IC-GU12

International Consortium of Universities in South and Southeast Asia

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King Mongkut's University of Technology Thonburi

HOST UNIVERSITY

The United Graduate School of Agricultural Science Gifu University

CORE UNIVERSITY

Sustainable Innovations in Food and Plant Science Symposium

October 26–27, 2026

KMUTT, Bangkok, Thailand

People
Plants
Food
A Better Future

Organized by

INTERNATIONAL CONSORTIUM OF UNIVERSITIES IN SOUTH AND SOUTHEAST ASIA FOR THE DOCTORAL EDUCATION IN AGRICULTURAL SCIENCE AND BIOTECHNOLOGY (IC-GU12)

From Asia to a Sustainable Tomorrow

KNOWLEDGE
PEOPLE
PARTNERSHIP
FOR A RESILIENT FOOD SYSTEM

VENUE INFORMATION & HOUSEKEEPING

Venue

- The symposium will be held at **N12 Building, King Mongkut's University Technology Thonburi (KMUTT) Bangmod Campus**.
- Please note that KMUTT has multiple campuses. The symposium venue is the **Bangmod Campus**.
- Please refer to the campus map for the location of the symposium venue.

Transportation

- Shuttle van transportation will be provided for participants staying at Park Village Rama II Hotel.

  Morning: Park Village Rama II Hotel → KMUTT Bangmod Campus

  Evening: KMUTT Bangmod Campus → Park Village Rama II Hotel

- Detailed departure times will be announced separately.

Campus Map

During the Symposium

- **Presentation Guidelines**
  - All presentations must be delivered in English.
  - Please prepare your presentation in PowerPoint (PPT/PPTX) format.
  - Please bring your presentation file on a USB flash drive.
  - Please copy your presentation file to the computer in the symposium room before your session begins.
  - Each oral presentation consists of 12 minutes for presentation followed by 3 minutes for discussion.
- **Meals & Refreshments**
  - Lunch boxes will be provided on both days of the symposium.
  - Coffee and refreshments will be provided during the scheduled coffee breaks.
  - Please follow the directions of the symposium staff regarding the distribution of lunch boxes and refreshments.
- **General Information**
  - Please wear your name badge during the symposium.
  - Please keep mobile phones and other electronic devices on silent mode during oral presentations.
  - Please follow the directions of the symposium staff during the symposium and reception.
- **Wi-Fi**
  - Wi-Fi is available via eduroam.
  - Participants using eduroam are encouraged to set up and test their connection before arriving at the venue.

Program

Sustainable Innovations in Food and Plant Science Symposium

October 26–27, 2026 | KMUTT, Bangkok, Thailand

Oral presentations: 12 min presentation + 3 min discussion

October 26 (Mon.) — Postharvest, Food & Bioresources

9:00–9:25 Registration

9:30–10:00 Opening Ceremony — MC: Prof. Kohei Nakano (UGSAS-GU)

Opening Remarks: Prof. Ken Hiramatsu (Symposiun Char: Dean of UGSAS-GU)

Welcome Remarks: Assoc. Prof. Varit Srilaong (Local Organizing Committee Chair: Dean of School of Bioresources and Technology, KMUTT)

Photo Session

Session 1 — Fruit Physiology, Ripening and Postharvest Biology (Session Chair: Dr. Pongphen Jitareerat, KMUTT)

No.	Time	Presenter	Country	Presentation
1	10:00–10:15	Gang Ma	Japan	Effects of Foliar Application of a GA and NAA Mixture on Peel Puffing and Fruit Coloration in Satsuma Mandarin
2	10:15–10:30	Hanghang Zhang	Japan	Coordinated Regulation of Lignin Biosynthesis, Primary Metabolism and Respiration Contributes to Juice Sacs Granulation During Citrus Fruit Ripening
3	10:30–10:45	Manasikan Thammawong	Japan	Clock and Cold-Responsive Gene Expression During Chilling Injury and Recovery in Postharvest Cucumber Fruit
4	10:45–11:00	Kasumi Nakagawa	Japan	A Banana Peel-Derived Bacillus Strain Promotes Fruit Ripening Through Extracellular Metabolites

11:00–11:15 Coffee Break

Session 2 — Postharvest, Packaging and Emerging Technologies (Session Chair: Prof. Kohei Nakano, Gifu University)

No.	Time	Presenter	Country	Presentation
5	11:15–11:30	Khandra Fahmy	Indonesia	Optimization of Modified Atmosphere Packaging for Alleviating Chilling Injury in Tongar Avocados
6	11:30–11:45	Henny Purwaningsih	Indonesia	Development of Smart Packaging Based on Nano-Chitosan/Micro-Cellulose with TiO_2 Active Functionality and Purple Corn Cob Anthocyanin Indicators for Tuna Fish
7	11:45–12:00	Nazifi Ahmad	Thailand	Combined Ozone Fumigation and Plasma-Activated Water Dipping Mitigate Postharvest Decay and Internal Browning in Pineapple
8	12:00–12:15	Apiradee Uthairatanakij	Thailand	Plasma-Activated Water Affects the Growth and Biochemical Properties of Lettuce

12:15–14:15 Lunch Break

12:30–14:15 Roundtable Lunch Meeting of ICGU-12 (Venue: 1st Floor, N19 Building)

Session 3 — Food Quality, Aroma, Processing and Preservation (Session Chair: Dr. Varit Srilaong, KMUTT)

No.	Time	Presenter	Country	Presentation
9	14:15–14:30	Chalermchai Wongs-Aree	Thailand	Alcohol Acyltransferase (AAT): A Pivotal Enzyme Integrating Multiple Metabolic Pathways to Define the Characteristic Aroma of Tropical Fruits
10	14:30–14:45	Kotaro Takahashi	Japan	Evaluation of Retronasal Aroma During Food Mastication Using an Artificial Mastication Device
11	14:45–15:00	Teppei Imaizumi	Japan	Effects of Vacuum Microwave Drying on Structural Characteristics and Off-Flavor Compounds in Edible Cricket
12	15:00–15:15	Yasmin Azzahra	Thailand	Fungal Control and Quality Responses of Electron Beam Irradiated Riceberry During Storage

15:15–15:35 Coffee Break

Session 4 — Natural Products, Microbial Resources and Bioinnovation (Session Chair: Prof. Tomio Yabe, Gifu University)

No.	Time	Presenter	Country	Presentation
13	15:35–15:50	James Paul T. Madigal	Philippines	Nipa Sap-Derived Yeasts for Bioethanol Starter Culture Development
14	15:50–16:05	Irmanida Batubara	Indonesia	Metabolomic Approach of Antimicrobial Compounds in Resistant Enteropathogenic Escherichia coli (EPEC) from Eucalyptus deglupta Branches
15	16:05–16:20	Franchezka Yda G. Manglal-lan	Philippines	Ficus minahassae (Hagimit): From Philippine Traditional Medicine to a Plant-Based Topical Anti-Inflammatory Agent

16:20 End of Day 1 | 17:30 Banquet

October 27 (Tue.) — Soil, Water, Plant & Biological Sciences

Session 5 — Soil Health, Biogeochemistry and Soil–Plant Interactions (Session Chair: Prof. Ken Hiramatsu, Gifu University)

No.	Time	Presenter	Country	Presentation
16	9:30–9:45	Komariah	Indonesia	Modulation of Soil Carbon and Nitrogen Cycling by Biochar-Based Microbial Fuel Cells Under Flooded Rice Conditions
17	9:45–10:00	Aktavia Herawati	Indonesia	Assessment of Soil Quality Index (SQI): A Comparative Study of Simple Additive and Weighted Additive Methods in Upland and Cropland Systems
18	10:00–10:15	Widyatmani Sih Dewi	Indonesia	Unlocking Multifunctional Bioinoculants: Synergy of Rhizosphere and Earthworm Bacteria Across Long-Term Rice Systems

10:15–10:35 Coffee Break

Session 6 — Agricultural Water, Soil–Water Processes and Crop Management (Session Chair: Dr. Komariah, Sebelas Maret University)

No.	Time	Presenter	Country	Presentation
19	10:35–10:50	Dwi Priyo Ariyanto	Indonesia	Underground Bio-Engineers: Linking Termite Assemblages to Soil Hydro-Physical Properties and Aggregate Stability in Forest Monocultures
20	10:50–11:05	Kazuki Mizune	Japan	Relationships Between Floc Strength and Consolidation and Erosion Characteristics of Flocculated Soil Sediments
21	11:05–11:20	Atsushi Yamaguchi	Japan	Toward Controlling Sediment Transport in Agricultural Engineering: A Colloid-Science Approach
22	11:20–11:35	Kentaro Otsuka	Japan	Evaluation of Upstream Water-Level Monitoring for Early Gate Operation During Extreme Rainfall in a Main Irrigation Canal
23	11:35–11:50	Zuhdiyah Matienatul Iemaaniah	Indonesia	Growth Response of Local Chili (Capsicum annuum L.) on Vertisol Soil Under Three Cultivation Conditions

12:00–13:00 Lunch Break

Session 7 — Crop Production, Plant Resilience and Remote Sensing (Session Chair: Dr. Manasikan Thammawong, Gifu University)

No.	Time	Presenter	Country	Presentation
24	13:00–13:15	Sikander Pal	India	Roots as Architects of Plant Resilience: From Belowground Competition to Climate-Resilient Crops
25	13:15–13:30	Andriyana Setyawati	Indonesia	Optimization of Elicitor and Light Conditions on Potato Microtuber cv. Dayang Sumbi
26	13:30–13:45	Tomoaki Yamaguchi	Japan	Remote Sensing and Explainable AI for Rice Production: From Prediction to Prescription in Farmers' Fields
27	13:45–14:00	Atsuhiro Iio	Japan	Diurnal Changes in Crown PRI Derived from UAV-Based Multispectral Imagery in a Japanese Deciduous Broad-Leaved Forest

14:00–14:20 Coffee Break

Session 8 — Plant Health, Pest Management and Biological Sciences (Session Chair: Prof. Masato Yayota, Gifu University)

No.	Time	Presenter	Country	Presentation
28	14:20–14:35	Thiara Celine E. Suarez	Philippines	Comprehensive Analysis of Global and Japanese Distribution of Rose Viral Pathogens
29	14:35–14:50	Tri Joko	Indonesia	Biocontrol Potential and Mechanistic Insight of Citrus-Derived Endophytic Bacillus Against Huanglongbing
30	15:05–15:20	Kana Hanazaki	Japan	Diversity of Pre-Fertilization Egg Coat Elevation Among Ascidians
31	14:50–15:05	Chihiro Himuro	Japan	From Reproductive Biology to Eradication: Sterile Insect Technique for the West Indian Sweetpotato Weevil Euscepes postfasciatus in Okinawa, Japan

15:20–15:40 Closing Ceremony — MC: Prof. Kohei Nakano (UGSAS-GU)
Closing Remarks: Prof. Masato Yayota (Vice Dean of UGSAS-GU)

Effects of Foliar Application of a GA and NAA Mixture on Peel Puffing and Fruit Coloration in Satsuma Mandarin

Gang Ma*, Lancui Zhang, Hanghang Zhang, and Masaya Kato

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Abstract

Peel puffing is a physiological disorder in Satsuma mandarin (*Citrus unshiu* Marcow.) characterized by separation between the peel and pulp, which reduces fruit quality and storability. A mixture of gibberellin (GA) and prohydrojasmon (PDJ) is used to suppress peel puffing, but it delays peel coloration. In this study, the effects of a GA and NAA mixed solution on peel puffing and peel coloration of ‘Aoshima Unshu’ fruit were investigated. On September 15, 2022, ‘Aoshima Unshu’ fruit were sprayed on-tree once with either GA+PDJ or GA+NAA. Untreated fruit served as the control. Fruit were harvested at 0, 2, 4, and 6 weeks, with the first sampling conducted on November 2. Peel puffing was evaluated on longitudinally halved fruit using a 0–3 scale. Carotenoids were quantified by HPLC, and chlorophyll content was determined spectrophotometrically. Expression levels of carotenoid- and chlorophyll-related genes were analyzed by real-time PCR. The results showed that from 4 weeks after treatment, peel puffing increased rapidly in the control, whereas both GA+PDJ and GA+NAA treatments strongly suppressed its development. Total carotenoid content was lower in GA+PDJ-treated fruit than in control throughout the experimental period, whereas it was higher in GA+NAA-treated fruit than in GA+PDJ-treated fruit from 4 weeks after treatment. Total chlorophyll content was higher in GA+PDJ-treated fruit than in control throughout the experimental period, whereas it was lower in GA+NAA-treated fruit than in GA+PDJ-treated fruit at 2 and 4 weeks after treatment. Gene expression analysis showed that, at 4 weeks after treatment, GA+NAA treatment increased the expression of *CitZDS*, *CitLCYb1*, *CitLCYb2*, *CitHYb*, and *CitZEP*, while decreasing the expression of *CitCHL27* and *CitPORA* compared with GA+PDJ treatment. These results suggest that GA+NAA treatment suppresses peel puffing while promoting carotenoid accumulation and chlorophyll degradation, thereby improving peel coloration compared with GA+PDJ treatment.

Keywords: citrus fruit; coloration; puffing; plant hormone

Coordinated Regulation of Lignin Biosynthesis, Primary Metabolism and Respiration Contributes to Juice Sacs Granulation During Citrus Fruit Ripening

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Abstract

Juice sacs granulation is a major physiological disorder that impairs citrus fruit quality. Most previous studies have focused on postharvest granulation; however, its regulatory mechanisms during fruit ripening remain poorly understood. In this study, changes in lignin metabolism, primary metabolism, and respiration were investigated in Ponkan mandarin 'Ohta Ponkan' (*Citrus reticulata* Blanco) and Valencia orange (*C. sinensis* Osbeck) during fruit ripening. Ponkan mandarin developed visible juice sacs granulation at the late ripening stage, whereas Valencia orange showed no evidence of granulation. Ponkan mandarin exhibited significantly higher lignin accumulation, accompanied by enhanced expression of lignin biosynthesis-related genes, particularly *CitPRX*. In addition, Ponkan mandarin accumulated higher levels of soluble sugars, showed faster degradation of organic acids, and maintained a higher respiration rate than Valencia orange during fruit ripening. These coordinated physiological and molecular changes suggest that enhanced primary metabolism may promote carbon and energy allocation toward the phenylpropanoid pathway, thereby stimulating lignin biosynthesis and accelerating juice sacs granulation. These findings improve our understanding of the physiological and molecular mechanisms underlying juice sacs granulation during citrus fruit ripening and suggest a role for *CitPRX* in this process.

Keywords: granulation; fruit ripening; lignin metabolism; sugar and acid metabolism; respiration rate

Clock and Cold-Responsive Gene Expression During Chilling Injury and Recovery in Postharvest Cucumber Fruit

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Abstract

Chilling injury in cold-sensitive horticultural commodities involves progressive membrane dysfunction; however, molecular responses associated with recovery after cold removal remain poorly understood. This study investigated physiological and transcriptional responses during chilling and after a temperature shift to 20 °C in postharvest cucumber fruit. Fruit were stored continuously at 20 °C or 2 °C or transferred from 2 °C to 20 °C after 5 days of storage. Membrane integrity was evaluated by electrolyte leakage, while cold-responsive and circadian clock-associated gene expression was monitored at 4-h intervals. Continuous storage at 2 °C progressively increased electrolyte leakage and induced chilling injury symptoms. *CsCBF3* expression increased markedly after 72 h at 2 °C, indicating activation of the cold-response pathway during injury development. Expression of the clock-associated gene *CsLHY* also showed distinct temporal patterns between 2 °C and 20 °C conditions. Following transfer to 20 °C, electrolyte leakage decreased markedly, indicating recovery of membrane integrity. This physiological recovery was accompanied by rapid transcriptional changes: *CsCBF3* showed a transient increase immediately after the temperature shift, followed by strong suppression, while *CsLHY* expression also decreased. These results suggest that the temperature shift to 20 °C is accompanied by rapid reorganization of cold-responsive and clock-associated gene expression during recovery from chilling injury.

Keywords: chilling injury; circadian clock; cold response; cucumber

A Banana Peel-Derived *Bacillus* Strain Promotes Fruit Ripening Through Extracellular Metabolites

Kasumi Nakagawa*[1*], Airi Ito[1], and Kohei Nakano[2]

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Abstract

Banana is a climacteric fruit that continues to ripen after harvest, and controlling its ripening is essential for maintaining quality and reducing postharvest losses. Although ripening is influenced by temperature, physical damage, and ethylene, considerable variation in ripening rate is observed even among fruits stored under identical conditions. Microorganisms associated with plant surfaces are increasingly recognized as important factors affecting plant physiology, including growth and stress responses. However, little is known about whether fruit-associated microorganisms influence the ripening process. We hypothesized that microorganisms associated with the banana peel contribute to this variation and investigated ripening-associated microorganisms and their metabolites.

Non-ethylene-treated green bananas were surface-disinfected and stored at 20°C. Surface disinfection significantly delayed the increase in the ripening color index (RCI), suggesting that peel-associated microorganisms contribute to banana ripening. Seven bacterial strains isolated from rapidly ripening bananas were subsequently inoculated onto green bananas. Among them, strain OM-3 exhibited the strongest ripening-promoting activity, advancing the onset of the increase in RCI by approximately four days compared with the control. Analysis of the 16S rRNA gene sequence indicated that OM-3 is closely related to the genus *Bacillus.*

Application of the OM-3 culture supernatant accelerated the increase in RCI compared with washed bacterial cells, suggesting that the ripening-promoting activity may be attributable to extracellular metabolites. Fractionation of the culture supernatant showed strong ripening-promoting activity in the ethyl acetate fraction, whereas the aqueous fraction showed no apparent activity. Liquid chromatography-tandem mass spectrometry analysis detected indole-3-acetic acid (IAA) in the active fraction, suggesting that IAA may contribute to the ripening-promoting activity, although the involvement of other hydrophobic metabolites cannot be excluded.

These findings indicate that banana peel-associated microorganisms and their metabolites can influence postharvest ripening. Understanding and controlling fruit surface microbiota may provide a novel strategy for managing banana ripening and reducing postharvest food losses.

Keywords: banana; ripening; *Bacillus*; indole-3-acetic acid; postharvest loss

Optimization of Modified Atmosphere Packaging for Alleviating Chilling Injury in Tongar Avocados

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Abstract

This study aimed to develop a mathematical model for determining the optimal atmospheric conditions in a modified atmosphere packaging (MAP) system to reduce chilling injury in Tongar avocados during low-temperature storage. To establish the minimum oxygen limit (low O_2 limit), the relationship between O_2 concentration and respiratory quotient (RQ) was evaluated. Respiration rates were measured across different O_2 concentrations and modeled using the Michaelis–Menten equation. Gas concentration changes in the packaging were simulated with a mass balance model to predict the optimal packaging film permeability. The results showed that the low O_2 limit for Tongar avocados was approximately 4.41%, representing the critical threshold before the occurrence of anaerobic respiration. Furthermore, the developed respiration model showed high predictive accuracy, as indicated by a coefficient of determination close to one and a low RMSE. Simulations showed that polypropylene (PP) film with a thickness of 0.04 mm produced optimal atmospheric conditions for 14 days of storage. This condition effectively suppressed respiration rates and reduced chilling injury, as indicated by lower ion leakage and better visual quality compared to the control. Consequently, the developed mathematical model-based method could serve as a basis for designing an efficient MAP system to maintain the quality of Tongar avocados during low-temperature storage.

Keywords: Tongar avocados; modified atmosphere packaging; low O_2 limit; respiration model; film permeability

Development of Smart Packaging Based on Nano-Chitosan/Micro-Cellulose with TiO_2 Active Functionality and Purple Corn Cob Anthocyanin Indicators for Tuna Fish

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Abstract

Tuna fish (*Thunnus* spp.) is a high-value fishery commodity susceptible to quality deterioration during storage due to microbial activity and protein degradation, which generate volatile basic compounds. This study aimed to develop a smart packaging system based on a nanochitosan/microcellulose biocomposite that integrates intelligent packaging through an anthocyanin indicator and active packaging through TiO_2 nanoparticles to simultaneously monitor and maintain tuna quality. Microcellulose was isolated from oil palm fronds through delignification, bleaching, acid hydrolysis, and sonication, while nanochitosan was produced using an ionic gelation method. Anthocyanin was extracted from purple corn cobs using 96% ethanol acidified with 3% citric acid. Characterization included XRD, PSA, SEM, FTIR, CIELAB, physical-mechanical properties, antibacterial activity, and application testing on tuna based on TVB-N and pH. The microcellulose contained 7.99% lignin, 87.92% holocellulose, and 71.97% α-cellulose, with crystallinity increasing from 64.46% to 71.80% and particle size of 484.50 ± 20.95 nm. Nanochitosan exhibited an average particle size of 5.9 ± 0.2 nm and crystallinity index of 69.28%. Anthocyanin extract yielded 59.97 ± 0.05 mg/50 g dry weight, exhibiting color response to pH with ΔE of 9.55–59.38. Increasing anthocyanin concentration increased film thickness, moisture content, and solubility, while WVTR remained stable. Film with 1% TiO_2 exhibited tensile strength of 9.20 ± 1.25 MPa, elongation of 32.38 ± 1.41%, and WVTR of 1.129 ± 0.015. Antibacterial activity increased with TiO_2 concentration, peaking at 1.5% TiO_2 with zones of 14.22 ± 0.04 mm (*E. coli*) and 14.53 ± 0.11 mm (*S. aureus*). During 48 h application, TVB-N increased to 103.50 ± 0.75 mg N/100 g for indicator film and 91.86 ± 0.75 mg N/100 g for active film, with pH rising from 6.32 ± 0.01 to 8.03 ± 0.03. This biocomposite is highly potential as biomass-based smart packaging to monitor freshness and maintain tuna quality.

Keywords: smart packaging; nanochitosan/microcellulose biocomposite; anthocyanin; purple corn cob; food freshness indicator

Combined Ozone Fumigation and Plasma-Activated Water Dipping Mitigate Postharvest Decay and Internal Browning in Pineapple

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Abstract

Internal browning and postharvest decay limit the storage life and marketability of pineapple. This study evaluated plasma-activated water (PAW) dipping and ozone (O_3) fumigation, applied individually and sequentially, for maintaining the postharvest quality of pineapple cv. 'Pattavia' stored at 13 °C. A three-stage study was conducted to select effective PAW dipping durations (5–20 min) and O_3 fumigation durations (20–60 min at 325–350 ppm) and to compare the selected treatments individually and sequentially. Plasma activation altered the physicochemical properties of the water. PAW dipping for 20 min provided the greatest disease suppression, reducing disease severity by 55.6% relative to the control on day 25. O_3 fumigation for 60 min provided the best overall performance, delaying peel color changes, suppressing internal browning and reducing disease severity by 43.3% on day 25. In the third stage, PAW dipping for 20 min, O_3 fumigation for 60 min and their sequential application (O_3 followed by PAW) were compared with an untreated control during 35 days of storage. The individual treatments suppressed disease and internal browning while maintaining fruit-quality attributes; however, sequential O_3 fumigation followed by PAW dipping produced the strongest and most consistent overall response. This treatment kept the fruit free from visible disease through day 20 and reduced disease severity by 60.0% on day 35, compared with reductions of 28.0% and 24.0% following PAW and O_3 treatments alone, respectively. The sequential treatment also reduced internal browning by 77.8% on day 35 and limited pulp discoloration, accompanied by lower polyphenol oxidase and peroxidase activities during key storage periods. It also lowered respiration and H_2O_2 accumulation and generally maintained higher ascorbic acid content, and total phenolic content and DPPH radical-scavenging activity, although it increased weight loss during prolonged storage. Therefore, sequential O_3 fumigation followed by PAW dipping represents a promising sustainable strategy for mitigating postharvest decay and internal browning while maintaining pineapple quality during cold storage.

Keywords: disease; internal browning; ozone fumigation; pineapple; plasma-activated water

Plasma-Activated Water Affects the Growth and Biochemical Properties of Lettuce

Apiradee Uthairatanakij*, Natta Laohakunjit, Pongphen Jitareerat, Nattapon Kaisangsri, Orrapun Selamassakul, Ratchadaporn Karprasob, and Apichai Jenjob

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Abstract

Plasma-activated water (PAW) has recently emerged as an environmentally friendly technology with considerable potential for agricultural applications. It forms when reactive oxygen and nitrogen species (RONS) produced by cold atmospheric plasma dissolve in water, creating a chemically active aqueous medium, including H_2O_2, NO_2^-, NO_3^-, and O_3, which may act as signaling molecules and provide bioavailable forms of nutrients, thereby modulating physiological processes associated with plant growth and metabolite synthesis. This study investigated the effect of plasma-activated water (PAW) on the growth and biochemical changes of hydroponically grown Green Oak lettuce. PAW was prepared by subjecting it to plasma for 15 min before use. Seedlings were transferred to an NFT hydroponic system after 2 weeks of seed propagation. Lettuces grown in hydroponic systems with AB nutrient solution prepared with tap water (control) were compared with lettuces grown in AB nutrient solution (30, 50, 100%) prepared with PAW. All treatments were harvested on day 25, and then plant height and canopy, dry matter, chlorophyll content, total phenolic content, and minerals were measured. Results showed that using PAW for 15 min to prepare AB nutrient solution improved plant growth and increased total chlorophyll and total phenolic content compared with the control ($p < 0.05$). In addition, reducing the AB nutrient solution by 30% combined with PAW enhanced magnesium and potassium in the leaves. Our findings indicate that PAW can be used for lettuce production, and further study of defense mechanisms may be needed.

Keywords: bioactive compound; element; hydroponic; plant growth; plasma-activated water

Alcohol Acyltransferase (AAT): A Pivotal Enzyme Integrating Multiple Metabolic Pathways to Define the Characteristic Aroma of Tropical Fruits

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Abstract

Alcohol acyltransferase (AAT; EC 2.3.1.84) catalyses the final, committed step of volatile ester biosynthesis in fruits, condensing alcohols with acyl-CoA. Evidence from model and tropical species indicates that ester profiles are governed not only by transcript abundance, but also by catalytic specificity, substrate availability, subcellular and post-translational regulation. In 'Charentais' melon (*Cucumis melo* L.), recombinant CmAAT1 expressed in *Saccharomyces cerevisiae* exhibited activity towards a broad range of alcohols and acyl-CoAs, whereas the enzyme expressed in *E. coli* was inactive. In 'Ailsa Craig' tomato (*Solanum lycopersicum* L.), *LeAAT1*, identified through homology with *CmAAT1*, was ripening-specific, and the protein was catalytically versatile in yeast, yet the ripe fruit accumulates only trace amounts of esters. Expression of both genes is ethylene-dependent. In 'Monthong' durian (*Durio zibethinus* L.), AAT accepts diverse alcohols and straight-chain esters accumulate abundantly during ripening, whereas branched-chain esters emerge only at the late ripening stage. By contrast, ripe 'Thong Ploy' jackfruit (*Artocarpus heterophyllus* Lam.) is dominated by branched-chain esters in both diversity and abundance, some of which are already detectable in mature unripe fruit. In 'Nam Dok Mai' mango (*Mangifera indica* L.), esters have not been reported in ripe pulp; however, ethyl esters were induced in fruit held under active modified-atmosphere packaging with an ethanol-releasing sachet. Resolving the catalytic properties, localisation, post-translational control and precursor supply of AAT in individual species is therefore essential to explain, and ultimately to manipulate, the species-specific aroma of tropical fruits.

Keywords: ester biosynthesis; branched-chain esters; fruit ripening; post-translational regulation; tropical fruits

Evaluation of Retronasal Aroma During Food Mastication Using an Artificial Mastication Device

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Abstract

Retronasal aroma, which is perceived when food is consumed, is an important factor influencing food preference. Recent studies have highlighted the effects of mastication on aroma perception, and many studies have explained differences in aroma perception in terms of oral physiological factors, such as chewing frequency and salivary flow. However, during human mastication, individual differences in chewing behavior and salivary secretion occur simultaneously with changes in food structure, including fragmentation, water absorption, and bolus formation. Therefore, it is difficult to distinguish the contribution of food-related changes from that of physiological factors. Consequently, how structural and physical changes in food during mastication affect aroma release remains insufficiently understood.

This study aimed to clarify the temporal behavior of aroma release during mastication and to investigate how changes in bolus structure and condition affect aroma release. Unseasoned commercially available rice crackers were used as model foods. We developed an artificial mastication device that mechanically reproduces the mastication process and connected it to Direct Analysis in Real Time mass spectrometry to continuously monitor aroma compounds released during mastication. Changes in bolus structure and physical properties, together with aroma release, were evaluated over a 20-s mastication period. Roasted-aroma compounds, including methylpyrazine and acetylpyrrole, were targeted.

The temporal release patterns differed among aroma compounds, and compounds such as methylpyrazine and pyrrole also showed different release patterns among rice cracker samples. Aroma release was promoted by moisture supplied by artificial saliva and occurred concurrently with particle-size reduction and moisture penetration into the bolus. These findings suggest that mastication-induced changes in bolus structure, particularly particle-size reduction and saliva penetration, are important factors governing aroma release during oral processing.

Keywords: retronasal aroma; mastication; food bolus; food palatability; aroma release

Effects of Vacuum Microwave Drying on Structural Characteristics and Off-Flavor Compounds in Edible Cricket

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Abstract

Edible insects have attracted increasing attention as a sustainable alternative protein source. However, consumer acceptance of edible insects is often limited by undesirable aroma. This study evaluated the effects of vacuum microwave drying (VMW) on the structural characteristics and volatile compounds of edible cricket (*Acheta domesticus*), focusing on the relationship between structural modification and off-flavor characteristics. Crickets were dried by hot-air drying (HA), microwave drying (MW), or VMW. Structural characteristics were analyzed by X-ray micro-CT, and volatile compounds were determined by SPME-GC-MS/MS and PLS-DA. Additionally, whole and slurry samples were compared to evaluate the influence of structure on volatile characteristics. Drying-rate constants were 0.023, 0.337, and 0.240 min^{-1} for HA, MW, and VMW, respectively. VMW increased the total internal pore volume from 84,667 mm^3 in HA to 137,819 mm^3, corresponding to a 63% increase. Consistent with these structural differences, PLS-DA clearly differentiated volatile profiles among drying methods. Hexanal, a major off-flavor compound, decreased from 1.68 g^{-1} to 0.35 g^{-1}. Furthermore, grinding before drying reduced off-flavor compounds in HA, whereas little difference was observed between whole and slurry samples under VMW. These results suggest that VMW suppresses structural collapse and alters volatile profiles, with structural preservation during drying contributing to reduced off-flavor compounds.

Keywords: edible insect; vacuum microwave drying; volatile compounds; micro-CT; off-flavor

Fungal Control and Quality Responses of Electron Beam Irradiated Riceberry During Storage

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Abstract

Pigmented rice is increasingly valued for its rich nutritional composition and bioactive compounds associated with potential health benefits. However, fungal contamination has been reported in commercially available pigmented rice, raising concerns regarding its quality and food safety. Electron beam irradiation (EBI) offers a promising approach for fungal decontamination of cereal grains, but its effectiveness must be considered alongside its potential effects on the nutritional and technological quality of pigmented rice during storage. This study evaluated Riceberry rice irradiated at 0, 1, 3, and 5 kGy over 16 weeks of storage, focusing on fungal control, nutritional and bioactive characteristics, and pasting properties. Irradiation treatment and storage time significantly affected fungal contamination and inactivation efficiency ($p < 0.001$). The highest inactivation efficiency was observed at 5 kGy after 4 weeks of storage, reaching 97.11 ± 1.47%. EBI had limited effects on nutritional and bioactive characteristics, whereas storage significantly influenced several quality attributes ($p<0.05$). Pasting properties were more responsive to irradiation, with peak viscosity at week 16 decreasing from 498.21 RVU in the control to 293.25 RVU at 5 kGy, indicating changes in starch functionality. Overall, EBI provided effective fungal control while largely maintaining the nutritional and bioactive characteristics of Riceberry rice, although its technological functionality, particularly pasting behavior, was modified during storage.

Keywords: electron beam irradiation; pigmented rice; fungal contamination; nutritional quality; bioactive compounds

Nipa Sap-Derived Yeasts for Bioethanol Starter Culture Development

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Abstract

Bioethanol production in the Philippines remains dependent on expensive imported commercial starter cultures, creating significant economic barriers for micro, small, and medium enterprises. Indigenous microorganisms from regional feedstocks represent a sustainable alternative for achieving bioenergy self-sufficiency. This study evaluated the physiological characteristics, environmental stress tolerance, and batch fermentation kinetics of two yeast strains isolated from nipa palm (*Nypa fruticans*) sap—*Saccharomyces cerevisiae* (YMU1) and *Pichia kudriavzevii* (C3). Both isolates were screened for lactose assimilation, flocculation capacity, and hydrogen sulfide production. Multi-stress tolerance was assessed through sequential exposure to elevated temperature (45°C), high glucose (20%), and high ethanol (8%) concentrations. Growth kinetics and fermentation performance were evaluated in 6-liter batch systems using 22°Brix molasses medium over 168 hours.

YMU1 demonstrated superior ethanol productivity, achieving 77.55 g/L with an ethanol yield coefficient of 0.84 g/g sugar, significantly outperforming the industrial reference strain (72.64 g/L). While YMU1 exhibited a longer lag phase than commercial instant yeast, its sustained sugar utilization and metabolic efficiency resulted in the highest ethanol conversion rate. Strain C3 produced lower ethanol yields (61.0 g/L) but demonstrated exceptional thermotolerance, consistent with *Pichia* species characteristics. Both indigenous strains exhibited flocculation, facilitating biomass recovery and cell recycling. Although all strains produced hydrogen sulfide, this is less problematic in fuel ethanol production than in beverage fermentations.

Both nipa-derived yeasts maintained viability under cumulative stress conditions relevant to industrial fermentation, indicating robust metabolic resilience. These findings demonstrate that YMU1 is a viable candidate for commercialization as a cost-effective, locally adapted bioethanol starter culture. This development supports community-based bioenergy initiatives while reducing dependence on imported inocula, strengthening the economic and environmental sustainability of the Philippine bioethanol sector.

Keywords: biomass; ethanol; fermentation; stress tolerance

Metabolomic Approach of Antimicrobial Compounds in Resistant *Enteropathogenic Escherichia coli* (EPEC) from *Eucalyptus deglupta* Branches

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Abstract

Enteropathogenic *Escherichia coli* (EPEC) is a major cause of diarrhea in children in developing countries, with resistance to commercial antibiotics continuing to rise. This study aimed to evaluate the antimicrobial activity of *Eucalyptus deglupta* branch extracts against EPEC K1-1 and to characterize the diversity of its metabolites based on the extraction solvent polarity gradient using a metabolomic approach. The tests showed that four eucalyptus branch extracts had antimicrobial activity ranging from moderate to strong (based on inhibition zones, minimum inhibitory concentration (MIC), and minimum bactericidal concentration (MBC)), although still below the effectiveness of the positive control, amoxicillin. UHPLC-HRMS analysis identified 38 compounds from 13 chemical groups, such as sesquiterpenoids, triterpenoids, flavonoids, phenolics, and alkaloids. Principal Component Analysis (PCA), Hierarchical Cluster Analysis (HCA) dendrograms, and heatmaps confirmed the systematic separation of nonpolar and polar metabolites according to the solvent polarity gradient. Furthermore, the Partial Least Squares (PLS) regression analysis (VIP score > 1.00) identified 10 compounds that characterize EPEC antimicrobial activity, with the main candidates including (*E*,*E*)-α-farnesene, robustaol A, and 1,7-dihydroxy-3-methoxy-2-prenylxanthone. (*E*,*E*)-α-farnesene is known to work through a multitarget mechanism involving membrane destabilization and disruption of essential cellular functions. Liquid-liquid fractionation of the methanol extract identified the ethyl acetate fraction as the most promising fraction. Therefore, the ethyl acetate fraction of eucalyptus branches has high potential to be developed as a natural multitarget antimicrobial agent candidate to tackle EPEC infections.

Keywords: *(E,E)*-α-farnesen; EPEC; eucalyptus; metabolomics; robustaol A

Ficus minahassae (Hagimit): From Philippine Traditional Medicine to a Plant-Based Topical Anti-Inflammatory Agent

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Abstract

Ficus minahassae (Hagimit) is an indigenous Philippine plant traditionally used to relieve rheumatic conditions and inflammation, but its topical anti-inflammatory activity has not been well established experimentally. This study evaluated the anti-inflammatory activity of a topical *F. minahassae* formulation and examined its effects on inflammatory responses in a carrageenan-induced paw edema model in mice. Following carrageenan administration, mice were treated with *F. minahassae* cream, crude extract, mometasone furoate cream, cream based, and saline. Paw volume and temperature were monitored at 2, 4, 6, and 8 hours. Hematological parameters were determined, and the expression of *interleukin-1β* (*IL-1β*) and *interleukin-10* (*IL-10*) in paw tissue was assessed. *F. minahassae* cream reduced paw edema, with effects comparable to those of mometasone furoate. Paw temperature also differed significantly among treatments at 8 hours after inflammation induction. Hematological analysis showed changes in inflammatory indices, including neutrophil-to-lymphocyte ration, platelet-to-lymphocyte ratio, and granulocyte percentage. Increased expression of both *IL-1β* and *IL-10* was observed following *F. minahassae* treatment, suggesting modulation of inflammatory and regulatory responses. These findings provide experimental evidence for the topical anti-inflammatory activity of *F. minahassae* and support its traditional use for inflammation. The reduction in paw edema, together with changes in hematological indices and cytokine expression, indicates the potential of *F. minahassae* as a Philippine plant resource for the development of topical anti-inflammatory products.

Keywords: *Ficus minahassae*; Hagimit; indigenous medicinal plant; anti-inflammatory

Modulation of Soil Carbon and Nitrogen Cycling by Biochar-Based Microbial Fuel Cells Under Flooded Rice Conditions

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Abstract

Flooded rice cultivation is an important source of greenhouse gas emissions, particularly methane (CH_4), due to anaerobic microbial processes driven by carbon decomposition. Biochar-based microbial fuel cells (MFCs) offer a novel approach to regulate soil biogeochemical processes by combining carbon stabilization with bio-electrochemical electron transfer. This study aimed to evaluate the effects of biochar-based MFCs on soil carbon–nitrogen dynamics through redox-mediated processes in flooded rice soil. An experimental study was conducted using different biochar-based MFC electrodes under continuously flooded rice soil conditions. Soil responses were evaluated through measurements of methane (CH_4) and nitrous oxide (N_2O) emissions, soil organic carbon, total nitrogen, C/N ratio, microbial respiration, and soil redox potential (Eh). Data were analysed using ANOVA followed by Duncan's Multiple Range Test, Pearson correlation, and regression analyses. The results showed that biochar-based MFC application modified soil redox conditions and influenced carbon transformation pathways under flooded conditions. Soil organic carbon exhibited a strong positive relationship with C/N ratio ($R^2 = 0.931$), indicating that carbon accumulation was a major factor controlling carbon–nitrogen balance. In contrast, soil organic carbon showed a weak relationship with methane variability ($R^2 = 0.114$), suggesting that methane production was regulated not only by carbon availability but also by electron transfer processes and redox conditions. Methane emissions showed a negative relationship with soil respiration, suggesting that microbial carbon utilization was redirected toward alternative electron transfer pathways rather than methanogenesis. Nitrogen dynamics remained relatively stable, with no substantial increase in nitrous oxide emissions following MFC application. These findings demonstrate that biochar-based microbial fuel cells regulate flooded rice soil carbon–nitrogen dynamics through redox-mediated biogeochemical mechanisms. By enhancing carbon stabilization, modifying electron transfer pathways, maintaining nitrogen balance, and reducing methane emissions, biochar-based MFCs show potential as a climate-smart technology for sustainable rice production and low-carbon agricultural systems.

Keywords: microbial fuel cell; biochar; soil organic carbon; soil nitrogen

Assessment of Soil Quality Index (SQI): A Comparative Study of Simple Additive and Weighted Additive Methods in Upland and Cropland Systems

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Abstract

Soil quality assessment is critical for evaluating land capability to support sustainable agriculture and soil security. Although simple additive (SA) and weighted additive (WA) methods are widely used to calculate the soil quality index (SQI), spatial prediction performance comparisons between them remain limited. This study aimed to evaluate SA and WA SQI methods across upland and cropland systems in Mojogedang, Karanganyar, compare their spatial prediction accuracy using geostatistics, map priority management zones, and identify limiting soil variables. Soil sampling and laboratory analyses were conducted across 14 land map units (LMUs). Exploratory data analysis, paired Wilcoxon tests, Leave-One-Out Cross-Validation (LOOCV), and ordinary kriging interpolation were performed. Croplands exhibited higher total nitrogen, available phosphorus, and potassium due to fertilization, whereas soil organic carbon (SOC), soil pH, bulk density, and percentage of clay are comparatively consistent across both land types. Soil porosity is marginally greater in cropland, though not significantly, and microbal biomass carbon exhibit considerable variability. The paired Wilcoxon test showed no overall significant difference between methods ($p = 0.2657$). However, LOOCV revealed a scale-dependency paradox: WA's lower absolute RMSE (0.0319 vs. 0.2191) was a scale artifact caused by severe index range compression ($\Delta = 0.04$ vs. 0.50). When normalized against the index range, SA achieved 1.8x lower relative error (NRMSE = 43.8% vs. 79.8%) and double the spatial correlation ($r = 0.5126$ vs. 0.2624). Spatially, WA homogenized 99.3% of the landscape into a single "Fair" class, whereas SA preserved realistic zonation, identifying 144 ha (2.5%) of eastern cropland as degraded ("Poor"). Simple Additive (SA) provides superior spatial prediction accuracy and actionable utility for digital soil mapping, with SOC and microbial biomass carbon acting as primary limiting variables for targeted restoration.

Keywords: cropland; simple additive; soil quality index; total nitrogen; upland; weighted additive

Unlocking Multifunctional Bioinoculants: Synergy of Rhizosphere and Earthworm Bacteria Across Long-Term Rice Systems

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Abstract

Developing multifunctional bioinoculants is critical for advancing sustainable rice agriculture and restoring soil health. This study aimed to identify superior bioinoculants from the rhizosphere of rice plants and the body of the dominant earthworm, *Pontoscolex corethrurus*, across five different paddy field management systems: conventional, semi-organic, and organic systems managed for 7, 10, and 15 years, with five replications per system. The results demonstrated that different paddy field management practices significantly affected soil characteristics. A total of 20 distinct bacterial morphospecies were isolated from the rice rhizosphere, while 14 bacterial isolates were recovered from P. *corethrurus*. Functional screening revealed that these isolates possessed varied plant growth-promoting traits, including non-symbiotic nitrogen fixation, phosphate and potassium solubilization, biofilm formation, and phytohormone production. A clear functional divergence was observed between the two ecological niches: rhizosphere isolates exhibited a stronger capacity for indole-3-acetic acid (IAA) production, whereas earthworm-derived isolates demonstrated superior gibberellin synthesis. These distinct functional profiles highlight the complementary roles of rhizosphere and earthworm bacterial communities. The synergy between these diverse bacterial populations offers high potential for formulating a robust, multifunctional biofertilizer. Future research should focus on evaluating the performance of formulated bioinoculant consortia under greenhouse and field conditions to ensure sustainable rice growth and productivity.

Keywords: biofilm; biofertilizer; *Pontoscolex corethrurus*; plant growth-promoting rhizobacteria; sustainable rice farming

Underground Bio-Engineers: Linking Termite Assemblages to Soil Hydro-Physical Properties and Aggregate Stability in Forest Monocultures

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Abstract

Termites act as ecosystem engineers capable of altering soil structure. This study evaluated termite diversity and examined the impacts of termite activity on key soil physical properties, including soil porosity, bulk density, permeability, and aggregate stability under *Pinus merkusii* (planted in 1973, 1994, 2001, and 2016) and *Swietenia mahagoni* (planted in 1949 and 1973) stands in Alas Bromo Education Forest, Karanganyar, Central Java, Indonesia. Termite activity was observed using the wooden stake baiting method classified into five bait damage levels (K1–K5) across both rainy and dry seasons. Soil hydro-physical parameters were evaluated across 240 sampling points using infiltrometers. Four termite genera were identified (*Schedorhinotermes* sp., *Microtermes* sp., *Macrotermes* sp., and *Odontotermes* sp.). Termite diversity peaked in the 2001 Pine stand during the dry season ($H' = 2.54$) and was lowest in the 1973 Mahogany stand during the rainy season ($H' = 0.56$). Termite presence significantly increased soil aggregate stability ($p < 0.01$), reaching a "very stable" index of 124.67 (Pine 1973, K4) and 118.70 (Mahogany 1949, K2). Water movement properties improved significantly ($p < 0.05$), with maximum infiltration rate (19.93 mm/hr) and hydraulic permeability (1.29 cm/hr) recorded under severe bait damage (K5) compared to minimal damage (K1: 15.09 mm/hr and 0.66 cm/hr, respectively). Maximum soil porosity reached 53.82% under severe damage conditions (Pine 1973, dry season). Correlation analysis proved that termite activity was positively correlated with soil organic carbon content, aggregate stability, porosity, permeability, and infiltration rate, while negatively correlated with soil bulk density. In conclusion, subterranean termite bioturbation and organic matter deposition simultaneously enhance macroporosity, percolation capacity, and structural resilience, providing strong empirical evidence of their essential functional role as bio-engineers in forest plantation ecosystems.

Keywords: Alas Bromo; forest; Mahagony; pine; termite diversity

Relationships between Floc Strength and Consolidation and Erosion Characteristics of Flocculated Soil Sediments

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Abstract

Soil flocs settle to form sediment beds in water areas and in turbid-water treatment processes. Attractive forces between particles strongly affect sediment bed consolidation and erosion. However, the effects of interparticle attraction on consolidation and erosion characteristics remain insufficiently understood in heterogeneous systems such as soil suspensions.

In this study, to examine consolidation and erosion characteristics of sediment beds consisting of soil particles under different interparticle attraction conditions, flocs and sediment beds were prepared using KCl, $CaCl_2$, and chitosan to simulate different flocculation conditions in natural and engineered environments. After predetermined settling periods, floc strength was measured as an indicator reflecting interparticle attraction. Consolidation was evaluated from sediment-bed thickness, and critical shear stresses for characteristic erosion modes were determined using an erosion apparatus with impeller-generated flow. As impeller speed increased, two distinct thresholds were observed in all systems. At the first-stage thresholds, flocs near the bed surface began to be transported, whereas at the second-stage thresholds, the entire sediment bed was rapidly disrupted.

In chitosan-added systems, the flocs had a more open structure than those in salt-added systems, while their floc strength was approximately 20–30 times greater. Moreover, chitosan-added systems exhibited a thicker sediment bed than salt-added systems.

The first-stage erosion thresholds at low rotational speed showed no clear trend with degree of consolidation. In contrast, the second-stage erosion thresholds increased with consolidation in all systems. However, in chitosan-added systems, both consolidation and the thresholds increases were relatively small. Moreover, when second-stage erosion thresholds were comparable, chitosan-added systems showed thicker sediment beds than salt-added systems. These results suggest that the high floc strength in chitosan-added systems inhibited floc deformation and rearrangement, thereby suppressing consolidation and the associated increase in second-stage erosion thresholds. Additionally, the high floc strength may have increased the thresholds by strengthening the particle network within sediment beds.

Keywords: floc strength; interparticle interactions; flocculated sediment; consolidation; erosion

Toward Controlling Sediment Transport in Agricultural Engineering: A Colloid-Science Approach

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Abstract

Soils contain abundant colloidal particles, ranging in size from nanometers to micrometers. Soil colloids, although composed of various materials such as clay minerals, organic matter, and iron oxides, exhibit several common properties. One of the key characteristics of colloids is that they disperse or aggregate under the influence of interparticle forces. The dispersion/aggregation behavior of soil colloids affects sediment transport through changes in factors such as the sedimentation rate of soil particles and the rheology of soil suspensions. Therefore, sediment transport can be controlled by manipulating interparticle interactions based on colloid science.

In this presentation, the advantages of incorporating a colloid science perspective into studies of sediment transport in agricultural engineering are discussed through the following two research examples for different phenomena at different scales:

Purification of paddled water: To reduce the discharge of turbid water generated during puddling in paddy fields into surrounding water area, the effectiveness of chitosan, a biodegradable polyelectrolyte, and simple inorganic electrolytes, KCl and $CaCl_2$, on purification of paddled water was examined at both laboratory and field scales. In all treated systems, the concentration of suspended matter decreased rapidly after coagulant addition at the optimum concentrations determined from laboratory aggregation and sedimentation experiments.

Suppression of rill erosion: To improve erosion prediction technique, the effect of interparticle forces on soil erodibility under rill erosion was examined. The shear strength of soil increased as attractive interparticle forces were enhanced by the addition of a cationic polyelectrolyte even though the soil texture and dry bulk density were identical. Furthermore, rill erodibility in an excess shear stress model decreased linearly with increasing soil shear strength.

Keywords: soil; colloid; sediment transport; agricultural engineering; aggregation

Evaluation of Upstream Water-Level Monitoring for Early Gate Operation During Extreme Rainfall in a Main Irrigation Canal

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Abstract

Extreme rainfall events have increased the risk of overflow in irrigation canal systems, highlighting the need for early gate operation during flood events. This study applied a one-dimensional unsteady flow model to evaluate how gate operation timing influences overflow risk in a main irrigation canal. The analysis considered lateral inflow from a tributary, represented by the design discharge, causing a rapid water-level rise at the downstream end of the canal. Drainage operation was simulated by switching the downstream gate from overflow-weir to underflow operation. Gate operation was initiated when the water level at a designated monitoring point reached a predefined threshold.

Simulations based on the current operational guideline, which uses the downstream end of the main canal as the monitoring point, indicated that gate operation was initiated too late to prevent overflow. Two alternative monitoring locations—the tributary inflow point and an upstream point on the tributary—provided lead times of approximately 10 and 20 minutes, respectively, enabling gate operation before overflow occurred.

Furthermore, using the upstream tributary point as the operational trigger reduced the peak water level at the downstream end to nearly the same level as that achieved by switching the gate to underflow operation before the arrival of the design discharge. These findings demonstrate that strategically located water-level monitoring can provide valuable lead time for gate operation and improve flood management in irrigation canal systems during extreme rainfall events.

Keywords: agricultural water infrastructure; open canal flow; gate operation

Growth Response of Local Chili (*Capsicum annuum L.*) on Vertisol Soil Under Three Cultivation Conditions

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Abstract

Local chili (*Capsicum annuum L.*) is a high-value horticultural commodity with significant market demand, particularly in West Nusa Tenggara, a region where spicy flavors are a staple of the local diet. Chili growth and development are influenced by water availability, environmental conditions, and nutrient availability. This study aimed to evaluate the growth and flowering responses of local chili grown on Vertisol soil under three different cultivation conditions and to identify a more water-efficient cultivation alternative for the dry season. The research was conducted on Vertisol soil in Central Lombok Regency, West Nusa Tenggara, using a comparative experimental approach. The three cultivation conditions compared were: cultivation in paddy fields during the rainy season (relying on rainfall and waterlogged soil conditions); cultivation in polybags during the dry season with irrigation and the application of Liquid Organic Fertilizer (LOF); and cultivation in polybags during the dry season with irrigation but without LOF. The results showed that local chili cultivated in paddy fields during the rainy season exhibited superior vegetative growth and reproductive development compared to the two polybag cultivation conditions. Plants in the paddy fields demonstrated greater plant height, a higher number of leaves, and earlier flowering. Under dry-season polybag conditions, the application of LOF resulted in better growth and flowering responses compared to plants grown without LOF. Plants without LOF exhibited relatively lower vegetative growth and delayed flowering. These differences in response indicate that water availability and nutrient management play crucial roles in the growth and development of local chili on Vertisol soil.

Keywords: local chili; Vertisol; water management; rainy season; dry season

From Roots to Resilience: Decoding Root System Architecture for Climate-Resilient Crops

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Abstract

Roots, concealed beneath the soil surface, are dynamic hubs that enable plants to compete, acquire resources, and adapt to changing environments. Abiotic stresses such as drought, salinity and nutrient imbalance profoundly influence root growth and function. Under salinity, roots balance ion exclusion, selective uptake, and cellular sequestration through coordinated regulation of membrane transporters and ion compartmentalization. Phosphate deficiency, by contrast, promotes targeted root proliferation in resource-rich soil patches and enhances high-affinity phosphate transporters, enabling efficient nutrient acquisition. Identification of novel genetic factors controlling root traits and abiotic stress responses is crucial for developing climate-resilient crops. We have extensively used genome-wide association studies (GWAS) in maize, tomato, and pea to identify novel genetic factors putatively associated with salinity and low phosphate tolerance. From the candidate genes identified, *Zm00001d01100x* (ABCG transporter) and *Zm00001d05150x* (bHLH transcription factor) were associated with increased K^+ uptake and a more stable Na^+/K^+ ratio in tolerant lines under salinity. Further *in silico* analysis showed that the ABCG transporter was homologous to *AtABCG16*, a Jasmonic acid (JA) transporter that contributes to salinity tolerance via the JA pathway. Analysis of JA mutants, *Zm00001d01100x* and *Zm00001d05150x* knockout and overexpression lines, will elucidate the molecular mechanisms underlying salinity tolerance. For tomato, the GWAS conducted on 180 accessions showed that the *Solyc490xx* candidate gene was putatively associated with low phosphate tolerance. Our studies further demonstrate that maize landraces of the North-Western Indian Himalayan region possess greater potential for phosphate acquisition under low-phosphate conditions compared to commercial maize accessions. In addition, root phene states and their integration into root phene modules have revealed functional root configurations associated with abiotic stress tolerance in maize and pea. Ultimately, understanding roots' life underneath soil positions roots as active drivers of plant resilience and productivity for sustainable agriculture under increasingly challenging climates.

Keywords: root phenes; root phene modules; genome engineering; abiotic stresses; maize; pea

Optimization of Elicitor and Light Conditions on Potato Microtuber cv. Dayang Sumbi

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Abstract

The production of high-quality potato seeds in Indonesia is currently limited by the restricted availability. One of the techniques for providing superior, uniform, and disease-free seed potatoes in large quantities is through tissue culture for micro-tuber induction. This study aimed to analyze the effects of adding paclobutrazol and salicylic acid, and of different environmental conditions (dark and light), on the growth and induction of micro-tubers in the Dayang Sumbi potato variety. This research was conducted at the Plant Physiology and Biotechnology Laboratory, Faculty of Agriculture, Sebelas Maret University, Surakarta, from July to December 2025. The method used was a Completely Randomized Design (CRD) with three factors: the first factor was the concentration of paclobutrazol (0; 0.5; 1; and 1.5 ppm), the second factor was the concentration of salicylic acid (0; 0.5; and 1 ppm), and the third factor was environmental conditions (dark and light), with seven replications, followed by testing using Analysis of Variance (ANOVA) and then Duncan's Multiple Range Test (DMRT) with α=5%. If the ANOVA results show significance between factors, it will be followed by regression test. The research showed that a significant interaction between the addition of paclobutrazol, salicylic acid, and environmental conditions on the growth and development of micro-tubers. The dark environment has proven to be more responsive and conducive in accelerating the initiation and increasing the number and weight of micro-tubers compared to the light environment, which tends to stimulate vegetative growth. Paclobutrazol acts effectively as an inhibitor of gibberellin biosynthesis to suppress vegetative growth and induce tuber formation, while salicylic acid functions as an elicitor that supports this process. The combination of 0.5 ppm paclobutrazol and 1 ppm salicylic acid in a dark environment resulted in optimal micro-tuber productivity, yielding a 6.5-fold increase compared to the control treatment.

Keywords: dark environment; elicitor; tissue culture

Remote Sensing and Explainable AI for Rice Production: From Prediction to Prescription in Farmers' Fields

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Abstract

Experienced rice growers combine canopy assessment with management decisions they cannot fully articulate, and farmer-to-farmer transfer of this tacit knowledge is less effective when training is indirect. Experience also ceases to apply after generational turnover, climate warming, or topsoil replacement during decontamination. This presentation examines whether remote sensing and explainable artificial intelligence (XAI) can render this perception and decision-making explicit and transferable.

Perception was addressed first. Modelled on the way crop scientists observe canopies of contrasting plant type, a neural network was constrained to predict intermediate agronomic traits, leaf area, plant height and tiller number, before estimating biomass from unmanned aerial vehicle (UAV) and ground-based RGB imagery. It generalised across genetically diverse accessions with lower prediction error than conventional algorithms. The relative importance of these traits differed between short- and tall-statured cultivars, extending crop-science interpretability beyond predictive accuracy.

Decision-making was addressed using records from Tomioka, Fukushima, where decontamination had replaced the topsoil and rendered prior experience inapplicable. Three seasons of data on 26 soil, weather and management variables were modelled with random forests and interpreted using Shapley additive explanations. Cluster analysis identified a consistently low-yielding group, which attribution linked to low maximum temperature during early growth in a very-early-maturing cultivar, yielding recommendations on floodwater depth and transplanting date.

A multimodal large language model then devised and executed additional analyses and reinterpreted the results, producing field-level recommendations. Twelve crop scientists and fourteen large language models evaluated these against seven criteria, confirming that such output can be converted into usable field advice. Assigning the model the personas of farmers, extension advisors and crop scientists is being tested to improve recommendation quality. Work in progress further integrates six decades of prefectural cultivar trials with farm management system records, so that productivity differences between fields and regions can be attributed in one framework.

Keywords: rice; explainable artificial intelligence; UAV remote sensing; tacit knowledge; agronomic decision support

Diurnal Changes in Crown PRI Derived from UAV-Based Multispectral Imagery in a Japanese Deciduous Broad-Leaved Forest

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Abstract

The frequency of severe drought stress is increasing even in the humid forests of Japan due to global climate change. Drought stress can alter tree crown color through chlorophyll degradation and anthocyanin accumulation in leaves, making stressed trees detectable even in RGB images obtained with conventional cameras. However, by the time such visible symptoms appear, trees may have already suffered severe and potentially irreversible damage. Therefore, methods for detecting drought stress in trees at an early stage are needed. The photochemical reflectance index (PRI) is considered a promising spectral index for early detection because it reflects photoprotective responses associated with declines in photosynthetic activity. Although PRI has been extensively studied at the leaf level and in small plants, studies examining mature trees under field conditions remain limited. In this study, we examined diurnal changes in crown-level PRI during summer for approximately 700 canopy trees representing 20 species in a deciduous broad-leaved forest, using a drone equipped with a 15-band multispectral camera. We found that crown-level PRI in *Acer nipponicum*, a species with relatively low photosynthetic capacity, was markedly lower than that in other species. In addition, clear inter-individual variation in PRI was observed within dominant species; however, this variation was not related to inter-individual differences in stem growth rate. Results from comparisons of PRI with non-photochemical quenching (NPQ) and the frequency of dead branches within the crown will also be presented at the symposium.

Keywords: stress; PRI; drone; crown; multispectral camera

Comprehensive Analysis of Global and Japanese Distribution of Rose Viral Pathogens

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Abstract

Roses are globally significant ornamental plants valued for their economic and cultural importance, yet viral diseases threaten cultivation worldwide. More than 26 viruses infect roses, causing substantial economic losses through reduced plant vigor, floral quality, and aesthetic value. Despite their significance, comprehensive knowledge of rose viral diversity and distribution within specific national horticultural systems remains limited. This dissertation integrates a global systematic review of rose viral pathogens with a targeted molecular survey in Japan to bridge this knowledge gap.

The global review consolidated existing literature on 14 major rose-infecting viruses spanning multiple virus families, examining their taxonomy, transmission mechanisms, host ranges, symptomatology, and economic impacts. Subsequently, a nationwide molecular survey was conducted across five botanical sites in Japan (Gifu, Tokyo, Hiroshima, Aichi, and Shizuoka) to investigate the occurrence and genetic diversity of rose viruses. A total of 250 leaf samples, including symptomatic and asymptomatic plants, were analyzed using genus- and species-specific reverse transcription polymerase chain reaction (RT-PCR) assays targeting known rose viruses. Positive amplicons were sequenced and subjected to phylogenetic analysis to determine genetic relationships with global reference strains.

Five viruses were detected in Japan: Prunus necrotic ringspot virus (PNRSV), rose cryptic virus 1 (RCV-1), rose spring dwarf-associated virus (RSDaV), rose yellow mosaic virus (RoYMV), and rose yellow vein virus (RYVV). PNRSV was the most prevalent (42 of 250 samples), with marked regional variation. Phylogenetic analyses revealed geographically structured viral populations, indicating localized transmission networks alongside global dissemination patterns. Three mixed infections were identified, demonstrating viral complexity in Japanese rose populations.

This multi-scale analytical framework demonstrates that Japan simultaneously participates in global rose viral pathogen dynamics while hosting distinct regional populations. Findings provide essential baseline data for developing targeted surveillance, diagnostic protocols, and management strategies to protect ornamental rose cultivation.

Keywords: rose viruses; molecular survey; phylogenetic analysis

Biocontrol Potential and Mechanistic Insight of Citrus-Derived Endophytic *Bacillus* Against Huanglongbing

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Abstract

Citrus is an economically important horticultural commodity; however, its production is severely threatened by Huanglongbing (HLB), a devastating disease associated with the phloem-limited bacterium Candidatus Liberibacter asiaticus (CLas). Harnessing tissue-dwelling endophytic bacteria represents a promising strategy for HLB management, as these beneficial microorganisms can promote plant growth and enhance disease resistance through mechanisms such as phytohormone production, induction of host defense responses, and antimicrobial activity. This study aimed to isolate endophytic Bacillus spp. from citrus plants and evaluate the potential of selected strains to reduce CLas titer, suppress HLB development, promote plant growth, and modulate defense-associated metabolites in lemon (Citrus limon). Endophytic Bacillus spp. were isolated from citrus leaf tissues and screened by PCR for genes associated with plant growth promotion (ipdC, acdS, pqqE, and nifH), and antimicrobial activity (aiiA, sfp, fenD, bamC, and ituA). *Bacillus tropicus* BYL-4, which harbored all nine target genes, was selected for further evaluation. Colonization by strain BYL-4 was verified in surface-sterilized tissues, while CLas titers were quantified using absolute qPCR. Liquid chromatography–tandem mass spectrometry (LC–MS/MS) was conducted to evaluate host metabolic responses. The results showed that treatment with *B. tropicus* BYL-4 significantly reduced CLas titers, suppressed disease progression, and promoted plant growth. Metabolomic profiling revealed substantial modulation of defense-associated pathways, particularly phenylpropanoid and flavonoid biosynthesis, antioxidant and redox regulation, membrane lipid metabolism, and amino acid/nitrogen pathways. Several metabolites, including ferulic acid, 4-O-feruloylquinic acid, flavanone, proanthocyanidin C1, glutathione, riboflavin, phosphatidylcholine, hydroxy-linoleic acid, L-arginine, and spermine, were enriched in HLB-affected plants treated with BYL-4. These findings highlight *B. tropicus* BYL-4 as a multifaceted biocontrol candidate for integrated HLB management.

Keywords: *Bacillus tropicus*; citrus; huanglongbing; metabolomics; sustainable agriculture

Diversity of Pre-Fertilization Egg Coat Elevation Among Ascidians

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Abstract

The extracellular matrix surrounding animal eggs is important for fertilization and for the protection of oocytes and embryos. In sea urchins, the vitelline layer elevates after fertilization to form the fertilization membrane, which contributes to the block against polyspermy. We found that in *Phallusia philippinensis* (Ascidiidae), a marine invertebrate ascidian belonging to the phylum Chordata, the vitelline coat (VC) markedly elevates upon spawning into seawater regardless of fertilization. In this study, we examined whether marked pre-fertilization VC elevation is also observed in eggs of ascidian species other than *P. philippinensis*, investigated its underlying mechanism, and assessed its role in fertilization.

Eggs from seven ascidian species, *P. philippinensis*, *Ascidiella aspersa*, *Ascidia sydneiensis samea*, *Ascidia zara* (family Ascidiidae), *Ciona robusta*, *Ciona savignyi* (Cionidae) and *Styela plicata* (Styelidae), were collected by dissection and transferred to seawater at pH 8.2. Marked VC elevation was observed in Ascidiidae species. Since the oviduct of *P. philippinensis* is maintained at a lower pH than seawater and eggs become fertilizable as exposure to seawater elevates their intracellular pH, we examined the effect of pH in Ascidiidae and found that VC elevation was inhibited in low-pH (pH 4.5-pH 6.5) seawater. We also tested the involvement of osmotic pressure and elevation was suppressed in seawater containing bovine serum albumin (high molecular weight molecules) as well. To investigate the involvement of proteases in VC elevation, we tested several protease inhibitors and found that VC elevation was suppressed by leupeptin. Finally, eggs in which VC elevation had been inhibited by high molecular weight molecules were successfully fertilized, with no significant difference from control eggs.

The presence of pre-fertilization VC elevation across multiple Ascidiidae species suggests that this phenomenon may have been acquired in the common ancestor of this family. These findings may provide insight into the reproductive strategy of Ascidiidae.

Keywords: egg; vitelline coat; pH; ascidian; fertilization

From Reproductive Biology to Eradication: Sterile Insect Technique for the West Indian Sweetpotato Weevil *Euscepes postfasciatus* in Okinawa, Japan

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Abstract

The sterile insect technique (SIT) is an area-wide pest control method in which large numbers of sterilized insects are released to mate with wild individuals. Because these matings produce no viable offspring, repeated releases suppress the wild population and can ultimately lead to eradication. In Okinawa Prefecture, Japan, SIT was successfully used to eradicate the melon fly, *Bactrocera cucurbitae*, throughout the prefecture and, in combination with the male annihilation technique, the sweetpotato weevil, *Cylas formicarius*, from Kume and Tsuken Islands. We are currently attempting to eradicate the West Indian sweetpotato weevil, *Euscepes postfasciatus*, a globally important pest of sweet potato, *Ipomoea batatas* (L.) Lam., using SIT. Understanding the reproductive biology of *E. postfasciatus* is essential for improving the effectiveness of SIT. Our recent studies have shown that females remain unreceptive to remating for approximately 14 days after mating. This prolonged refractory period is induced by components of the male ejaculate, whereas its duration may be influenced by female physiological processes, such as the degradation or inactivation of ejaculate components. Consequently, when a wild female first mates with a fertile wild male, she is unlikely to remate with a sterile male during this period, thereby reducing the effectiveness of sterile-male releases. Conversely, when a sterile male mates with a wild female first, the prolonged refractory period can enhance SIT efficacy by preventing her from subsequently mating with fertile wild males. We have also found that the qualitative composition of the male ejaculate varies depending on the larval diet. Optimizing the larval diet used in mass-rearing systems may therefore produce males whose ejaculates more strongly suppress remating by wild females, thereby further improving the effectiveness of SIT.

Keywords: sweet potato; sterile insect technique (SIT); pest control; weevil; mating behavior