fully pyrolyzed biochar. Based on the characterization results, bamboo biochar with 13.6% fixed carbon is best suited for soil conditioning and water filtration, mahogany shell biochar with 7.3% fixed carbon is suited for composting additives, and mahogany leaf biochar with 3.5% fixed carbon is recommended as supplemental fuel. The developed low-cost drum carbonizer offers a technically feasible, low-cost solution for on-site institutional waste conversion.

Keywords: biochar, drum carbonizer, mahogany, bamboo, slow pyrolysis

Advancing Surveillance and Biocontrol Measures Against Emerging Leaf Diseases of Rubber in the Philippines

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Abstract

Rubber tree (*Hevea brasiliensis*) cultivation is one of the most important agricultural industries in Mindanao, Philippines, providing a vital source of livelihood for thousands of farmers. However, the rubber industry is increasingly challenged by emerging diseases that have reduced productivity worldwide. This study assessed the prevalence of foliar diseases in rubber trees, including *Colletotrichum* leaf spot, *Corynespora* leaf fall, *Phytophthora* blight, powdery mildew, bird's eye spot, Pestalotiopsis leaf fall, algal leaf disease, and the first report of *Colletotrichum tropicale* in the country. Eighteen antagonistic endophytes were identified as potential biocontrol agents against key pathogens (*Colletotrichum tropicale*, *Corynespora cassiicola*, *Phytophthora palmivora*, and *Neopestalotiopsis clavispora*), with their effectiveness tested *in vitro* and in nursery settings. The research project also aided local government units (LGUs) and farmers in validating and monitoring the destructive Pestalotiopsis leaf fall disease. In collaboration with the DA-Philippine Rubber Research Institute (PRRI), the disease was confirmed in Cotabato and several other provinces, including Basilan, Zamboanga Sibugay, Bukidnon, and Agusan del Sur. Incident reports led to policy measures such as quarantine regulations and a state of calamity declaration in Basilan, prompting significant government intervention and ongoing research into the potential utility of the biocontrol agents identified in this project.

Keywords: emerging diseases, biocontrol, rubber tree, pathogens, endophytes

Effects of Palm Kernel Cake and Decanter Cake Combinations on Growth Performance, Carcass Traits, Gene Expression, and Breast Meat Composition in Broiler Chickens

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Abstract

This study assessed the impact of varying inclusion levels and combinations of palm kernel cake (PKC) and decanter cake (DC) on broiler chicken performance. A total of 1,260 one-day-old male broilers were randomly assigned to 18 groups: treatment 1 was the basal-diet control, while treatments 2 and 3 contained 5% PKC and 5% DC, respectively. Treatments 4 to 18 contained combinations of PKC and DC in different ratios (30:70, 50:50, 70:30) and inclusion levels (2%, 4%, 6%, 8%, 10%). Data were analyzed using the General Linear Model (GLM) procedure in Statistical Analysis System (SAS) software. Treatment differences were determined by one-way analysis of variance (ANOVA), and Duncan's Multiple Range Test was used for post hoc mean comparisons at $p < 0.05$. Dietary inclusion of PKC and DC combinations at levels of 6-10% resulted in lower ($p < 0.05$) body weight (BW) and body weight gain (BWG), accompanied by a higher ($p < 0.05$) feed conversion ratio (FCR). Likewise, broilers fed PKC and DC combinations at 8% and 10% inclusion levels had reduced ($p < 0.05$) carcass weight and breast relative weight. In contrast, hepatic growth-related and intestinal nutrient transporter gene expression remained unaffected ($p > 0.05$) across all treatment groups. Additionally, no significant effects ($p > 0.05$) were detected on the moisture, crude protein (CP), or ash content of broiler breast meat; however, higher inclusion levels resulted in higher ($p < 0.05$) ether extract (EE) content. In summary, PKC and DC can be used in various combinations at inclusion levels up to 4% without adversely affecting overall broiler performance. However, inclusion levels of 6% or higher generally reduced growth performance and feed efficiency, regardless of the combination ratio of these by-products.

Keywords: broiler performance, carcass traits, decanter cake, sustainable feed ingredient, palm kernel cake

Stochastic Weather Generator for Tropical Malaysian Oil Palm Systems

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Abstract

Weather generators provide synthetic daily climate data essential for agricultural risk assessment in tropical regions, where continuous, long-term meteorological records are frequently unavailable. In Malaysia's oil palm and other perennial crop systems, this data scarcity limits the reliability of yield and water balance simulations under variable climate conditions. This study developed and validated MsiaGen, a stochastic daily weather generator built for Malaysia's humid tropical climate, and evaluated its capacity to reproduce observed weather statistics and support oil palm yield simulation. MsiaGen generates minimum and maximum air temperature using a skew normal distribution to capture asymmetry in the observed data, wind speed using a Weibull distribution, and rainfall using a Gamma distribution conditioned on a two-state Markov chain for wet and dry day sequencing, with a first-order autoregressive process linking successive days. The model was calibrated with data from 12 sites and validated independently at 11 additional sites spanning Peninsular and East Malaysia. At the monthly scale, mean absolute errors were below 1.2% for temperature, 2.4% for wind speed, and 1.8% for rainfall, with near-zero bias and Kling-Gupta Efficiency scores above 0.8. At the daily scale, quantile-quantile comparisons showed close agreement for temperature within the common range of 21 to 28 °C (minimum) and 25 to 39 °C (maximum). Cumulative distribution analysis indicated that $85 \pm 10\%$ of daily temperature errors fell within ± 2.0 °C, $94 \pm 6\%$ of wind speed errors fell within ± 1.0 m/s, and $83 \pm 5\%$ of rainfall errors fell within ± 20 mm, though accuracy declined for rainfall above 80 to 100 mm and wind speeds above 3 to 4 m/s, reflecting the limited length of the observational records (3 to 5 years) and the difficulty of representing distribution tails. Oil palm yield simulations driven by MsiaGen-generated weather at two independent plantation sites reproduced the temporal yield dynamics observed across multiple planting densities. These results indicate that MsiaGen offers a data-efficient and site-adaptable tool for generating realistic tropical weather sequences, with direct application to climate risk assessment and crop simulation modeling for oil palm and other perennial crops grown under data-scarce tropical conditions.

Keywords: stochastic weather generator, Markov chain, skewed temperature distribution, oil palm yield, tropical agriculture

Screening and Response of Commonly Used Farmers' Varieties of Rice (*Oryza sativa* L.) to Different Levels of Saline Soil Conditions

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Abstract

This research study aims to identify and classify some rice varieties commonly used by farmers in the coastal municipalities of San Andres and Calatrava, Romblon. Salinity is a major problem for rice areas situated along the coast of the island province of Romblon. It focuses on the response of rice varieties to varying levels of salinity in the soil. The study examined the responses of three farmers' commonly used rice varieties (PSB Rc18, NSIC Rc160, and NSIC Rc216) to different levels of salinity during seed germination and early vegetative phases. Additionally, these varieties, along with controlled varieties IR29 (salt-sensitive control) and FL478 (salt-tolerant control), were evaluated for their responses to NaCl stress during the vegetative, reproductive, and ripening phases. Results showed that PSB Rc18 exhibited salt tolerance during seed germination, while NSIC Rc160 and NSIC Rc216 were sensitive to salt stress. During the vegetative to ripening phases, the three common rice varieties showed varying responses in morphological and agronomic parameters under different levels of saline soil conditions. NSIC Rc160 was observed to be tolerant to salt in terms of its number of tillers and plant height, while NSIC Rc216 was tolerant in terms of leaf counts during vegetative and reproductive phases. PSB Rc18 was observed to be salt sensitive during early vegetative growth but tolerant during the booting stage. Responses of the three rice varieties to levels of soil salinity differ across growth stages and phases. This study provides insights into the salt tolerance or salt sensitivity of common rice varieties.

Keywords: soil salinity, saline rice varieties, island-based rice farming

Evaluation of Locally Formulated Feed on Growth Performance of Broiler and Native Chicken

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Abstract

Locally formulated feeds (LFF) play a substantial role in the growth performance of broiler chickens (BC) and native chickens (NC), ensuring that diets are suitable and adaptable, while also supporting sustainable poultry production, strengthening food security, and promoting the use of available local resources. This study was conducted to determine and compare the effect of LFF on broiler and native chicken growth performance, which comprised the main plot with BC and NC, and the sub-plot with the different levels and types of feed. A total of 27 BC and 27 NC chickens were randomly divided into 3 treatments with 9 replications each, using a CRD and Split Plot Design. The results were numerically different but not statistically distinct. The introduction of LFF did not significantly alter the growth performance of native chickens compared to CF, while BC showed greater variability across treatments. Treatments 1 and 2 were statistically similar, but both were significantly lower than Treatment 3, indicating that broilers fed exclusively with CF attained the highest final weight. LFF affect weight gain, feed conversion, and overall health of poultry, ensuring that BC achieved fast growth while NC maintained their adaptability and resilience. BC and NC consumed comparable amounts of feed across treatments, indicating that the incorporation of alternative ingredients such as mabolo leaf meal and vermi meal did not deter acceptability or palatability. Findings also showed that locally formulated feeds can serve as a sustainable supplement to commercial rations and are therefore ideal for low-cost rural production.

Keywords: feed consumption, feed conversion ratio, ingredients, vermi meal, supplement

Pathways to Food Insecurity: The Role of Food Sourcing, Socioeconomic Status, and Health in Palawan

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Abstract

Food insecurity remains a major public health challenge in low- and middle-income countries, particularly in geographically isolated and resource-dependent regions such as Palawan, Philippines. This study examined the prevalence and determinants of moderate-to-severe food insecurity, emphasizing the role of household food-sourcing strategies. A cross-sectional analysis was conducted using data from 713 households participating in the Global Community Food and Health (CFaH) Philippines project. Food insecurity was assessed using the Food Insecurity Experience Scale (FIES), and multivariable Poisson regression models were used to identify associated factors. Overall, 33.9% (± 5.21) of households experienced moderate-to-severe food insecurity, while 4.1% (± 1.88) experienced severe food insecurity. Older age was associated with a lower likelihood of food insecurity (IRR = 0.98, $p < 0.001$). Higher educational attainment was strongly protective, with secondary education (IRR = 0.56, $p < 0.001$) and university education (IRR = 0.22, $p < 0.001$) significantly reducing risk. Conversely, unemployment was associated with increased food insecurity (IRR = 1.42, $p < 0.05$). Households practicing self-sourcing through food production were significantly less likely to experience food insecurity (IRR = 0.76, $p < 0.05$), whereas reliance on purchased food showed a higher, although non-significant, likelihood of food insecurity (IRR = 1.79, $p > 0.05$). These findings underscore the importance of strengthening local food production, improving educational and employment opportunities, and promoting diversified food access pathways to enhance household resilience and reduce food insecurity in vulnerable coastal communities.

Keywords: food insecurity, food sourcing, food production, socioeconomic determinants, Palawan

Environmental Management Practices in the Agricultural Sector: A Contingency Theory Perspective

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Abstract

This study investigates the role of organizational structure of decision making in fostering and enhancing environmental management practices. This study also considers the moderating impact of external pressures from global awareness, social relationships, technological dynamics, and governmental initiatives on this process. Building on contingency theory, this study argues that a decentralized structure is more suitable for agricultural firms to adapt to external pressures while implementing environmental management practices. The survey data were drawn from 161 agricultural firms in Malaysia. The findings show that decentralized structure positively influences environmental management practices in the agricultural sector, while external pressure from technological dynamics and governmental initiatives has less impact on environmental management practices. Interestingly, the results show the important roles of technological dynamics and governmental initiatives, which positively support the impact of decentralized structure on environmental management practices. Overall, the findings underscore the interconnectedness of organizational structure and environmental management practices, especially in the context of agricultural firms.

Keywords: environmental management practices, organizational structure, global awareness, technological dynamics, governmental initiatives

University-Led Technological Upgrading of a Mushroom Supply Chain in Laguna, Philippines

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Abstract

Small-scale mushroom producers in Laguna face recurring problems with substrate supply, environmental control, uneven harvests, short shelf life, and limited market reach. This study examined how the Laguna State Polytechnic University Mushroom Research and Production Center responded by gradually upgrading a local mushroom supply chain. A narrative case study with producer-centered supply-chain mapping involved seven representatives, one from each purposively selected mushroom grower group. Data were obtained through survey, in-depth interviews, document review, and social-network mapping. Frequency, percentage, percentage change, yield indicators, and cost-and-return measures summarized quantitative data, while interview accounts were thematically analyzed and triangulated with documentary evidence. The chain map covered input sourcing, fruiting-bag preparation, cultivation, processing, and marketing. Results showed three forms of upgrading: process upgrading through deployable automation, hobbyist cabinets, and mushroom-fish integration; product upgrading through white, pink, yellow, and brown oyster mushrooms; and coordination upgrading through LSPU-led knowledge and market networks. Controlled cultivation recorded 1.0 kg per bag per three-month cycle versus 0.6 kg traditionally and shortened harvest intervals from 5-7 to 3-5 days. A four-month deployable house production cycle produced 2,600 kg of fresh mushroom from 3,000 fruiting bags, generating PHP 650,000 gross revenue and PHP 487,250 net return. All seven groups reported that networks improved access to inputs, farming knowledge, and markets through collective sourcing, group marketing, trade fairs, and online channels. Technology strengthened production, while university coordination connected upstream supplies with downstream markets. Persistent constraints included raw-material shortages, pest infestation, weather variability, financial and technological limitations, and incomplete market coordination. University-led upgrading is most effective when production technologies are matched with supply-chain relationships and services.

Keywords: mushroom supply chain, technological upgrading, university-led innovation, social networks, food security

Examining Socioeconomic Factors and Adoption Challenges of IoT Technologies among Youth Agropreneurs in Malaysia

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Abstract

The adoption of Internet of Things (IoT) technology, particularly in fertigation systems, has the potential to improve agricultural productivity and support better farm management. In Malaysia, the government is actively encouraging IoT adoption among agropreneurs, particularly youth, as they are perceived as individuals who are open to innovation and change. However, their participation in this transformation remains constrained by socioeconomic disparities and adoption barriers. Hence, this study aims to describe the socioeconomic characteristics of youth agropreneurs in Peninsular Malaysia, identify the challenges related to IoT adoption, and examine the relationship between socioeconomic factors and IoT adoption. Data were collected through a structured questionnaire involving both IoT adopters and non-adopters among 352 youth agropreneurs in Peninsular Malaysia. The data collected were analyzed using descriptive analysis to profile the respondents, while cross-tabulation and Chi-square analyses were conducted to examine the relationship between socioeconomic characteristics and adoption challenges. The results indicate that high initial investment costs, concerns about risks, limited technical skills, and lack of knowledge were identified as the main challenges influencing adoption. The results further revealed that several socioeconomic factors, including age, education level, monthly income, and geographical location, were significantly associated with IoT adoption. However, farming experience did not show a significant relationship with adoption. These results suggest that digital transformation in agriculture is shaped not only by technological availability but also by the socioeconomic context of intended users. The findings provide useful information for policymakers, agricultural agencies, and technology providers in developing targeted support programs, training initiatives, and policies to encourage wider IoT adoption. This study contributes to the growing literature on digital agriculture by emphasizing the importance of socioeconomic factors in overcoming barriers to IoT adoption among youth agropreneurs in Malaysia.

Keywords: Internet of Things (IoT), youth agropreneurs, socioeconomic factors, adoption challenges, digital agriculture

Bamboo-Based Agroforestry Innovations for Climate-Resilient Agriculture and Food Security

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Abstract

Climate change, land degradation, biodiversity loss, and food insecurity continue to threaten the sustainability of agricultural systems across Asia. These challenges require innovative land-use strategies that enhance agricultural productivity while strengthening ecosystem resilience. This paper presents the research, extension, and technology commercialization initiatives of Mariano Marcos State University (MMSU) in promoting bamboo-based agroforestry as an innovative model for climate-resilient agriculture and food security. The paper synthesizes MMSU's experiences in bamboo propagation, plantation establishment, rehabilitation of degraded lands, sustainable bamboo shoot production, value-added processing, enterprise development, and community capacity-building activities. Through the integration of scientific research, technology transfer, extension services, and multi-sectoral partnerships, bamboo-based farming systems have been promoted among local communities, government agencies, and industry partners. The MMSU experience demonstrates that bamboo-based agroforestry improves soil and water conservation, enhances carbon sequestration, restores degraded landscapes, and increases biodiversity. The integration of bamboo into farming systems also diversifies farm production, creates additional livelihood opportunities through bamboo shoots and value-added products, and strengthens farmers' resilience to climate-related risks. University-led innovation and extension programs have further accelerated the adoption of sustainable technologies and strengthened institutional collaboration. The study concludes that bamboo-based agroforestry is a scalable, university-driven innovation that supports climate resilience, environmental sustainability, and food security while providing a replicable model for sustainable agricultural transformation.

Keywords: bamboo-based agroforestry, climate resilience, food security, nature-based solutions, sustainable agriculture

Comparing the Characteristics of Biochar and Hydrochar Production Using Pyrolysis and Hydrothermal Methods: Effect on Seedling Growth

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Abstract

Biochar and hydrochar are increasingly used for environmental remediation and soil improvement because they supply essential nutrients and enhance soil physical and chemical properties. Enriching these carbon-rich materials with nutrient-rich wastes such as eggshells has shown potential for improving soil fertility and crop production, especially in acidic soils. This study aimed to compare the characteristics of carbon-rich materials, namely biochar and hydrochar, produced from poultry litter alone or mixed with eggshell, and to evaluate their effects on rice seedling growth. Poultry litter was collected from D'Khairan Poultry Farm in Sungai Besar, Selangor, Malaysia, while eggshells were obtained from restaurants. Hydrochar was produced in the Department of Civil Engineering, Faculty of Engineering, Universiti Malaya, whereas biochar was produced at the Head House, Faculty of Agriculture, Universiti Putra Malaysia. Hydrochar was produced by hydrothermal carbonization at 240 °C for 3 hours using a biomass-to-water ratio of 1:3. Biochar was produced by pyrolysis at 400 °C for 5 hours. Standard physical and chemical analyses determined material properties, while scanning electron microscopy, X-ray diffraction, and Fourier-transform infrared spectroscopy assessed surface morphology, structural characteristics, and chemical composition. A laboratory experiment arranged in a completely randomized design determined the germination index under different biochar and hydrochar treatments. Approximately 61.2% and 68.96% of the poultry litter and eggshell feedstocks were converted into biochar and hydrochar, respectively. Biochar recorded pH and electrical conductivity values of 9.04 and 8.67 mS cm⁻¹, whereas hydrochar recorded 8.70 and 2.08 mS cm⁻¹, indicating that both materials were alkaline, although biochar was more saline. Nutrient contents were higher in the carbon-rich materials than in untreated litter. Biochar had a larger surface area and a developed porous structure, indicating greater nutrient adsorption capacity than hydrochar. However, hydrochar still had a greater surface area than raw litter. X-ray diffraction showed that hydrochar contained more calcite crystals, likely because eggshell was incorporated during production. Fourier-transform infrared analysis indicated greater aromatic condensation and graphitic carbon formation in biochar due to the higher processing temperature, resulting in higher carbon content than hydrochar. Mass losses were approximately 38.8% for pyrolysis and 31.04% for hydrothermal carbonization. The germination test showed significant differences between lower and higher treatment concentrations of biochar and hydrochar, respectively. These effects may reflect increased nutrient availability, beneficial microbial activity, reduced phytotoxicity, and improved conditions for rice seedling growth. The results support further evaluation under glasshouse and field conditions to confirm their broader agronomic effectiveness.

Keywords: chicken manure, eggshell, biochar, hydrochar, rice

Evaluation of UAV-Derived Multispectral Indices for Estimating Soil Moisture in Oil Palm Plantation Areas

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Abstract

Soil moisture is an important factor for crop growth and water management in oil palm plantations. Conventional soil moisture measurements provide useful information but are limited to individual sampling locations and can be time-consuming when larger areas need to be assessed. This study evaluated the potential of Unmanned Aerial Vehicle (UAV) multispectral data for estimating soil moisture in oil palm plantations. Field measurements of Volumetric Soil Moisture Content (VMC) were collected from 32 sampling points and compared with UAV-derived spectral bands to derive the Soil-Adjusted Vegetation Index (SAVI). Pearson and Spearman correlation analyses, regression analysis, bootstrap resampling, permutation testing, and leave-one-out cross-validation (LOOCV) were used to examine the strength and reliability of the relationships. The simple SAVI regression explained approximately 40.3% of the variation in measured soil moisture. Leave-one-out cross-validation gave an R^2 of 0.379, with an RMSE of 0.058 m^3/m^3 and MAE of approximately 0.048 m^3/m^3 . These results suggest that UAV multispectral data, particularly SAVI, have potential for providing rapid spatial information on soil moisture conditions in oil palm plantation areas. Further studies using larger datasets and different soil and plantation conditions are recommended to confirm the reliability of the approach.

Keywords: UAV, multispectral imagery, SAVI, soil moisture, oil palm

Root Zone Cooling System for Sustainable Intensified Vertical Modular Hydroponics Crop Production

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Abstract

Sustainable Development Goals (SDG) 12 on responsible consumption and production and 13 on climate action, set forward by the United Nations, are directing research and government policy-making toward sustainable and improved livelihoods. This calls for human-driven solutions with sustainable impact for the end-users, the farmers and the community. Root zone cooling systems are being employed to control environmental factors affecting production, such as temperature and relative humidity, which have a direct effect on water quality parameters, especially in hydroponics production. Hence, a root zone cooling system for sustainable intensified vertical modular hydroponics crop production was designed by Bulacan Agricultural State College researchers. The general objective of the study was to design an intensified vertical modular hydroponics (IVMH) system with a root zone cooling system for crop production, determine its effects on water quality, growth and yield, and analyze area and water productivity and financial viability. Two sets of IVMH were established, one with a cooling system and one without. The root zone cooling system employed frozen ice bags submerged in the nutrient solution tank. Treatments 1, 2, and 3 used 3, 4, and 5 ice bags per day, respectively, while Treatment 4 served as the control, where no cooling system was applied in the recirculating hydroponics system. Thirty test plants per tower were randomly selected and labelled. The application of the root zone cooling system lowered the nutrient solution tank temperature by an average of 6.0 °C at 12:00 noon, before the temperature dissipated, compared with the nutrient solution tank without root zone cooling. Lowering the temperature kept pH and electrical conductivity within the recommended range. Of all the treatment and replication combinations tested, only T1R1 and T2R3 showed statistically significant differences. T1R1 stood out with an area productivity of 9.07 kg/m² and a water productivity of 223.95 kg/m³, with an extremely high F-value and a very low p-value (0.000). T2R3 also showed some effect (p = 0.009), but it was not as strong as T1R1. Financial viability showed a 20.68% return on investment and a 1.33 benefit-cost ratio, with a payback period of 4.84 years.

Keywords: root zone cooling system, sustainable intensified vertical modular hydroponics, nutrient solution, Sustainable Development Goals (SDG) 12 and 13, hydroponics production

Development and Performance Analysis of IoT-Enabled Nutrient Auto Dosing for Hydroponic Farming

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Abstract

Hydroponic farming, which utilizes soilless cultivation systems, requires precise regulation of nutrient concentration and pH to ensure optimal crop growth. Fertilizer A and Fertilizer B formulations are commonly used to supply essential macro and micronutrients in hydroponic systems. However, many existing nutrient dosing systems still rely on manual adjustments or provide limited automation and remote monitoring capabilities. This study presents an Internet of Things (IoT)-based nutrient auto-dosing system integrated with an Intelligent Nutrient Dosing Algorithm (INDA). The system employs electrical conductivity (EC) and pH sensors to continuously monitor nutrient solution conditions, while peristaltic pumps automatically dispense Fertilizer A, Fertilizer B, and pH adjustment solutions based on dosage predictions generated by INDA. These sensors and actuators are connected to a LilyGo T-Relay MCU development board with a WiFi gateway that links to the Blynk user interface platform. All sensors and actuators are tested and calibrated to ensure the accuracy of measurements. The performance characteristics analyzed in this study are nutrient volume estimation, tank volume prediction, and nutrient homogenizing duration. The developed algorithm predicts the nutrient volume required to achieve a target EC value. The homogenization characteristics of the nutrient solution were evaluated by measuring the mixing time required for newly added nutrients to become uniformly distributed within the tank. Homogenization time increased with the target EC level, requiring approximately 35 s, 117 s, and 135 s to achieve EC increments of 0.50, 1.00, and 1.50 mS/cm, respectively. This increase was primarily attributed to the longer dosing duration required to deliver larger fertilizer volumes using peristaltic pumps and the slower diffusion of nutrients at higher solution concentrations. The results demonstrate that the proposed IoT-based nutrient auto-dosing system can accurately regulate nutrient concentrations while providing automated operation and remote accessibility. Cloud connectivity enables real-time monitoring, data logging, and remote system management. This approach offers a practical and efficient solution for nutrient management in hydroponic production systems, supporting optimum resource utilization and crop performance.

Keywords: auto-dosing, nutrient concentration, Arduino IDE, leafy vegetables

Hormonal Gene Expression Changes in *Burkholderia glumae*-Infected Rice Seeds

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Abstract

Burkholderia glumae is a seed-associated bacterial pathogen that adversely affects rice germination and early seedling establishment. However, its influence on abscisic acid (ABA)- and gibberellin (GA)-regulated pathways during germination remains poorly understood. This study evaluated the impact of *B. glumae* inoculation on key hormonal and metabolic marker genes during germination of MR297. Seeds were sampled at 24, 48, and 72 hours after soaking in a bacterial solution. Relative transcript levels of *OsNCED3*, *OsABA8ox1*, *OsGA20ox1*, and *OsAmy3D* genes were quantified using qPCR, with *OsActin* as the reference gene. Gene expression was calculated using the $2^{-\Delta\Delta C_t}$ method based on three biological replicates. Bacterial inoculation induced dynamic transcriptional variation in both ABA and GA pathways. The ABA catabolic gene *OsABA8ox1* showed consistent upregulation, increasing from 1.66-fold at 24h to 5.43-fold at 72h, while the GA biosynthetic gene *OsGA20ox1* increased from 2.24-fold to 7.99-fold over the same period. In contrast, *OsNCED3* exhibited a biphasic response, with slight upregulation at 24h, downregulation at 48h, and strong induction at 72h post-inoculation. The GA-responsive alpha-amylase marker gene *OsAmy3D* was downregulated at 24-48h, followed by moderate upregulation (1.59-fold) at 72h. These findings suggest that *B. glumae* infection alters hormonal regulation during rice seed germination, potentially inciting early imbalances in ABA-GA signaling and delaying the activation of starch mobilization. Such disruptions may contribute to impaired seedling establishment. The identified marker genes provide a useful basis for further investigation into the molecular mechanisms underlying pathogen-induced germination defects.

Keywords: *Burkholderia glumae*, germination, abscisic acid, gibberellin, qPCR

Phenotypic Screening of *Oryza rufipogon* Accessions for Resistance to *Pantoea ananatis*-Induced Bacterial Leaf Blight

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Abstract

Bacterial leaf blight (BLB) of rice is a disease which has been traditionally associated with *Xanthomonas oryzae* pv. *oryzae* but has recently been associated with other emerging pathogens including *Pantoea ananatis*. This pathogen has a wide host range and is very adaptable; hence there is a need for the identification of new and durable sources of resistance. Wild rice species, especially *Oryza rufipogon* is a source of genetic variability which has a potential to be used in disease resistance breeding. However, little information is available about the resistance of *O. rufipogon* to BLB caused by *P. ananatis*. Twenty-three accessions of *Oryza rufipogon* were screened in the greenhouse with controlled conditions to determine their BLB susceptibility. This experiment was carried out in a randomized complete block design (RCBD) including two susceptible controls with four replications.. The standard leaf clipping method was used to inoculate the plants and the disease severity was evaluated 21 days after inoculation (DAI) based on the International Rice Research Institute (IRRI) Standard Evaluation System for Rice. This method allowed the reliable phenotypic evaluation and reproducibility of results among replications. The results showed significant variation between the evaluated accessions, suggesting that the wild rice population has a wide diversity of BLB responses. Resistant reactions were observed in four accessions (IRGC 86701, IRGC 104484, IRGC 104870 and IRGC 106106), indicating the presence of effective defense mechanisms against *P. ananatis*. One accession was classified as moderately susceptible, one as susceptible, and the majority (17 accessions) as highly susceptible. These findings highlight the aggressive nature of the pathogen and suggest that resistance traits are relatively rare within the germplasm tested. The resistant *O. rufipogon* accessions identified in this study represent valuable genetic resources for the improvement of BLB resistance in cultivated rice. These accessions provide a basis for further genetic dissection of resistance mechanisms through advanced genomic approaches such as genome-wide association studies (GWAS), quantitative trait locus (QTL) mapping, and candidate gene analysis. The identification and utilization of resistance-associated alleles from wild rice germplasm could facilitate the development of durable BLB-resistant rice cultivars, contributing to sustainable disease management and enhanced rice productivity.

Keywords: *Oryza rufipogon*, bacterial leaf blight, *Pantoea ananatis*, phenotypic screening, disease resistance

Weed Management of *Paspalum conjugatum* in MD2 Pineapple Plantation

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Abstract

Weeds compete directly with pineapple planting for sunlight, moisture, nutrients and often act as hosts for insect pests. In MD2 pineapple plantation, silver-shine plastic mulch is commonly applied across the planting beds to suppress weed growth. At FGV Tawai 03, Gerik, Perak, Ametryn 80% is used as a standard practice for sprays as pre-emergence and early post-emergence herbicide for effective control of weed that emerged on the planting hole and inter-row of the planting bed. However, the hardy weed *Paspalum conjugatum* has not been effectively eliminated by this approach. Therefore, a herbicide evaluation study was conducted to assess the efficacy of selected herbicides against *Paspalum conjugatum* in the MD2 pineapple plantation. A quadrat trial consisting of four treatments was laid out in a randomized complete block design (RCBD) with three replications. Each experimental plot measured 4.0 m². The herbicide treatments included Ametryn 80% (T1), Fluazifop-P-butyl 13.2% (T2), Diuron 40% + Ametryn 40% (T3) and Diuron 80% (T4). Results showed that Fluazifop-P-butyl 13.2% (T2), Diuron 40% + Ametryn 40% (T3) and Diuron 80% (T4) effectively eliminated *Paspalum conjugatum*, achieved complete weed control by 4 weeks after treatment (WAT). The result also clearly showed that MD2 pineapple plant is tolerant to these herbicides without showing any phytotoxicity symptom following these herbicides application. Hence, Fluazifop-P-butyl 13.2%, Diuron 40% + Ametryn 40% and Diuron 80% were effective herbicides for controlling *Paspalum conjugatum* and safe for use in large scale MD2 pineapple plantation.

Keywords: MD2 pineapple, herbicide, *Paspalum conjugatum*

Effects of Gelam (*Melaleuca cajuputi*) Leaf Hydrosol on Insect Pest and Beneficial Arthropods in Sweet Potato

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Abstract

Sweet potato (*Ipomoea batatas*) production is severely constrained by insect pests and vector-borne diseases, particularly Sweet Potato Virus Disease (SPVD), which reduce yield and crop quality. The widespread use of synthetic insecticides has raised concerns on environmental harm, resistance by pests, as well as adverse effects on useful arthropods. This study looked at the performance of Gelam (*Melaleuca cajuputi*) hydrosol of leaf as a botanical pest control agent in the growth of sweet potato with a particular emphasis on insect pests and beneficial arthropods. The experiments were conducted at the UniSZA Besut Campus on two plots: hydrosol-treated and the conventional plot, applied with synthetic insecticides. The Malaise traps, sticky traps, yellow pan traps, and pitfall traps were used to monitor the insects every two weeks and identify them at the laboratory. The findings indicated that the number of insect pests (560 individuals) was lower in the hydrosol treated plot than in the conventional plot (740 individuals). It is noteworthy that the major pest species, such as *Cylas formicarius*, and *Bemisia tabaci* reductions were significantly reduced in the hydrosol plot. The results indicate that Gelam leaf hydrosol could serve as an ecologically neutral tool to control pests to reduce the population of insects and cause minimal harm to useful arthropods. Based on this study, it is possible to recommend the application of Gelam hydrosol in integrated pest management (IPM) methods because of sustainable production of sweet potatoes.

Keywords: sweet potato, gelam, beneficial arthropods, integrated pest management

Behavioral Patterns, Morphological Characteristics, and Histological Architecture of the Vomeronasal Organ of *Hystrix brachyura*

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Abstract

The Malayan porcupine (*Hystrix brachyura*) is a nocturnal rodent widely distributed across Southeast Asia. Despite its wide distribution, the Malayan porcupine remains poorly studied, particularly regarding its behavioral ecology and chemosensory system. Sex-related variation strongly influences mammalian behavior, reproductive signaling, and sensory processing. Chemical communication is a fundamental mechanism regulating social interactions, reproductive behavior, territoriality, and mate recognition in many mammalian species. In nocturnal mammals, where visual cues are often reduced, chemical signals become particularly important for facilitating communication between individuals and coordinating reproductive activities. The detection and interpretation of these chemical signals are mediated by specialized sensory systems that influence a wide range of behavioral and physiological responses. Therefore, this study serves as a baseline investigation of behavioral ecology and chemosensory anatomy in the Malayan porcupine. This study aims to investigate behavioral patterns and characterize the morphology and histology of the vomeronasal organ (VNO) of *H. brachyura*. Behavioral observations were conducted using camera trapping to document reproductive and dyadic interactions. Morphological features of the VNO were examined through macroscopic observation and morphometric measurements. Histological analyses were performed using hematoxylin and eosin staining, supported by CT imaging of transverse anatomical sections. It is expected that distinct behavioral patterns will be associated with VNO-related sensory function. Differences in VNO morphology are anticipated to reflect sexual dimorphism and functional specialization. Histological results are expected to describe the structural organization of the vomeronasal system. Overall, this multidisciplinary study provides foundational knowledge on the behavioral ecology and chemosensory biology of *Hystrix brachyura*, supporting future conservation strategies and captive breeding management in Malaysia.

Keywords: *Hystrix brachyura*, vomeronasal organ, behavior, histology, morphology

A Spreadsheet Tool for Simulating Whiteleg Shrimp Growth Under Water Quality Stress

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Abstract

Shrimp farming relies heavily on tight operational control to remain profitable, as water quality fluctuations pose financial risks through reduced growth and poor feed conversion. To address this, we modified the shrimp growth model developed by Franco et al. (2006) to predict the growth of whiteleg shrimp (*Litopenaeus vannamei*) in aquaculture systems. The original mechanistic model is based on a bioenergetic framework encompassing ingestion, gut processing, assimilation, and respiration that lead to dynamic growth outputs, namely total length (mm) and fresh weight (g). Our study expanded this model to incorporate dynamic physiological stress responses to critical water quality variables, in particular dissolved oxygen (DO), turbidity, pH, and temperature. The expanded model was programmed and simulated in Microsoft Excel, using a daily time-step over a standard 100-day production cycle under varying environmental scenarios. The validity of the model's behavior was evaluated by comparing shrimp weight output simulation against values in published literature. The predicted shrimp weight growth aligned closely with literature values, supporting the underlying biological logic of the model. Furthermore, the expanded shrimp growth model showed a clear response to changes in water quality conditions. Simulation scenarios demonstrated distinct growth reductions under water quality stress, with DO, pH, and turbidity producing stronger negative effects on yield than temperature. By translating the complex bioenergetic interactions into an accessible spreadsheet tool (Microsoft Excel), this study provides farm managers with a predictive decision-support framework to anticipate yield loss caused by water quality fluctuations and to evaluate potential intervention strategies through scenario testing. Future work will focus on calibrating and validating the model with field data.

Keywords: shrimp growth model, water quality, aquaculture, spreadsheet tool, precision aquaculture

Determination of True-to-Type Coconut Palms in Malaysian Varieties Sungai Gulang-Gulang (SGG) and Tacunan Dwarf (TACD) Using SNP Markers and Artificial Intelligence Approaches

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Abstract

Ensuring the authenticity of coconut planting materials is essential for improving productivity, supporting breeding programs, and strengthening food security in sustainable agricultural systems. In Malaysia, the Sungai Gulang-Gulang (SGG) and Tacunan Dwarf (TACD) coconut varieties are widely promoted due to their early bearing, high yield potential, and adaptability. However, the absence of reliable early-stage identification tools for true-to-type palms poses a major constraint, often leading to the distribution of non-true-to-type seedlings that reduce plantation performance and economic returns. This study aims to develop an integrated framework combining Specific-Locus Amplified Fragment sequencing (SLAF-seq)-derived single nucleotide polymorphism (SNP) markers, digital phenotyping, and artificial intelligence (AI) for accurate early-stage identification of true-to-type SGG and TACD coconut seedlings. High-density SNP markers will be identified using SLAF-seq to discover informative genetic markers capable of distinguishing true-to-type and non-true-to-type individuals. In parallel, digital phenotypic traits will be acquired using RGB imaging and spectral reflectance analysis to capture morphological and physiological traits associated with genetic purity. The genotypic and phenotypic datasets will then be integrated to train an AI-based classification model for rapid and precise varietal identification. Integrating SNP-based genetic signatures with phenotypic trait patterns is expected to improve classification accuracy compared with conventional visual assessment. The resulting framework is expected to provide a robust, scalable, and early-stage screening tool for coconut variety authentication, thereby improving planting material quality, accelerating breeding programs, and supporting long-term sustainable coconut production and food security.

Keywords: *Cocos nucifera*, SLAF-seq, SNP markers, digital phenotyping, artificial intelligence

Impact of Prolonged Dry-Season Stress on Fruit Quality of MD2 Pineapple in Northern Peninsular Malaysia

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Abstract

Prolonged dry season and increasing climate variability nowadays pose variation of risks to pineapple production, especially for MD2 cultivar which been quite vulnerable to changes. Moreover, market had been requesting consistent fruit size and appearance make supervising for MD2 fruit quality to be crucial. This study was conducted in Changlun, Kedah where the area has experiencing extreme dry period from December 2025 to March 2026, where monthly rainfall was below 20 mm, continued with low rainfall in April 2026 (<100 mm). The objective of this study was to evaluate the impact of prolonged dry season stress on fruit defect incidence, severity of dry stress symptoms and fruit quality of MD2 pineapple under commercial plantation conditions. An observational field study using mixed sampling approaches was implemented. First, a full census was carried out across five production plots, namely plot 72, 73, 74, 79 and 80 was conducted to determine defect incidence and frequency distribution. Second, 121 symptomatic plants were subjected to detailed field diagnostic assessment using purposive census sampling, focusing on unusual symptoms for three production plots. Third, 55 of normal, short crown and short with scorching crown fruits from three production plots were sampled for selected quality measurements likes fruit weight, length and circumference. Fruit defects were grouped into biotic damage, abiotic stress injury, developmental defects, and disease/other disorders. Overall, 87.7% of fruits were normal, while 12.3% showed defects. Developmental defects were the most prevalent (7.4%), followed by abiotic stress injury (3.1%) and biotic damage (1.7%). Disease and miscellaneous defects were minimal (0.1%). There is substantial variation at plot level. For Plot 73, it is recorded to has highest biotic damage (9.1%) which are crown damage by animal infestation, such as rat attacks. This occurs likely due to association with increased of animal activity or migration during dry conditions. On the other hands, Plot 72 has showed the highest developmental defects (13.0%). Major developmental symptoms observed at Plot 72 were small fruits and stunted plants. These findings show that prolonged dry season stress can impair fruit quality directly or through plant development, and subsequently increase vulnerability to secondary pest damage. Adaptive mitigation strategies could be adopted such as supplemental irrigation, canopy protection, and intensified pest surveillance are recommended during prolonged dry season to minimize yield and quality losses. This study provides practical field evidence of climate-related production risks to MD2 pineapple cultivation in northern Peninsular Malaysia.

Keywords: drought, dry season, fruit quality, MD2 commercialization plantation

Evaluation of Different Inclusion Levels of Palm Kernel Expeller and Empty Fruit Bunch on *In Vitro* Gas Production and Rumen Fermentation in Beef Cattle

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Abstract

Palm kernel expeller (PKE) and empty fruit bunches (EFB) have potential as alternative raw ingredients in beef cattle feed formulations. This study evaluated the effects of incorporating PKE and EFB at varying levels on *in vitro* gas production and rumen fermentation characteristics in beef cattle. Six dietary treatments were formulated: T1 (70% PKE, 5% EFB), T2 (70% PKE, 10% EFB), T3 (70% PKE, 15% EFB), T4 (65% PKE, 5% EFB), T5 (65% PKE, 10% EFB), and T6 (65% PKE, 15% EFB). Rumen fluid was collected from slaughtered beef cattle, pooled, and used as the inoculum for the *in vitro* gas production study. The experiment was conducted twice, and all data were analyzed and presented as mean values. After 48 h of incubation, T5 produced the highest gas production ($P < 0.05$), reaching 101.52 mL/500 mg, and was associated with superior *in vitro* dry matter degradability (*ivDMD*) and *in vitro* organic matter degradability (*ivOMD*), with values of 60.11% and 70.35%, respectively. Volatile fatty acid (VFA) analysis revealed that T1 produced a higher ($P < 0.05$) total VFA concentration (60.04 mM) compared to other treatments, but not significantly different ($P > 0.05$) from T5 (53.54 mM), suggesting comparable fermentation efficiency between these two treatments. In terms of individual VFA profiles, T5 exhibited the highest acetic acid concentration (16.66 mM), followed by T1 (15.59 mM), although no significant differences were observed among treatments ($P > 0.05$). Overall, the findings indicate that moderate inclusion levels of PKE and EFB, as represented by T5, optimize rumen fermentation characteristics and degradability, making it a promising dietary formulation for improving feed utilization efficiency in beef cattle.

Keywords: beef cattle, dry matter degradability, organic matter degradability, palm by-products, rumen fermentation

Biosynthesis of Copper Oxide Nanoparticles Using Turkey Berry (*Solanum torvum*) Root Extract as a Potential Bio-Coating Against *Colletotrichum musae* in Señorita Banana (*Musa acuminata*) Cultivar

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Abstract

Anthrachnose disease caused by *Colletotrichum musae* is a major postharvest problem affecting Señorita banana (*Musa acuminata*) cultivars and results in significant economic losses during storage and marketing. This study aimed to biosynthesize copper oxide nanoparticles (CuO-NPs) using Turkey berry (*Solanum torvum*) root extract and evaluate their antifungal potential as a bio-coating against *C. musae* through in vitro and in vivo assays. CuO-NPs were synthesized through green synthesis and characterized using UV–Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, and Scanning Electron Microscopy (SEM). UV–Vis analysis revealed absorption peaks within the 250–350 nm range, indicating successful CuO-NP formation. FTIR spectra identified functional groups such as O–H, C=C, C–N, and C–O, confirming the role of phytochemicals as reducing and stabilizing agents, while SEM images showed irregular and aggregated polycrystalline morphologies. Antifungal activity was evaluated using poisoned food technique and fruit coating application at concentrations of 25 ppm, 50 ppm, and 75 ppm. Results showed that CuO-NPs reduced radial mycelial growth and fungal development, with higher concentrations exhibiting greater inhibition during early observation periods. Two-way Analysis of Variance (ANOVA) indicated that observation day significantly affected percent inhibition ($P < 0.05$), whereas treatment concentration and interaction effects were not statistically significant ($P > 0.05$). In vivo results demonstrated reduced infection, lesion diameter, and disease severity in treated fruits, particularly under unwounded conditions. These findings suggest that biosynthesized CuO-NPs from *S. torvum* root extract have potential as an eco-friendly bio-coating for postharvest anthracnose management in banana fruits.

Keywords: copper oxide nanoparticles (CuO-NPs), green synthesis, antifungal activity, anthracnose, bio-coating.

Effects of Fish Oil Supplementation in an Egg Yolk-Tris-Glycerol Extender on Post-Thaw Semen Quality in Kamphaeng Saen Beef Bulls

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Abstract

Post-thaw sperm quality is a critical determinant of the efficiency of artificial insemination and genetic conservation in breeding bulls. Cryopreservation and thawing can induce oxidative stress and damage sperm membranes and cellular structures, thereby compromising sperm motility and functional integrity. Fish oil is a rich source of polyunsaturated fatty acids and may modulate oxidative damage and maintain sperm membrane integrity. This study evaluated the effects of fish oil supplementation in an egg yolk-Tris-glycerol (ETG) extender on the post-thaw semen quality of Kamphaeng Saen beef bulls. Semen was collected from 5 bulls at 1-week intervals. Each ejaculate was divided equally into 4 treatments: 1) ETG extender (Control), 2) ETG supplemented with 1 mg fish oil/ml (FO1), 3) 2 mg fish oil/ml (FO2), and 4) 3 mg fish oil/ml (FO3). Semen samples were cooled from 37 to 4 °C, packaged in 0.25 ml French straws, and frozen in liquid nitrogen vapor at approximately -120 °C for 4 min before storage in liquid nitrogen at -196 °C for 24 h. After thawing, semen quality was assessed using computer-assisted sperm analysis (CASA), including total motility, progressive motility, sperm velocity, sperm movement characteristics, and sperm abnormality. Malondialdehyde (MDA) levels were also determined as an indicator of lipid peroxidation. The FO3 treatment showed the highest total sperm motility (70.08%) compared with the Control (59.80%), FO1 (60.27%), and FO2 (56.13%) treatments; however, the difference was not statistically significant, although a trend was observed ($P = 0.073$). No significant differences among treatments were detected in progressive motility, sperm velocity, sperm movement characteristics, sperm abnormality, or MDA levels ($P > 0.05$). In conclusion, supplementation of fish oil at 3 mg/ml in an ETG extender showed a potential beneficial trend in post-thaw sperm motility in Kamphaeng Saen bulls. Further studies with larger sample sizes and additional oxidative stress and sperm function biomarkers are warranted to confirm these findings and elucidate the underlying mechanisms.

Keywords: cryopreservation technologies, cryoprotective additives, fish oil, Kamphaeng Saen bulls

Melatonin-Mediated Postharvest Preservation of Carabao Mango for Enhanced Storage Efficiency

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Abstract

Melatonin (MLT) was reported to ameliorate chilling injury (CI) in other mango cultivars, hence this study aimed to enhance the cold tolerance of ‘Carabao’ mango fruits through MLT treatment, and to elucidate the mechanism behind CI amelioration during storage at 7°C for six weeks and poststorage at 24°C. MLT treatment delayed the onset of CI by one week, reduced the incidence of external CI symptoms like lenticel spotting and peel discoloration, and internal CI symptoms manifested as vascular streaking and flesh browning. Extended storage at 7°C for six weeks, however, did not considerably ameliorate CI. The observed amelioration of CI with MLT was attributed to reduced production of H₂O₂, lowered electrolyte leakage and polyphenol oxidase activity thus the reduction in the severity of peel and pulp discoloration. MLT significantly increased the activities of antioxidant enzymes catalase and ascorbate peroxidase. Further, MLT-treated fruit had higher total phenolic content than the control.

Keywords: *Mangifera indica*, melatonin, chilling injury, catalase, ascorbate peroxidase

Application of Biosolids Incorporated with Plant Growth Rhizobacteria (PGPR) in Napier Grass (*Pennisetum purpureum* cv. Pak Chong)

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Abstract

Biosolids are nutrient-rich by-product of wastewater treatment. They offer a sustainable alternative to chemical fertilizers for agricultural production. Hence, it is believed that plant growth-promoting rhizobacteria (PGPR) combined with biosolids can improve biosolid quality as a potential biofertilizer. The transition from the laboratory to the field remains a major gap, which typically limits the potential for growing the application of PGPR in agriculture. Another constraint of microbes' products for field applications is the short shelf-life of the inoculants. Hence, based on the characteristic of biosolids where the available carbon in the biosolids can encourage the growth of PGPR, it could be considered as a carrier for PGPR microbes. This study investigates the application of biosolids as an organic fertilizer for *Pennisetum purpureum* cv. Pak Chong is a high-yielding Napier grass variety which widely cultivated for livestock feed. This research aims to evaluate the combination effects of biosolids with Plant Growth Promoting Rhizobacteria (PGPR) on biomass production. A field experiment was conducted using a Randomized Complete Block Design (RCBD) with five treatment levels of biosolids application alongside with a control group which fertilizer application at Kampung Kubang Besar, Kelantan. Key parameters measured in this study included plant height, leave length and width, SPAD value of leave, stem girth, fresh weight, and soil physicochemical properties before and after treatment, and proximate analysis of Napier grass (dry matter, ash, crude protein (CP), crude fat, NDF, ADF and ADL). This findings indicate that combination biosolids with Plant Growth Promoting Rhizobacteria (PGPR) significantly improved plant performance and biomass production compared to the control, while also enhancing soil organic matter and nutrient retention. These results suggest that biosolids can serve as a sustainable fertilizer source, reducing reliance on synthetic inputs and supporting environmentally responsible forage production. The study highlights the potential of biosolids recycling in promoting circular agriculture and sustainable livestock feed systems.

Keywords: biosolids, Plant Growth Promoting Rhizobacteria (PGPR), Napier, crude protein (CP), proximate analysis

Characterizing Papain Inhibitor–Expressing Isoforms in *Ganoderma boninense* for Antifungal Intervention Against Basal Stem Rot Disease

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Abstract

Ganoderma boninense is a phytopathogenic fungus causing basal stem rot (BSR) in oil palm, resulting in severe yield losses and eventual palm death. Current management strategies show variable effectiveness due to pathogen genetic variation and environmental factors. Research is ongoing to develop improved mitigation approaches, including the characterization of virulence factors to better understand fungal pathogenicity. Although effectors and cell wall-degrading enzymes have been identified in *G. boninense*, their native expression during infection remains poorly understood. To gain further insight into the pathogenicity of this fungus, this study was therefore initiated to focus on one of its virulence factors, the papain inhibitor (PI), which is predicted to suppress host cysteine protease defenses and facilitate successful pathogen infection. Data mining using Iso-Seq transcriptome databases identified two PI genes, *GbPI01* and *GbPI02*, both exhibiting expressed isoforms. Isoform formation may contribute to functional diversification during host–pathogen interactions. Functional prediction suggested that *GbPI01* acts as an apoplastic effector, whereas *GbPI02* is a non-effector protein. Gene expression analysis using qPCR on *Ganoderma*-infected roots of oil palm clonal materials showed that *GbPI01* was steadily upregulated from 1 to 9 weeks post-infection (wpi), reaching a peak expression of 6.743-fold at 9 wpi, suggesting a role in host–pathogen interactions. In contrast, *GbPI02* remained consistently downregulated below 1.0, with the lowest expression of 0.175-fold at 4 wpi, indicating a limited role in pathogenicity. BLAST analysis revealed that *GbPI01* shares 81–90% sequence similarity with other *Ganoderma* species and 100% similarity with two strains in the in-house *G. boninense* genome database, while showing less than 70% similarity with species from other genera. These findings suggest that *GbPI01* is highly conserved in *G. boninense* and may serve as a potential target for antifungal strategy development. Functional studies are currently underway to further elucidate its role during *G. boninense* infection. The findings from this study are expected to contribute to the development of more effective strategies to combat BSR, ultimately helping to reduce economic losses in the oil palm industry.

Keywords: papain inhibitors, *Ganoderma boninense*; basal stem rot, iso-seq transcriptome, expression analysis

Performance Evaluation of Locally-Formulated Feed Resources on the Growth Performance of Native Pigs

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Abstract

This study evaluated the effect of various locally-formulated feed resources on the growth performance of native pigs (*Sus domesticus*), in response to the high cost and limited accessibility of commercial pig feeds. Twelve piglets were randomly assigned to four treatments: pelleted feed, chopped/shredded feed, boiled feed, and the recommended markaduke native pig (MNP) ration. Proximate analysis was conducted on the feed samples to determine moisture, ash, crude fiber, crude fat, and protein content. Parameters such as weight gain, body length, and height were monitored over six weeks. Results indicated that pigs fed with pelleted local feed achieved the highest weight gain and feed conversion efficiency. While height and length differences were not statistically significant, the pelleted feed group showed the most consistent growth performance. Cost analysis revealed the economic advantage of using local ingredients over commercial rations. These findings support the potential of pelleted, locally-formulated feeds as a sustainable and affordable alternative for backyard pig farming in rural communities.

Keywords: native pigs, local feed resources, growth performance, feed formulation, proximate analysis

Multivariate Analysis of Selected Rice Genotypes for Submergence Tolerance by Using Stress Tolerance Indices

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Abstract

Submergence tolerance in rice is increasingly important for food security, as frequent flooding threatens global rice production and the livelihoods of millions. Effective evaluation of submergence tolerance requires analytical approaches capable of simultaneously assessing multiple traits and classifying genotypes across diverse flooding conditions. In this study, 47 rice genotypes, including a tolerant control, FR13A, were evaluated over one season for plant height, stem elongation, relative chlorophyll content, survival rate, and their associated stress tolerance indices (STIs) under control and progressive submergence conditions for two weeks. The ANOVA results demonstrated that the submergence treatment significantly influenced post-submergence chlorophyll content and survival rate ($p \leq 0.05$), whereas plant height, stem elongation, and percentage elongation were not significantly affected. Genotypic differences were highly significant ($p \leq 0.01$) for most traits, including plant height, stem elongation, chlorophyll content, and survival rate. Furthermore, significant genotype x submergence interactions were observed for plant height after treatment, stem elongation, and survival rate, indicating differential genotypic responses to stress. Principal component analysis (PCA) revealed that the first two components explained 38.8% (Dim1) and 24.3% (Dim2) of the total variation. Dim1 identified tolerant genotypes based on survival rate and chlorophyll content, while Dim2 highlighted sensitive genotypes based on stem elongation. Based on the PCA biplot and Fernandez group classification, the 47 genotypes were classified into four groups: tolerant (10 genotypes, Dim1+, Dim2+), moderately tolerant (18 genotypes, Dim1+, Dim2-), moderately susceptible (11 genotypes, Dim1-, Dim2+), and susceptible (8 genotypes, Dim1-, Dim2-). Overall, the multivariate approach using STIs successfully identified 10 genotypes, including FR13A, as top submergence-tolerant rice genotypes suitable for short duration progressive flood-prone environments. These genotypes are recommended for further evaluation and utilization in future breeding programs.

Keywords: stem elongation, multivariate analysis, survival, principal component analysis, submergence tolerance

Driving the Circular Economy: *Trametes* GanoBF1 as a Green Technology for Sustainable Oil Palm Biomass Degradation and Disease Control

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Abstract

The oil palm industry in Southeast Asia faces a critical threat from *Ganoderma boninense*, which causes Basal Stem Rot (BSR). Infected biomass left in plantations acts as a primary inoculum source for infection. Current mechanical and chemical control methods have shown limited success. This study introduces a novel “Green Technology” biological formulation utilizing the white-rot fungus *Trametes lactinea* GanoBF1. Developed as an eco-friendly substrate of rubberwood sawdust and vermiculite mix, the formulation was applied to oil palm trunk discs in field trials at the MPOB-Keratong Research Station to assess its biodegradation and biocontrol potential. The technology successfully implements a “Circular Economy” by turning waste into value through rapid decomposition of oil palm biomass. Field results demonstrated that BSR-diseased trunks treated with *Trametes* GanoBF1 achieved a 64% mass loss after 12 months, significantly higher than the 25% observed in untreated controls. The fungus effectively colonized the trunks vertically and was also proven non-pathogenic to oil palm seedlings over an 18-month safety trial. Additionally, acute oral toxicity tests confirmed the formulation is non-toxic. *Trametes* GanoBF1 offers a sustainable, cost-effective strategy for in-plantation biomass management. By accelerating the recycling of infected trunk waste and minimizing *Ganoderma* inoculum, this innovation provides a viable zero-waste solution for the industry.

Keywords: biological control, biodegradation, green technology, circular economy, biomass recycling

Estimation of Young Oil Palm Biomass and Carbon Stock

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Abstract

Oil palm plantations are not only economically important but also environmentally beneficial through their ability to store carbon. However, most previous studies have focused on estimating the biomass of mature oil palms due to the potential commercial value of their residue. This has resulted in a limited understanding of biomass accumulation and carbon stock estimation during the early growth phase, which is generally defined as 0 to 6 years after planting. Therefore, this study was conducted to address this gap. Biomass and carbon stock of young oil palms were estimated using a non-destructive allometric approach based on frond measurements at the MPOB Kluang Research Station, Bukit Lawiang, involving palms aged 1.5 years after planting. The estimated above-ground biomass was 4.77 ± 1.43 Mg ha⁻¹, corresponding to a carbon stock of 2.24 ± 1.35 Mg C ha⁻¹. These values fall within the range reported in previous studies for similar age classes. The results indicate that frond biomass is a significant component of total biomass in young oil palms and contributes substantially to carbon storage during the early growth stage. Overall, the study provides important baseline information on early-stage biomass accumulation, supports improved carbon accounting, and provides information to understand the carbon accumulation trajectory across the full oil palm growth cycle.

Keywords: oil palm, above-ground biomass, carbon stock

Evaluation of FGV's Tissue-Cultured Bentong Ginger (*Zingiber officinale* Roscoe) in a Fertigation System: Growth, Yield, and Phytochemical Analysis

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Abstract

Bentong ginger (*Zingiber officinale* Roscoe) cultivation is constrained by the limitations of conventional rhizome-based propagation, including the high demand for planting materials, exposure to soil-borne diseases, and the need for prolonged fallow periods between planting cycles. Farmers are often forced to trade off between reserving harvested rhizomes for replanting and selling them for income. To address these challenges, FGV has implemented tissue culture technology to support the mass production of Bentong ginger planting materials. Accordingly, this study aimed to evaluate the growth, yield performance, and phytochemical accumulation of in-vitro propagated Bentong ginger ramets under different potting mixture compositions in a fertigation system and to compare its performance with conventionally rhizome-propagated Bentong ginger. The study was conducted in a shade house with a fertigation system that facilitates drip irrigation six times per day, with gradual increases in nutrient volume and electrical conductivity. Five treatments were arranged in a randomized complete block design with three replicates, where Bentong ginger ramets were tested across four treatments composed of varying proportions of cocopeat and burnt rice husk (BRH), alongside one rhizome-based control in 100% cocopeat. Plant height and tiller number were measured monthly, and rhizomes were harvested at 4, 6, and 8 months after planting (MAP) for growth and yield evaluation. Rhizomes harvested at 6 MAP were further analyzed for dry matter distribution and phytochemical content. All treatments reached peak vegetative growth and early rhizome bulking at 6 MAP, with Bentong ginger ramets outperforming the rhizome-based control. At 6 MAP, the 100% BRH treatment significantly improved multiple measured parameters ($P < 0.05$), producing the highest plant height (147.30 ± 2.21 cm), total plant biomass (6.60 ± 0.83 kg), rhizome weight (3.94 ± 0.50 kg; $P = 0.002$), rhizome height (15.41 ± 2.28 cm), and rhizome length (38.61 ± 2.50 cm). Rhizomes accounted for 35.6%-50.6% of total plant dry matter, with the greatest total dry weight recorded in the 100% BRH treatment (0.52 ± 0.05 kg/plant; $P = 0.001$). Phytochemical analysis further showed that planting material and potting mixture composition had no significant effect on 6-gingerol (0.72%-0.77%) and 6-shogaol (0.11%-0.18%) contents. These findings indicate that Bentong ginger ramets outperformed rhizome-based ginger under fertigation, while 100% BRH provided the highest rhizome yield at 6 MAP, highlighting its potential as an ideal potting mixture for early harvesting systems.

Keywords: Bentong ginger, tissue culture, fertigation, burnt rice husk, rhizome yield

SGFP-Tagging of *Ganoderma boninense* via *Agrobacterium*-Mediated Transformation and Microscopic Analysis of Early Colonization in Oil Palm Roots

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Abstract

Basal stem rot (BSR), caused by *Ganoderma boninense*, is the most detrimental disease affecting oil palm in major palm oil-producing countries such as Malaysia, Indonesia, and Thailand. The disease arises via root-to-root infection. The absence of adequate data on infection mechanisms creates a gap in the pathosystem, necessitating the development of new methods for disease monitoring. Therefore, *Agrobacterium tumefaciens*-mediated transformation was employed to efficiently transfer the T-DNA harboring a synthetic green fluorescent protein (SGFP) gene into the fungal genome, aiding in pathogen monitoring within the plant system. *Agrobacterium* strain AGL1, harboring binary vector pCAMBgfp carrying the hygromycin phosphotransferase resistance gene (hpt) as a selectable marker coupled with a synthetic green fluorescent protein (SGFP) variant S65T as a reporter gene, was used for transformation. Two *G. boninense* isolates, PER71 and ET61, varying in pathogenicity, were selected for transformation. The minimal inhibitory concentration (MIC) of wild-type *G. boninense* isolates PER71 and ET61 was identified at 50 and 55 µg/mL Hygromycin B (HygB), respectively. Putative transformants were assessed on selective media containing Hygromycin B, generating 20 stable transformants: PER71+SGFP (9 transformants) and ET61+SGFP (11 transformants). Expression of the SGFP gene did not alter the pathogenicity of the transformants based on the bole infection assay. Confocal laser scanning microscopy (CLSM) enabled *in vivo* visualization of SGFP-tagged *G. boninense* during infection of oil palm at 0 to 3 days after inoculation. This study provides an understanding of the infection structure of *G. boninense* during its invasion of plant systems.

Keywords: basal stem rot (BSR), *Ganoderma boninense*, *Agrobacterium tumefaciens*, synthetic green fluorescent protein (SGFP), infection hyphae

Evaluation of Newly Developed Hybrid Grain Maize Varieties for Growth and Yield Traits

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Abstract

Maize (*Zea mays L.*) is an important cereal crop and a major energy source in livestock feed; however, grain maize production in Malaysia remains limited, resulting in heavy dependence on imports. Therefore, the development and evaluation of high-yielding hybrid maize varieties adapted to local agroecological conditions are essential to improve domestic production and strengthen feed security. This study aimed to evaluate the growth and yield performance of newly developed hybrid grain maize varieties, estimate genetic parameters related to grain yield, and determine the relationships among growth and yield traits. The experiment was conducted at Field 15, Faculty of Agriculture, Universiti Putra Malaysia, using six hybrid maize varieties arranged in a Randomized Complete Block Design with three replications. Data were collected on growth traits, including plant height, number of leaves, stem diameter, days to tasseling, and days to flowering, as well as biomass yield, yield components, and grain yield. Analysis of variance was used to determine varietal differences, while mean separation was performed using the Least Significant Difference test at the 5% significance level ($P < 0.05$). Correlation analysis was conducted to assess relationships among measured traits, and broad-sense heritability was estimated to evaluate the genetic influence on trait expression. Significant differences were observed among the hybrid varieties for most growth, yield component, and grain yield traits ($P < 0.05$). TM2 consistently demonstrated superior performance, recording the highest grain yield, thousand-grain weight, and number of kernels per ear. Grain yield showed strong positive relationships with plant height, biomass yield, number of kernels per ear, and thousand-grain weight. Several traits exhibited moderate to high broad-sense heritability, indicating substantial genetic influence and potential for selection improvement. Overall, TM2 was identified as the most promising hybrid variety under the study conditions, while traits strongly associated with grain yield and exhibiting moderate to high heritability may serve as useful selection criteria in maize breeding and variety evaluation programs in Malaysia.

Keywords: grain maize, hybrid varieties, growth traits, grain yield, broad-sense heritability

Preliminary Morpho-Molecular Evaluation of a Cryptic Weevil Associated with Young Oil Palms in Malaysia

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Abstract

Accurate identification of palm-associated weevils is essential for effective biosecurity management, as morphologically similar cryptic species are easily overlooked or misidentified in oil palm ecosystems. This study investigated the identity of unknown weevils associated with symptomatic young oil palms in Johor, Malaysia, which were initially mistaken for the notorious red palm weevil, *Rhynchophorus ferrugineus*. An integrative morpho-molecular diagnostic approach was applied to three collected adult specimens, combining anatomical measurements with mitochondrial cytochrome oxidase subunit I (COI) and 16S rRNA gene sequencing. Morphometric analysis confirmed that the insects were vastly smaller than typical red palm weevils, characterized by a mean total body length of 12.61 ± 0.76 mm, a mean rostrum length of 1.26 ± 0.16 mm, and a mean elytral length of 2.00 ± 0.04 mm. Molecular analysis further excluded the specimens from the genus *Rhynchophorus*, with COI sequences exhibiting a low 84.94-85.17% identity to *Sphenophorus compressirostris*, while 16S rRNA gene sequencing generated a closer 93.36% identity match to *Sparganobasis subcruciata* and a 91.94% match to a *Sphenophorus* sp. These findings establish the first preliminary molecular record of a *Sphenophorus*- or *Sparganobasis*-like lineage associated with Malaysian oil palms, highlighting a critical industry vulnerability where visual field misidentification could compromise regional pest surveillance, mask a destructive internal basal-boring risk, and delay vital management interventions.

Keywords: 16S rRNA, cryptic weevil morphology, cytochrome oxidase I, *Elaeis guineensis*

Quantifying Reference Evapotranspiration and Crop Evapotranspiration of Durian in Johor, Malaysia, for Precision Irrigation

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Abstract

Accurate estimation of reference evapotranspiration (ET₀) is a fundamental step in estimating crop evapotranspiration (ET_c) and implementing precision irrigation systems for durian (*Durio zibethinus*) cultivation in tropical climates. However, the reliability of gridded climate datasets available for orchard-scale application remains uncertain, particularly under heterogeneous microclimatic conditions. The aim of this study is to quantify reference evapotranspiration as the main component for crop evapotranspiration estimation by evaluating long-term NASA POWER climate data from 2005 to 2024 against corresponding on-site weather station measurements collected in 2025 at a commercial durian orchard in Batu Pahat, Johor, Malaysia. The FAO-56 Penman-Monteith equation was used to calculate ET₀ for both datasets to develop a validated climatic baseline for subsequent assessment of crop evapotranspiration. The framework acts as the meteorological basis for the incorporation of crop coefficients (K_c) in the future computation of crop evapotranspiration (ET_c). Results showed that NASA POWER significantly overestimated daily ET₀ compared with ground observations, highlighting limitations in describing microclimatic conditions at the orchard scale. The NASA POWER daily ET₀ mean was 5.108 mm/day, while on-site observations recorded 3.712 mm/day, resulting in a mean bias of 1.396 mm/day. Statistical analysis revealed a significant difference between datasets ($t(11) = 10.258$, $p < 0.001$), indicating deviations between gridded satellite-based climate data and localized orchard observations. These results indicate that uncorrected satellite-derived climatic data can introduce systematic bias in the assessment of evaporative demand, the basis for quantifying crop evapotranspiration. The validated meteorological dataset developed in this study provides a reliable foundation for future development of durian-specific dual crop coefficient (K_c) models, which can be used for accurate quantification of crop evapotranspiration and enhanced precision irrigation management in the durian industry in Malaysia.

Keywords: crop coefficient, crop evapotranspiration (ET_c), durian (*Durio zibethinus*), Penman-Monteith, reference evapotranspiration (ET₀)

Effects of Graded Levels of Dietary Canola Meal with XAP Enzyme in Broiler Chickens

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Abstract

Canola meal (CM) is a promising alternative protein source for broiler diets because of its high protein content, wide availability, and relatively low cost. However, its application is limited by anti-nutritional factors that may reduce nutrient utilization, particularly at high dietary inclusion levels. Supplementation with exogenous enzymes containing xylanase, amylase, and protease (XAP) may improve nutrient availability and support greater utilization of CM in broiler diets. This study evaluated the effects of graded dietary CM inclusion levels (5%, 10%, 15%, and 20%) supplemented with XAP on growth performance, carcass characteristics, intestinal morphology, and gut health in broiler chickens. A total of 990 one-day-old Cobb 500 broilers were randomly allocated to six dietary treatments with eleven replicates of fifteen birds each and reared for 35 days. Growth performance, carcass characteristics, fecal score, and intestinal histomorphology were evaluated. The results showed that dietary inclusion of up to 20% CM with XAP supplementation did not adversely affect growth performance, feed conversion ratio, mortality, or the European Broiler Index. Dietary treatments significantly influenced cumulative feed intake, carcass yield, abdominal fat deposition, spleen weight, and intestinal morphology, whereas fecal scores remained within the normal range throughout the experiment. These findings suggest that XAP supplementation enhances the utilization of canola meal and supports higher dietary inclusion levels while maintaining broiler performance and intestinal health.

Keywords: canola meal, broiler chickens, XAP enzyme, intestinal morphology, growth performance

Exploring Aminoquinone Functionalization of Rice Husk and Poultry Litter Biochar for Electric Fertilizer Production

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Abstract

Aminoquinone functionalized biochar is a promising redox-active soil amendment that can improve nutrient cycling and electron transfer in agricultural soils. However, systematic evaluation of feedstock or biochar suitability for this type of functionalization remains limited. This study compared rice husk biochar (RHB) and poultry litter biochar (PLB), along with their raw feedstocks, in the context of their physical, chemical, and functional properties to evaluate their suitability for aminoquinone functionalization to develop an “electric fertilizer” for sustainable rice farming. Both feedstocks were pyrolyzed at 400 °C, then tested for nutrient content (N, P, K, S, Ca, Mg, Fe, total carbon, organic matter) and structural properties using FTIR, BET surface area analysis, and FESEM-EDX. Results showed PLB had higher levels of N, P, K, Ca, and Mg, making it nutritionally richer. RHB, however, had much better surface area and structure for chemical functionalization. Pyrolysis increased RHB’s surface area about 11-fold (from 4.49 to 52.13 m²/g), while PLB’s surface area decreased (from 9.38 to 5.65 m²/g) due to pore blockage from extensive mineralization. Both biochars were mesoporous, with average pore widths of 43.6 Å (RHB) and 51.2 Å (PLB). RHB also had a unique silica-rich structure (11.27 wt% Si) and higher carbon content (46.46% to 57.97% after pyrolysis), giving it more reactive sites for grafting p-phenylenediamine or benzoquinone. FTIR confirmed these structural changes in both materials. Overall, RHB proved to be the better feedstock for grafting aminoquinone to develop an electric fertilizer due to its high surface area, silica-rich matrix, and reactive carbon framework.

Keywords: biochar, aminoquinone functionalization, electric fertilizer

AgriCapsule AI: Smart Access to Agricultural Knowledge

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Abstract

AgriCapsule AI is an AI-powered library assistant designed to simplify and personalize access to agriculture-related resources. It leverages artificial intelligence, natural language processing, and QR code integration to deliver tailored academic materials based on each user's research focus. Traditional library systems often overwhelm students and researchers in agriculture due to scattered information and inefficient search processes. AgriCapsule AI was developed to overcome these challenges by combining smart technology with user profiling. The idea was born from the need for a faster, more intuitive way to connect agricultural researchers with relevant resources. The system generates customized reading lists by analyzing a user's research focus through AI. It uses unique QR codes linked to individual profiles, enabling quick access via mobile devices or library terminals. Its specialization in agricultural fields like crop production, soil management, livestock farming, fisheries and aquaculture, agricultural technology, plant protection, agribusiness, and agricultural extension makes it distinct from general library systems. AgriCapsule AI is easily integrable into existing university libraries, requiring minimal user training. It saves time, enhances research quality, and supports evidence-based learning for students, lecturers, and agricultural practitioners. The development involved mapping user-library interaction issues, testing AI models for topic relevance, and piloting QR-based access. Feedback from agricultural students and librarians refined the system into a practical, user-focused tool.

Keywords: AgriCapsule AI, smart library, AI assistant, agricultural research, knowledge access

Implementation of Malaysian Good Agricultural Practices (myGAP) and Socio-economic Determinants of Adoption Intention among Pepper Farmers in Sarawak

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Abstract

Pepper (*Piper nigrum*) cultivation remains a main source of livelihood for rural communities in Sarawak. To increase competitiveness in the global market, pepper farmers are encouraged to adopt Malaysian Good Agricultural Practices (myGAP). This study had two objectives: (i) to examine the extent to which pepper farmers currently implement selected myGAP practices, and (ii) to investigate the associations between farmers' socio-economic characteristics and their intention to adopt myGAP. A cross-sectional survey was conducted among 385 pepper farmers across five districts in Sarawak using a structured questionnaire. Descriptive statistics were used to summarize farmers' socio-economic characteristics and the implementation of selected myGAP practices, while Fisher's Exact Test was employed to examine the associations between socio-economic characteristics and farmers' intention to adopt myGAP. The findings revealed that although the respondents had not formally adopted myGAP, the majority were already implementing many of the recommended myGAP practices. However, notable gaps remained in administrative record-keeping, soil cover management practices such as mulching and cover cropping, and integrated pest management (IPM). Based on Fisher's Exact Test, age and yield are associated with intention to adopt myGAP. These findings suggest that demographic and production-related factors may influence farmers' intention to adopt myGAP. The study highlights the need for continuous extension programs to promote formal myGAP adoption while strengthening farmers' knowledge and implementation of key practices, particularly in record-keeping, sustainable soil management, and IPM. Expanding training to include financial literacy and farm business management could further enhance farmers' readiness to adopt myGAP and improve the sustainability and competitiveness of pepper farming.

Keywords: *Piper nigrum*, Good Agricultural Practices (GAP), rural farmers

Design and Development of a Smart Seeding Mechanism for Hill Paddy Cultivation

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Abstract

Hill paddy cultivation in rural and upland areas is often labour-intensive and time-consuming, with conventional planting practices potentially resulting in inconsistent planting operations. To address these challenges, this study aims to develop a smart seeding mechanism, known as TUGAL, to support more efficient and systematic hill paddy planting. The TUGAL prototype integrates an ESP32-based control system with GPS, LoRa wireless communication and an OLED display. The system consists of transmitter and receiver units, where GPS is used for positioning, while LoRa enables wireless communication between the units. The OLED display provides operational information for monitoring during system operation. The development process involved hardware integration, system programming, communication configuration, prototype assembly and functional testing. Preliminary testing focused on evaluating the functionality and stability of the ESP32 controller, GPS positioning, LoRa communication, OLED display and seeding mechanism. Troubleshooting was conducted progressively to address issues related to hardware connections, pin configuration, programming and communication stability. The developed prototype demonstrates the potential of integrating smart technologies into hill paddy planting operations. The TUGAL system provides a foundation for further development towards precision and semi-autonomous agricultural machinery. Further field testing is required to evaluate planting accuracy, operational reliability and system performance under actual hill paddy cultivation conditions.

Keywords: hill paddy, smart seeding mechanism, precision agriculture, ESP32, LoRa

From Peel to Profit: A Circular Economy Model in Transforming Banana Pulp and Peel into Market-Ready Products Through Value Addition, Sensory Acceptability, and Cost Analysis

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Abstract

Banana processing generates valuable by-products that are often underutilized. In Aborlan, Palawan, where saba banana is a major agricultural commodity, banana chip by-products present an opportunity for circular economy-based product development. This project initiative focuses on converting banana chip by-products into banana energy bars and fermented value-added products such as banana wine, liquor, and vinegar. This aligns with agricultural post-harvest processing, waste utilization, and enterprise development by converting low-value or discarded materials into marketable products for local processors and farmer cooperatives. The banana energy bar is developed from discarded banana chip material combined with other ingredients to produce a compact, chewy, and locally sourced snack. The banana peel-based product line applies fermentation and processing technologies to produce banana wine, with possible extension to liquor and vinegar production. The initiative also highlights cost analysis computation, including raw material cost, packaging, labor, utilities, unit cost, mark-up, and cost-volume-profit considerations, to determine product feasibility and pricing strategy. Sensory acceptability results support commercialization potential, with the products recording high acceptability and strong consumer purchase intent. Overall, the project demonstrates how WPU-developed technologies can reduce banana processing waste, create new income streams, and strengthen community-based agri-enterprises in Palawan and the Philippines.

Keywords: waste valorization, banana peel utilization, energy bar, banana fermentation, by-product development

A Climate-Based Irrigation Need Scheduling for Improving Water Productivity in Rice Cultivation under Tropical Drought Conditions

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Abstract

Rice cultivation is one of the largest consumers of freshwater in Malaysia. Conventional continuous flooding (CF) practices contribute to inefficient water use, particularly during the off-season when drought conditions frequently occur. Climate-based irrigation need (IN) scheduling offers a promising approach to improving water productivity while sustaining rice production. This study evaluated climate-based IN scheduling using the Crop Water Requirement (CWR) approach to estimate irrigation requirements under tropical drought conditions. Reference evapotranspiration (ET₀) was calculated using the FAO-56 Penman-Monteith method in CROPWAT 8.0 based on 10 years of meteorological data from Kota Bharu station obtained from METMalaysia and validated using data collected from an on-site weather station. Crop evapotranspiration (ET_c) and IN were subsequently determined through a soil water balance approach and evaluated under five irrigation treatments: CF 10 cm, CF 8 cm, 5 cm alternate wetting and drying (AWD), 1 cm climate-based IN scheduling, and rainfed conditions. The results showed that ET₀ estimated from the on-site weather station was consistently higher (p-value = 0.0016) than that derived from Kota Bharu regional meteorological data, highlighting the importance of localized climate information for accurate irrigation planning. Climate-based IN scheduling substantially reduced irrigation water application, achieving approximately 87% water savings compared with CF under controlled field conditions, while producing total grain yields ranging from 175.15 to 218.70 g across irrigation treatments. Although continuous flooding produced the highest grain yield, optimized irrigation treatments substantially improved water-use efficiency, demonstrating the potential of climate-based irrigation scheduling to enhance water productivity under tropical drought conditions.

Keywords: crop water requirement, irrigation need, Penman-Monteith, rice, drought

Data-Driven Prediction of Water Use Efficiency in Malaysian Durian Orchard

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Abstract

Efficient water management is essential for improving the sustainability and productivity of commercial durian cultivation in tropical environments. This study developed and evaluated machine learning based models to predict Water Use Efficiency (WUE) in a Malaysian durian orchard using routinely measured environmental and irrigation variables. Monthly observations were collected from 70 geo-tagged trees from January 2024 to December 2025 to construct the modelling dataset. WUE was calculated as the ratio of satellite-derived actual evapotranspiration to the total irrigation supplied to the tree, while irrigation, rainfall, air temperature, relative humidity, wind speed, and soil moisture were selected as predictor variables. Five machine learning algorithms, namely Random Forest (RF), Gradient Boosting Machine (GBM), Extra Trees (ET), XGBoost, and CatBoost, were calibrated using an 80:20 calibration-validation data split with hyperparameter optimisation. Model performance was assessed using the coefficient of determination (R^2) and root mean square error (RMSE). Feature importance, partial dependence plots, and SHAP analyses were further employed to interpret predictor contributions and model behaviour. Among the evaluated algorithms, the Random Forest model achieved the highest validation performance ($R^2 = 0.4341$; RMSE = 0.7472), followed closely by CatBoost ($R^2 = 0.4309$) and Extra Trees ($R^2 = 0.4139$). Although the ensemble models demonstrated excellent calibration accuracy, substantial calibration-validation performance gaps indicated overfitting and limited generalisation. The results further revealed that WUE is governed by complex, non-linear interactions among irrigation and climatic variables rather than a single dominant predictor, making accurate prediction inherently challenging. The relatively modest predictive performance suggests that additional tree specific and phenological variables are required to improve model robustness. Nevertheless, the developed AI framework provides valuable insights into the key environmental drivers influencing WUE and establishes a practical foundation for future data-driven irrigation management and precision agriculture applications in Malaysian durian orchards.

Keywords: machine learning, irrigation, durian, precision agriculture

Phenotypic Characterization and SSR-Based Genetic Diversity of Mutant *Zoysia japonica* in Comparison with Other *Zoysia* Species

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Abstract

Turfgrass breeding focuses on enhancing the plant characteristics to optimize agronomic performance and achieve better economic value. Mutant *Zoysia japonica* requires comprehensive characterization, which is crucial for germplasm identification and selection of superior parental lines. This study aims to discriminate among four *Zoysia* species variants by integrating phenotypic analysis with SSR molecular markers to achieve precise genotypic identification. Experiments were performed using a Completely Randomized Design (CRD) with five replications. All plants were established in regular arrays of 27 x 37 x 9 cm trays. Each tray was planted with 10 plugs (3 cm x 3 cm x 3 cm). The growing medium was prepared with 80% sand and 10% topsoil. Lime and CIRP were applied at a rate of 1 t/ha. NPK Green 15-15-15 was applied every two weeks at a rate of 0.5 kg N/100 m²/month. The plant material included one mutant line, mutant *Zoysia japonica* (V1), and three original species named common *Zoysia japonica* (V2), *Zoysia japonica* var. Steud (V3), and *Zoysia matrella* (V4). The mutant variant was derived from the wild-type common *Zoysia japonica* through a mutation breeding program. Integration of morphological traits and SSR marker analysis enhanced the discrimination of germplasm and classification of breeding populations. Initially, a total of 10 SSR primers were selected. Of the 10 SSR primer pairs, seven (N11, N14, N15, N16, N18, N19, N20) were screened for further polymorphic analysis. Fifteen morphological traits were analyzed, exhibiting marked phenotypic heterogeneity among variants (CV: 2.08% to 75.2%). UPGMA clustering based on SSR markers classified the variants into three genetic clusters (Jaccard distance: 0.167 to 0.615, PIC: 0.31 to 0.44), corroborating the phenotypic differentiation among them. V1 exhibited compact dwarf growth with reduced plant height and number of leaves, while V2 and V4 demonstrated improved plant architectural characteristics, whereas V3 exhibited a robust root system with high biomass production. The findings demonstrated that gamma irradiation successfully generated marked phenotypic and genetic variation. The integration of morphological and molecular data enhanced complementary insights for accurate germplasm identification and selecting promising parental lines. These findings provide important insights into *Zoysia* species diversity and provide a significant contribution to future breeding initiatives.

Keywords: *Zoysia japonica*, phenotypic heterogeneity, mutation breeding, germplasm discrimination

Sequence-Resolved Discovery of Immunomodulatory Peptides from Cricket Protein Hydrolysate as a Functional Alternative Protein Ingredient

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Abstract

Cricket protein hydrolysate (CPH) is a promising alternative-protein-derived ingredient, but the active peptide sequences and mechanisms underlying its potential bioactivity remain difficult to define. In this study, CPH was evaluated in LPS-stimulated BV2 microglial cells using an integrated strategy combining cellular assays, transcriptomics, LC–MS/MS-based de novo peptidomics, structure-based screening, and peptide validation. CPH attenuated LPS-induced inflammatory activation, as shown by reduced pro-inflammatory cytokine production, nitric oxide release, and ROS accumulation. Transcriptomic analysis showed that CPH broadly modulated inflammation-related pathways, including TNF, Toll-like receptor, NOD-like receptor, IL-17, and JAK–STAT signaling. JAK–STAT signaling was further examined because of its biological link with IL-6-mediated microglial inflammatory responses. De novo peptidomics identified abundant short-chain peptides in CPH, followed by peptide characterization, bioinformatic filtering, structure-based prioritization, molecular dynamics simulations, and cellular validation of selected candidates. Several CPH-derived peptides showed predicted compatibility with the STAT3 SH2 domain and reduced LPS-induced IL-6 and TNF- α secretion, oxidative stress, IBA1-associated microglial activation, and STAT3 phosphorylation. Mechanistic assays further indicated that suppression of LPS-induced IL-6 production contributed to the reduced STAT3 activation observed in peptide-treated cells. Collectively, these findings establish a sequence-resolved workflow for identifying immunomodulatory peptides from cricket protein hydrolysate and support CPH as a promising source of functional peptides capable of modulating IL-6-associated microglial inflammatory signaling.

Keywords: cricket protein hydrolysate, alternative protein, bioactive peptides, de novo peptidomics, microglial inflammation

Reproductive Performance and Larval Development of *Pangasianodon hypophthalmus* and *Barbonymus gonionotus* Following Different Hormonal Induction Treatments

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Abstract

Artificial breeding is crucial for sustainable aquaculture production as wild broodstock populations continue to decline due to overfishing and habitat degradation. This is especially important for economically valuable freshwater species such as *Pangasianodon hypophthalmus* (locally known as striped catfish) and *Barbonymus gonionotus* (locally known as Java barb). The reliance on hatchery-based seed production has created a need for efficient hormonal induction protocols appropriate for the reproductive biology of each species. This study evaluated the effectiveness of two hormonal treatments, Ovaprim and Ovaplant, on reproductive performance and ovarian responses in *P. hypophthalmus* and *B. gonionotus*. Female broodstock in the Ovaprim treatment received human chorionic gonadotropin (hCG) as a priming injection followed by Ovaprim (0.5 mL/kg), with egg stripping performed 10–12 h after treatment. For the Ovaplant treatment, females received a single implant 12–24 h before stripping. Reproductive performance was assessed based on fertilization rate, hatching success, larval survival, and ovarian histology. Both Ovaprim and Ovaplant successfully induced spawning and resulted in high fertilization and hatching rates in both species, with reproductive responses varying between species and hormonal treatments. Ovaprim resulted in better fertilization and egg quality in *P. hypophthalmus*, potentially reflecting its asynchronous ovarian development and responsiveness to acute luteinizing hormone stimulation. In contrast, Ovaplant produced more consistent spawning and improved reproductive performance in *B. gonionotus*, possibly due to its sustained hormone release, which may provide better synchronization between hormonal stimulation and oocyte maturation in this group-synchronous species. Histological observations supported these reproductive responses, showing differences in the distribution and developmental stages of ovarian oocytes between hormonal treatments. In conclusion, both hormonal treatments were effective in inducing spawning, with each species showing distinct reproductive responses. The findings highlight the importance of selecting hormonal induction protocols according to the reproductive characteristics of each species and provide useful information for improving broodstock management, hatchery seed production, and sustainable aquaculture practices.

Keywords: artificial breeding, hormonal induction, fertilization, reproductive performance, larval development

Synergistic Effects of Calcium Carbide Residues and Application Frequencies on Growth and Photosynthetic Efficiency in Banana Under Tropical Climate

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Abstract

Calcium carbide residues (CCR) are industrial waste landfilled mainly as calcium hydroxide in the form of wet slurry with high water content, due to a lack of recycling potential. In Malaysia, banana covers more than 11% of the whole fruit production areas, comprising the second fruit production zone after durian. The strong demand has contributed to the expansion of the international banana trade, with Malaysia as the 53rd largest banana provider, exporting USD 10.3 million worth of bananas to global markets in 2020. The aim of this study is to evaluate the synergistic regulation of CCR effects on banana growth performance with different soil application rates of CCR at different intervals. All treatments of five different doses of CCR (0, 0.15, 0.30, 0.45, and 0.60 g/plant) at different soil application frequencies (7, 14, and 21-day intervals; DI) were arranged in a randomized complete block design (RCBD) with four replications. Results showed that soil application with 0.30 g/plant CCR significantly increased plant height, pseudo-stem diameter, and canopy diameter at 12th week after transplanting by 23.7, 12.83, and 20.26 cm, respectively. A significant interaction was observed among the treatments, and the plantlets that received 0.30 g of CCR at 14 DI showed a significant increase in leaf area, with a mean value of 255.35 cm², total chlorophyll content in the leaf of 3.88 mg/g, and fresh biomass of shoot of 66.62 g/plant. In line with the regression analysis, the optimum application dose of CCR (0.33 g/plant) is recommended for farmers during the nursery stage to maximize leaf area and enhance calcium uptake, thereby strengthening cell walls and improving structural rigidity of plant tissues. Leaf area serves as a key growth indicator associated with photosynthetic efficiency and subsequent banana growth performance under tropical climate conditions.

Keywords: banana, calcium carbide, chlorophyll, growth, photosynthesis

Spatial Variability of Photosynthetic Nutrient Use Efficiency in Durian

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Abstract

Nutrient management of durian trees is inherently complex due to the large variation in field conditions. This study aimed to: (i) evaluate the spatial variability of photosynthetic nitrogen, potassium, phosphorus, magnesium, and calcium use efficiencies in durian trees and delineate management zones for site-specific nutrient application; and (ii) determine the effects of terrain, clone, and soil properties on the spatial variation of photosynthetic nutrient use efficiency using a generalized linear model. A total of 63 trees were geo-referenced over two fruiting seasons at two phenological stages: flowering/fruit set (FFS) and fruit maturation/harvesting (FMH). Photosynthetic nutrient use efficiency (PNUE) was calculated based on photosynthetic rate (P_n) and leaf nutrient concentrations. Spatial variability of PNUE within the field was evaluated using geostatistical analyses. Descriptive statistics showed that the coefficients of variation (CV%) were highly variable, ranging from 18.4 to 40.59%. Semivariogram modelling demonstrated strong to moderate spatial dependence, with a nugget-to-sill ratio ranging from 0.06 to 0.54. Kriging maps showed clear spatial patterns, with higher PNUE typically found in terrain that was more undulating than flat. The results of the generalized linear model analysis also showed that terrain had a significant impact on PNUE, while soil and clone characteristics typically had less impact. These results show significant spatial variation in the efficiency of photosynthetic nutrient use in durian orchards and emphasize the significance of site-specific nutrient management. Incorporating spatial variability into nutrient management strategies may enhance the effectiveness of nutrient utilization and promote more sustainable and productive durian production.

Keywords: durian, geostatistics, nutrient use efficiency, photosynthesis, terrain

Assessing Smart Agriculture Technology Adoption Among Chili Farmers in Malaysia

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Abstract

Chili (*Capsicum* spp.) is a major vegetable crop in Malaysia, valued for domestic consumption and the food processing industry. In 2024, national chili production was estimated at 43.5 thousand MT, with Kelantan contributing the highest output at 9.8 thousand MT (DOA, 2024). However, domestic production remains insufficient, as reflected by a decline in the Self-Sufficiency Ratio (SSR) from 38.2% to 35.8%, indicating increasing reliance on imported chili. Pest and disease outbreaks, climate variability, and rising input costs are among the key constraints affecting local production. The adoption of smart agricultural technologies can help improve farm management efficiency, optimize input use, and reduce production risks. Therefore, this study assessed the level of smart agricultural technology adoption among chili farmers in Malaysia. A total of 200 chili farmers were involved in the study. Data were analyzed using a Fuzzy Logic approach to develop a smart agricultural technology adoption index based on the level of technology use across eight major farming parameters. The index values were classified into low, moderately low, moderately high, and high adoption levels. The findings showed that the index ranged from 0.31 to 0.58, with 80% of technology applications classified as moderately low and the remainder as moderately high. The average use of smart agricultural technologies across farming parameters was at a moderate level, ranging from 0.30 to 0.70, with irrigation and fertilization recording the highest mean score of 0.70. Overall, the adoption of smart agricultural technologies among chili farmers remained at a moderately low to moderately high level, indicating substantial potential for further improvement. Farmers' perception of high investment and production costs was identified as a major barrier to technology adoption. Targeted exposure, training, technical guidance, and financial support are therefore necessary to encourage wider adoption. Greater adoption of smart technologies could improve yield and quality, reduce crop losses, enhance operational efficiency, and increase farmers' income, thereby contributing to greater resilience and strengthening Malaysia's domestic chili supply security.

Keywords: chili, smart agricultural technologies, Fuzzy Logic

Prey Preferences and Consumption Capacity of Discus, *Symphysodon* spp., Fry

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Abstract

Discus (*Symphysodon* spp.) is a highly valued commercial species in the global ornamental aquaculture industry. However, standardized larval rearing protocols remain limited, and information on the early feeding ecology, nutritional management, and environmental requirements of discus during this critical stage remains scarce. This study determined the prey preference and consumption capacity of Discus during the early developmental stage. Experiments were conducted using different ages of Discus fry, comprising 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, and 37 days post-hatching (DPH). The prey preferences experiment for Discus fry was conducted using three types of prey: *Moina macrocopa* neonates and adults, and *Artemia* sp. nauplii. For the consumption capacity experiment, due to limited mouth gape, Discus fry were given *Moina* neonates from 9 to 19 DPH, followed by *Moina* adults from 21 to 37 DPH. In the prey preferences experiment, fry at 9 DPH preferred *Moina* neonates among all three prey types ($p < 0.05$), whereas no significant difference was observed at 11-13 DPH. From 17-25 DPH, fry significantly preferred to feed on *Artemia* nauplii compared with other prey types. At the later stage of 27-37 DPH, *Moina* adults became the most consumed prey. In the consumption capacity experiment, fry at 9 DPH were able to consume an average of 57.2 *Moina* neonates per day. Consumption increased progressively to 110.9 neonates per day by 21 DPH. A sudden drop to 63.1 prey per day at 21 DPH was observed when *Moina* adults were used as prey. Consumption then increased to 101 *Moina* adults per day by 37 DPH. In conclusion, Discus fry preference is restricted by mouth size, highlighting the need to provide prey of a suitable size at different developmental stages. In addition, production of sufficient live food is necessary to support the increase in consumption capacity of fry as it grows. These findings can be used as a guideline to establish a more standardized production protocol for improving larval survival and growth, supporting consistent production of high-quality Discus for the ornamental fish industry.

Keywords: *Symphysodon* spp., *Moina*, *Artemia*, prey size preferences, larviculture

Species Diversity at Seagrass Meadow of Merambong Shoal, Johor

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Abstract

Merambong Shoal is located at the mouth of the Pulai River estuary off the coast of Johor, stretching for an approximate distance of 1400 m. It is one of the most ecologically important seagrass meadows in the region. The subtidal shoal supports diverse seagrass species from the genera *Enhalus*, *Thalassia*, *Halophila*, *Halodule*, *Cymodocea*, and *Syringodium*. This seagrass meadow provides important feeding, nursery, and shelter habitats for fishes, crustaceans, molluscs, and other benthic organisms. Habitat assessment of this site was carried out for five consecutive months from April to August 2026. During this period, fish and invertebrate species were photographed and then identified to genus level. Among the species identified were ocellate butterflyfish, dusky spinefoot, milk-spotted puffer, green spotted puffer, prickly leather-jacket, matted filefish, estuary seahorse, green wolf eel, fan-bellied leatherjacket, Indian mud moray eel, mangrove Jack, alligator pipefishes, whiptail stingray, West Atlantic mantis shrimp, chocolate chip starfish, slate pencil urchin, spineless cuttlefish, blue swimming crab, green carpet anemone, pink warty sea cucumber, mangrove horseshoe crab, coloured tube anemone, biscuit sea star, seabass, diamond tuskfish, painted sand star, mullet, eel catfish, green scat, polychaete worm, conch, smooth clam, flag pen shell, shrimp, false scorpionfish, yellow spotted marine flatworm, and ball sea cucumber. Fish species from 16 families included Centrogenyidae, Chaetodontidae, Dasyatidae, Labridae, Latidae, Leiognathidae, Lutjanidae, Monacanthidae, Mugilidae, Muraenidae, Plotosidae, Pseudochromidae, Scatophagidae, Siganidae, Syngnatidae, and Tetrodontidae. Invertebrates from 18 families included Astropectinidae, Cerianthidae, Chaetopteridae, Cucumariidae, Echinometridae, Goniasteridae, Limulidae, Oreasteridae, Penaeidae, Phyllophoridae, Pinnidae, Portunidae, Pseudocerotidae, Sepiidae, Squillidae, Stichodactylidae, Strombidae, and Veneridae.

Keywords: fish, invertebrate, seagrass meadow, Merambong Shoal

Spatial Distribution and Physiological Biomarkers for Non-invasive Diagnosis of Cacao Vascular Streak Dieback

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Abstract

Visual assessment alone is inherently subjective and fails to capture the subclinical physiological stress and spatial shifts of cacao vascular streak dieback (VSD). This study investigated the spatial distribution of the VSD disease severity index (DSI), its correlation with fluorescence signals, and whether VSD-infected leaves could be differentiated from early to severe infection. Field observations ($n = 300$) were conducted in June and July 2026 at the Malaysian Cocoa Board, Bagan Datuk. Ordinary kriging with a spherical semi-variogram model was used to analyze and map the DSI. Pearson correlations between DSI and fluorescence signals were assessed following hierarchical clustering and variance inflation factor pruning. The Partial Least Squares-Linear Discriminant Analysis (PLS-LDA) model was used to discriminate between early ($DSI \leq 3$) and severe ($DSI > 3$) infections. Results showed that DSI shifted from moderate spatial dependence in June (33.15%) to weak spatial dependence in July (80.42%). Its spatial range expanded from 5.17 to 22.54 meters, respectively. Blue-green fluorescence under ultraviolet excitation emerged as a robust biomarker and maintained a significant positive correlation with DSI of 0.22 ($p < 0.01$) and 0.15 ($p < 0.05$), respectively. The overall accuracy of the PLS-LDA model improved from 63% in June to 71.33% in July. This demonstrates that while VSD becomes more spatially randomized as it spreads, its physiological biomarkers become more distinct.

Keywords: cacao, diagnosis, fluorescence sensor, spatial, vascular streak dieback

From Soil to Hive Transmission of *Aspergillus caelatus*: A New Pathogen in Stingless Bee Colonies

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Abstract

Heterotrigona itama and *Geniotrigona thoracica* have gained significant popularity as commercial honey producers in Malaysia during the 21st century. Similar to other bee species, stingless bees are susceptible to pathogen infections, where disease-related population declines threaten honey yields, agricultural productivity, and biodiversity. Therefore, this study evaluated the health status of stingless bee colonies across selected bee farms in Malaysia. Adult *H. itama* and *G. thoracica* specimens were collected from 79 colonies across nine farms and screened for known honey bee and stingless bee pathogens using 15 specific primer sets. All molecular screening yielded negative results, indicating the absence of these targeted pathogens within the sampled populations. However, during bee sampling at the Infoport Halal Hub, Universiti Putra Malaysia, a collapsed *H. itama* colony was observed. A fungal isolate was successfully isolated from the collapsed hive and identified as *Aspergillus caelatus*. Subsequent bioassays revealed that *A. caelatus* exhibits high virulence against both *H. itama* and *G. thoracica*. Infected larvae displayed lethargy 1–2 days post-treatment (DAT), followed by the emergence of white mycelium on the integument. By 8 DAT, the fungal pathogen induced 100% larval mortality in both host species, with LC₅₀ values of 7.58×10^3 conidia/ μ L for *H. itama* and 6.24×10^3 conidia/ μ L for *G. thoracica*, accompanied by dense yellow-green conidial growth on the cadavers. Overall, *A. caelatus* demonstrated extreme pathogenicity toward both stingless bee species, resulting in rapid and severe larval mortality. These findings represent the first documented case of a fungal outbreak in Malaysian stingless bees, demonstrating that meliponiculture requires strict microclimate management, adequate hive ventilation, and strategic distance from damp agricultural soils to prevent catastrophic colony collapse.

Keywords: Stingless bees, entomopathogenic fungus, fungal disease, bee health status

Revealing Promising Candidates: Performance Evaluation of Rice Genotypes Using Yield and Component Yield

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Abstract

Rice (*Oryza sativa*) productivity is strongly influenced by both grain yield and its associated yield components. This study evaluated the agronomic performance of selected rice genotypes to identify promising candidates with high yield potential and desirable yield-related traits. A field experiment was conducted using 12 rice genotypes in a Randomized Complete Block Design (RCBD) with three replications. Data were collected on plant height, number of tillers, panicle length, number of filled grains per panicle, 1000-grain weight, and grain yield. Analysis of variance (ANOVA), mean comparison, correlation analysis, and principal component analysis were used to assess genotype performance and relationships among traits. Significant variation was observed among the evaluated genotypes for several agronomic and yield-related characteristics. The results indicated that MR 366, MR 368, and MR 371 consistently demonstrated superior performance and were identified as promising candidates based on their grain yield and favourable yield components. Grain yield was associated with key yield-related traits, particularly the number of filled grains and 1000-grain weight, highlighting their importance in genotype selection. Overall, the findings demonstrate substantial variability among the tested rice genotypes and provide useful information for selecting high-performing materials for future rice breeding and varietal development. The identified promising genotypes could serve as potential candidates for further evaluation under different environments and production conditions.

Keywords: rice genotypes, grain yield, yield components, genotype evaluation, yield potential