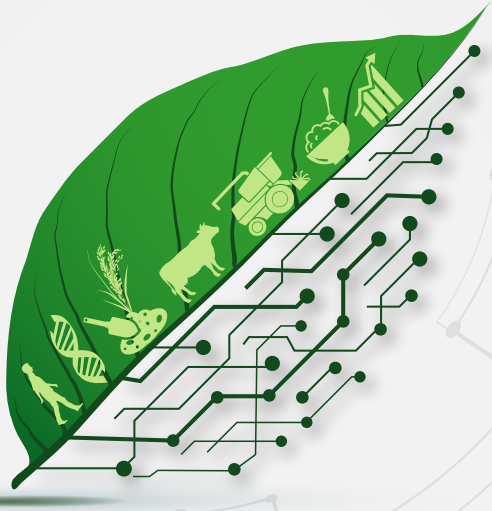
Research and Innovations for Resilient Agriculture



PROCEEDINGS

33rd ANNUAL CONGRESS OF THE POSTGRADUATE INSTITUTE OF AGRICULTURE

17 November 2021

Postgraduate Institute of Agriculture
University of Peradeniya

THIRTY-THIRD ANNUAL CONGRESS

November 17, 2021

Postgraduate Institute of Agriculture

PROGRAMME

Inaugural Session

Chairperson: Prof. C.M.B. Dematawewa, Director, PGIA

9.00 a.m.	National Anthem
9.10 a.m.	Welcome address by **Prof. P.C.G. Bandaranayake** Coordinator – PGIA Congress 2021
9.20 a.m.	Address by **Mr. V.G.T.D. De Silva** President, Postgraduate Agriculture Students' Association
9.30 a.m.	Address by **Prof. S.S. Kodithuwakku** Dean, Faculty of Agriculture, University of Peradeniya
9.40 a.m.	Address by **Prof. C.M.B. Dematawewa** Director, Postgraduate Institute of Agriculture, University of Peradeniya
9.50 a.m.	Address by **Prof. M.D. Lamawansa** Vice Chancellor, University of Peradeniya
10.00 a.m.	Address by the Chief Guest **Mr. Vimlendra Sharan** Sri Lanka and Maldives Country Representative at UN FAO
10.15 a.m.	Presentation of the Journal **"Tropical Agricultural Research, Vol. 33(1)"**
10.20 a.m.	Keynote Address by **Prof. Jessica Fanzo** Professor of Global Food Policy and Ethics Johns Hopkins Nitze School of Advanced International Studies, USA
10.50 a.m.	Research Highlights of the 33rd PGIA Annual Congress
11.00 a.m.	Commencement of Technical Sessions

Technical Session I

Stakeholder Behavior in Agricultural Processes

Chairperson: Prof. A. Ekanayake
Venue: Seminar Room A, PGIA

11.00 a.m. Dietary Diversity among Adolescents Aged 11–13 in the City of Colombo, Sri Lanka
A.D.D.C. Athauda, D.G.N.G. Wijesinghe and G.A.P. Chandrasekara

11.15 a.m. Market Potential for Quality Certified Dried Fish: A Consumer Choice Experiment in the Galle District of Sri Lanka
M.U.N. Gunawardana, W.N. De Silva and M. Aanesen

11.30 a.m. Behavioral Factors Influencing the Adoption of 1/2S d/2 Tapping System by Smallholder Rubber Farmers in Moneragala District
P.K.K.S. Gunarathne, H.V.A. Wikramasuriya, M.W.A.P. Jayathilaka and W. Wijesuriya

11.45 a.m. The Typology of Tea Smallholding Development Societies: Assessing their Multifunctional Approach in Badulla District of Sri Lanka
K.G.J.P. Mahindapala, M.W.A.P. Jayathilaka, L.N.A.C. Jayawardana, A. Abeysooriya and N. Gamage

12.00 noon Spatial Integration of Vegetable Markets of Sri Lanka during COVID-19 Pandemic
D.M.N.J. Kumari, J. Weerahewa and D. Hemachandra

12.15 p.m. Strengthening the Livelihood Resilience of Smallholder Dairy Farmers against External Shocks in the Northern Dry-Zone of Sri Lanka
S. Prasath and K. Umashankar

Technical Session II

Food Quality and Processing

Chairperson: Prof. N. Marikkar
Venue: Seminar Room B, PGIA

11.00 a.m. Identifying Panel Inconsistency in Sensory Profiles using Multivariate Analysis of Variance (MANOVA) and Follow–up Canonical Variate Analysis (CVA)
D.R. Fernando, S. Samita and T.U.S. Peiris

11.15 a.m. Nutritional and Phytochemical Composition of Leaves of *Moringa oleifera* Lam. Grown in Low Country Wet Zone of Sri Lanka
M.S.S. Fawmiya, B.E.P. Mendis, R.P.N.P. Rajapakse, R. Sivakanesan and A.H.M. Mawjood

11.30 a.m. Determination of Nitrite, Nitrate, Total Fat and Heme Iron Contents in Selected Ready to Eat (RTE) Processed Meat Products Available in Sri Lanka
M.B.F. Jemziya and T. Mahendran

11.45 a.m. Manufacturing of Low Haze Instant Tea Extracts Using Sri Lankan Broken Mixed Fannings (BMF) as Raw Materials
K.A.P. Dalpathadu, H.U.K.D.Z. Rajapakse, C.V.L. Jayasinghe and S.P. Nissanka

12.00 noon Total Phenolic Content, Antioxidant Activity and *in vitro* Bioaccessibility of Minerals in "Gasnivithi" (*Talinum triangulare*) and "Keren koku" (*Acrostichum aureum*) Available in Sri Lanka
P.S. Peduruhewa, K.G.L.R Jayathunge and R. Liyanage

12.15 p.m. Effect of Thermal Processing on the *in vitro* Bioavailability of Minerals and Anti-nutritional Factors from Indian Almond (*Terminalia catappa*) Nuts
G.M. Saibu, O.B. Adu, O.O. Ogunrinola, S.O. Ogun, G.A. Adeyemo, C.M. Nnaife, R.A. Alli1, O.H. Olokodana, M.A. Aruna and O.O. Oguntibeju

Technical Session III

Agricultural Production and Environment

Chairperson: Prof. A.N.F. Perera

Venue: Seminar Room C, PGIA

11.00 a.m. Population Parameters of *Penaeus semisulcatus* (De Haan, 1884), Caught by Fyke Net Fishers from Kachchai Fishing Ground of Jaffna Estuary, Sri Lanka
N. Vithursha, N. Ragavan and U. Edirisinghe

11.15 a.m. Effects of Elevated Temperature and CO_2 on Biomass and Sucrose Accumulation of Selected Sugarcane Genotypes
A.L.C. De Silva, W.A.J.M. De Costa and L.D.B. Suriyagoda

11.30 a.m. Effect of Exotic Tilapia (*Oreochromis* spp.) on the Population of Native Fish, Climbing Perch (*Anabas testudineus*, Bloch, 1792) in Malwathu Oya-Nachchaduwa Floodplain
P.A.C.T. Perera, C.M.B. Dematawewa, T.V. Sundarabarathy, S.P. Kodithuwakku and U. Edirisinghe

11.45 a.m. Cellulose Decomposition Potential of Soil as Affected by Vegetable Cultivation: A Case Study in Kegalle District, Sri Lanka
W.A.M.S. Wickramaarachchi and W.S. Dandeniya

12.00 noon Micronutrient Status in Commercial Sugarcane-growing Alfisols at Sevanagala, Sri Lanka
H.A.S. Weerasinghe, G.P. Gunaratne, A.N. Jayakody and R.S. Dharmakeerthi

12.15 p.m. Analysis of Water Productivity in Paddy Cultivation within the Ulagalla Tank Cascade System in Sri Lanka
K.K.P.N. Kahathuduwa and D.V.P. Prasada

Technical Session IV

Pest and Disease Management in Agriculture

Chairperson: Prof. D.C. Bandara
Venue: Seminar Room D, PGIA

11.00 a.m. Impacts of Nutrient Management and Crop Rotation on Weed Dynamics in Rice under Dry Zone (DL1b) of Sri Lanka
W.M.D.M. Wickramasinghe, D.A.U.D. Devasinghe, D.I.D.S. Benaragama, L.D.B. Suriyagoda and W.C.P. Egodawatta

11.15 a.m. Management of Sugarcane Smut Disease Using Triazole Fungicides and Synthetic Elicitors
A.N.W.S. Thushari and D.M. De Costa

11.30 a.m. Prevalence of Bovine Tuberculosis among Cattle and Buffaloes in the Central Province of Sri Lanka
Y.H.P.S.N. Kumara, A. Amarasinhe, P.G.A. Pushpakumara, H.M.S. Wasana, W.M.T.D. Rathnakumara, G.A. Gunawardana and B. Alexander

11.45 a.m. Snap Bean Breeding for Rust Resistance: Validation of Molecular Markers for the *Ur-11* Gene Introgression
H.M.P.S. Kumari, C.K. Weebadde, P.C.G. Bandaranayake, M.A.P. Corrales and R.G.A.S. Rajapakshe

12.00 noon Varietal Screen for Susceptible Stage of *Saccharum* Hybrids for *Deltocephalus menoni* (Hemiptera: Cicadellidae), Vector of Sugarcane White Leaf Disease
K.M.G. Chanchala, K.S. Hemachandra, L. Nugaliyadde, V.K.A.S.M. Wanasinghe and W.R.G. Witharama

12.15 p.m. Screening of Finger Millet (*Eleusine coracana*) Germplasm in Sri Lanka for Blast Disease (*Magnaporthe grisea*) Resistance
W.M.R. Kumari, D.K.N.G. Pushpakumara, W.M.W. Weerakoon, D.M.J.B. Senanayake and H.D. Upadhyaya

Technical Session V

Technological Interventions in Agriculture

Chairperson: Prof. E.R.N. Gunawardana
Venue: Seminar Room E, PGIA

11.00 a.m. Ex-post Study on Expected Utility of Weather Information: Quasi Experiment on Sri Lankan Paddy Farming
N.M.K.C. Premarathne, A. Senaratne and L.H.P. Gunaratne

11.15 a.m. Regeneration of Plantlets of Tea [*Camellia sinensis* (L.) O Kuntze] cv. TRI 5001 through Somatic Embryogenesis in Liquid Dynamic Medium
K.K. Ranaweera, M.A.B. Ranatunga, J.P. Eeswara, S. Thilakarathne and H. Kadono

11.30 a.m. Evaluation of Clay Brick and Laterite Brick as Low-Cost Adsorbents for the Removal of Cd^{2+} and Pb^{2+} in Aqueous Solutions
K.R. Hettiarachchi, D.M.S.H. Dissanayaka, M.I.M. Mowjood and R.A.A.S. Rathnayaka

11.45 a.m. Pulse-Width-Modulation Control of a Heat Pump Dryer with Cascade Evaporators and Parallel-Flow Condensers
A.J. Fernando, K.S.P. Amaratunga, D.A.N. Dharmasena, R.M.R.D. Abeyrathna, I.L. Gajasinghe, H.S.T. Weerakoon, E.M.A.C. Ekanayake and D.M.S.P. Bandara

12.00 noon Modelling the Particle Size Distribution of Pulverized Gallnuts
E.M.A.C. Ekanayake, K.S.P. Amaratunga and A.J. Fernando

12.15 p.m. Assessment of Mobile-based Extension Service Usage by Medium-scale Tea Growers in Kandy District, Sri Lanka
K.G.M.J.W. Gunapala, U.I. Dissanayeke and C. Munasinghe

Lunch Break

01.00 p.m. – 01.30 p.m.

Invited Presentation I

Chairperson: Prof. D.M. De Costa

Time: 01.30 p.m.

Dissecting & Modulating the Regulation of Postharvest Ripening Pathways in Tomato Towards Reduced Produce Waste & Loss

Prof. Diane Beckles
Professor of Postharvest Integrative Biology
University of California Davis
USA

Display of Posters

2.10 p.m. – 3.00 p.m.

Invited Presentation II

Chairperson: Prof. A.J. Mohotti

Time: 03.00 p.m.

Impact of Climate Change on Tea Production and the Adaptation Strategies

Prof. Wenyan Han
Tea Research Institute
Chinese Academy of Agricultural Sciences

Closing Session

Chairperson: Prof. C.M.B. Dematawewa, Director, PGIA

3.45 p.m.	Invited Presentation by Distinguished PGIA Alumnus **Prof. Udith Jayasinghe-Mudalige** Secretary, Ministry of Agriculture
4.20 p.m.	Presentation of Awards
4.35 p.m.	Closing Remarks **Prof. P.C.G. Bandaranayake** Coordinator – PGIA Congress 2021
4.50 p.m.	Vote of Thanks **Ms. L.M.J.N.K. Dissanayake** Secretary, Postgraduate Agriculture Students' Association, PGIA

November 16, 2021
Postgraduate Institute of Agriculture, Peradeniya

Poster Evaluation
PROGRAMME

Session I: Stakeholder Behaviour on Food Quality and Safety

Venue: Seminar Room A, PGIA

10.00 a.m. Dietary Micronutrient Adequacy in Early Adolescence in the City of Colombo, Sri Lanka
A.D.D.C. Athauda, D.G.N.G. Wijesinghe and G.A.P. Chandrasekara

10.05 a.m. Assessment of Knowledge and Practices regarding Iron Deficiency Anaemia among Pregnant Women in Kattankudy D.S. Division of the Batticaloa District
M.R. Roshana and T. Mahendran

10.10 a.m. Willingness to Pay for Sustainable Seafood Products across Regions: A Meta-analysis
I.P. Lokugamage, W.N. De Silva and M. Aanesen

10.15 a.m. Effect of Marketing Mix Antecedents on Consumer Brand Preference of Milk Powder
M.G.T. Lakmali, G.C. Samaraweera, N.M.N.K. Narayana and W.M.R. Laksiri

10.20 a.m. A Comparative Analysis of Stakeholder Linkages in Integrated Farming System (IFS) for Technology Reach in Selected Agro-Climatic Zones (ACZ) of Karnataka
H.R. Ramya, M.C.A. Devi, N. Naveena, S. Subash and P. Kar

10.25 a.m. A Study on Food Safety Assurance in the Sri Lankan Hospitality Sector and Relevance of Legislations to Promote Food Safety
K.G.A. Omalka, R.P.N.P. Rajapakse and B.E.P. Mendis

Session II - Disease Control and Pest Management in Food Crops

Venue: Seminar Room B, PGIA

10.00 a.m. Antifungal Potential of Leaf Extracts of Selected Plants against *Colletotrichum gloeosporioides* Causing Anthracnose in Papaya
R.W.K.M.R.U.S. Bandara, D.W.M.M.M. Kumari and G.D.N. Menike

10.05 a.m. Composition and Antimicrobial Activity of Different Plant Parts of *Parthenium hysterophorus* L.
K. Niranjan, R. Kapilan, P.N. Yapa and P. Kavashana

10.10 a.m. Status of *Fusarium* Head Blight on Wheat Fields in Southwestern Ethiopia
M. Kebede, G. Adugna and B. Hundie

10.15 a.m. Antimicrobial Properties of *Garcinia cambogia* Fruit Rinds and Leaves
K.T.N.K. Wijithasena, P.C. Arampath and K.M. Somawathie

10.20 a.m. Evaluation of Effectiveness of Diamond Back Moth Management Strategies in Cabbage of Up Country Region in Sri Lanka
H.A.S.N. Hettiarachchi and K.S. Hemachandra

10.25 a.m. Wild Rice Species in Sri Lanka as Genetic Resources in Breeding for Brown Planthopper (*Nilaparvata lugens* (Stål) Resistance in Rice
A.V.C. Abhayagunasekara, G.D.S.N. Chandrasena, D.M.O.K.B. Dissanayake, J.M.S.M. Jayasundara, D.K.N.G. Pushpakumara, W.L.G. Samarasinghe and P.C.G. Bandaranayake

10.30 a.m. Assessment of Grain Preference among Selected Rice Varieties by Field Rat, *Bandicota bengalensis* and House Rat, *Rattus rattus* in Sri Lanka
S.R. Sarathchandra, K.P.S.D. Hennayake, M.P.H.K. Jayaweera, L. Nugaliyadde, K.S. Hemachandra and A.D.N.T. Kumara

10.35 a.m. Pesticides Used in Rice Cultivation: Application Pattern by Farmers in Trincomalee District, Sri Lanka
D.M.P.N.K. Dissanayke, S.N.T. De Silva, S. Pathmarajah, K.A.D.A. Kodagoda, T.M.R. Chandimal and H.M.T.D. Herath

Session III - Experimentation and Data Analysis

Venue: Seminar Room C, PGIA

10.00 a.m. Effect of Seed Treatments on Seed Germination of *Madhuca longifolia* ("Mee") Seeds
H.G.M.K. Karunarathna, J.P. Eeswara and M.C.M. Iqbal

10.05 a.m. The Effects of Varying Light Intensity on the Growth and Tissue Nutrient Contents of *Allium porrum* Cultivated Hydroponically under Greenhouse Conditions
B. Ntobela, O.O. Oguntibeju, E.A. Akinpelu and F. Nchu

10.10 a.m. Mid-IR Spectral Characterization and Chemometric Evaluation of Different Solvent Extracts of Coconut Testa Flour
K.M.R.U. Gunarathne, J.M.N. Marikkar, E. Mendis, C. Yalegama, L. Jayasinghe and B.S.K. Ulpathakumbura

10.15 a.m. Niche Partitioning of Sri Lanka White-Eye and Oriental White-Eye (Passeriformes: Zosteropidae) in Sympatry
W.M.C.S. Wijesundara, M.W.S.K. Yatigammana and G.L.L.P. Silva

10.20 a.m. Fitting the Linear, Poisson and Gamma Distributions to Data of a Tropical Pest Study
K. Iamba

10.25 a.m. Factors Influencing the Success of Tank Rehabilitation Projects in India and Sri Lanka: A Meta-Analysis
S. Sirimanna and D.V.P. Prasada

10.30 a.m. Time Series Analysis of Rainfall using ARIMA and SAMA Circular Model: Study from Vadamaradchi, Jaffna, Sri Lanka
T. Sellathurai, T. Sivananthawerl, S.S. Sivakumar, T. Mikunthan and T. Karunainathan

Message from the Chief Guest

It gives me great pleasure to share a message on the occasion of the 33rd Annual Congress of the Post Graduate Institute of Agriculture of the University of Peradeniya.

The theme of the annual congress "Research and Innovation for Resilient Agriculture" is timely in a backdrop where science-based solutions are needed to eradicate hunger and reverse climate change. World hunger is on the rise with over 800 million people going to bed hungry every day. Smallholder farmers who produce more than one-third of the world's food are some of the worst affected by poverty as agriculture continues to be an unpredictable and unsafe sector.

The key to unlocking the full potential of the agriculture sector to feed a growing population while protecting the environment, lies in evidence-based policies and decision-making. Research and Development to make farming science based, innovative, resilient, and empowering can go a long way in reducing hunger and malnutrition. Agricultural R&D provides some of the highest rates of return among all rural development investments.

Focusing on agricultural innovation is essential to increase productivity, promote sustainable agricultural growth and alleviate poverty. I commend the Post Graduate Institute of Agriculture for providing a platform for students from around the world to share their research, fueled by innovative and new ways of thinking that is much needed to drive the engine of growth in Sri Lanka.

Putting information within reach and supporting the transition to sustainable agriculture is at the heart of FAO's work. FAO serves as a knowledge network, collecting, analyzing and disseminating data that aid development. We are committed to developing an enabling environment and to enhance national agriculture research in Sri Lanka by promoting studies, policy dialogues, networks and partnerships at all levels.

I extend my warm congratulations to all the researchers who have showcased their work today. Your contributions will go a long way in developing inclusive, resilient and robust agri-food systems in Sri Lanka.

Vimlendra Sharan
Representative for Sri Lanka and the Maldives
Food and Agriculture Organization of the United Nations (FAO)

Message from the Director

It is a rare privilege and delight to deliver this message on the occasion of the 33rd Annual Congress of Postgraduate Institute of Agriculture (PGIA), where a highly selected group of local and foreign postgraduate students proudly stage their valuable research findings in Agriculture on an online platform of a highly learned audience of academics, researchers, and other stakeholders of agriculture. Since its establishment in 1976, the PGIA has assumed the national leadership in human resource development in terms of postgraduate education in Agriculture in Sri Lanka. With over 350 foreign qualified academics and professionals serving in the teaching panel, PGIA has stuck to its mandate remarkably producing over 300 Masters and PhD degree holders annually.

Introduced in 1989, the Annual Congress has been the most glamorous scientific event of PGIA attracting elite agriculture professionals of all disciplines. The scientific sessions of PGIA Congress, adorned by keynote speeches of eminent international scientists, ensure comprehensive coverage of all disciplines of Agriculture and allied fields. The high quality research studies of the students, funded by local and international grants, are aimed at producing discoveries and innovative solutions in Agriculture to achieve the SDGs of the country and the region. Meticulous efforts of the Editorial Board ensure the articles across the globe submitted online undergo a rigorous review process before selection for presentation at the Congress and subsequent publication in the Tropical Agricultural Research journal of the PGIA.

Sustained effects of the Covid 19 pandemic significantly shifted the focus PGIA Congress from its' famous on ground glamour to virtual mode with a much larger group of online audience. The hybrid mode adopted has enabled an Opening Ceremony on ground with Mr. Vimlendra Sharan, Sri Lanka and Maldives Country Representative at UN FAO (Chief Guest) and other dignitaries followed by a virtual interactive platform for all presenters with audience joining online, and an on ground Awarding Ceremony with Prof. Udith Jayasinghe-Mudalige, Secretary, Ministry of Agriculture being the Chief Guest of the Closing Session.

The highly energetic coordinator of the PGIA Annual Congress this year, Prof. P.C.G. Bandaranayake was able to summon one of the largest group of volunteers as the Organizing Committee and the team deserve a great applause for making the event a virtual success during these demanding times. Sincere appreciations also go to all those who were behind the scene supporting in staging the 33rd Annual Congress so professionally including the Sub Committees, the Boards of Study, the chief editors and editorial board, reviewers, judges, PGIA staff, and well-wishers.

I wish the 33rd Annual Congress a grand success.

Prof. C.M.B. Dematawewa
Director/ Postgraduate Institute of Agriculture

Message from the Vice-Chancellor

I am delighted and honored to send a congratulatory message to the 33rd Annual Congress of the Postgraduate Institute of Agriculture (PGIA). As the Vice-Chancellor, I also would like to take this opportunity to greet and thank all the speakers, paper presenters, and participants.

The PGIA Congress has been an annual event since 1989, drawing together experts from across the agri-food and feed industries.

I am confident that this conference will be a platform for our academia, students, and other researchers to showcase and share the latest research initiatives and innovations in your chosen specialty interest areas.

On behalf of the University of Peradeniya, I would like to convey my sincere gratitude to the distinguished keynote speaker and other invited speakers for sparing their time. I also profusely compliment the Chairperson and members of the organizing committee (PGIA Congress-2021), and all other personnel for organizing this event in keeping with the standards and traditions of the university.

I congratulate all the presenters on their valuable contributions and wish them a productive and memorable experience. I hope you will join us next year too.

I wish PGIA Congress 2021 a fruitful conference!

Prof. M.D. Lamawansa
Vice Chancellor
University of Peradeniya

Message from the Dean

It is indeed a privilege and pleasure to send this message to the 33rd Annual Congress of the Postgraduate Institute of Agriculture (PGIA) as the Dean of the Faculty of Agriculture, University of Peradeniya. During the last several, I have witnessed its progress and its contribution as a fertile ground on which ideas could blossom forth while postgraduates obtain much-needed exposure and experience.

The Annual Congress has brought academics, scientists, policymakers, private sectors and NGOs along with postgraduate researchers to a common forum to discuss and debate matters and to make efforts to remedy many problems through integrated and holistic thinking, which help to build the much-needed research capacity human resources and research culture in the postgraduate education. The Annual Congress has also provided the critical mass of ideas and knowledge to make a significant impact on the agricultural development of the country and the region. Thus, the words "Annual Congress of the PGIA" brings to my mind a seat of learning and experience, new knowledge and service to the University and the nation. In this regard, I take this opportunity to appreciate the vision and dedication of the personnel who initiated this congress 32 years ago and those who have helped to continue it annually to date. It is with pride I stated that the members from Faculty of Agriculture, University of Peradeniya had contributed significantly to bring this event to its present standards, yet now is the high time to revisit its role to match with today's context in postgraduate education, especially during this Covid-19 pandemic and post Covid-19 era.

This year too, I am highly optimistic that the Annual Congress will provide a forum for discussing cutting-edge science in a multi-disciplinary audience even through the distance mode. I take this opportunity to congratulate this year's Congress Coordinator and the Organizing Committee, and the Director of the PGIA for their untiring effort in organizing the event under the current situation without stopping it.

On behalf of the Faculty of Agriculture, the University of Peradeniya, the major partner of the PGIA in its academic and research activities, I wish the 33rd Annual Congress every success. Furthermore, I sincerely hope that this event delivers all its responsibilities to stakeholders during this difficult period as well.

Prof. S.S. Kodithuwakku
Dean/ Faculty of Agriculture
University of Peradeniya

Message from the President, Postgraduate Agriculture Students' Association

I am pleased and privileged to convey this message on behalf of the Postgraduate Agriculture Students' Association (PASA) on the occasion of the 33rd Annual Congress of the Postgraduate Institute of Agriculture of the University of Peradeniya, which will be held in 17th November 2021.

The annual congress is one of the main academic events of PGIA which provides a platform for academia, scientists, policymakers, and notably students to disseminate, discuss, and debate their unique scientific findings in all disciplines of agricultural and allied sciences with a wider audience.

This year too, the annual congress has to be staged amidst the COVID-19 pandemic situation. We, as the student body of PGIA, are very much grateful to the organizers for striving in providing the opportunity for the young scientists around the world to present their postgraduate research findings by holding Annual congress of the PGIA similar to previous years without fail. I personally believe that every student of the PGIA perceive the significance and the value of this scientific event, which is organized with the prime objective of benefitting the student body. We applaud the PGIA for its devotion and arduous effort.

On behalf of PASA, I would like to express our gratitude to the Congress Coordinator and the Organizing Committee for their tremendous efforts in organizing and accomplishing this event with great success during this new normal situation.

Mr. V.G.T.D. De Silva
President, Postgraduate Agriculture Students' Association (PASA)
Postgraduate Institute of Agriculture
University of Peradeniya

Message from the Congress Coordinator
33rd Annual Congress, Postgraduate Institute of Agriculture

The 33rd PGIA Annual Congress continues the long tradition of providing an opportunity for postgraduate students, academia, and scientists from all over the world representing broad spectrum of disciplines to gather around the common theme. The theme of the 33rd annual congress is "Research and Innovations for Resilient Agriculture", and will be staged as a virtual event this year owing to the COVID-19 pandemic. The keynote speaker, Prof. Jessica Fanzo (John Hopkins, USA), and two invited speakers, Prof. Diane Beckles (UC Davis, USA) and Prof. Wenyan Han (Chinese Academy of Agricultural Sciences), will also join the event online.

Over the years, the Annual Congress of the PGIA has become one of the most recognized scientific platforms in the country. The PGIA congress particularly aims to disseminate key findings of the research in agriculture and allied sciences that have led or are leading to higher degrees of postgraduate students and young scientists from Sri Lanka and the globe. Findings of the research are presented in the Congress in oral and poster sessions, and are published in abstract form in the Congress Proceedings. This year, we organized four pre-Congress workshops aiming the capacity development of young scientists on publishing and presenting scientific information. The outstanding studies presented at the Congress will be published as a full paper in one of the top-ranking indexed journals in the country - Tropical Agricultural Research (TAR), published by the PGIA.

This year, we received 56 full-length original research papers. After a rigorous peer-reviewing process, fifty one were selected to be presented at the Congress. The eight technical sessions of the Congress are arranged to find common interests and create synergy among the different disciplines. The sessions include oral and poster presentations assembled and the presenters exhibiting high standards of scientific excellence will be recognized through awards.

I would like to thank Mr. Vimlendra Sharan, the FAO Country Representative, Prof. M.D. Lamawansa, the Vice-Chancellor, University of Peradeniya for grassing the inaugural session. My sincere thanks are also extended to the keynote speaker: Prof. Jessica Fanzo and the two invited speakers: Prof. Diane Beckles and Prof. Wenyan Han, who share their thoughts and visions at PGIA congress 2021. I am grateful to the Editors-In-Chief and Editorial Board members of the journal, authors, and reviewers of papers, the Chair Persons, and Evaluators of the technical sessions for their invaluable contribution to making the 33rd Annual Congress a success. Special tributes are due to the Director of the PGIA and his staff, and the organizing committee of the Congress led by the abled Chairpersons of four subcommittees, generous Sponsors, and everyone who encouraged and supported this event in numerous ways. It is indeed a pleasure to work with them.

I sincerely hope that the PGIA Congress 2021 will be a memorable scientific experience to all the participants.

Prof. P.C.G. Bandaranayake
Congress Coordinator, 2021

Past Directors of Postgraduate Institute of Agriculture University of Peradeniya

Prof. S. Samita	*July 2014 – September 2017*
Prof. B.C.N. Peiris	*October 2011 – June 2014*
Prof. A.L.T. Perera	*August 2006 - September 2011*
Prof. R.O. Thattil	*January 2002 – August 2006*
Prof. H.P.M. Gunasena	*March 1997 – January 2002*
Prof. Y.D.A. Senanayake	*January 1987 – March 1997*
Prof. T. Jogaratnam	*February 1978 – December 1986*
Prof. R.R. Appadurai	*June 1975 – February 1978*

Past Congress Coordinators

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The 32nd Annual Congress of the PGIA – 2020

Overall Best Presentation:

A.B. Abeysekera, B.V.R. Punyawardena, B. Marambe, I.M.S.P. Jayawardena, T. Sivananthawerl and V.N.M. Wickramasinghe
The Effect of Indian Ocean Dipole Events on the Second Inter-monsoonal Rainfall in the Wet Zone of Sri Lanka

Oral Presentations:

- ***V.H.H. Nadeeshani, W.L.G. Samarasinghe, K.M.S. Wimalasiri, K.D.R.R. Silva and W.M.T. Madhujith***
  Comparative Analysis of the Nutritional Profiles of Selected Solanum Species Grown in Sri Lanka

- ***B. Kiriwaththuduwa, A. Wijesuriya, T.D. Silva, S.W. Ranwala and W. Wijesuriya***
  Characterization of Conserved Sugarcane (*Saccharum* spp.) Germplasm for Parental Selection in Directional Breeding of Economically Important Traits

- ***W.A.M. Fernando, S.A. Weerasooriya, and S.S. Kodithuwakku***
  Effect of Emotional Intelligence on Job Satisfaction: A Case Study from a Leading Call Centre in Sri Lanka

- ***M.G.D. Abeysekara and D.V.P. Prasada***
  Returns to Factors of Production and Total Factor Productivity in Coconut Plantations in Sri Lanka

- ***S.K.D. Wijesinghe, E.D.N.S. Abeyrathne, J.K. Vidanarachchi and R.P.N.P. Rajapakse***
  Bioactive Properties of Fish Protein Hydrolysates from Amazon Sailfin Catfish (*Pterygoplichthys pardalis*) from Victoria Reservoir in Sri Lanka

- ***T.S.P. Jayaweera, H.A.D. Ruwandeepika, V.K. Deekshit, S.P. Kodithuwakku, H.W. Cyril , I. Karunasagar and J.K. Vidanarachchi***
  Biofilm Forming Ability of Broiler Chicken Meat Associated *Salmonella* spp. on Food Contact Surfaces

- ***A.B. Abeysekera, B.V.R. Punyawardena, B. Marambe, I.M.S.P. Jayawardena, T. Sivananthawerl and V.N.M. Wickramasinghe***
  The Effect of Indian Ocean Dipole Events on the Second Inter-monsoonal Rainfall in the Wet Zone of Sri Lanka

- ***M.R.C.P. Wickramasinghe, N.D.K. Dayawansa and R.P. De Silva***
  Modeling Spatial Variability of Runoff Generation in Mahakanumulla Village Tank Cascade System in Sri Lanka Using Soil and Water Assessment Tool

***Poster Presentations*:**

- ***W.M.D.M. Wickramasinghe, T.D.C. Priyadarshani, U.S. Herath, D.I.D.S. Beneragama, U.G.A.I. Sirisena and W.C.P. Egodawatta***
  Effect of Nitrogen Fertilizer, Weeds and Planting Density on Incidence and Severity of Narrow Brown Leaf Spot in Rice Cultivation in Anuradhapura District of Sri Lanka

- ***A.T. Shanadi, G.C. Samaraweera, D.L. Wathugala, W.A. Indika and M.K.S. Madushika***
  Proposing a Mobile Based Guideline Model of Good Agricultural Practices (GAPs) for Potato Cultivation in Sri Lanka

- ***T.D. Ranasinghe, D.M. De Costa and R.S. Dharmakeerthi***
  Evaluation of Some Potential Protocols to Extract DNA from Paddy Soil

CHAIRPERSONS AND JUDGES OF TECHNICAL SESSIONS - 2021

Oral Sessions

SESSION I: Stakeholder Behaviour in Agricultural Processes
Venue: Seminar Room A, PGIA

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Venue: Seminar Room B, PGIA

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SESSION III: Agricultural Production and Environment
Venue: Seminar Room C, PGIA

Chairperson	Prof. A.N.F. Perera
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SESSION IV: Pest and Disease Management in Agriculture
Venue: Seminar Room D, PGIA

Chairperson	Prof. D.C. Bandara
Judges	Dr. J. Damunupola Dr. V. Basnayake Prof. N. Ranathunga
Session Coordinator	Dr. S.A.C.N. Perera

SESSION V: Technological Interventions in Agriculture
Venue: Seminar Room E, PGIA

Chairperson	Prof. E.R.N. Gunawardana
Judges	Prof. M. Vithanage Dr. A. Gunawardena Dr. H.K. Kadupitiya
Session Coordinator	Mr. F.H.C.A. Silva

Poster Sessions

SESSION I: Stakeholder Behaviour on Food Quality and Safety
Venue: Seminar Room A, PGIA

Judges	Dr. N. Jayasena Dr. R. Liyanage Dr. S. Somasiri
Session Coordinator	Dr. E.R.J. Samarakoon

SESSION II: Disease Control and Pest Management in Food Crops
Venue: Seminar Room B

Judges	Prof. N. Ranathunga Dr. S.S.De.S. Jayagoda Dr. G.D.K. Kumara
Session Coordinator	Ms. S.S.K. Chandrasekara

SESSION III: Experimentation and Data Analysis

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Keynote Address & Invited Presentations

Dietary Diversity among Adolescents Aged 11 – 13 in the City of Colombo, Sri Lanka

A.D.D.C. Athauda*, D.G.N.G. Wijesinghe[1] and G.A.P. Chandrasekara[2]

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Sri Lanka

Dietary diversity is a key indicator in assessing access, utilization, and quality of diet. Lack of dietary diversity is strongly associated with an inadequate intake of essential micronutrients. A cross-sectional study was conducted to determine the dietary diversity among adolescents aged 11-13 in the city of Colombo. A sample of 634 adolescents was selected using multistage stratified cluster sampling technique. A three-day diet diary was used to collect the types and quantities of food items consumed. The dietary diversity score was determined based on Food and Agriculture Organization's nine food groups. The food variety score was calculated by a simple count of the number of food items consumed in a single day. Socio-demographic data were gathered using a general questionnaire. Household food security status data were gathered using USDA 18 item questionnaire. The mean (± SD) dietary diversity score was 4.36 (± 1.28), and the mean food variety score was 9.69 (± 2.82). Dietary diversity score and food variety score were high among boys and adolescents in national schools. Adolescents who consumed Vitamin A and Iron rich food were 41.1% and 78.2% respectively. The dietary diversity of adolescents aged 11-13 years in the city of Colombo could be categorized as medium diversity.

Keywords: Adolescents, Dietary diversity, Food security, Food variety

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Market Potential for Quality Certified Dried Fish: A Consumer Choice Experiment in the Galle District of Sri Lanka

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Dried fish is the most common processed fish consumed in Sri Lanka. The country imports dried fish since local production satisfies only about 60% of the demand. Local producers face marketing challenges because of the low price they receive. This may be caused by non-compliance with product quality standards. However, there is a lack of empirical information on consumer behaviour for dried fish. The study focuses on estimating consumers' willingness to pay for the key features in the purchase of dried fish and determining their preference. The study comprised a consumer survey of 180 households, with 60 households in each of the urban, rural, and estate sectors in Galle district: including a choice experiment. The results indicated that the average weekly consumption of dried fish per capita in Galle is 115.2 g, with no significant difference between sectors ($p > 0.05$). Sprat is the highest preferred species in all sectors, followed by Yellowfin tuna in urban and rural areas, and Bigeye scads in estates. Smell and appearance were the key organoleptic features considered by consumers. Over 50% preferred dried fish with a fresh and well-dried appearance. The results of the Choice experiment indicated that consumers prefer locally produced, sun-dried, quality-certified dried fish. Urban and rural consumers were willing to pay an extra amount of SLR 374.21 and 325.89 respectively, for 100 g of quality certified dried fish compared to non-certified. The study recommends that producers should be encouraged to obtain quality certifications by providing financial, educational, and technological support.

Keywords: Choice experiment, Consumer, Dried fish, Quality

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Behavioral Factors Influencing the Adoption of 1/2S d/2 Tapping System by Smallholder Rubber Farmers in Moneragala District

P.K.K.S. Gunarathne*, H.V.A. Wikramasuriya, M.W.A.P. Jayathilaka and W. Wijesuriya[1]

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The adoption of 1/2S d/2 (tapping system) by rubber smallholders is far behind the expectation in Moneragala District. This study was carried out to find out the effective behavioral factors that influence the adoption of 1/2S d/2. The data were collected employing a self-administrated survey among 361 rubber smallholders who had been tapping holdings in 2020, using stratified random sampling. The conceptual model was developed based on the decomposed theory of planned behavior. The variables were measured with the use of validated items. The responses of rubber smallholders for items were captured on a five-point Likert scale. Two-stage model-building process was applied. The conceptualized model was empirically tested using partial least square structural equation modeling by bootstrapping procedure using the SMART- PLS 3.2 software. The composite six-predictor conceptual framework and structural model could explain 79% of the variance in the adoption of 1/2S d/2 by rubber smallholders. Adoption of 1/2S d/2 by rubber smallholders was positively and significantly correlated with the behavioral factors of behavioral intention and perceived behavioral control. Perceived behavioral control under adoption was the most significant influential factor. There were positive significant relationships among the following variables; compatibility and attitude, relative advantage and attitude, perceived usefulness and attitude, and perceived ease of use and attitude. The perceived usefulness had the most significant effect on attitude among the four components of compatibility. These findings can help to boost the behavioral intention of rubber smallholders in Moneragala District in using 1/2S d/2, especially by improving the aspects of facilitating conditions and subjective norms.

Keywords: Adoption, Rubber smallholders, 1/2S d/2 tapping system, Structural equation model

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The Typology of Tea Smallholding Development Societies: Assessing their Multifunctional Approach in Badulla District of Sri Lanka

K.G.J.P. Mahindapala[1*], M.W.A.P. Jayathilaka, L.N.A.C. Jayawardana[2], A. Abeysooriya[3] and N. Gamage[3]

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Farmer-based organisations (FBO) have mechanisms to address the collective issues of farmers. The traditional approaches adopted by the FBOs to empower farmers have been challenged by internal and external dynamics in the present socio-economic context. Evidence shows that FBOs of the tea smallholding sub-sector are facing a crisis in the execution of collective performance. The 'Multipurpose Service Approach' has been proposed to address the broader needs of farmers. Tea Small Holding Development Societies (TSDS) have been established to look after the wellbeing of tea smallholders. This study sought to identify the various activities carried out by TSDS in Badulla district and to classify TSDS based on adherence to the multifunctional service approach. Data were collected from twenty-one TSDS (selected through stratified random sampling technique) using structured interviews. TSDSs' 'participation in the identified twelve activities was assessed using a 0 - 10 score method. Data were analyzed descriptively and using Sign, Man-Whitney test, and cluster analysis. TSDS in Badulla district showed a different level of execution of multifunctions. The supply of inputs in production support packages was at a satisfactory level (sore > 6) in the majority of TSDS. However, the role of the organisation in linking the extension service with the members was not satisfactory. The provision of loans and other financial services was poor. Market-oriented activities were kept to a minimum. There was a lack of policy dialogue within the organization. Based on the variability of the practicing of multifunctional service approach, six clusters could be identified including one with almost dormant TSDSs in many of the activities considered. Five other clusters had varying levels of engagement in different functions on certain aspects. The overall multifunctional service approach performances of TSDS in the region were found to be unsatisfactory.

Keywords: Badulla district, Farmer-based organisation, Multifunctional approach, Tea smallholder

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Spatial Integration of Vegetable Markets of Sri Lanka during COVID-19 Pandemic

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Majority of the vegetables moving through traditional supply chains go through Dambulla Dedicated Economic Centre (DDEC), which is the main wholesale market in Sri Lanka. The price changes in DDEC have been transmitted to other regional markets directly. COVID-19 may have affected the smooth price transmissions among these markets. The study aimed to assess the degree of market integration of the regional Economic Centres in Sri Lanka with DDEC before and during the COVID-19 pandemic. The study analysed the weekly wholesale prices of beans, carrot, tomato, and brinjal markets in two time periods namely; 2018 and 2019 as the pre-COVID-19 period, and 2020 June to 2021 June as the COVID-19 affected period. Price details of selected nine regional Economic Centres and DDEC were used in the study. The analysis was carried out in the first differenced form, which conformed to the Augmented Dickey-Fuller (ADF) tests of stationary. Pairwise comparison between prices at DDEC and regional markets was done using the Engle-Granger Co-integration test. Short-run price disequilibrium was tested using Vector Auto-Regression model (VAR) and Vector Error Correction Model (VECM). Results revealed that before the pandemic in all regional markets, except in Ampara, Keppetipola, and Galle regional markets, prices for beans, carrot, tomato and brinjal were 100 percent transmitting between the main Economic Centre of the country, hence spatially integrated with DDEC. During the COVID-19 period, Dehiaththakandiya, Thambuttegama, Nuwara Eliya, Meegoda, and Colombo Economic Centres were showing cointegrated behaviour with DDEC only for the price transmissions of beans. None of the other vegetable markets were spatially integrated with DDEC during the COIVD-19 period. Thus, the study revealed that despite various government interventions to keep the vegetable market channels smoothly and consistently, the COVID-19 has negatively affected the vegetable marketing system of the country.

Keywords: COVID-19, Market integration, Augmented Dickey Fuller test, Engle-Granger co-integration, Vegetables

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Strengthening the Livelihood Resilience of Smallholder Dairy Farmers against External Shocks in the Northern Dry-Zone of Sri Lanka

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Improving dairy farmers' livelihood resilience help them sustain in farming and reap higher economic returns. This study was conducted in the Jaffna District, which is part of the dry zone of Sri Lanka. A total of 203 dairy households were selected using the stratified purposive random sampling method. Households' livelihood resilience to environmental challenges and shocks was determined through Structural Equation Modelling (SEM). SEM path diagram was developed based on the model developed by Food and Agriculture Organization, which uses resilience as a latent variable. It was a function of six components that were not directly measured from the data set. The SEM analysis revealed that the latent variable 'livelihood resilience' had a significant positive association with the five components. Further, the dietary diversity index ($P>|z| = 0.081$), the quality score of health services ($P>|z| = 0.052$), frequency of assistance ($P>|z| = 0.000$), quality evaluation of assistance ($P>|z| = 0.000$), land owned ($P>|z| = 0.086$), educational level ($P>|z| = 0.017$), and the number of household members who have lost their jobs ($P>|z| = 0.010$), significantly enhanced the livelihood resilience. The finding of this study would help to develop a policy framework that could be supportive in gaining sustainability in milk production through fostering the livelihood resilience of the dairy farmers in the Northern Dry Zone of Sri Lanka.

Keywords: Dairy farm households, Jaffna district, Structural equation model, Livelihood resilience

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Identifying Panel Inconsistency in Sensory Profiles using Multivariate Analysis of Variance (MANOVA) and Follow-up Canonical Variate Analysis (CVA)

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Inconsistency in sensory evaluation is a serious problem, and it often leads to the loss of large revenue. Screening tasters before the sensory evaluation is the only remedy to overcome this inconsistency. This paper aimed at showing how the above requirement can be achieved by using Multivariate Analysis of Variance (MANOVA) and follow–up Canonical Variate Analysis (CVA). The approach was illustrated using sensory profiles of Sri Lankan tea. The principle behind the approach is that any discrepancy between assessors on several attributes is detected simultaneously using MANOVA, and discrepancy interacts with the factors such as products or regions is detected using CVA. Data used for the study consisted of sensory scores given by eight tea tasters for 13 tea growing regions on six attributes; colour, brightness, strength, flavour, aroma, and overall quality. Samples from four factories represented a region, and data were collected for one-year on monthly basis. Data from each month were analyzed separately. The Wilk's Lambda statistics of MANOVA revealed the assessor effect as well as the assessor × region interaction effect ($P < 0.05$) every month, indicating the inconsistency among assessors. The CVA for each region, specifically the 95% confidence regions of CV bi–plots, clearly identified clusters of assessors. Based on the location of these clusters in bi–plots, assessors who are suitable for different attributes were also identified. MANOVA followed by CVA can effectively be used to identify discrepancies between assessors, discrepancies between assessors interacting with factors such as geographical region, and selecting consistent assessors depending on product or region and season in evaluating sensory attributes of tea.

Keywords: Canonical Variate Analysis, Consistent assessors, Multivariate statistical methods, Panel disagreement, Sensory evaluation

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Nutritional and Phytochemical Composition of Leaves of *Moringa oleifera* Lam. Grown in Low Country Wet Zone of Sri Lanka

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Moringa oleifera Lam. (Family- Moringaceae) is a native plant popularly known as Murunga or Murungai in Sri Lanka. Different parts of this plant are utilized for dietary and diverse therapeutic purposes. The accumulation of plant metabolites with nutritional and therapeutic properties mainly depends on certain ecological and environmental factors. Thus, this study investigated the composition of such important metabolites and other elements in aqueous extracts of *M. oleifera* leaves collected from the Low Country Wet Zone of Sri Lanka. Accordingly, the average dry matter composition was 91.15%, and the rest of the composition was in the order of ash (14.77%), crude protein (14.9%), crude fiber (9.4%), crude fat (4.3%), and nitrogen free extract (56.59%) on dry matter (w/w) basis. Moreover, leaves were rich in a variety of vitamins including vitamin A (954 µg/100g), vitamin B complex (B2: 10.1 mg/ 100g, B3: 0.21 g/100g, B6: 0.12 g/100 g), vitamin C (56.8 mg/100g) and vitamin E (66.7 mg/ 100g). In addition, important minerals such as potassium (130 mg/100g), calcium (117.31 mg/100g), sodium (6.12 mg/100g), ferrous (4.06 mg/100g), magnesium (3.75 mg/100g) and zinc (1.95 mg/100g) on dry matter (w/w) basis. The hot water extract of 100 g of the dry leaf was rich in tannins (271 mg Gallic acid equivalent), alkaloids (144 mg Atropine equivalent), flavonoids (115 mg Quercetin equivalent), and total phenols (52 mg Gallic acid equivalent). This study reveals that the leaves of *M. oleifera* grown in the Low Country Wet Zone of Sri Lanka are rich in essential and non-essential nutrients and therapeutic phytochemicals, thus can be considered as a good source of a dietary ingredient and ethnomedicine.

Keywords: Mineral, *Moringa oleifera*, Nutrients, Phytochemical, Proximate composition

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Determination of Nitrite, Nitrate, Total Fat and Heme Iron Contents in Selected Ready to Eat (RTE) Processed Meat Products Available in Sri Lanka

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Sri Lankan processed meat industry produces a variety of meat products. Global meat production and consumption have increased rapidly in recent decades, with harmful effects on the environment and public health. Nitrite, nitrate, heme iron, and certain types of fats such as trans-fats are potentially harmful compounds. The nitrite, nitrate, total fat, and heme iron that exist in 12 processed meat products commonly available in the Sri Lankan market were examined to get an idea about their availability in local products. The FAO classification for semi-processed and processed meat products was followed in the study, and ten replicates were included in the analysis. The Ready to Cook (RTC) processed meat samples were procured and then cooked according to the standard procedures. The nitrite and nitrate content were determined by AOAC 973.31 method, while total fat content was determined using AOAC 963.15 method on fresh weight basis. The heme iron content was analyzed using acidified acetone extraction method. The results were statistically interpreted using analysis of variance and Duncan's multiple range test at 0.05 significant level. The Ready to Eat (RTE) bacon and RTE salami had the highest nitrite (7.25 mg/kg) and nitrate content (89.66 mg/kg), respectively. The RTE burger and RTE jerky had the lowest content of nitrite (0.99 mg/kg) and nitrate content (1.85 mg/kg), respectively. The raw-cooked beef products (15.80%) and dried chicken products had the lowest percentage (3.49%), and fermented beef sausages had the highest percentage (26.41%) of total fat compared to the other types of processed meat products used in this study. The raw-cooked chicken products had the lowest content (0.33 mg/100 g), and the dried beef products had the highest content (5.40 mg/100 g) of heme iron compared to the other selected processed meat products. In conclusion, the cured and fermented meat products commonly available in the Sri Lankan market consist of comparatively higher amounts of nitrite, nitrate, fat, and heme iron than the freshly processed and dried meat products.

Keywords: Meat processing, Public health, Ready to Eat (RTE), Processed meat products, Sri Lanka

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Manufacturing of Low Haze Instant Tea Extracts Using Sri Lankan Broken Mixed Fannings (BMF) as Raw Materials

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Haze or tea cream in instant tea significantly affects tea-based product manufacturing due to its impact in preparing unclouded tea infusions. The effect of pre-processing temperature of spray drying and growing elevation with haze development of instant tea production from Broken Mixed Fannings (BMF) was studied by analyzing total polyphenol (TPC), caffeine content, yield, and haze value in instant tea. The highest ($p < 0.05$) haze content (86.1 NTU) and TPC percentage (16.33%) were found in Up country, whereas the lowest values of the same were found in Low country (29.7 NTU & 11.94%, respectively). A strong positive correlation (0.992) was observed between TPC and haze level, while a negative correlation showed between caffeine and haze level (-0.967). However, there were no significant differences for haze, TPC and caffeine contents among tea estates in the same elevation category. The highest yield (27.17%) and lowest haze value (48.75 NTU) of instant tea were reported at the pre-process spray drying temperature of 70 °C when compared with 40, 50, 60, 80, and 90 °C. The method was validated in large-scale production and could be recommended as a proven methodology to reduce haze development and acquire a high yield of instant tea.

Keywords: Broken mixed fannings, Caffeine, Instant tea, Haze, Polyphenols

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Total Phenolic Content, Antioxidant Activity and *in vitro* Bioaccessibility of Minerals in "Gasnivithi" (*Talinum triangulare)* and "Keren koku" (*Acrostichum aureum*) Available in Sri Lanka

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Underutilized wild edible species or neglected crop species are still used at low levels within the local communities but show a high potential to contribute to food supply with more health benefits. This study was conducted to assess the nutritional properties of two underutilized wild edible species, namely, *Acrostichum aureum* (Keren koku) and *Talinum triangulare* (Gasnivithi) available in Sri Lanka. Plant extracts were analyzed for their ascorbic acid content (AAC), total phenolic content (TPC), antioxidant activities (AA), and mineral contents (Ca, Cu, Zn, and Fe). Bioaccessibility of minerals was also tested through an *in vitro* digestion model. Ca is the most abundant micronutrient (45.61-102.91 mg/100g) in both tested species, while *in vitro* bioaccessibility assay demonstrated a higher fraction of Ca (47.46%) in *A. aureum* and Cu (64.68%) in *T. triangulare* than the other tested minerals. The highest concentration of AAC and TPC was found in *T. triangulare* (AAC: 8100 mg/100g; TPC: Gallic acid equivalent, 347.45 mg/100g) followed by *A. aureum* (AAC: 1650 mg/100g; TPC: Gallic acid equivalent, 279.83 mg/100g). Studied species were found to have significant antioxidant activities as evaluated by two different methods, such as using 2,2-diphenyl-1-picryhydrazylhydrate (DPPH) and 2,2'-azobis (2-ethylbenzoline-6-sulfonic acid) (ABTS) radical scavenging activity. Concerning tested data, *T. triangulare* has shown the greatest antioxidant activity in both methods (DPPH: 0.173 IC_{50} mg/mL: ABTS: 431.11 mg Trolox equivalent antioxidant capacity/g). *A. aureum* also showed favorable antioxidant activity as 0.192 IC_{50} mg/mL in DPPH assay and 342.78 mg Trolox equivalent antioxidant capacity/g in ABTS assay. Hence, consumption of identified underutilized plant species may serve as good sources of antioxidants and minerals in their natural form.

Keywords: Bioaccessibility, Minerals, Antioxidants, Phenolic content

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Effect of Thermal Processing on the *in vitro* Bioavailability of Minerals and Anti-nutritional Factors of Indian Almond (*Terminalia catappa*) Nuts

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Terminalia catappa L. (Indian almond) is an underutilized crop rich in minerals. However, investigation and information on the bioavailability of minerals and the presence of anti-nutritional factors in the nut are lacking. Several traditional food-processing methods are used domestically to enhance the bioavailability of micronutrients and decrease the effects of anti-nutrients in plant-based foods. Therefore, this study was conducted to determine the effect of thermal processing on anti-nutritional factors and *in vitro* digestibility of minerals of *Terminalia catappa* nuts. The mineral concentration (Na, Ca, P, Mg, Cu, Fe, and Zn) of raw and processed (boiled, roasted, dried and pressure cooked) *T. catappa* seeds were determined. The mineral concentration (Na, Ca, P, Mg, Cu, Fe, and Zn) of the raw *T. catappa* nut (6.25 to 50.7 mg/100g) was significantly higher ($p < 0.05$) than those of processed nuts. Pressure cooking led to the greatest loss in mineral content (0.44-33.90 mg/100g), followed by boiling (0.55-34.18 mg/100g), roasting (3.75-37.45 mg/100g), and drying (5.00-44.36 mg/100g) in descending order. *In vitro* mineral digestibility was generally low in the raw *T. catappa* nut (1.69% to 20.00%) compared to the processed samples (6.23% to 50%). There was a reduction in the concentration of tannin and phytate in the processed samples in boiled (3 mg/g, 0.35 mol/kg), roasted (10 mg/g, 0.40 mol/kg), pressure cooked (4 mg/g, 0.35 mol/kg), respectively as compared to the raw sample (tannin, 13 mg/g; phytic acid, 0.54 mol/kg). The greatest reduction in tannin and phytic acid occurred in boiled samples, followed by pressure cooked and roasted samples. The thermal processing methods enhanced the *in vitro* mineral digestibility of analyzed minerals of *T. catappa* nut and reduced the anti-nutrients in the nuts of *Terminalia catappa.*

Keywords: Anti-nutrients, Bioavailability, Minerals, Processing, *Terminalia catappa*

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Population Parameters of *Penaeus semisulcatus* (De Haan, 1884) Caught by Fyke Net Fishers from Kachchai Fishing Ground of Jaffna Estuary, Sri Lanka

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This study was conducted to analyse the population parameters of male and female *Penaeus semisulcatus* in Kachchai fishing ground of the Jaffna estuary. Length and weight of randomly selected 400 shrimps were measured bi-weekly from June 2019 to May 2020. The monthly data were analyzed by using FAO-ICLARM stock assessment tool and Microsoft Excel. Results revealed that male and female *P. Semisulcatus* were having isometric growth (b = 3) and had the same Fulton condition factor (K̄ = 0.7). Female *P. semisulcatus* had a comparably higher length and weight than males. The asymptotic length, condition factor and growth performance index were 19.9 cm, 0.13 yr^{-1}, and 1.172, respectively for females and 14.8 cm, 0.6 yr^{-1}, and 2.119, respectively for males. These shrimps were found to be recruited, having a peak from October to January. The computed natural and fishing mortality in males and females were 1.53 yr^{-1} and 0.52 yr^{-1} and 0.19 yr^{-1} and 0.01 yr^{-1}, respectively. The *P. semisulcatus* stock in the Kachchai fishing ground of the Jaffna estuary seemed to be underfished (Exploitation rate (E) > 0.5). These findings will be helpful for the rational management of *P.semisulcatus* fishery at Kachchai landing site of the Jaffna estuary.

Keywords: Jaffna estuary, Length-frequency data, *Penaeus semisulcatus*, Population parameters, Stock assessment

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Effects of Elevated Temperature and CO_2 on Biomass and Sucrose Accumulation of Selected Sugarcane Genotypes

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Global warming due to increasing atmospheric CO_2 concentration and the resulting increase of air temperature is a major challenge to crop production. Hence, the objectives of this study were to determine the: (a) responses of biomass and sucrose accumulation of sugarcane to elevated CO_2 (ECO_2) and elevated temperature (ET_a), both individually and together, and (b) genotypic variation of these responses. A three factor factorial experiment considering the combination of CO_2 concentrations and temperatures as the main-plot factor and eight sugarcane varieties as the sub-plot factor was conducted in a split-plot design in open-top chambers. Plots in open field conditions were considered as the negative control. The main plot factor had four levels, *i.e*. combinations of ambient/elevated CO_2 concentrations (344-351/777-779 ppm) and ambient/elevated temperatures (34.9-35.6/36.6-38.4 °C). Significant treatment × variety interaction effects were observed on the number of shoots per hill, Pol and pure obtainable cane sugar (POCS) in cane juice. Significant genotypic variations were observed in all variables measured. Elevated T_a increased the number of shoots per hill in 4 out of 8 varieties. Dry weight basis biomass accumulation of sugarcane did not show a clear response to the simulated future climatic conditions. Elevated T_a decreased Pol and POCS. The response of Pol and POCS to ECO_2 and the combination of ECO_2 and ET_a varied depending on varieties with decreased, increased or no response. Notably, Pol and POCS in the variety SL88116, which had higher respective values at ambient and simulated future climatic conditions were not affected by either of ECO_2 and ET_a individually or in combination. The responses and the significant genotypic variation observed in sucrose accumulation to ECO_2 and ET_a, both individually and together, demonstrate considerable scope in sugarcane to develop varieties to maintain the stability of sugar recovery in CO_2 rich warm climates.

Keywords: Biomass accumulation, Elevated CO_2 and temperature, Open-top chambers, Sucrose accumulation, Sugarcane

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Effect of Exotic Tilapia (*Oreochromis* spp.) on the Population of Native Fish, Climbing Perch (*Anabas testudineus* Bloch, 1792) in *Malwathu Oya-Nachchaduwa* Floodplain

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Nachchaduwa is a man-made reservoir that has been constructed across the upper *Malwathu Oya seasonal river*. It is routinely stocked with *Oreochromis niloticus*, while both *O. niloticus* and *O. mossambicus* (*Oreochromis* spp.) are abundant in the reservoir. This study was carried out in the floodplain close to *Malwathu Oya-Nachchaduwa* inlet to investigate the impact of exotic fish on native fish, Climbing Perch (*Anabas testudineus*). During monsoon rains, the river overflows and a large number of water pockets appear in the floodplain. Species composition and fish density in water pockets were studied. Further, gut contents of fish in water pockets, as well as in the reservoir and upper *Malwathu Oya* were also studied. *A. testudineus* bred in the water pockets. During wet seasons, *Oreochromis* spp. moved upstream and entered the floodplain. Density (number/m^2) of eggs and fry of *A. testudineus* significantly ($p < 0.05$) but negatively correlated with the density of adult *Oreochromis* spp. due to ingestion of fry and eggs. Moreover, the density of adult *A. testudineus* showed significant ($p < 0.05$) negative linear relationships with *Oreochromis* spp. Gut content analysis showed that both exotic species had ingested eggs and fry of *A. testudineus*. *O. niloticus* had ingested a higher number of eggs and fry compared to *O. mossambicus*. In the three aquatic environments, minimum predation was in upper *Malwathu Oya*, where natural in-stream habitats were found. Predation in *Nachchaduwa* reservoir was less than in water pockets. As such, the severity of exotic fish impacts depends on the type of aquatic environment they inhabit.

Keywords: *Anabas testudineus*, Exotic effects, *Malwathu Oya*, *Nachchaduwa* reservoir, Tilapia

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Cellulose Decomposition Potential of Soil as Affected by Vegetable Cultivation: A Case Study in Kegalle District, Sri Lanka

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The potential of microbial communities for organic C decomposition is a crucial factor determining CO_2 emissions from soil, C storage and short-term nutrient turnover. We conducted a study to assess cellulose decomposition potential (CDP) of soils as affected by vegetable cultivation. We selected ten sites cultivated with vegetables, and five sites under natural vegetation, distributed in *Atulugama* and *Kanangama* Grama Nilaldhari divisions in Kegalle District, Sri Lanka. The cultivated lands have been managed with organic fertilizers (n = 4), synthetic fertilizers (n = 3), or a combination of both types of fertilizers (n = 3). Soils collected at 0-15 cm depth were used in a laboratory incubation experiment to assess CDP in triplicates for two weeks. The *in-situ* CDP was studied by placing litter bags containing cotton wool and cellulose filter papers (two cellulose sources) separately, at 5 cm depth in the field in two replicates for four and six weeks, respectively. There was no significant correlation ($P > 0.05$) between CDP observed under laboratory and field conditions. The effect of land management on CDP was significant ($P < 0.05$) only in laboratory incubation, in which soils collected from the lands cultivated with synthetic fertilizers alone had nine-fold high CDP compared to the soil from uncultivated lands. *In-situ* decomposition of added cellulose filter papers and cotton wool after one month ranged from 13-100% and 61-65%, respectively. Nearly 44% of samples exhibited over 80% decomposition of cellulose filter papers. From these samples, 75% were from cultivated lands. Results suggest that vegetable cultivation affected CDP differently depending on the nature of cellulose input and the history of fertilizer management.

Keywords: Cellulose decomposition, Litterbag, Organic fertilizer, Soil microorganisms

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Micronutrient Status in Commercial Sugarcane-growing Alfisols at *Sevanagala*, Sri Lanka

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Continuous mono-culture cropping could deplete the plant available micronutrient reserves in sugarcane-growing soils. This study attempted to investigate the current status of micronutrient availability in commercial sugarcane-growing Alfisols at *Sevanagala*, Sri Lanka. Sugarcane-growing Alfisols at *Sevanagala*, covering both irrigated and rain-fed cropping systems, and low humic gley (LHG) and reddish brown earth (RBE) are great soil groups. A stratified random sampling technique covering both cropping systems and great soil groups was employed to obtain 263 samples. Soil samples were analysed for available Fe, Mn, Zn and Cu contents using the standard DTPA procedure. Available Fe and Zn contents exhibited significant differences among cropping systems and great soil groups. These element concentrations were significantly higher in RBE soils (75 mg/kg and 1.1 mg/kg in irrigated and rain-fed systems, respectively) when compared to LHG soils (43 mg/kg and 0.6 mg/kg in irrigated and rain-fed systems, respectively). Available Fe and Mn contents were at sufficient levels for sugarcane in most soils. In contrast, Zn and Cu contents of soil samples exhibited deficiencies (< 0.1 mg/kg) within cropping systems and great soil groups. The results indicated that appropriate nutrient management practices are required to overcome Zn and Cu deficiencies in sugarcane-growing Alfisols in *Sevanagala* and to mitigate any negative effects on the crop yield and quality.

Keywords: Alfisols, Micronutrients, Sri Lanka, Sugarcane, Cropping system

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Analysis of Water Productivity in Paddy Cultivation within the *Ulagalla* Tank Cascade System in Sri Lanka

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The village tank cascade systems are identified as an important invention of the hydraulic civilization of Sri Lanka. Water productivity is a widely used indicator to measure the performance of such irrigation systems. A combination of agronomic and socioeconomic factors acts as key elements influencing water productivity in paddy cultivation and its temporal variation. This study investigated the variations and determinants of the upstream and downstream water productivity of *Ulagalla* tank cascade system in dry zone Sri Lanka. A comparative study was carried out for four scenarios: upstream *Yala* (2019), upstream *Maha* (2019/2020), downstream *Yala* (2019) and downstream *Maha* (2019/2020) to investigate the factors that affect upstream and downstream water productivity in paddy cultivation During the study period, the highest water productivity was recorded in the *Maha* (2019/2020) season of upstream. Wildlife conflicts and previous crop losses due to natural disasters had significant ($p = 0.05$) negative relationships whereas, command area and tank waterhead had significant ($p = 0.05$) positive relationships with water productivity in paddy cultivation in the *Yala* season of both upstream and downstream. Availability of lining in the field canal and tank waterhead had significant ($p = 0.05$) positive relationships with water productivity in paddy cultivation in the *Maha* season of both upstream and downstream. Compared to the available benchmarks, the revealed values for the hydrological endowment of the cascade are at a satisfactory level (CAA to WA value was recorded as 8.74 and COA to WA value was recorded as 0.97). But, due to the siltation of tanks, the water holding capacity of the cascade as a whole has reduced by approximately half of its initial capacity. The water productivity in paddy cultivation of the upstream and the downstream was at satisfactory levels with reference to regional benchmarks.

Keywords: Cascade downstream, Cascade upstream, Small tanks, Water productivity in paddy cultivation

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Impacts of Nutrient Management and Crop Rotation on Weed Dynamics in Rice under Dry Zone (DL1b) of Sri Lanka

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Integrated weed management (IWM) is a widely used management tool for controlling weeds in cropping systems. Crop rotation and diverse nutrient management strategies are essential components in IWM. However, the effect of crop rotation and nutrient management systems on weed dynamics in Sri Lankan rice-based cropping systems are not yet known. Therefore, an experiment was conducted to identify density, biomass, and abundance of weeds concerning two different nutrient management systems (Synthetic; SNM and Integrated; INM) and under rice monoculture and rice-maize rotation (variety Bg300 of rice and hybrid variety Pacific-998 of maize) for four seasons in the University Farm of the Faculty of Agriculture, Rajarata University of Sri Lanka. Cultivating maize crop in the *Yala* season increased weed density and weed biomass compared to having rice in both crop rotation cycles. During the first cycle, the weed density was high under INM in the rice crop phase. However, in the second cycle, both the crop phases (rice and maize) resulted in low weed density under INM compared to SNM. A high percentage of sedges was reported in crop rotation during the *Yala* seasons, and the grasses were reported in mono-cropping in both seasons. Grass biomass did not change with the nutrient management however, the biomass of sedges increased only with the synthetic fertilizers. High weed density and weed biomass observed with maize during the first cycle was substantially reduced during the second cycle under both nutrient management systems. The results indicate that reducing synthetic fertilizer by 50% and incorporation of organic matter (INM) has substantially improved weed management in both rice and maize crops.

Keywords: Cropping system, Integrated-nutrient management, Rice, Synthetic nutrient management, Weed density

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Management of Sugarcane Smut Disease Using Triazole Fungicides and Synthetic Elicitors

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Sugarcane smut caused by *Sporisorium scitamineum* is a devastating disease of sugarcane. As a management strategy, seed setts of resistant varieties are treated with fungicides after the hot water treatment. As a novel management strategy, the possibility of using low concentrations of fungicides and synthetic elicitors was evaluated under *in-vitro* and field conditions. Three fungicides (Tebuconazole, Hexaconazole and Metalaxyl 8% + Mancozeb 64% WP) and two synthetic elicitors (salicylic acid (SA) and jasmonic acid (JA)) were tested *in-vitro* at 250, 500, 750 and 1000 ppm concentrations for their efficacy on inhibition of the germination of smut teliospores. Tebuconazole, Hexaconazole, and salicylic acids completely inhibited the germination of the teliospores at 500 ppm, 250 ppm and 750 ppm concentrations, respectively. Metalaxyl 8% + Mancozeb 64% WP and JA inhibited the teliospore germination by 52% and 58%, respectively at 1000 ppm concentration. In the field evaluation, smut pathogen was artificially inoculated to the seed setts of a resistant (Co 775) and a susceptible variety (SL 88 116) treated with fungicides and SA at selected concentrations. Disease incidence (DI) was recorded, and disease severity (DS), Area Under Disease Progress Curve (AUDPC) and Percentage Reduction of the Disease (PRD) was calculated. Tebuconazole 500 ppm, Hexaconazole 250 ppm, Hexaconazole 500 ppm and salicylic Acid 1000 ppm were successful in controlling the disease significantly ($P = 0.05$), in terms of DI, DS, AUDPC and PRD, hence can be used as a dip treatment of seed setts for the control of sugarcane smut disease.

Keywords: Hexaconazole, Salicylic Acid, *Sporisorium scitamineum*, Sugarcane, Tebuconazole

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Prevalence of Bovine Tuberculosis among Cattle and Buffaloes in the Central Province of Sri Lanka

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Bovine tuberculosis (bTB) is a chronic disease of cattle and a proven global zoonotic disease. This study was designed to identify the prevalence of bTB using Single Intradermal Comparative Cervical Tuberculin (SICCT) test in cattle and buffaloes in the Central Province (CP) of Sri Lanka. The SICCT test was performed in cattle and buffalo farms (n = 20), which included 616 animals, in the three districts (Nuwara Eliya; NE, Kandy; KN, and Matale; MT) in CP. In SICCT positive samples, randomly selected serum samples (n = 33) of 8 farms were subjected to a rapid antibody (Ab) test, which was used as an additional complimentary test to increase the accuracy of screening. Logistic regression was employed to examine the effects of different risk factors; body condition score (BCS), breed, reproductive status, herd origin, age, sex, and parity, which are considered in bTB infection in cattle and buffaloes. The overall prevalence of bTB in individual cattle and buffalo was 22% (n = 139/616), and the herd-level prevalence was 50% (n = 10/20). When the three districts were considered, 34% and 19% of individuals in NE and KN, respectively showed positive reactions to SICCT, while all the individuals in MT were negative. Only 26% (n = 7/33) of cattle and buffalo serum samples used for rapid antibody testing were positive. Significant statistical associations were observed with bTB and BCS, breed, reproductive status, and herd origin ($P < 0.05$). However, the associations with age, gender, and parity were not statistically significant ($P > 0.05$). It can be concluded that the estimated prevalence of bTB among cattle and buffaloes in the central province of Sri Lanka was considerably high, as determined by the SICCT test. It is suggested that the SICCT test is a reliable tool in the screening of bTB in cattle and buffaloes and can be used to assess the island-wide prevalence of bTB in all regions of Sri Lanka.

Keywords: Bovine tuberculosis, Buffalo, Cattle, Prevalence, Sri Lanka

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Snap Bean Breeding for Rust Resistance: Validation of Molecular Markers for the *Ur-11* Gene Introgression

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Bean rust caused by *Uromyces appendiculatus* fungus is one of the most destructive diseases reported in temperate, tropical, and sub-tropical regions, affecting the quality and quantity of *common* bean (*Phaseolus vulgaris* L*)* yield. The present study aimed to improve the breeding process of snap beans for rust resistance by identification of patterns of inheritance of resistant genes using phenotypic and molecular markers. Among the different genes identified, *Ur-11* has a wide-spectrum of resistance to 89 out of 90 reported races of the rust pathogen. Therefore, the common bean cultivar PI 181996, carrying the *Ur-11* gene, was used as the rust resistance donor parent, while the local popular *snap bean* variety Kappetipola nil, susceptible to all locally reported races of the rust pathogen in Sri Lanka, was selected as the susceptible (Recurrent) parent. The introgression of the *Ur-11* gene from the cultivar PI 181996 in F_1, F_2, and BC_1F_1 populations was phenotypically evaluated using standard screening method. The introgression was validated with random amplified polymorphic DNA (RAPD) marker, OPAC 20, and sequence characterized amplified region (SCAR) marker, SAE 19 and GT 2. Coupling markers (OPAC 20 and GT 2) and repulsion marker (SAE 19) showed 95% and 100% of expected results for phenotypically resistant and susceptible lines, respectively. The results showed that the *Ur-11* gene in PI 181996 can be tagged with SCAR marker GT-2 and SAE 19 and can be used for marker-assisted selection to identify the presence of the *Ur-11* gene in the snap bean rust-resistance breeding programs. Introgression of the *Ur-11* gene helped the development of genetic resistance in local snap bean races against the rust pathogen. Further, the selected progenies can be developed as new rust resistant snap bean breeding lines.

Keywords: Inheritance of resistance, Marker-assisted breeding, Single gene inheritance, *Uromyces appendiculatus*

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Varietal Screen for Susceptible Stage of *Saccharum* Hybrids for *Deltocephalus menoni* (Hemiptera: Cicadellidae), Vector of Sugarcane White Leaf Disease

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Deltocephalus menoni is a sap-sucking insect causing severe losses to the cane sugar industry by feeding on the crop and acting as the vector of sugarcane white leaf disease (WLD) in Sri Lanka. This study was conducted to determine the most preferred age of the sugarcane plant for optimum feeding of *D. menoni.* Sugarcane plants of the varieties SL 92 5588, SL 97 1442, SLC 2009 01, and SL 96 128 at six age categories from 1-6 months, were selected for the study, and female *D. menoni* adults were used to measure the amount of feeding. Variation of the feeding of *D. menoni* on each variety with the plant age was estimated separately. The feeding of the *D. menoni* significantly varied with the age of the crop, where the highest feeding rate of 6.8 mm^2 was recorded on four months old sugarcane plants. The amount of secreted honeydew, measured as an indicator of the suitability of sugarcane for feeding of *D. menoni,* increased gradually from one month of age of sugarcane plant and reached the peak at four-month age. When the plant turned five-month, the amount of honeydew secretion reduced gradually and significantly dropped at six months. A similar trend was observed in the amount of honeydew secreted by feeding, on each variety, including the resistant check. The highest amount of feeding of 6.8 mm^2 at four-month age indicates that the four-month age of the sugarcane hybrids is the most vulnerable stage for *D. menoni* feeding, and the three to five-month period is the susceptible period for feeding.

Keywords: Feeding, Sugarcane white leaf disease (WLD), Vector, Susceptible stage

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Screening of Finger Millet *(Eleusine coracana)* Germplasm in Sri Lanka for Blast Disease (*Magnaporthe grisea*) Resistance

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Finger millet (*Eleusine coracana* L. Gaertn) is the third important cereal crop in Sri Lanka, mostly cultivated in rain-fed uplands in dry and intermediate zones of the country. Among different biotic stresses, blast disease (leaf, finger and neck blast) caused by *Magnaporthe grisea* is an economically important disease to rice and finger millet worldwide. The host resistance is the most viable option for managing disease as it is mainly grown in low input systems. One hundred and thirty-nine finger millet accessions (local origin (113), exotic origin (17) and unknown origin (9)) collected from Plant Genetic Resource Center, Sri Lanka were field screened for leaf blast disease in three seasons under artificial inoculation at the Field Crops Research and Development Institute, Mahailluppallama. The result revealed, almost all the tested accessions were susceptible to leaf blast at the early seedling stage. However, 5-6 weeks after sowing, the severity of leaf blast decreased drastically, and all the germplasm showed resistant or moderately resistant reactions. The finger blast and neck blast severity were scored under natural infection and found very low under both high and low-density planting. Seven and 87 accessions consistently showed immune reactions for finger blast and neck blast, respectively. A negative correlation was observed between the days to flowering and blast disease. The early flowering germplasm such as Ac12968 and Ac2384 from Jaffna, TVFM, 13-1, TVFM-04 and TVFM-02 from Killinochchi showed a higher severity score for leaf, finger and neck blast compared to other accessions. A significant positive correlation was found between finger blast and neck blast. In contrast, no correlation was found between finger blast or neck blast with leaf blast. Hence, the accessions identified for resistant or moderately resistant to blast disease can be used to develop or direct the introduction of blast disease resistance finger millet varieties in Sri Lanka.

Keywords: Finger blast, Leaf blast, Neck blast, Severity score

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Ex-post Study on Expected Utility of Weather Information: Quasi Experiment on Sri Lankan Paddy Farming

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Weather information creates certainty and confidence in the minds of farmers to use other inputs, which reflect as expected utilities and finally as crop yields. Sri Lankan paddy farmers use both traditional and scientific weather information to capture the uncertainty of rainfall which mainly affects the cultivation decisions. There are no studies conducted in Sri Lanka to find out the impact of the expected utility value of weather information on paddy farmers. To fill this gap, an ex-post valuation study was carried as a quasi-experiment. A sample of 900 paddy farmers was selected as the control group (450) and the treated group (450) by multi-stage random sampling from six districts representing paddy major cultivation patterns. The treated group provided location-specific weather information as rainfall forecasts. The control group was assumed to be using traditional knowledge or general weather information. The baseline survey was conducted in 2016. The end survey was conducted in 2018 using the same pre-tested structured questionnaire. The CRRA utility function was estimated to find the expected utility. Difference in Difference (DID) regression was used to quantify the effect of the treatment as the provision of location-specific rainfall forecasts by considering the differences of paddy yield per hectare per farmer as the dependent variable. The results revealed, the treated group has derived the highest expected utility. DID regression results revealed, the interaction was significant ($p < 0.05$), and the coefficient of interaction was 960.54. Therefore, low-risk aversion can be achieved by the provision of location-specific weather information. Such effort is important to increase the full utilization of factors of paddy production.

Keywords: Expected utility of weather information, Ex-post valuation of weather information; Quasi experiment in weather information

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Regeneration of Plantlets of Tea [*Camellia sinensis* (L.) O Kuntze] cv. TRI 5001 through Somatic Embryogenesis in Liquid Dynamic Medium

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Somatic embryogenesis is an efficient micropropagation technique for the mass multiplication of tea plants. Optimization of protocols is necessary for somatic embryo induction, development, multiplication and regeneration of plantlets for various explants of tea. The present study was conducted using cotyledon-derived somatic embryos, leaf and stem nodal callus of TRI 5001 tea cultivars explants, and liquid dynamic Murashige and Skoog (MS) media supplemented with different growth regulator combinations against solid MS medium. A significantly higher cotyledon-derived somatic embryo multiplication rate was observed in MS medium supplemented with 3 mg/L TDZ. Leaf callus proliferation, compact and embryonic callus formation was comparatively higher in MS medium containing 1.1 mg/L TDZ and 1.86 mg/L NAA. Subsequently, somatic embryo formation was observed in MS medium supplemented with 0.1mg/L NAA, 1mg/L BAP and 0.2 mg/L GA_3. Higher stem nodal callus proliferation and compact callus formation were recorded in MS containing 0.11 mg/L TDZ, and 0.1 mg/L IBA and higher embryonic callus formation were observed in MS supplemented with 0.1 mg/L TDZ and 1.86 mg/L NAA. Plant regeneration was achieved from somatic embryos formed from cotyledons on MS medium supplemented with 3 mg/LBAP, 0.1 mg/L NAA. The liquid dynamic MS medium supplemented with different growth regulator combinations are useful in developing efficient somatic embryogenesis protocols from cotyledon-derived somatic embryos, leaf and stem nodal callus of tea for mass multiplication.

Keywords: Embryonic callus, Liquid medium, Somatic embryogenesis, Tea

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Evaluation of Clay Brick and Laterite Brick as Low-Cost Adsorbents for the Removal of Cd^{2+} and Pb^{2+} in Aqueous Solutions

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Adsorption is recognized as a low cost and effective method for treating Cadmium and Lead in wastewater. Adsorption has emerged as a better alternative treatment method characterized as a highly efficient, effective, and economically feasible wastewater treatment method, especially for the developing world. Therefore, this study focused on investigating the potential of construction demolition wastes (CDWs), laterite bricks (LB) and clay brick (CB) to remove Cd and Pb in synthetic wastewater. A series of batch adsorption experiments were conducted to study the adsorption characteristics and capacities. The results revealed that the maximum adsorption capacity of CB and LB reached 210.85 mg/g and 210.72 mg/g for Pb^{2+}, respectively. The maximum adsorption capacity of Cd^{2+} by CB and LB was 4.52 mg/g and 4.51 mg/g. The *Langmuir* and *Freundlich* models fitted well for $0 \leq C_i \leq 1000$ mg/L of Cd^{2+} adsorption on both CB and LB from adsorption *isotherms*. Adsorption of Pb^{2+} onto CB and LB is well captured by all *isotherm* models tested. A similar pattern of adsorption was observed among all CB and LB particle sizes (< 0.5, 0.5-1.0, and 1.0–2.0 mm), indicating that the particle size of tested adsorbents does not affect the adsorption *isotherms* of Cd^{2+} and Pb^{2+}. However, the particle size ranges used in this study lay within a narrower range, which might be the reason for not showing any difference in adsorption among the different size fractions. Therefore, it can be concluded that both CB and LB are effective and environmentally friendly adsorbents to remove Pb^{2+} and Cd^{2+}in wastewater.

Keywords: Adsorption *isotherm* models, Cadmium, Clay brick, Laterite brick, Lead

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Pulse-Width-Modulation Control of a Heat Pump Dryer with Cascade Evaporators and Parallel-Flow Condensers

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The agricultural products are heterogeneous, and the drying process parameters need to be changed accordingly to obtain a high-quality product. Heat pump dryers are extensively used to dry agricultural produce due to their potential to produce superior quality dried products that preserve the colour, flavour, and aroma. Therefore, the objective of this study was to develop a mechanism to manipulate the inflow air temperature of the drying chamber of a novel heat pump dryer with cascade evaporators and parallel flow condensers. The inflow air temperature for the drying chamber was controlled by the pulse-width-modulation (PWM) technique with a duty cycle which provided a measure of controlling the voltage supplied to the electric motors. Raspberry pi 4 microprocessor with DHT22 sensors was used to collect temperature and relative humidity data, and solid-state relays were used to control the duty cycle of the condenser. The parallel-flow condensers, inlet and outlet temperatures, and relative humidity were recorded, and then the average temperature values were recorded. The duty cycle was changed by developing a program using the Python programming language. An Excel-based psychrometric calculator was developed to analyze the collected data. The average condenser outlet temperatures were 56.6 ± 0.1 ℃, 54.9 ± 0.1 ℃, and 52.6 ± 0.1 ℃, and the average condenser inlet temperatures were 43.2 ± 0.0 ℃, 42.8 ± 0.1 ℃, and 41.2 ± 0.1 ℃ for 60%, 80%, and 100% duty cycles, respectively. The linear regression analysis provided a relationship of $y = -0.1x + 62.7$ for the duty cycle and the drying chamber inlet temperature with R^2 of 0.9926. The power consumption rate of the condenser reduced with an increasing duty cycle. The results concluded that the PWM control system is a viable method to control the inflow air temperature to the drying chamber.

Keywords: Condensation, Drying, Evaporation, Heat pump, Pulse-width-modulation

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Modelling the Particle Size Distribution of Pulverized Gallnuts

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Gallnut extracts are extensively used as pharmaceuticals and food and feed additives. Particle size distribution is an essential parameter of pulverized gallnuts in phytochemical extraction because maintaining uniformity and the required particle size is essential for increasing the extraction efficiency. Further, identifying a suitable model for the particle size distribution for gallnut would improve the pulverizing process efficiency, especially for the process monitoring and final quality controlling. Therefore, the objective of this study was to model the particle size distribution of pulverized gallnuts. Four different moisture contents, 0.00% (d.b.), 9.16 ± 0.05% (d.b.), 11.92 ± 0.7% (d.b.), and 19.1 ± 0.6% (d.b.) were selected for the study. The equilibrium moisture content of the gallnuts was 11.92 ± 0.7% (d.b.). As a consequence, the low moisture contents were obtained by dehydration, and high moisture contents were obtained by adsorption in a controlled environment. Sieving was done in the range of 0.075-10.000 mm, and gallnut particles under twelve mesh sizes were analysed. Two widely used mathematical models, Rosin-Rammler Bennet (RRB) and Gates-Gaudin-Schuhmann (GGS) models were tested with the pulverized gallnut at different moisture contents. Different model parameters for both RRB and GGS models were calculated, and regression analyses were conducted. The results indicated that the GGS model fitted well than the RRB model for particle size distribution data at four different dry basis moisture contents with a high coefficient of determination in the range of 0.909 - 0.983 and low values for residual sum square in the range of 0.017 - 0.026. In conclusion, the GGS model appropriately describes the particle size distribution of gallnuts.

Keywords: Gallnuts, Gates-Gaudin-Schuhmann model, Particle size distribution, Rosin-Rammler Bennet model, Pulverization

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Assessment of Mobile-based Extension Service Usage by Medium-scale Tea Growers in Kandy District, Sri Lanka

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Tea (*Camellia sinensis* (L.) Kuntze) is one of the major foreign exchange earning agribusinesses in Sri Lanka, where several mobile-based extension services have emerged to deliver information to tea growers. This study contributes to understanding the present status of mobile-based extension services, perception, and factors affecting the usage of mobile-based extension services by medium-scale tea growers. A telephone survey was conducted for selected 56 medium-scale tea growers in the Kandy district using Simple Random Sampling techniques. Data collection was performed using a pre-tested questionnaire with open and close-ended questions. The majority of the respondents were above 50 years old (77%), were educated up to the advanced level (77%), were part-time tea growers (59%), and had experience in tea cultivation for ten years or more (75%). All respondents owned mobile phones with the majority (89%) having access to the Internet through smartphones. Nevertheless, 61% of respondents were not exposed to any mobile-based extension services related to tea cultivation. Further, 59% of the respondents perceived that existing mobile phone-based extension services are far less effective in providing new knowledge. The results of the Pearson Chi-Square test showed that the awareness of mobile-based extension services was significantly associated with education level X^2 (4, N = 56) = 9.951, $p < 0.05$. The usage of mobile-based extension service significantly associated with the education level, X^2 (4, N = 56) = 12.245, $p < 0.05$ and Internet access X^2 (2, N = 56) = 9.148, $p < 0.05$. In conclusion, it is necessary to improve current mobile-based extension services to make them more user-friendly and more technology transfer oriented. It is also suggested to develop a single Information Communication Technology platform to support all media formats for information sharing.

Keywords: Awareness, Kandy district, Medium-scale tea growers, Mobile-based extension services, Usage

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Dietary Micronutrient Adequacy in Early Adolescence in the City of Colombo, Sri Lanka

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The prevalence of overnutrition in early adolescents in the city of Colombo rising during the past decades and energy-dense diet is consumed due to rapid nutrition transition. A cross-sectional study was conducted using early adolescents aged 11-13 years in the city of Colombo to determine the adequacy of micronutrient intake. A total of 634 subjects were recruited using the multistage stratified cluster sampling technique. Socio-demographic data were collected using a general questionnaire. Dietary intake data were gathered using a three-day diet diary. Diet diaries were analyzed for daily micronutrient intake using FoodBase 2000 software. The mean intake of micronutrients was compared with the recommended dietary allowance (RDA) values and the percentage of subjects below the RDA of the nutrient was determined. The micronutrient intake of Calcium, Iron, Zinc, Magnesium, Iodine, Vitamin A, Thiamin, Riboflavin, Vitamin B12, Folate and Vitamin C are below the RDA value. Daily Selenium and Niacin intake met the RDA. Daily Vitamin B6 met the RDA value only in females. In general, early adolescents aged 11-13 years in the city of Colombo do not consume adequate amounts of micronutrients and are in a hidden hunger.

Keywords: Adolescents, Hidden hunger, RDA

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Assessment of Knowledge and Practices regarding Iron Deficiency Anaemia among Pregnant Women in Kattankudy D.S. Division of the Batticaloa District

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The purpose of this study was to evaluate the knowledge and practices regarding anaemia among pregnant women at the Kattankudy D.S. division of the Batticaloa district. A total of 352 pregnant women were enrolled, and a consecutive sampling technique was adopted. A semi-structured interview schedule was used to collect data. The descriptive analysis was used to study the socio-demographic and baseline data of the participants, and the Friedman test was used to determine the relationship between variables. According to the findings, the majority of the pregnant women were between the ages of 25 and 30 years old, with Advanced Level (A/L) as their educational qualification and the nuclear family as their type of family. Most of the pregnant women were housewives, with family income between Rs. 10,000-30,000 per month and taking a non-vegetarian diet. While considering their baseline data, 59.9% of the women were multigravida, whereas the majority of the pregnant women had pregnancy spacing for more than three years. The haemoglobin (Hb) level of the women showed that the majority of them (80.1%) had ≥ 11 gd/L (normal), and only 19.9% of them had < 11 g d/L (anaemic). There was a significant relationship ($p < 0.05$) between pregnant women's educational level and their knowledge of the causes of anaemia. Most of them were following good practices regarding the prevention of anaemia. Therefore, with the help of available knowledge and practices, continuous education and awareness programmes are necessary among pregnant women to avoid the risk factors of anaemia during pregnancy in this study area.

Keywords: Anaemia, Iron deficiency, Knowledge, Practices, Pregnant women

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Willingness to Pay for Sustainable Seafood Products across Regions: A Meta-analysis

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The current significance of sustainable seafood products is increasing, as the negative environmental and social impacts associated with the seafood industry increase. However, these sustainable seafood markets cannot be achieved without being aware of consumer preferences. This research analyses consumers' willingness to pay for various attributes of sustainable seafood by incorporating 55 estimates gathered from 23 studies using a meta-analysis. Average price premiums calculated for sustainable attributes *i.e.,* environmentally friendly, organic, and locally produced seafood are 14.4%, 17.4%, and 22.1% respectively. The results of the meta-regression model show that compared to the baseline locally produced seafood, consumers have placed significantly higher price premiums (β = 6.6668, p = 0.024064) for organically farmed seafood. However, the environmentally friendly seafood attribute is not significant (β = 1.2310, p = 0.62154). Thus, it implies that consumers understand and perceive organic seafood as sustainable seafood. There are variations in the willingness to pay of consumers based on the estimation method. In addition, the conjoint analysis estimates a significantly higher willingness to pay for sustainable seafood (β = 17.8833, p = 0.000805) than the other methods, showing that it is a more sound and suitable method to elicit consumer willingness to pay. Compared to Asians, Americans (β = 25.3595, p = 0.0000177) have a significantly higher willingness to pay, followed by Europeans (β = 7.7627, p = 0.077280).

Keywords: Consumer preference, Meta-analysis, Sustainable seafood

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Effect of Marketing Mix Antecedents on Consumer Brand Preference of Milk Powder

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Milk powder has become an essential component of the diet of Sri Lankan consumers. However, recent information related to contamination of imported milk powder with hazardous elements has made a considerable impact on the preference of milk powder brands among consumers in Sri Lanka. The current study aims to explore the effect of selected marketing mix antecedents on consumer brand preference of milk powder. Primary data was collected through an online survey. The convenience sampling technique was used in selecting the sample of 100 consumers. The collected data were analyzed by SMART PLS using partial least squares. The findings revealed that brand personality (T = 2.507; *P* = 0.012) and country of origin (T = 2.506; *P* = 0.013) have a significant effect on milk powder brand preference. Furthermore, the study concludes that there is a significant positive influence of brand preference on brand loyalty to milk powder (T = 11.679; *P* = 0.000). Moreover, results revealed that consumers prefer domestically produced milk powder brands over imported brands. The findings of this study are of great significance for local milk powder companies and marketing practitioners to implement strategies to enhance the availability and marketing of domestically manufactured milk powder. Further, marketers should pay more attention to the brand personality to attract more consumers towards their respective milk powder brands.

Keywords: Brand loyalty, Brand preference, Milk powder

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A Comparative Analysis of Stakeholder Linkages in Integrated Farming System (IFS) for Technology Reach in Selected Agro-Climatic Zones (ACZ) of Karnataka

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This paper attempts to identify the stakeholders of the integrated farming system (IFS) and the extent of linkage for technology reach. The study envisages the active role of stakeholders in technology dissemination and diffusion in Karnataka State of India. An Actor Linkage Matrix was developed to study the extent of reciprocal linkage among the stakeholders of IFS in select five districts; further to identify and analyze the roles performed by the stakeholders to benefit farmers to adopt the integrated farming system in different zones. The research results indicated that the overall linkage index was strong in the case of the coastal zone (70.10), moderate in Hilly zone (67.06), Southern dry zone (64.53), Northern Transitional zone (59.39) districts and found to be weak in central dry zone (49.73) district. The different roles played by key stakeholders as perceived by IFS farmers were analyzed in the research study in terms of transfer of technology, awareness creation, financial support, policy formulation & implementation, facilitative, research support, collaborative, training and demonstrations, end-user of technology adoption. The study explored the key actions performed by the stakeholders of IFS, vis-a-vis dissemination of information, human resource development, facilitative roles for market access and capacity building activities. The identified gaps in technology reach and adoption among farmers need to be addressed by creating a common platform for strong research-extension-farmer-market linkage to disseminate advanced technologies of agriculture and allied sectors in farmers' fields which would facilitate, decreasing the wide gap and enhance technology adoption. Also, there is need a for public-private partnerships among farmers, for which Farmer Producer Organizations/Self Help Groups/Commodity Interest Groups/Non-Government Organizations and private sector institutes should extend their linkage with farmer producers to diversify or intensify the farming system.

Keywords: Stakeholders, Integrated farming system, Key informant technique, Actor Linkage Matrix, Technology reach and Linkage index

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A Study on Food Safety Assurance in the Sri Lankan Hospitality Sector and Relevance of Legislations to Promote Food Safety

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The hospitality industry serves as one of the major anchors supporting the nation's economy. Assurance of food safety is increasingly demanded by the customers and inadequacies lead to food safety issues. This research aimed to study food safety assurance in the Sri Lankan hospitality sector and the relevance of governing legislations to ensure food safety. Information gathering was focused to understand the hierarchy of the industry to identify relevant organizations to collect information. Classification of food business operators in the hospitality sector was identified to obtain information at the operator level. Legislations governing the hospitality sector were studied to identify their adequacy to ensure food safety with related clauses. Data were collected using a literature survey, focus group discussions, interviews and questionnaires. Considering the relative compliance to food safety practices and practical feasibility awareness levels of staff from 3, 4 and 5-star hotels (Registered under SLTDA) on relevant legislations and food safety practices were evaluated. The results of the study showed that the main organizations in the hospitality sector having mandates to promote tourism in Sri Lanka do not adequately address food safety assurance by promoting legislations updated with requirements for food safety. As a whole, there are inadequacies in the F&B sector of the hospitality industry in Sri Lanka to meet the food safety requirements specified in the relevant acts. Further, awareness among the staff of star hotels on legislations and the requirements for food safety is weak and becomes a hindrance to assuring food safety.

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Keywords: Acts & regulations, Food safety, Hospitality sector in Sri Lanka, Sanitary & Hygienic practices, Star hotels

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Antifungal Potential of Leaf Extracts of Selected Plants against *Colletotrichum gloeosporioides* Causing Anthracnose in Papaya

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Synthetic fungicides currently used as the primary means for controlling anthracnose in papaya could result in high amounts of toxic residues and fungicidal resistance. The current study assessed the antifungal potential of selected plant leaf extracts against *Colletotrichum gloeosporioides*, and the effect of these plant extracts on the pathogenicity. Aqueous and methanolic leaf extracts of five plant species named *Azadirachta indica*, *Calotropis procera*, *Lantana camara*, *Moringa oleifera*, and *Ricinus communis*, with 100 µg/µL concentration were screened for their inhibitory effect against *C. gloeosporioides* using agar well diffusion assay. Fifty grams of powdered samples of each plant leaves were extracted with 250 mL of absolute methanol and water by reducing the dryness on a rotary evaporator under vacuum at 40 °C and 60 °C water bath temperatures, respectively. The effect of leaf extracts on the pathogenicity was determined by calculating the reduction of spore concentration of *C. gloeosporioides*. All aqueous leaf extracts did not show antifungal activity at the concentration of 100 µg/µL. Only the methanolic extracts of *A. indica* and *M. oleifera* did show a potential antifungal activity. *A. indica* and *L. camara* resulted in the lowest spore concentrations, 1.2 × 104 spores/mL and 2.4 × 104 spores/mL respectively, showing an antagonistic effect on spore production. Methanolic extract of *A. indica* showed not only the highest potential antifungal activity but also a significant effect on the spore concentration of the pathogen. Hence, the effect of *A. indica* and *L. camara* could be studied further as promising antifungal agents against *C. gloeosporioides.*

Keywords: Agar well diffusion assay, Antifungal potential, *Azadirachta indica*, *Carica papaya*, *Lantana camara*

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Composition and Antimicrobial Activity of Different Plant Parts of *Parthenium hysterophorus* L.

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Parthenium hysterophorus L. is one of the noxious weeds and an aggressive colonizer of crops. Control of this weed is a big challenge due to many limitations. Utilizing its biomass on large scale can open a new path for effective and sustainable management of this weed. We conducted this preliminary research to study the proportion of the components of lignocellulosic biomass in different parts of the plant, whole mature and young plants. The water extracts were prepared by soaking dried powder of different plant parts in water for one week. The effect of extracts was studied in triplicates, against selected microbial plant pathogens isolated from diseased plant specimens. The whole mature plant contains a higher proportion of cellulose in percentage dry weight (48 ± 0.33) followed by stem (45 ± 0.21) whole young plant (41 ± 0.10), root (21 ± 0.00), leaf (28 ± 0.01), and inflorescence (21 ± 0.14). Reducing sugar in mg/mL was higher in stem (1.94 ± 0.01) and root (1.17 ± 0.00) followed by the whole mature plant (0.95 ± 0.20), leaf, stem mixture (0.93 ± 0.11), inflorescence (0.67 ± 0.02), whole young plant (0.23 ± 0.19), and leaf (0.17 ± 0.01). The data were analyzed using one-way ANOVA. Tukey's multiple comparison test was used to determine a significant difference at $p < 0.05$. Cellulose in different parts of the plant differs significantly ($p < 0.05$), with the highest value in the whole mature plant and stem. Soil-borne plant pathogenic bacteria, *Pseudomonas sp*. (ZOI 1.8 ± 0.13 cm, 2.6 ± 0.21 cm) and *Ralstonia sp*. (ZOI 2.3 ± 0.11 cm, 1.5 ± 0.01 cm) were highly inhibited by the water extracts of stem and root of *the Parthenium* plant. Water extracts from leaf and inflorescence showed some inhibition on *Pseudomonas sp*. and not on *Ralstonia sp.* Mature extract of *Parthenium* inhibited all the soil-borne fungi (*Scelerotium rolfsi*, *Colletotricum sp.*, *Fusarium sp*., and *Pythium sp*.) tested. Percentage inhibition on Scelerotium sp. (81.93%) and *Colletotricum* sp. (45.45%) differs significantly ($p < 0.05$) from other fungi tested. Lignocellulosic biomass in the above-ground parts (except inflorescence) of this weed (young and mature) is a potential source of cellulose, and the plant has biocidal activity on plant pathogenic microbes.

Keywords: Cellulose, Plant extracts, Pathogens, *Parthenium*, Zone of inhibition

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Status of *Fusarium* Head Blight on Wheat Fields in Southwestern Ethiopia

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We assessed the status of *Fusarium* Head Blight (FHB) on 52 wheat (*Triticum aestivum)* fields from five districts within three zones of Oromia, Ethiopia. The assessment was done in four spots along the diagonal of each field by using modified Horsfall-Barrett's scale. The results showed that the prevalence of FHB was 93.9%, with significantly varied levels of incidences and severity among zones and the districts and the zones. The highest disease incidences, 38.7 and 26.0% were recorded in Buno-Bedele and Jimma zones respectively. The highest field-severity and FHB-index of 28.2 and 13.9% were recorded in Buno-Bedele. Besides, the most grown varieties Danda'a and Digalu, were vulnerable to FHB sustaining 32.3 and 30.5% incidence, 21.8 and 21.7% field-severity, and 10.5 and 8.8% FHB-index. The variation in FHB intensity was influenced by altitude, tillage frequency before sowing, and rainfall received during flowering to hard-dough stages. This study revealed that FHB is becoming a potential disease in wheat in Southwestern Ethiopia (SWE). Thus, demand an intervention to reduce its possible risk to wheat across SWE.

Keywords: *Fusarium* head blight, Incidence, Severity, *Triticum aestivum*

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Antimicrobial Properties of *Garcinia Cambogia* Fruit Rinds and Leaves

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Pathogenic and spoilage microorganisms cause infectious diseases and food spoilage. Presently, the application of natural products rich in antimicrobial substances is recommended to overcome these problems. *Garcinia cambogia* (Lam), Goraka (Sinhalese), or Kodukkaippuli (Tamil) is one of the well-known spices used in the preparation of traditional dishes and herbal medicine. We conducted this study to evaluate the antimicrobial effect of *Garcinia* against *Escherichia coli, Salmonella typhi, Listeria monocytogenes, Shigella dysenteriae,* and *Fusarium oxysporum*. Methanol, water, and vinegar (natural, 4.5% w/v acetic acid) were used as the solvents to extract the bioactive compounds from *Garcinia* fruit rinds and leaves separately. The antibacterial activity and antifungal activity of *Garcinia* extracts were evaluated by the agar disc diffusion method and the poisoned food method respectively. The gram-positive and gram-negative bacteria were sensitive for all the *Gracinia* rind extracts, and the diameter of the inhibition zone ranged from 13.1 ± 1.10 mm to 7.6 ± 0.62 mm. Methanol rind extract (20%) has the highest percentage inhibition value, 100%, and inhibits the growth of *F. oxysporum*. In conclusion, *Garcinia* rinds and leaves extract possessed antibacterial activity against all the tested bacterial strains and antifungal activity on *F. oxysporum*. The antimicrobial activity of *Garcinia* depends significantly on the part of the plant and the solvent used in the extraction. Methanol was the best solvent compared to water and vinegar for extracting the antimicrobial compounds available in *Garcinia* fruit rinds and leaves. Methanol extracts of *Garcinia* rinds and leaves are potentially effective antimicrobial agents against pathogenic and food spoilage microorganisms. Further research on antimicrobial effect, mechanism of effective compounds in *Garcinia* rinds and leaves exacts are recommended.

Keywords: Antifungal, *Escherichia coli*, Inhibition, Spice, Spoilage

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Evaluation of Effectiveness of Diamond Back Moth Management Strategies in Cabbage of Up-country Region in Sri Lanka

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Diamond Black Moth (DBM) (*Pluella xylostella*) is one of the key pests of cabbage (*Brassica oleraca*) in the central highland of Sri Lanka that causes a significant yield loss. Farmers heavily use insecticides to control DBM while ignoring eco-friendly pest management strategies. Attempts were made to evaluate the effectiveness of three non-chemical strategies and their combinations to suppress the DBM population. Field experiments were carried out at the Agriculture Research Station, Seeta-Eliya during the *Yala* seasons of 2020 and 2021. Yellow color blinking light (BL), sprinkler irrigation (SI), and insect-proof net (IPN) were selected as non-chemical measures in comparison to insecticides and untreated control. Treatments were arranged in a Randomized Complete Block Design with three replicates. BL was established at 2m height from the ground and lighted from 6 pm to 6 am, and watering by using SI system was practiced from 6.00 pm to 6.30 pm every day throughout the cropping season. IPN was established at 1m height around the plot at the planting. Results revealed a significant involvement of BL and IPN in the reduction of DBM larval infestation. BL coupled with SI surrounded by IPN was found the most effective treatment with the average reduction of 61.12% DBM larval infestation compared to that of untreated. Insecticide-treated plots and BL + SI + IPN treated plots were not statistically significant during both cropping seasons. In the case of average yield increment, BL + SI + IPN treated plot and insecticide-treated plot recorded 40.4% and 45.1% increment respectively compared to that of control. The damage severity was lowest in BL+SI+IPN treated plots and insecticide-treated plots in 2020 *Yala* (23.99) and 2021 *Yala* (21.67) respectively. In conclusion, routine application of insecticides could successfully be replaced with blinking light in combination with sprinkler irrigation and insect-proof net in controlling the DBM.

Keywords: Cabbage, Diamond back moth, Non-chemical pest management strategies

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Wild Rice Species in Sri Lanka as Genetic Resources in Breeding for Brown Planthopper (*Nilaparvata lugens* (Stål) Resistance in Rice

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Brown planthopper (BPH) *Nilaparvata lugens* (Stål.) is considered the most destructive rice pests in rice-growing countries. In Sri Lanka, BPH outbreaks have been reported in the recent past resulting in considerable gaps in rice production. The development of resistant varieties is the most economical and environmentally sound strategy for managing BPH. The resistance breeding process starts identifying new genetic resources for BPH resistance and comparative analysis with existing donors. So far, scientists have identified 38 genes/QTLs responsible for the BPH resistance. This study explored the BPH resistance in five wild rice species in Sri Lanka, including the endemic species *Oryza rhizomatis.* One recommended rice variety; *Bg 352*, fourteen *O. rhizomatis* accessions, and one accession from *Oryza nivara*, *Oryza rufipogon*, *Oryza granulata,* and *Oryza eichingeri,* were screened by honeydew test. The experiment was arranged in a complete randomized design with fifteen replicates with *Bg 380* and *Ptb 33* as susceptible and resistant checks respectively. The lower amount of honeydew excretion in all tested *O. rhizomatis* accessions, *O. nivara*, *O. granulata,* and *O. eichingeri* accessions suggested BPH resistance. Both Ptb 33 and *O. rufipogon* showed a similar level of resistance with low honeydew excretion. The varieties Bg 352 and Bg 380 showed a high amount of honeydew excretions confirming higher susceptibility to the BPH. Therefore, all fourteen accessions of *O. rhizomatis* and selected accessions of *O. nivara*, and *O. eichingeri* are potential BPH resistant donors for rice breeding programs. Further, the coding sequences (CDS) of known BPH genes of O. sativa were used as queries to search similar genes in wild rice genomes. The CDS coverage and phylogenetic analysis suggest, of known BPH resistant genes, at least *BPH6, BPH9, BPH14-1*, and *BPH18,* are present in *O. rhizomatis*, *O. eichingeri*, *O. nivara*, and *O. rufipogon* genomes. This information will assist in marker-assisted breeding attempts with identified genetic resources.

Keywords: Backcross breeding, Crop wild relatives, Endemic species, Honeydew test, "Hopperburn"

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Assessment of Grain Preference among Selected Rice Varieties by Field Rat, *Bandicota bengalensis* and House Rat, *Rattus rattus* in Sri Lanka

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Rice is the staple food with an average per capita consumption of 100 kg in Sri Lanka. Paddy losses during storage are still a significant factor affecting food security. Rodents have a significant direct and indirect impact on storage losses. Therefore, management practices are needed to protect grains from rodents. Before implementing them, it is necessary to identify grains that are susceptible to rodent infestation. Such infestations may be due to the specific properties of rice varieties. However, such information is not documented clearly. Therefore, the objective of this study was to determine the preferable grain varieties of *Bandicota bengalensis* and *Rattus rattus* species. The experiments included 45 commonly available rice varieties, and each replicate consisted of 250 g of each variety. A hundred rats from two species, *B. bengalensis* and *R. rattus* were used in the experiment. The experiment was arranged in a Completely Randomized Design with three replications. The amount of grains consumed by rodents was measured after three days, five days, and seven days from the establishment of the experiment as three data points. Data were analyzed using ANOVA of SAS, and the treatment means were compared using the least significant difference (LSD). The data suggest that *B. bengalensis* mostly preferred At311, Bg409, and Bg250, while the least preferable varieties were At307, Bw312, At303, Bg379/2, and Bw351. *R. rattus* had the highest preference for Bw367 and Bw453, while the lowest preference for At373, Bg300, Bg400, At362, Bw351, At354, At311, and Bg450. The preliminary data gathered suggest that the grain preference of rodents depends on the rodent species and grain characters such as variety, size, physicochemical characters, and nutritional composition, and such information could be considered in designing proper rice grain storage to minimize the post-harvest losses by rodents.

Keywords: *Bandicota bengalensis*, Infestation, Paddy storage loss, Rat preference, *Rattus rattus*, Rodents

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Pesticides Used in Rice Cultivation: Application Pattern by Farmers in Trincomalee District, Sri Lanka

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Violation of scientific recommendations and malpractices in pesticide usage is much debated due to the rapid increase in chronic kidney disease in agricultural areas of Sri Lanka. The Government of Sri Lanka has recently banned the use of several pesticides based on their harmful effects. Though various studies on pesticide usage in vegetable cultivation are available, only a few studies are on rice cultivation in Sri Lanka. In this context, we conducted this study to assess the present situation and practices of pesticide usage in rice cultivation after imposing these restrictions. A questionnaire survey and face-to-face interviews were conducted in 2019/2020 with 174 farmers selected through a multi-stage cluster sampling method in rice cultivation areas in the Trincomalee district. The WHO hazard classed *Ia* and *Ib*, prohibited in the country were not applied in the study area. However, 63% of pesticides applied in the area belong to the class *II* (moderately hazardous) category, which is not highly recommended by FAO. In addition, we identified issues such as poor agricultural practices, such as violations of scientific recommendations (> 50%), not using protective gears when applying pesticides (63%), combining two or more pesticides to produce a mixture (26%), poor control of dumping empty pesticide containers (> 80%), drinking water without checking the quality (55%), and not consulting agriculture extension service (82%). However, young farmers are more aware of the consequences of malpractices in the use of pesticides, while educational level has no significant influence. In this regard, it is necessary to create public awareness of the hazards of pesticide misuse through awareness campaigns, regular monitoring, and follow-up mechanisms at the field level, and regular assessment of pesticide residuals in the ecosystem.

Keywords: Agriculture, Chronic kidney disease, Farmer education, Hazard, Health

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Effect of Seed Treatments on Seed Gemination of *Madhuca longifolia* ("Mee") Seeds

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Madhuca longifolia (*Sinhala. Mee*) is a forest tree with high reforestation potential in the Dry zone of Sri Lanka. Seasonality in seed production and lack of plant production are drawbacks of this species. Experiments were designed to overcome these by *ex vitro* and *in vitro* methods. Mechanically scarified seeds under *ex vitro* conditions showed maximum germination (90%), while treatments with 100 ppm gibberellic acid (GA_3), distilled water (DW), and 2% potassium nitrate (KNO_3) resulted in higher germination (GA_3 - 75%; DW - 70%; KNO3 - 70%) than the control (66%) after one month. The highest shoot growth was observed for GA_3, KNO_3 and DW (8.3, 8.6 and 8.5 cm, respectively) treatments, while rooting was not affected by any of the treatments. *In vitro* germination was tested on liquid Murashige and Skoog (MS) media with different benzylaminopurine (BAP) concentrations after removing the seed coat and sterilization with 5% (v/v) NaOCl for 5 minutes followed by 0.1% (w/v) $HgCl_2$ for another 5 minutes. The germination percentage of half-strength MS medium with 1.0 mg/L BAP (84%) and half-strength MS with 0.5 mg/L BAP (78%) was higher than the media without any growth hormone. *M. longifolia* has seed coat dormancy that can be overcome efficiently by mechanical scarification at the early stages after seed harvest. Seeds were germinated under *in vitro* conditions with half MS combined to 0.5 mg/L of BAP for *in vitro* multiplication studies.

Key words: Dormancy, *Ex vitro*, *In vitro*, *Madhuca longifolia*, Seed germination

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The Effects of Varying Light Intensity on the Growth and Tissue Nutrient Contents of *Allium porrum* Cultivated Hydroponically under Greenhouse Conditions

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Manipulating cultivation protocols to improve the yield and quality of medicinal plant materials is a crucial aspect of medicinal plant research. Controlling light intensity influence the photosynthetic process, secondary metabolite production, and growth & development of medicinal plants. In this study, we investigated the effects of varying light intensity on the growth, chlorophyll contents, and tissue nutrient contents of *Allium porrum*, which, like other Allium genus members, is recognised as a source of medicinal materials. The results showed that the light intensity had varying effects on the growth parameters of *A. porrum*. Aerial-part height was significantly increased with reduced light intensity (40% shading), whereas fresh & dry weights and the number of leaves significantly decreased under low light intensity. The interaction between light and different growing seasons significantly ($P < 0.05$) affected plant height, fresh root, and aerial-part weight, and aerial-part dry weight. The study also found that low light intensity (40% shading) significantly ($P < 0.05$) induced higher N, P, Ca, and Zn concentrations in the plant tissue. In conclusion, decreased light intensity favours the growth of *Allium porrum* in height and plant tissue Zn, N, P, and Ca contents, while high light intensity favours higher biomass accumulation. Seasonal light intensity and day length variations may have modulated the observed effects on the growth parameters observed in the plant.

Key words: *Allium porrum*, Light intensity, Medicinal plants, Plant cultivation

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Mid-IR Spectral Characterization and Chemometric Evaluation of Different Solvent Extracts of Coconut Testa Flour

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Fourier transform infrared spectroscopy (FTIR) is a rapid analytical tool used for the chemical characterization of foods. The focus of this study was to apply FTIR analysis for chemical mapping and differentiation of different solvent extracts obtained from coconut testa flour (CTF). CTF collected from five different local coconut cultivars namely; *Gon Thembili, Ran Thembili, San Raman* Tall, Tall x Tall and commercial hybrid was sequentially extracted with hexane, ethyl acetate (EtOAc), and methanol (MeOH). FTIR spectra of crude extracts were recorded within the range of 4,000–500 cm^{-1}, and the spectral data were analysed using principal component analysis (PCA). The spectra obtained for both hexane and EtOAc extracts were mostly alike in their contour. The prominent absorption peak at ~1745 cm^{-1} represented lipid molecules in the extracts. The additional peaks that appeared in the EtOAc extract (at ~3460 and ~1635 cm^{-1}) were due to the presence of phenolic constituents. Spectra of MeOH extract exhibited many differences from those of the previous two. The major absorbance peaks found at ~3450, ~1610, ~1523, ~1450, ~1055, ~600 cm^{-1} were mainly explicated to the existence of phenolic constituents and carbohydrates in large quantities. PCA analysis of the spectra showed clear discrimination among the different cultivars with respect to each extract type where 98% of the total variance was found in hexane extracts while both EtOAc and MeOH extracts resulted in 93% of the total variance. This study concluded that FTIR spectral analysis of different solvent extracts was useful to identify the differences in the bimolecular distribution of CTF.

Key words: Coconut testa flour, Crude extracts, FTIR, Functional groups, Principle component analysis

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Niche Partitioning of Sri Lanka White-Eye and Oriental White-Eye (Passeriformes: Zosteropidae) in Sympatry

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When two ecologically similar, sympatric species compete in sympatry, their traits, whether behavioural or morphological, are expected to diverge in the area of sympatry, while remaining similar in the areas of allopatry. The objective of the present study was to document the divergence of some behavioural traits (in terms of niche breadth and overlap) and morphological characters (in terms of bill length) in two white-eye species *viz.* Sri Lanka White-Eye (SLWE, *Zosterops ceylonensis*) and Oriental White-Eye (OWE, *Z. palpebrosus*), which occur both allopatrically and sympatrically in Sri Lanka. Niche breadth and overlap were measured using standard measures using the computer software Ecological Methodology. Captured specimens in allopatric and sympatric zones of both species were assessed for bill lengths. The study showed that there was a significant decrease in niche breadth of the OWE in sympatry (not so pronounced in the SLWE), indicating possible competition with the SLWE. Further, the bill length of the SLWE in the sympatric and allopatric zones was significantly different. Thus, the results indicated that the OWE may have been adapted to exploit a different food niche in sympatry with the closely related SLWE through niche divergence and morphological divergence associated with its feeding apparatus.

Key words: Sri Lanka and Oriental White-Eyes, Allopatry, Sympatry, Niche breadth and overlap, Bill length

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Fitting the Linear, Poisson and Gamma Distributions to Data of a Tropical Pest Study

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Generalized linear models (GLMs) are used when the variance is not constant, and/or when the errors are not normally distributed. Some ecological and entomological response variables invariably suffer from these two standard assumptions, and GLMs are excellent at dealing with them. According to the residual deviance (Goodness of Fit) and Akaike information criterion (AIC) as an estimator of model quality, we confirmed that Gamma GLM is the best fit for the data set on cabbage flea beetle (*Chaetocnema confinis* C.). Both AIC and deviance were low in the Gamma model, while high values were noted for Poisson and Linear GLMs. Our study confirms that severe skewness often existed in data sets pertaining to parasitology and entomology. The Gamma distribution was able to provide a better and robust alternative estimator than Poisson and Linear distributions. Poisson distribution is mostly used to model the count of events occurring within a given time interval. Poisson and linear GLMs did not fit well with the data set and that was evident by their high scaled deviance (G^2).

Key words: Modelling, Residuals, Null model, Reduced model, Full model

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Factors Influencing the Success of Tank Rehabilitation Projects in India and Sri Lanka: A Meta-Analysis

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The rehabilitation of tank systems is being used as an effective tool to increase crop production in water scarce areas. This study conducts a meta-analysis on 48 economic impact analysis studies on the topic of tank rehabilitation. The performance of the tank rehabilitation is measured through the benefit-cost (B/C) ratio, and the factors affecting the performance of tank rehabilitation are analyzed through the meta-analysis. The results of the study reveal that the mean B/C ratio of the rehabilitation projects carried out in Sri Lanka is 2.49, while it is 2.52 for India. The regression analysis highlights that the rainfall, farmer participation and conducting operation and management (O&M) activities along with the physical rehabilitation in the tank rehabilitation have significant positive impacts on the B/C ratio of tank rehabilitation projects. The significance of rainfall explains the fact that in the areas with less rainfall the success of rehabilitation projects was found to be low due to the inability of increasing cropping areas and cropping intensity due to water scarcity. The involvement of farmers in multiple stages of rehabilitation projects including planning, developing and executing showed a significant impact on tank rehabilitations proving that the active and voluntary participation of all stakeholders guarantees the successful implementation and post management of the rehabilitation. The rehabilitation projects focused on implementing O&M strategies showed high B/C ratios comparatively, which also implied the importance of farmer involvement.

Key words: B/C ratio, Meta analysis, Participatory approach, Tank rehabilitation

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Time Series Analysis of Rainfall Using ARIMA and SAMA Circular Model: Study from Vadamarachchi, Jaffna, Sri Lanka

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The time series analysis was performed with Seasonal Autoregressive Integrated Moving Average (SARIMA) and SAMA circular model (SCM) for the rainfall of Ampan, Karaveddi and Puloly regions of Jaffna to understand the behaviour of rainfall and forecast it with a suitable model. Minitab 17 software was used to run the model with the available monthly data from 2013 to 2019. Time series plots were used for pattern recognition, autocorrelation function (ACF) and Lijung-Box Q statistics (LBQ) were used to find the independence of the residuals. The probability plot was used to test the normality of residuals. The model with the lowest predicting errors was selected to forecast the future values. The monthly rainfall fluctuates around the mean of 41.6, 71.9 and 35.3 mm for Ampan, Karaveddi and Puloly respectively. The models SARIMA (0,0,0) (0,1,1)6, SARIMA (1,2,1) (0,1,1)6, and SARIMA (1,1,0) (0,1,1)6 were found as most appropriate for Ampan, Karaveddi and Puloly respectively and$Y_t = Y_{t-1} - 0.18 + 23.5 \sin 2\omega t + 28.5 \cos 1.5\omega t\ 20.10 \cos 2\omega t\ \ 26.47 \cos 5.5\omega t$, $Y_t = Y_{t-1} - 2Y_{t-2} - 5.9 + 73.5 \sin 4.5\omega t$ and $Y_t = Y_{t-1} - 2Y_{t-2} + 0.69 + 23.17 \cos 5.5\omega t$ were found as most appropriate SCM for Ampan, Karaveddi and Puloly respectively. Among these models, SCM predicts reliable data with minimum error. It finds the seasonal and cyclic pattern of the rainfall. A five-month seasonal and cyclic behaviour was noted with 13 - months interval in Ampan. Similarly, 10 - months seasonal in Karaveddi and only 13 - months interval cyclic pattern in Puloly. Anderson Darling (AD) value for Ampan is 0.40, Karaveddi is 0.63, and Puloly is 0.68. The estimated rainfall shows a decreasing trend in Ampan 0.2057 mm/year and an increasing trend in Puloly 1.15 mm/year and Karaveddi 0.61 mm/year. The decreasing trend of monthly rainfall in Ampan and decreasing in the other two regions is an alarming sign to the agriculture sector.

Key words: Rainfall, SARIMA, SCM, Time series analysis

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Keynote Address & Invited Presentations

KEYNOTE ADDRESS

Can We Have it All? Considering the Trade-offs in Achieving both Human and Planetary Health

Prof. Jessica Fanzo

Professor of Global Food Policy and Ethics
Johns Hopkins Nitze School of Advanced International Studies
USA

INVITED PRESENTATION I

Dissecting & Modulating the Regulation of Postharvest Ripening Pathways in Tomato Towards Reduced Produce Waste & Loss

Prof. Diane Beckles

Professor of Postharvest Integrative Biology
Department of Plant Sciences
University of California Davis
USA

INVITED PRESENTATION II

Impact of Climate Change on Tea Production and the Adaptation Strategies

Prof. Wenyan Han

Tea Research Institute
Chinese Academy of Agricultural Science

Can We Have it All? Considering the Trade-offs in Achieving both Human and Planetary Health

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In the context of the broad global trends of population growth, the climate crisis, and inequitable diets, food systems need to be re-oriented to ensure they can produce enough food that nourishes the world. At the same time, food systems must decrease the pressure on biodiversity loss, conserve land and water resources, minimize air and water pollution, and lower greenhouse gas emissions. The current COVID-19 pandemic has imposed an additional level of pressure on the governance, functionality, efficiency, and resilience of food systems, with potentially long-lasting implications. This re-orientation includes moving towards on-farm sustainable food production practices, lessening food loss and waste, addressing poverty by creating jobs and decent livelihoods, and providing safe, affordable, and healthy diets for everyone. This is a lot to ask of an already entrenched system involving diverse actors with diverging priorities and motivations. Food policy is central to changing systems, and bold policies must be applied to accelerate and incentivize economic, societal, and technological transformations towards a more socially just and sustainable global food system. But policy decisions come with synergies, trade-offs, and short- and long-term, often unexpected consequences. In a world of uncertainty, can we have both human and planetary health-can we have it all? This seminar will explore that question through a global lens that takes the audience through a range of sticky debates that plague food system transformation and governance.

Keywords: Planetary health, Population growth, Climate crisis, Food systems

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Dissecting & Modulating the Regulation of Postharvest Ripening Pathways in Tomato Towards Reduced Produce Waste & Loss

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Tomatoes are important experimental models for studying the underlying biological processes that dictate quality and shelf-life of fruit with soft, succulent tissues. Tomatoes, however, like many horticultural crops are highly perishable. Improving tomato fruit quality and prolonging shelf-life could expand the already broad appeal and consumption of this popular, nutrient-rich fruit, while simultaneously reducing postharvest loss and waste. Postharvest practices, specifically early harvest and low-temperature storage are sometimes used to extend tomato shelf life, but often reduce fruit quality. Understanding the underlying pathways that intersect to lead to this outcome could help to refine the knowledge needed to optimize fruit quality after prolonged storage. In my talk, I will describe two approaches we have taken to delve into this phenomenon. First, we applied knowledge of the *CBF1*-gene which has been repeatedly shown to engender cold tolerance in transgenic plant tissues when it is ectopically overexpressed. Our aim, therefore, was to develop transgenic tomato lines where *CBF1* expression could be elevated in fruit after a) chemical, and b) cold induction, to determine if high levels of *CBF1* would protect fruit from postharvest chilling injury. By restricting *CBF1* overexpression to fruit after harvest, and after cold storage, we hoped to mitigate against pleiotropic effects of elevated *CBF1* levels on tomato development and growth. Our second aim focused on fruit DNA methylation, which is one of the critical epigenetic mechanisms that control tomato fruit ripening and development. To our knowledge, the changes in DNA methylation coincident with fruit handling, postharvest storage, and how these practices specifically influence fruit quality, are still unclear. We are therefore assessing the methylome, the transcriptome, and key physiological and biochemical processes in fruit stored under different postharvest conditions, to identify novel regulatory control points that dictate changes in fruit quality attributes. Collectively, these two aims are expected to both broaden and advance our understanding of how postharvest factors influence tomato fruit ripening regulatory mechanisms, which has implications for supply chain flexibility and agricultural sustainability, essential elements of a resilient agricultural system.

Keywords: Postharvest, Postharvest chilling injury, Fruit quality, Ripening pathways, Gene expression

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Impact of Climate Change on Tea Production and the Adaptation Strategies

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Climate change has being affected tea production and is going to pose a major threat to tea cultivation. Tea is a major cash crop in China, India, Sri Lanka, Kenya and many other developing countries. Therefore, understanding of the impact of climate change on tea production and taking mitigation and adaptation strategies is necessary to combat climate change.

With the change of the climate, the current tea growing regions may become unsuitable for cultivation. A shift to higher latitudes and higher altitude ecosystems may be necessary and the growing duration lengthened in subtropical areas. Tea production would be improved by temperature increase and CO_2 elevation, but would be significantly affected by drought, heavy rains, frosts, the proliferation of pests and diseases, and soil degradation. Tea quality is likely to deteriorate due to the imbalance in the ratio of free amino acids to polyphenols since both increase of temperature and CO_2 elevation enhance polyphenols and reduce amino acids. Increase of temperature and CO_2 will also change soil microbial structure and stimulate soil N_2O and CO_2 emission. Elevated CO_2 would increase C and reduce the concentration of almost all other nutrients in tea plants, more fertilizers will be required for the balance of nutrient supply. The extreme weathers reduce biodiversity in tea ecosystem, pest and disease would outbreak more frequently.

To combat climate change, appropriate planning for adaptation and mitigation needs to be developed and extended for sustainable development of the tea industry. Government policies, R&D for new technologies and techniques, community involvement and technology extension, should be integrated and implemented. Tea garden ecosystem should be diversified and improved by planting shading trees, combining with animal husbandry and promoting low-carbon farming systems. Field infrastructure such as soil and water conservation, drainage and irrigation systems should be improved. New technologies/products, including resistant tea cultivars, new soil amendments and fertilizers, new pest and disease control equipment should be developed and extended.

Key words: Climate change, Tea production, Tea Garden ecosystem, Adaption and mitigation strategies

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- *Keynote speaker, Prof. Jessica Fanzo, Professor of Global Food Policy and Ethics, Johns Hopkins Nitze School of Advanced International Studies, USA*
- *Invited speakers, Prof. Diane Beckles, Professor of Postharvest Integrative Biology, University of California Davis, USA and Prof. Wenyan Han, Tea Research Institute, Chinese Academy of Agricultural Sciences*
- *Invited Alumni speaker, Senior Prof. Udith Jayasinghe-Mudalige, Secretary, Ministry of Agriculture*
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