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Book of Abstracts

AgSURS | 2023

Explore the World Through Research & Innovation

Faculty of Agricultural Sciences | Sabaragamuwa University of Sri Lanka

Undergraduate Research Symposium / 2023

Explore the World through Research and Innovation

11th May 2023

Faculty of Agricultural Sciences / Sabaragamuwa University of Sri Lanka.

Undergraduate Research Symposium
Faculty of Agricultural Sciences

(AgSURS 2023)

Sabaragamuwa University of Sri Lanka

11th May, 2023

"Explore the World Through Research & Innovation"

Book of Abstracts

AgSURS 2023

Faculty of Agricultural Sciences

Sabaragamuwa University of Sri Lanka

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Undergraduate Research Symposium

Faculty of Agricultural Sciences

11th May, 2023

Explore the World Through Research & Innovation

Thematic Areas

Agricultural Economics and Agribusiness Management

Food Processing and Post-harvest Technology

Plant Nutrient and Soil Science

Plant Breeding and Biotechnology

Livestock Production, Aquaculture and Food Safety

Food Processing and Post-harvest Technology

Plant Protection

Agri-Environmental Modelling

Crop Production Technology

Faculty of Agricultural Sciences,
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Keynote Address

Prof. H.M. Saman K. Herath

Application of Ethics in Research Conduct and Publication

It is with great pleasure and pride I am sharing the following details related to the keynote speech delivered at the 'Undergraduate Research Symposium 2023', which is organized by the Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka under the theme of "Explore the World Through Research and Innovations". Given the focus on budding researchers, I believe that sharing some information related to application of ethics in research conduct and publications is important for their career development as a researcher, at least for some of them.

Research involves creating new knowledge through scientific approaches where conclusions are drawn based on observations of the experiments. Importantly, research helps extend human knowledge beyond what already exists. Although different protocols, methodologies, techniques and approaches are applied in research with certain assumptions a question arises whether all adopting practices are in line with an acceptable ethical framework. A need for such ethical framework in conducting research and thereafter, in publishing research findings has been understood over decades due to the inhumane practices adopted in certain studies. For example, Nazi Medical Experiments (1933 – 1945), Tuskegee Syphilis Study (1932), Willow brook Study (1950s – 1970s) and Jewish Chronic Disease Hospital Study (1960s) was prominent among them. Considering the unethical nature of these studies, it led to the development of 'Ethical Codes and Regulations' to demarcate boundaries of the research process (planning, conducting and publishing) with the objective of minimizing harm to the participants. Nuremberg Code, Belmont Report, American Psychological Association (APA) Guide etc. are such 'Ethical Codes and Regulations' introduced initially for addressing the issue.

In general, the research projects that involve human participants, use of the products of human participants, animal participants, work that potentially impacts on human participants, and some other studies such as research related to environment and plants (prone to extinction) etc. need to be cleared for ethics prior to commencing the research. Hence, practicing permitted ethical approval during research conduct is the prime responsibility of the researchers.

If research does not generate papers, it might just as well not have been done (Whitesides, 2004).Therefore, publications should be resulted after research and it is the sole duty of the authors, reviewers, journalists and publishers to adhere to the ethical applications relevant to the publishing process. Scientific publication is a team effort where authors, the journal and reviewers have to play a collaborative role. Peer review may not always be entirely independent unless otherwise the ethical adherence is not practiced by any of the above parties.

In conclusion, the research should be conducted and published always in order to add new knowledge to the existing level. Following ethical guidelines will ensure that trustworthy knowledge is transferred through research publications. Continuity of research is important in this regard with acceptable quality and standards so as to ensure the process of research for the betterment of the future.

Reference

Whitesindes, G.M. (2004). Whiteside's paper: Writing a paper. Advanced Materials, 16(15): 1375-1377.

Prof. H.M. Saman K. Herath
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Message from the Chief Guest

Senior Professor Udaya Rathnayake

It is a great pleasure for me to extend my deepest appreciation for the 2nd Symposium of Agricultural Sciences Undergraduates Research, (AgSURS 2023) of the Faculty of Agricultural Sciences capturing the theme of Explore the World through Research and Innovation".

Research skills are an important part of the curriculum, and our research effort continues to focus on key areas of study reflecting national and international priorities, ensuring that we play our part as global citizens. Whether you are a student, academic or potential collaborator, you will find opportunities to achieve research excellence in a meaningful way in Sabaragamuwa University of Sri Lanka.

Holding the annual student research session with simple and charm manner convince the stakeholders to establish an affordable path to continue the event without huge burdens. Including a keynote speech from an eminent scholar as a role model enable the participants and contributors enhance their wisdom and virtue. I also take this opportunity to appreciate and thank the Dean of the Faculty of Agricultural Sciences and the Symposium committee for their tireless effort to make the 2nd under graduate Research Symposium a success.

I am sure this will motivate our undergraduates to enhance their research capacity while improving their soft skills like presentation skills and team sprit which are beneficial for them to step up to the world of work.

With best regards,

Snr. Prof. R.M.U.S.K. Rathnayaka,
Vice-Chancellor,
Sabaragamuwa University of Sri Lanka.

Message from the Dean
Faculty of Agricultural Sciences
Prof. P.M. Asha S. Karunaratne

I am delighted to issue this message for the 2nd Undergraduate Research Symposiums of the Faculty of Agricultural Sciences - AgSURS 2023. This conference is aimed at bringing together undergraduate researchers, from different agricultural disciplines to a common platform on the theme; "Explore the World through Research and Innovation".

Research and innovation play an essential role in generating smart and sustainable growth by producing new knowledge. The AgSURS provides the opportunity for students to present their research and findings. Presenting at the symposium gives students a valuable presentation experience, as well as a place to network and learn about research in a variety of fields.
Organizing such a symposium reinforces our objective of developing an environment of exchange of ideas for the progress of the agricultural sector. The hard work and dedication of all the members of the organizing committee during the preparation of this symposium are highly appreciated. Without them, the event would not have been possible.

Finally, I wish all the best to the organizers and participants to make their effort a success.

Prof. P.M. Asha S. Karunaratne,
Dean,
Faculty of Agricultural Sciences,
Sabaragamuwa University of Sri Lanka.

Message from the Symposium Chair
Dr. R.A.M.S. Bandara

Greetings!

It is a great pleasure in forwarding this message on behalf of the organizing committee of the Agricultural Sciences Undergraduate Research Symposium (AgSURS -2023). The effort of the symposium is to bring together the undergraduate researchers of the faculty from different agricultural disciplines to a common platform under the theme 'Explore the World through Research and Innovation'. AgSURS-2023 is expanded for a wider audience while offering a scientific and an industrial forum for the students to present and discuss their research projects that they worked on in their final year and the respective research findings. This year a remarkable increase in student participation was noticed in comparison to the previous year, and a total of 66 research abstracts are presented in the symposium. All the research abstracts submitted by the students to the symposium were peer reviewed and are published in the symposium proceedings. I thank the undergraduate researchers who submitted their abstracts, and extend my gratitude to the members of the editorial board and the reviewers for their diligent work to uphold the quality of this publication.

AgSURS-2023 is organized with a few novel events aiming improve the quality and effectiveness of the event. Pre-symposium workshops on effective tips and skills on scientific presentation were organized by the organizing committee to develop the research skills of students; thesis writing; and research project presentations in line with the AgSURS-2023. A separate forum was opened to the other undergraduates in the faculty to submit their research abstracts with the objective of promoting a research culture in the faculty. A scientific photography Competition-Image of Research was opened for the undergraduate researchers highlighting student talent in using visual resources in Science. Renowned scientists from different agricultural and allied disciplines are invited to lead the panels of research presentations and the discussions. Dignitaries from related industries are also invited to the symposium aiming at networking within the industry and developing research careers of the undergraduates.

Being the symposium chair while being an alumni member of the faculty is a great opportunity to get the support of the Agri Alumni Association for the event. I am proud to announce that the key note speaker is also an alumni member of the faculty. We are privileged to have Professor H M S K Herath, Dean, Faculty of Animal Science and Export Agriculture, Uwa WellassaUniversity of Sri Lanka as the keynote speaker of the AgSURS-2023. AgSURS-2023 is a great team work of the organizing committee consists of Mr. G A H Galahitigama (Symposium Coordinator), Ms. P W M Tharindi and Mr. Sellapperuma (JointSymposium Secretaries). I truly thank for their untiring efforts and the given support to make this event a great success while believing my vision. My gratitudes also go to Prof. Chandrika Dissanayeke, Prof. Anil Gunarathne and Prof. Kapila Kumara for chairing the scientific committee, Publication committee and the logistic committee respectively.

The organizing committee is immensely grateful to AVON Pharmo Chem (Pvt) Ltd. for considering the sponsorship proposal for AgSURS-2023 symposium. The AgSURS-2023 is honored to have Agri Alumni Association and the AHEAD project as its other partners.

I sincerely hope that you will find this symposium enjoyable and valuable, and wish you all a Fruitful academic experience at the AgSURS-2023!

Dr. RM Amila S Bandara,
Symposium Chair- AgSURS-2023.
Faculty of Agricultural Sciences,
Sabaragamuwa University of Sri Lanka.

Theme: Food Processing and Post-Harvest Technology I (FPT-I)

Session Chair: Dr. W.S.M. Senevirathne

Session Rapporteur: Ms. Ruwini Basnayake

Session Coordinator: Mrs. H.K.N.Udayangani

IT Assistant: Mr. J.A.P. Madhushanka

Session Assistants: Mr. G.S.G. Rupasinghe, Ms. L.D.T. Muthunayaka

Panelists: Prof. S.B. Navarathne, Dr. Rumesh Liyanage, Mr. Rohitha Dabarera, Mr. M.S. Andrew, Mr. M.C. Niroshan Jayasooriya

Theme: Plant Nutrient and Soil Science (PS)

Session Chair: Prof.Saman Herath
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Session Assistants: Mr. G.I.S. Alwis, Ms. A.D.S.P. Ariyachandra
Panelists: Prof. Lalith Suriyagoda, Dr. Nadeeka Thisera, Mr. Harsha Dissanayake, Mr. Kasun Geeganage, Mr. Ruchira Wijesinghe

Theme: Plant Breeding and Biotechnology (PB)

Session Chair: Dr. Muditha Meegahakumbura

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Session Assistants: Mr. M.V.U.M. Sugathadasa, Ms. I.A.Y.R. Indurugalla
Panelists: Mr. Prasanna Dayasena, Dr. Arosha Buddapriya, Ms. Nishadi Liyanage, Ms. Bhagya Dissanayake

Theme: Livestock Production, Aquaculture and Food Safety (LAF)

Session Chair: Dr.Malika Nambapala
Session Rapporteur: Mr. Nimesh Madushanka
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IT Assistant: Mr. W.M.K.B. Wasala
Session Assistants: Mr. D.K.N. Gamage, Ms. B.D. Lakshmi
Panelists: Dr. Gayani Weerasinghe, Dr. Sunil Gamage, Mr. J.A. Athula, Mr. N.P.P. Liyanage

Theme: Agricultural Economics and Agri-Business Management II (ABM-II)

Session Chair: Mrs. Buddika Dharmarathne

Session Rapporteur: Ms. Ruwini Bandara

Session Coordinator: Ms. Achini Jayakody

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Session Assistants: Mr. H.W.K. Madumalka, Ms. D.G.H.D.S. Manimekala
Panelists: Dr. Premachandra Wattage, Mr. Achintha Ekanayake, Mr. B.E.S. Bandara, Ms. Chathurika Banagala

Theme: - Food Processing and Post -Harvest Technology II (FPT-II)

Session chair: Mr Janitha Liyanage

Session Rapporteur: Mr. Isuru Hettiarachchi

Session Coordinator: Ms. W.H.P.Sandamali

IT Assistant: Mr. J.A.P.Madhushanka

Session Assistants: Mr. K.L.B. Priyamal, Ms. K.V.G. Kannanthudawa

Panelists: Mrs. J.W.A. Sajiwanie, Mrs. K.A. Tennakoon, Mr. Promod Bandara, Mrs. Wathsala Herath

Theme: Plant Protection (PP)

Session Chair: - Prof. Udeni Jayalal

Session Rapporteur: Mr. Harshana Galahitigama

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Panelists: Dr. U.A.G.I. Sirisena, Dr. M.G.D.L. Priyantha, Dr. B.M.V.S. Basnayake, Dr. K.M.G. Chanchala

Theme: Agri -environmental Modelling (AEM)

Session Chair: Prof Saman Koswatta

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Session Coordinator: Ms. Anuradha

IT Assistant: Mr. P.S.T. Punchihewa

Session Assistants: Mr. H.S.C. Mendis, Ms. B.A.D. Prasadi

Panelists: Prof. Renuka Rathnayake, Prof. A.D. Ampitiyawaththa, Prof. E.P.N. Udayakumara, Prof. Sunethra K Gunathilake

Theme: Crop Production Technology (CPT)

Chair: Prof K.G. Premathilaka

Rapporteur: Ms. Ovini Dissanayake

Coordinator: Ms. Isuri Udayana

IT Assistant: Mr. W.M.K.B. Wasala

Session Assistants: Mr. W.M.L.B. Wijethunga, Ms. W.M.P.H. Weerasekara

Panelists: Dr. D.W.S.B. Dissanayake, Dr. Sangeeth Rathnayaka, Mr. B.S. Bandusekara, Mr. D.D.S.S. Dissanayake

Theme: Poster Presentations(PO)

Session Chair - Dr. P.K.G.S.S. Bandara
Rapporteur - Mr. M. Naveenan
Session Coordinator - Ms. Thilini Ranaweera

IT Assistant: Ms. G.H.N.U. Silva

Session Assistants: Mr. N.P.M. Abeysinghe, Ms. P.K. Hitige

Panelists: Dr. T.M.S.A. Tennakoon, Ms. P.G.A.S. Warnasooriya, Mr. Chathura Madushanka

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Agricultural Economics and Agribusiness Management I (ABM-I)

Did the Overnight Ban Smash the Sri Lankan Paddy Farmers? Evidence from Chemical Fertilizer Policy Reform

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The overnight ban of chemical fertilizer on 27th April 2021, immediately disrupted the fertilizer supply which is procured as a major raw material in paddy cultivation in Sri Lanka. As such, farmers had been pushed to the status of confusion and been insecure to overcome the loss of production. As the substitution for continued agricultural operations, the nation was widely pushed to organic fertilizers over months. This study aims to analyze the rice value chain focusing on major challenges faced by paddy farmers during 2021/22 Maha season due to the chemical fertilizer ban. The survey was conducted during the month of July, 2022 in four districts namely Anuradhapura, Polonnaruwa, Kaluthara and Kurunegala with 406 paddy farmers whereas qualitative data was gathered through Focus Group Discussions (FGDs). Apart, the Key Informant Interviews (KIIs) existed for other stakeholders such as collectors, millers and traders. The collected data was analysed using porter's value chain analysis model. The lack of adequate raw materials for organic fertilizers, quality issues and no proper organic subsidy program were key constraints identified in the study. Moreover, the reduction of harvest, low profit, market price fluctuations, government unsystematized price control; illegal market transactions and artificial shortage by hoarding were reasons for the temporary drop of maintaining an efficient rice value chain in the country. The poor knowledge of organic farming techniques and adverse market opportunities happening in the society were threatening to current agricultural operations. They should be mitigated to implement the organic farming conversion as a feasible operation. Moreover, the supply of quality fertilizers, implementing advanced farming methods, developing farmer base and value-added product flow regards to organic would be wide future opportunities to meet. Therefore, sufficient fertilizers to secure harvest and favourable floor prices are much needed to ensure the national rice production process is to be alive. Then it will strengthen the paddy farmers' living conditions in order to establish the sustainable rice value chain in Sri Lanka.

Keywords: *fertilizer ban, fertilizer policy framework, paddy cultivation, supply shortage, value chain analysis*

Challenges in Coconut Procurement Process among Small-Scale and Large- Scale Coconut Growers in Sri Lanka, A Study in Kurunagala District

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In Sri Lanka, the plantation sector plays a major role in the export sector, where tea, rubber and coconut have been the major export agricultural commodities. As an agricultural commodity, coconuts must undergo a series of operations before they reach the market as a raw material and a value-added material. One of the major initial steps in the supply chain for coconuts is the process of procurement. The small-scale and the large-scale coconut growers are vital players in the coconut procurement in the coconut industry. This study was designed to examine the challenges in the coconut procurement process among small-scale and large-scale coconut growers in Kurunagala district, Sri Lanka. In this study, the considered objectives, understood the role of procurement in identifying and managing intra and inter organizational issues that impact supply chain performance, rating the leading factors for problems in the procurement process, finding out what factors participants expected from procurement and finding initiatives that will aid in developing systematic procurement performance by addressing issues. The study was mainly based on primary data, which was collected through the questionnaires. A questionnaire was distributed to a sample of 90 coconut growers, including both small-scale and large-scale growers and 10 industry-based people in the coconut industry in Kurunagala district. Further the study used secondary data from coconut cultivation statistics. The results revealed that the process complexity, price instability, supplier performance and logistic and transport are significant and it shows that these problems discriminate against the procurement performance of the coconut supply chain. When considering reasons for procurement issues, 72.68% of Garret's rank level was obtained by improper management practices and 62.94% of Garret's rank level was obtained by the poor infrastructure that prevailed in the country. Addressing the aforementioned challenges will have a direct impact on procurement performance sustainability and the resilience of the coconut supply chain.

Keywords: *challenges of procurement, coconut industry, procurement, supplier involvement, supply chain*

Impact of Current Economic Crisis on Operational Performance of Biscuit Industry in Sri Lanka

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The main objectives of this study are to examine how biscuit manufacturing companies are affected by the prevailing economic crisis, to assess the effects of marketing strategies on company performance in such conditions, and to identify those that can help companies to maintain successful performance despite turbulence in their operational environment. An interview guide was used to interview five leading biscuit manufacturers identified as firms A, B, C, D and E. Data were collected and analyzed qualitatively. Firms that modify their strategies appropriately can maintain or improve their operational performance in times of a crisis. The strategic changes most likely to achieve this outcome were measured mainly in terms of demand for biscuits, cost of production and other financial ratios. Return on Assets of the biscuit industry has been reduced by 0.14, liquidity ratio has decreased by 0.18 and assets turnover ratio has decreased by 0.24. These reductions expose the industry to a financial risk. Financial leverage ratio has increased by 0.25, which says company operational expense incrasement. The results explore that during this economic crisis, the profitability of biscuit industry in Sri Lanka has been affected adversely. As a whole the demand for Sri Lankan biscuit products has decreased by 29.76% while cost of biscuit production has been increased by 161.96% while biscuit price has been increased by 260%. The study adds a specific focus on marketing strategies such as focusing more on promotional strategies and going for innovative products which need low cost of production. to existing studies of general measures taken by companies during economic crises. Companies had to face different obstacles in using these strategies. However, most of them proved that they can face their weaknesses and apply these strategies in a turbulent period like an economic crisis.

Keywords: *biscuit industry, economic crisis, financial ratios, operational performance, strategies*

Current Status of the Market for Pasta and the Factors Affecting Consumer Preference on Local Made and Imported Pasta: The Case of Gampaha District, Sri Lanka

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Sri Lankan pasta market can be divided into two; consumers who prefer locally-made pasta and consumers who prefer imported pasta. The study focuses on the Gampaha district with a sample of 390 pasta consumers and observes their preference between the two types and the factors affecting their preference was also observed. The sample's preference has been divided into 71% for locally made pasta and only 29% for imported pasta. Demographic factors like age, gender, employment status, educational level, and the number of family members in the family were surveyed and could see a measurable difference between the pasta preferences within those demographic factors. The estimated Local pasta production had an upward trend from the year 2010 to 2019. The knowledge and awareness of the respondents on the local pasta market were not at a satisfactory level. Factors like price, quality, availability, promotion, packaging, and taste of the product, which affected the consumer preference between locally made pasta and imported pasta were analyzed by binary logistic regression. The results have shown that factors like product price and product availability were in favour of the local pasta preference and the product quality, promotion, packaging, and taste were in favour of the imported pasta preference. Obtaining quality certificates such as ISO, HACCP, and GMP for local pasta products, strategically promoting local productions to the market, following attractive and informative packaging methods, and often improvement in product sensory attributes were some suggestions to increase locally-made pasta preference. As the government's strict import policy due to the on-going economic crisis in Sri Lanka, local pasta producers have met difficulties to obtain imported raw materials such as durum wheat flour; it was suggested to follow further research on local alternatives to replace durum wheat flour as the main ingredient of pasta.

Keywords: *binary logistic regression, consumer preference, durum wheat flour, locally made pasta*

Factors Leading to Brand Loyalty in Selected Dairy Products in Sri Lanka

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Brand loyalty is defined as positive feelings towards a brand and the dedication to purchase the same brand repeatedly, now and in the future, regardless of a competitor's actions or changes in the environment. This study was carried out to determine the factors affecting the brand loyalty of selected dairy products in Sri Lanka. Further, the research provides information on the level of brand loyalty among existing consumers and the consumer behaviour towards these selected dairy products in Sri Lanka. The sample for this study was taken from people who consume selected dairy products; yoghurt, drinking yoghurt, or curd covering all nine provinces of Sri Lanka and the convenience sampling method was used to select the sample of 302 respondents. Primary data was gathered through a structured questionnaire containing likert scale and categorical questions via both the web (a Google form) and in-person surveys. The data was analysed using multiple linear regression and descriptive statistics. The results of multiple linear regression analysis denoted that the significant values of product quality (0.025), trust on the brand (0.000), and product availability (0.009) were $P<0.05$; and price (0.869), packaging (0.134), and advertising (0.176) were $P>0.05$. This result indicated that product quality, trust on the brand, and availability have statistically significant relationships with brand loyalty while expressing positive impacts on brand loyalty. Apart from that, the findings of the study indicated that existing consumers of selected dairy products are brand loyal according to the mean values of their opinions on brand loyalty. With regards to consumer behaviour towards selected dairy products, 42.4% of the respondents consumed dairy products two/three times a week, and the most consumed dairy product was yoghurt, with 75.2% of responses. Moreover, 60.3% of the respondents bought the dairy products from a retail shop, and 79.1% of the sample had a favourite dairy brand.

Keywords: *brand loyalty, consumer behaviour, curd, dairy products, yoghurt*

An Investigation of Constraints Associated with the Turmeric Supply Chain in Sri Lanka

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Turmeric is an important commercial crop contributing to the preparation of meals, contribution to the national income of the country, empowerment and the employment of rural people. Therefore, uplifting the efficiency of the turmeric supply chain by identifying the constraints is an important factor in the country. This study was undertaken to map turmeric supply chain actors and identify their roles, analyze the gross profit margin, determine the purchase patterns, identify the constraints of all partners and provide suggestions to overcome them. Data were collected through stratified random sampling, representing 100 farmers, 63 intermediaries and 200 consumers. The drafted supply chain revealed that the major supply chain actors were farmers, input suppliers, village collectors, wholesalers, island-wide spice collectors, retailers and spice manufacturers. The supply chain activities; of producing, collecting, sorting, grinding, packing, and marketing were identified. The Department of Export Agriculture, service associations and the Export Development Board were the supply chain supporters. The gross profit margin was calculated as 66% and it was totally carried out by the intermediaries of the supply chain. The results of descriptive statistics showed that the major constraints that affected the farmers, retailers, collectors and wholesalers were cost of seed (64%), price fluctuation (77%), product inconsistency (77%) and price setting (72%). Even traditional farmers located in the research area, there were constraints starting from input supply to selling the turmeric. The results of the study recommend building the interaction between farmers and traders as the most favorable strategy in order to overcome the constraints. Moreover, providing loan facilities, technological implementations and export markets were identified to rectify the turmeric supply chain-related constraints.

Keywords: *constraints, intermediaries, multiple regressions, supply chain, turmeric*

Impact of Digital Marketing on the Performance of SMEs: Special Reference to Kandy District

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Digital marketing is one of the strategies that businesses use to reach customers and advertise their products/services. This study focused on generating empirical evidence on the relationship and impact of digital marketing on business performance in the context of Small and Medium Enterprises (SMEs) in the Kandy district. The research objectives were a) to explore digital marketing tools among SMEs in selected Divisional Secretariat divisions of Kandy, b) to explore factors that influence moving from non-digital tools to digital tools for marketing, and c) to examine the relationship between digital marketing tools and SMEs' performance. The data were collected from a randomly selected sample of 213 respondents via a structured questionnaire and in-depth interviews. Descriptive statistics and regression analysis were used to analyze the data. Digital marketing methods: online advertising, mobile marketing, and social media marketing with Facebook, Instagram / Tik Tok were identified as commonly used strategies. The binary regression results revealed that relative advantage, time, and cost-effectiveness positively influence SMEs' move from non-digital tools to digital tools. To investigate the relationship between digital marketing and the performance of SMEs, calculate the overall financial performance score (sales & profitability) and strategic performance (customer satisfaction). Findings also revealed that there was a positive relationship between digital marketing tools and the performance of SMEs. According to multiple regression results, the performance of SMEs is significantly affected by Influencer marketing, Facebook marketing, online advertising, and Instagram/ TikTok marketing. In contrast, mobile marketing does not significantly affect the performance of SMEs. Digital marketing allows businesses to connect with and engage their target customers more effectively and efficiently. During the pandemic, the need and role of digital tools are enormous to businesses. SMEs in the Kandy district should use digital marketing to improve their performance

Keywords: *digital marketing, digital tools, Kandy district ,performance, SMEs,*

Food Processing and Post- Harvest TechnologyI (FPT-I)

Development of a Smoked Tender Jackfruit (*Artocarpus heterophyllus*) Product that Resembles Meat-based Barbeque, as a High-value Vegan Food for the Export Market

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Jackfruit (*Artocarpus heterophyllus*) is a dicotyledonous plant that belongs to the family Moraceae. Jackfruit in Sri Lanka is wasted largely at its different maturity stages due to limitation of consumption. As a solution to minimize this wastage and also as a meat alternative vegan food, a smoked tender jackfruit product was developed using Cinnamon (*Cinnamomum zeylanicum*) as firewood for smoking. The suitable temperature, the amount of wood and suitable smoking duration were tested according to Box-Behnken design in Response Surface Method (RSM). The prepared smoked tender jackfruit samples with salt and pepper were evaluated using nine point hedonic test for sensory properties (colour, appearance, texture, taste, odour and overall acceptability) to determine the most suitable sample and its salt and pepper content. Firewood (150 g) for smoking at 80°C temperature about 20 minutes was the most effective treatment combination to prepare 1 kg of smoked product. Proximate composition of the product was 79.05% moisture, 1.02% crude fat, 3.08% protein, 7.19% crude fiber, 2.04% ash and 8.02% carbohydrates. The microbial content of the vacuum packed final product was estimated as Total Plate Count (TPC) and yeast and mould count. The microbial content in smoked sample stored under refrigerator condition (4°C) was comparatively lower than non-smoked sample during three weeks period. Initial pH value was 3.84 and the brix value was 6°Bx in the smoked product. The colour development of the product was presented as increment of darkness of the outer appearance. The ideal L*a*b* colour values were L* 42.74, a* 5.55, b* 11.42 in the developed product. The texture became softer, with increased temperature and smoking duration. Presence of Polycyclic Aromatic Hydrocarbons (PAH4 marker) were tested using High Performance Liquid Chromatography (HPLC) method and they were not detected in the smoked product. The physical properties, chemical properties and microbial count of the finished product even after one month of shelf life, show promise to introduce it as a vegan food to the export market.

Keywords: *cinnamon firewood, food smoking, polycyclic aromatic hydrocarbons, response surface method (RSM), tender jackfruit,*

Incorporation of Jack Fruit (*Artocarpus heterophyllus*) Seeds Flour and Bread Fruits (*Artocarpus altilis*) Flour as Substitutes of Bread Crumbs in Manufacturing of Chicken Sausages

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Sausage filler is used to increase the yield of sausages. Bread crumbs is one of the commonly used sausage fillers in the industry. The ever-increasing price of bread crumbs and higher cooking loss in sausages with bread crumbs lead this study to determine the potential of two cheaper, locally available ingredients (jack fruit seed flour and bread fruit flour) to be used as alternative fillers in sausages production. It was also expected to value addition of jack fruits and bread fruits. Three types of chicken sausages were prepared including the control. Jack fruit seed flour and bread fruit flour were used to prepare the treatments with totally replacing filler (bread crumbs) in the control. Flour was obtained after drying (sun drying and oven drying) and grinding process of jack fruit seeds and bread fruit slices. Filler incorporation was 15% (w/w) in the recipe. Chicken sausages were manufactured by using standard sausages manufacturing process. Vacuum packed sausages were stored at -32℃. Proximate analysis, determination of physicochemical parameters and sensory evaluation (hedonic scale) were conducted for the products. One way analysis of variance (ANOVA) was used to compare the properties of products. There was no significant ($p>0.05$) difference in the cooking loss, ash, protein contents among the three products. There was a significant different ($p<0.05$) in the moisture, fiber, fat, pH and Water Holding Capacity (WHC) among three products. The highest value of moisture and fiber were observed in Bread Fruit flour incorporated Sausages (BFS). The highest mean value of fat and pH were observed in Jack fruit seeds Flour incorporated Sausages (JFS). The highest mean value of WHC was observed in the control. Sensory data suggested that incorporation of jack fruit seeds flour and bread fruit flour influences the aroma and flavor of sausages. In sensory evaluation, flavor in the control product was the most acceptable attribute and JFS showed higher overall acceptability than BFS. The study revealed that the most suitable substitute for bread crumbs in manufacturing chicken sausages is jack fruit seed flour according to the organoleptic properties, proximate composition and WHC.

Keywords: *bread crumbs, bread fruit flour, filler, jack fruit seed flour, sausages*

Traditional Red Rice (*Oryza sativa*) Flour and Mung Bean (*Vigna radiate L*) Flour as Alternatives for Soy Protein Binder in Pork Sausage

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Binders are the substances used to improve flavor, cooking yield, emulsion stability and textural characteristics of sausage. Isolate Soy Protein (ISP) is the common ingredient used as sausage binder in meat processing industry. Sausage processors faced huge problems due to high cost of soy protein. Hence, more attention has been given to find alternative compounds to replace ISP with low costs. The focus of the present study was to evaluate the suitability of Mung Bean Flour (MBF) and traditional Red rice Flour (RF) as potential replacers of ISP. Two levels of treatment (3% and 6%) of MBF and RF were tested in reference to ISP (2%) in pork sausage making. Proximate composition, water holding capacity, emulsion stability, cooking loss, pH and sensory attributes of formulated sausages were tested. The moisture and ash contents were not significantly ($p>0.05$) different among treatments. The highest crude protein content (19.27%) was found in ISP added sausages followed by 6% MBF (17.72%). while slightly increased fat (23.01%) was noticed in 6% MBF treatment. The addition of MBF produced sausage with high fiber. The highest Water Holding Capacity (WHC) was found in the control followed by 6% MBF treated sample and the lowest in RF treated samples. Sausages with lowest cooking loss were exhibited from 6% MBF treatment. The addition of 3% RF resulted in the highest Total Fluid Release (TFR) and Fat Loss (FL) indicating weaker emulsion stability among the tested treatments. pH values ranged from 6.0-6.4 for the tested sausages. MBF significantly reduced the pH and this was more at 6% MBF treatment. Sensory data analysis performed with 30 untrained panelists using a five- point hedonic scale indicated that there were significant differences in color, flavor, texture and overall acceptability among the tested samples. In overall evaluation of physical and sensory attributes it can be concluded that incorporation of 3% MBF gave the most desirable quality characteristics over the control and thus could be considered as an potential alternative for ISP.

Keywords: *mung bean flour, physicochemical properties, pork sausage, red rice flour, sensory properties*

Opportunity Analysis for Value-Added Banana Chips Using Substandard Bananas in Commercial Farms

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Banana is a major fruit crop grown commercially in Sri Lanka. There are many varieties of bananas cultivated in Sri Lanka. However, the Cavendish banana variety is the most popular commercially grown variety in major banana-growing countries of the world including Sri Lanka. One of the major problems of commercial banana farmers is generating a large amount of refused bananas due to physical damage to the fruit. Due to external damage, the quality level and price level of the fruits are compromised. This research work was undertaken to regain the cost of cosmetically damaged bananas up to a profitable level by producing banana chips as a value addition. The research location was the CIC quality banana project, Hingurakgoda and customer analysis was done based on Hingurakgoda, Medirigiriya and Lankapura Divisions for value addition. Three samples were produced by using different flavours such as spicy flavour, sweet flavour and salty flavour banana chips. The sensory analysis of the products was done by using the hedonic test and ranking test, both concluded that the "spicy flavour banana chips sample" was the best sample. Microbiological analysis was done by the Food & Nutritional Laboratory of CIC Seed Farm. The analysis concludes that the product is under a safe limit within 30 days of ambient storage. The consumer analysis results conclude that most participants prefer to buy banana chips from retail stores and supermarkets. The majority of the participants rated Rs.150-200 for 100 grams of banana chips and the attributes that most consumers care about when buying chips were price, taste, quality, quantity and availability. A feasibility analysis evaluated the opportunity to develop a banana chips unit on commercial farms by comparison of selling raw green bananas without value addition for local intermediate sellers. The net present value was being positive and internal rate of return was being greater than the interest rate (25%) concluded that the project is feasible. Thus, banana chip production by using refused bananas is a profitable and feasible project for commercial banana farmers.

Keywords: *banana chips, customer analysis, feasibility analysis, refused banana, value addition*

Effect of Different Types of Wood Chips on the Sensory Properties and Microbial Status of Smoked Emulsion-Type Chicken Sausages

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This study investigated the effects of different wood chip types, respectively Cinnamon (*Cinnamomum verum*), Mahogany (*Swietenia macrophylla*), Acacia (*Acacia auriculiformis*), and Teak (*Tectona grandis*), on the colour, sensory characteristics (appearance, colour, aroma, flavour, texture, and overall satisfaction), and microbial reducing percentage of smoked emulsion type chicken sausages. A non-smoked sample was used as a control. Sensory evaluation was tested by 31 panellists (trained and untrained) using a seven-point hedonic. After the chamber process, the microbial reducing percentage was tested using the total plate count test. All smoked samples did not significantly differ in microbial reducing percentage after the chamber process. The lightness value (L*) of the smoked sample with Mahogany (57.25 ± 0.57) and Acacia (58.43 ± 0.97) displayed a significant difference from the control (59.73 ± 0.70), and also the highest L* value revealed in Cinnamon (60.30 ± 0.89). The redness value (a*) and the yellowness value (b*) of the smoked sample with Mahogany (20.05 ± 0.58, 27.38 ± 0.57), Acacia (18.83 ± 0.97, 28.38 ± 1.02), and Teak (20.27 ± 0.59, 28.30 ± 0.67) showed a significant difference from the control (16.80 ± 0.67, 25.65 ± 0.53). In the sensory evaluation, all samples did not show significant aroma or flavour differences. Also, appearance and colour did not significantly differ from samples that were smoked with Mahogany, Acacia, and Cinnamon ($0.05<p$). The highest overall satisfaction was shown in the smoked sample with Acacia, which differed from the control and Teak ($0.05>p$). Therefore, the overall results suggested that the Acacia, Cinnamon, and Mahogany wood chips could be potentially utilized as local wood chips for smoking sausage in the meat industry. However, further studies need to be done to compare the microbial effect that occurred due to smoking for commercial application of the used wood chips.

Keywords: *acacia, cinnamon, mahogany, smoked sausage, wood chips*

Potential Application of Gizzard Fat in Manufacturing of Emulsion Type Chicken Sausage

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The qualities of the fat used in sausage manufacturing could affect the properties of the final product, even affecting the cost of production.The chicken slaughterhouse by-products such as gizzard fat can have technological, nutritional and economic advantages in sausage making. The aim of the study was to investigate the ability to use commonly discarded gizzard fat in chicken sausage, using traditionally used fat source, the chicken skin, as the reference. Sausage samples were prepared by incorporating gizzard fat with 50%, 75%, and 100% replacing the traditional chicken skin. The control sample was prepared with chicken skin in 100%. All the sausage samples were kept at -18°C after processing prior to analysis. Water holding capacity, proximate composition, emulsion stability, cooking loss, pH, color, and texture of sausages were tested. The texture of the sausages was measured with a texture analyzer, and a Chroma meter was used for color parameters. Colour, texture, juiciness, overall acceptability, and flavor were also tested by conducting a sensory evaluation after frying the samples. Sausages with gizzard fat (50%, 75% and 100%) significantly ($p<0.05$) reduced the moisture and protein content but increased the fat content more than the control. The addition of gizzard fat significantly ($p<0.05$) improved the water holding capacity and emulsion stability and significantly reduced the cooking losses ($p<0.05$) than those in the control. The incorporation of gizzard fat significantly ($p<0.05$) changed pH to be more acidic with increasing levels of gizzard fat. Gizzard fat at the level of 75% and 100%, had a significant ($p<0.05$) effect on the colour of the sausage (redness a*). The hardness was significantly ($p<0.05$) increased as the level of gizzard fat was increased. Sensory analysis revealed that the incorporation of gizzard fat had a significant effect on sausage color ($p<0.05$) while not influencing flavor, overall acceptability, texture, and juiciness compared to the control. The study concluded that the sausages incorporated with gizzard fat improved the water holding capacity, fat composition, emulsion stability, cooking loss (lower), hardness, and sensory properties (colour acceptance), indicating its potential application as a source of fat for chicken sausage manufacturing.

Keywords: *chicken sausage, chicken skin, gizzard fat, physicochemical properties*

Impact of Selected Vegetable Mixture Incorporation on Physicochemical, Nutritional and Organoleptic Properties of Chicken Sausages

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The present study was conducted to evaluate the effect of different inclusion levels (0, 6, 12 and 18%) of a pre-formulated vegetable mixture (VM) containing pumpkin (54%), carrot (45.25%) and drumstick leaf powder (0.75%) on the nutritional, physicochemical and sensorial quality characteristics of chicken sausages. The experimental design was complete randomized design evaluating four treatments (Control: 0%, VM6: 6%, VM12: 12% and VM18: 18% vegetable mixture). Each treatment had four replicates and four sausages (22 $\pm$ 3.4 g) per replicate (n=4). Treatments were analysed for the proximate composition, gross energy, cooking loss, cooking yield, pH, water holding capacity (WHC), moisture retention, texture profiles, juiciness, external and internal colour (CIE L*, a* and b*), folding test qualities and the extract release volume (ERV). Sensory attributes were evaluated using 30 untrained panellists for toughness, aroma, taste, texture, juiciness, appearance, surface colour and overall acceptability on a 7-point hedonic scale. The moisture (63.09% - 67.9%) and the crude fibre (0.32% - 1.4%) contents of sausages were found to be increased with increasing levels of the vegetable mixture while crude fat (12.44% - 13.58%), crude protein (15.78% - 17.02%) and ash contents (2.4% - 2.83%) were found to be declined. All the physicochemical attributes except the internal colour measurements (L*, a* and b*) were affected by the inclusion level ($P<0.05$). Among the inclusion levels tested VM18 yielded the optimal pH (6.14), the highest moisture retention (60.65%), WHC (37.35%), external a* (18.30), juiciness (15.90%) and the lowest hardness (7.22 N), folding test value (2.25) and the ERV (35.80 ml). Overall, the present study concluded that the inclusion of minced vegetable mixture in the sausage formulation at an 18% level maximally contributes to the development of the physicochemical properties tested. The inclusion of the vegetable mixture at a rate of 6% and 12% attracts panellists the most.

Keywords: *chicken sausages, physicochemical properties, sensory attributes vegetable mixed sausages*

Development of A Cookie Using Composite Flour of Wheat (*Triticum aestivum*), Cassava (*Manihot esculenta*) And Green Gram (*Vigna radiata*)

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Cookies, otherwise known as biscuits are a popular cereal food which is commonly consumed by the populace as a ready to eat, convenient and inexpensive food item. Cookies are produced mainly from wheat flour. However, consumption of wheat flour is not much healthy. Therefore, it is very important to develop a cookie using composite flour in order to enhance the nutritional value by using native nutritious flour of cassava and green gram instead of imported wheat flour. In this research, cookies were tested with a composite flour of wheat, cassava and green gram using different ratios as (120:30:0, 150:0:0, 0:150:0, 45:75:30, 75:60:15 and 0:120:30). The best combination to make nutritious and healthier cookies were determined by sensory scores (Appearance, Taste, Aroma, Colour, Mouth feel, Texture and Overall acceptability) using a seven-point hedonic scale. The sensory evaluation was done by using 25 panellists and 75 from randomly selected consumers. Results have shown that the 75:60:15 ratio cookies gave the highest mean ± standard deviation values for sensory attributes. All the attributes were significantly different. Analysis of variance (ANOVA) test has shown significant difference in all the sensory attributes among each cookie sample. Duncan post hoc test result for pairwise comparison has shown the mean difference of overall acceptability between 75:60:15 cookie type and all other cookie types were significant. The results revealed that the sample was subjected to proximate analysis. According to the proximate results, moisture, ash, fat, protein, carbohydrates and energy (as kcal/ 100g) were 2.8%,1.3%, 17.0%, 5.0%, 73.9% and 468.6 kcal/ 100g respectively. Thus, the study suggests that the wheat, cassava and green gram flour can be mixed (75:60:15) to produce high quality consumer acceptable cookies.

Keywords: *cassava, composite flour, cookies, green gram, sensory analysis*

Plant Nutrient and Soil Science(PS)

Study of the Variation of Piperine and Essential Oil Composition in Ceylon Black Pepper (*Piper nigrum* L.) with Different Geographical Conditions in Sri Lanka

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Piper nigrum L., commonly known as Ceylon black pepper is one of the most important traditional spices in Sri Lanka. Mainly, Low and Mid-country wet and intermediate agro-climatic zones are the most appropriate zones for pepper cultivation. Piperine and essential oil are major compounds found in black pepper which affect its quality where piperine is the major secondary metabolite responsible for its pungency. Climatic conditions, soil properties, varieties, and management practices are the factors that affect for piperine and essential oil content of black pepper. The experiment was carried out to study the variation of piperine and essential oil composition in Ceylon black pepper with different geographical conditions in Sri Lanka. Black pepper samples in semi-matured stage and the same variety were collected from Central, Uva and Southern provinces. Temperature, relative humidity, rainfall, soil pH, bulk density, and Cation Exchange Capacity (CEC) data were collected. Samples were tested to determine the piperine and essential oil content at Industrial Technology Institute and results were obtained. Simple linear regression analysis was performed to investigate any significant effect among piperine content and essential oil content with the above factors. Soil maps were created corresponding to each province representing soil pH, bulk density and CEC values. Results envisaged that the highest piperine and essential oil was recorded in the samples collected from the Central province, while the lowest was obtained from the Southern province. There was no significant effect ($p>0.05$) in rainfall, soil pH, CEC with piperine and essential oil content of black pepper. However, there was a significant effect ($p<0.05$) in temperature, relative humidity and soil bulk density with piperine and essential oil contents indicating the effect of these factors on the piperine and essential oil content of black pepper. Piperine and essential oil content in black pepper depends on the relative humidity, soil bulk density and temperature according to the study.

Keywords: *climatic conditions, essential oil, Piper nigrum* L., *Piperine*

Nutrient Exchange by Cinnamon (*Cinnamomum zeylanicum* Blume) Wood Biochar as Affected by the Methods of Preparation

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At the commercial level, most of the growers use higher doses of inorganic fertilizers causing problems related to nutrient retention and leaching. The bark of the cinnamon wood has the potential to be used as value-added products. Biochar can retain nutrients and also it can slowly release them into the soil solution. The present study aimed to test the effect of different methods of biochar preparation using cinnamon wood, in relation to the nutrient exchange properties. The methods used to prepare biochar were the Muffle furnace method (T2), cone pit method with 50 minutes of burning (T3) and cone pit method with 70-minute burning (T4), double barrel method with burning time for 70 minutes (T5) and for 90 minutes (T6) were used as treatments. The experiment was carried out over 2 months using a nutrient solution (20% Urea, 10% Muriate of Potash and 10% Triple Supper Phosphate) being added at the rate of 600 ml per column at the beginning and at the middle of the experiment. One litre of water was added and drained out after 24 hours continuously and every 8-day intervals sample were taken for the analysis. The column only with subsoil (T1) examined the highest nitrogen (N) amount in the leachate. Nitrogen leached out from the soil can dramatically be reduced by treating the soil with cinnamon wood biochar and T5 (667.33 ppm) and T6 (583.33 ppm) showed the best nitrogen retention in the soil among the methods tested. Lost of Phosphorus (P) was observed in most of the treatments. However, phosphorus in available form was detected in T6 (8.99 ppm) in the final media. In addition to the retention of nitrogen, phosphorus and potassium (K), biochar is able to release P and K into the soil. It is evident from results that the method of preparation of cinnamon wood biochar affects nutrient retention by biochar in the soil media.

Keywords: *biochar, cinnamon wood, leaching, nutrient retention*

Effect of Cinnamon Wood (*Cinnamomum zeylanicum* Blume) Biochar as a Potting media for Cinnamon Seedling

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Production of cinnamon (*Cinnamomum zeylanicum* Blume) has gained popularity and the land area used for cinnamon cultivation has therefore increased in Sri Lanka. In order to meet the increasing demand for seedlings, the Department of Export Agriculture (DEA) recommended a potting mixture for nurseries. However, the nursery owners do not show much interest in using it due to the shortage of raw materials for the mixture. Biochar enhances soil physical, chemical and biological properties and facilitates plants to have access to nutrients. Present experiment was conducted to determine the effect of cinnamon wood biochar (CWB) as a potting medium for cinnamon seedlings. CWB was prepared by double barrel method (DBM) and Pit method (PM). The burning time period for both methods was 60 minutes and four levels of CWB (0%, 2%, 4%, 8% w/w) were applied mixing with sub soil. Four replicates were arranged in split plot design. Seed germination count was taken until 42 days for the seedlings. Plant height and number of leaves were taken as growth parameters and data was taken four times within a two weeks interval. After two months for the seedlings, nutrient solution was applied within a two week interval. As a nutrient solution, urea, triple super phosphate and muriate of potash were applied by mixing with water. At the end of the experiment, shoot length, tap root length, root dry mass, shoot dry mass, leaf area, pest and disease percentage and soil chemical parameters in potting mixture were measured. Biochar prepared by DBM with the mixing of sub soil and with the addition of nutrients solution gave higher shoot dry mass, root dry mass, tap root length and shoot length than biochar prepared by PM. Among the concentrations tested (0%, 2%, 4%. 8%) biochar mixed with 2% on a weight basis was the best among the rates used.

Keywords: *cinnamon wood biochar, double barrel method, pit method*

Special Organic Fertilizer Formulation from Municipal Solid Waste as the Major Feedstock

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This study attempts to upgrade the quality of organic fertilizer made from municipal waste. Windrow composting was used to compare the treatments. They were: T1 municipal organic solid waste (MOSW) + old compost; T2 MOSW + gliricidia + ERP (Eppawala rockphosphate) + sawdust with biofertilizer; T3 MOSW + gliricidia + ERP + banana waste + sawdust with biofertilizer and bio-charcoal as additives. Biofertilizer was used to introduce beneficial microorganisms and bio-charcoal was used to enhance the microbial activity and to neutralize possible contaminants. Pine soil and natural forest soil were used to make the effective microbial culture. After 21 days, samples were analysed for chemical properties in particular. The pH of the compost was slightly alkaline in T2 and T3 compared to the control. Treatments with saw dust and biochar showed significantly higher pH values ($p<0.01$). Among all the treatments, T3 showed the highest pH value (8.04 ± 0.003). The EC (electrical conductivity) was significantly higher in the control than that in the other treatments ($p<0.02$). In the control, 95% of the feedstock was MOSW. Compared to T2, T3 showed the highest EC value. Available phosphorous concentration was significantly higher in T2 and T3 than that of control ($p<0.04$). It appears that the addition of ERP with the microbial culture has led to increased content of soluble phosphorous. The treatment with biochar, T3 showed the highest phosphorous content. However, the available potassium content was the same in the control and T3 ($P<0.002$).When compared to the T2, T3 revealed a higher potassium content because, T3 was prepared with banana waste as an additional potassium source. Based on results, it can be concluded that MOSW can be used as a feedstock to produce high-quality organic fertilizers for high yielding crops. Microbes used have been effective in increasing phosphorous content of the fertilizer. Banana waste appears to be an effective potassium source.

Keywords: *biofertilizer, biocharcoal, improved high yielding crops, municipal solid waste, and special organic fertilizer formulation*

Effect of Different Potting Mixtures on Growth of Cinnamon (*Cinnamomum zeylanicum* Blume) Seedlings

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The use of the correct potting mixture is a prerequisite to producing healthy plants. Department of Export Agriculture (DEA) recommended potting media for cinnamon nurseries is a mixture of topsoil: coir dust: cow dung: and sand (1:1:1:1). Unavailability of required major potting mixture ingredients, especially topsoil and cow dung, is the main problem in cinnamon nurseries. The research was conducted to find out the most effective alternative potting mixtures for the growth of cinnamon seedlings. The DEA recommendation (T1), Sub soil (SS): half burnt paddy husk (HBPH) (6:1): 20% concentrated microbial solution (CMS) and 30% cow dung (CD) (T2), SS: HBPH (9:1): 20% CMS: 30% CD (T3), SS: HBPH (6:1): 30% CMS: 30% CD (T4), SS: HBPH (9:1): 30% CMS: 30% CD (T5) and SS: 30% CD (T6) were the treatment with four replicate which were arranged in Randomized Complete Block Design (RCBD). RCBD was used to block the solar radiation effect. Germination percentage, plant height, taproot length, leaf area, and dry weight of above-ground and below-ground biomass were measured as growth parameters. Presence of leaf caterpillars, upper leaf gall, lower leaf gall, and leaf blight were recorded. Chemical properties were measured in potting media, CMS and CD. The bacterial colony count was recorded from the first day to day 14 of CMS preparation. The result reviewed DEA recommended potting mixture was the best for the considered growth parameters. T2 showed the highest data on leaf area, plant height, and dry weight of below-ground biomass out of the considered alternative potting mixtures. The number of nutrients applied to the pots was the reason for the poor growth of cinnamon seedlings, compare to DEA media. It is evident from results that the sub soil: half burnt paddy husk (6:1), 20% CMS and 30% cow dung (T2) has the potential to be developed as an alternative potting mixture instead of department recommendation. The best time for application of CMS is 11 to 14 days after preparation.

Keywords: *bio-fertilizer, concentrated microbial solution, half-burnt paddy husk*

Estimation of Precise and Accurate Soil Porosity with Respect to Spatial Variability of Particle Density in Different Textured Soil in Catena

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Insight on the spatial variability of soil physical properties at different locations on a catena is required to formulate appropriate management strategies on crop production. Therefore, the objective of this research is to assess the effect of the variability in particle density and its interrelationships on soil porosity of different textured soil in a catena of faculty farm of Sabaragamuwa University of Sri Lanka. The particle density of soil is commonly assumed to be 2.65 g cm^{-3}. Thus, with different soil textures it is vital to interpret precise and accurate total porosity of different textured soil. Else ways, it would mislead the interpretation of the true porosity and aeration conditions at different locations within the land catena. Randomly collected samples from two depths (0-15 cm and 15-30 cm) of well drained, moderately drained and poorly drained soils in a soil catena, beach sand, river sand, grinded boulder was used to examine for soil particle density, soil bulk density, soil texture (%) and soil porosity. Results showed that the particle density in well drained, moderately drained, and poorly drained is varied from 1.7 to 2.1 gcm^{-3}. However, the particle density of beach sand, river sand and grinded boulder (2.57 $\pm$ 0.33, 2.61 ± 0.01, 2.50 ± 0.01) were almost to assumed particle density ((P<0.05). Moreover, calculated values of the total porosity were significantly different along the soil catena (P<0.05). A strong negative correlation was observed among clay and silt and the soil particle density (r = -0.91 and -0.90). Sand content was positively correlated with the soil particle density (r = 0.94). Evidence from results that the particle density indicated a significance difference from assumed values related to well drain, poor drain, moderate drain soil samples. Thus, the calculated true values of the total porosity within the soil catena of faculty farm were significantly varied (42.97% ± 1.25) and true values of the total porosity will be extremely useful to formulate precise and accurate management strategies for sustainable crop production.

Keywords: *bulk density, correlation analysis, particle density, soil catena, total porosity*

Field Validation by a Rapid Method to Determine Lime Requirement for Potato and Vegetable Cultivating Soils in Welimada (ADA) Segment

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Liming is a common agronomic practice to mitigate the soil acidity of farmer fields. However, there is no proper estimation to calculate the required amount of liming to adjust the expected level of soil pH. Therefore, a field experiment was conducted in 45 farmer fields at Welimada Assistant Director Agriculture (ADA) segment during the end of the *Yala* season, 2022 to validate the newly introduced rapid method to determine the site-specific lime requirement under farmer field conditions. Soil characteristics of initial soil pH, electrical conductivity, available phosphorous, available potassium, lime requirement using a newly developed method; organic matter, Cation exchange capacity, and soil pH at 14 days after the lime application was tested. Site-specific amounts of lime through newly developed methods for the fields were applied. Correlation analysis was performed through MINITAB-14 software to investigate the relationship between soil pH with other characteristics. The results revealed that out of 45 sites, 39 sites (86.7%) achieved the target pH level (6.4 ± 0.2) after lime application. Simultaneously, the calculated residual mean square error (0.07) and standard deviation (0.18) for final pH also represented higher validity of the tested model. In addition, correlation analysis confirmed that lime requirement negatively correlated with initial and final pH levels. Furthermore, Cation exchange capacity positively correlated with organic matter and initial and final pH while electrical conductivity showed a negative correlation at p=0.05 level. Thus, this study concludes that the newly introduced method was highly effective to determine the lime requirement for farming fields to correct soil pH up to 6.4.

Keywords: *Cation exchange capacity, lime requirement, soil acidity, upcountry areas*

A Comparison of Sugarcane Bagasse Based Biochar and Boiler Ash on Soil Physicochemical Properties and Initial Growth of Sugarcane

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Sugarcane is one of the crops which remove a higher amount of nutrients from the soil. However, its by-products have a wide use as soil amendments. As a by-product, boiler ash can enhance soil's physical properties and thereby increase root development. While, soil chemical properties could be adversely affected on soil quality. In contrast, the application of biochar is a proven technique to improve soil properties and limited information is available on the direct application of sugarcane boiler ash as a soil amendment. Therefore, this study was conducted as a pot experiment under shade house conditions to compare the effect of biochar and boiler ash on soil physicochemical properties and the initial growth of the sugarcane variety of SL 96 128. Ten treatment combinations including 1 t/ ha, 2 t/ ha, 4 t/ ha and 6t/ ha of biochar and boiler ash with the recommended chemical fertilizers and zero amendments as control treatments were arranged as randomized complete block designs with 4 replicates. After 3 months, soil physicochemical properties and plant growth performances were evaluated separately. The results revealed that the amended biochar and boiler ash had been facilitated to increase the plant nutrient availability. The variety SL 96 128 under different treatments was only significant with the zero amended level and other biochar and boiler ash amended levels were similarly performed. The highest amount of boiler ash application that 6 t/ ha showed a low pH buffering capacity of the soil. Results concluded that the application of boiler ash up to 6 t/ ha has not badly affected the sugarcane plants in this study for up to 3 months. The application of boiler ash should be practised under well-monitored conditions and further studies are needed to identify the effect of boiler ash by conducting a field level experiment for the complete cropping cycle of sugarcane.

Keywords: *boiler ash, soil amendment, sugarcane by-products*

Evaluation of Alternative Organic and Inorganic Potting Mixtures on Early Growth of Black Pepper (*Piper nigrum* L.) Nursery Plants

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Black pepper (*Piper nigrum* L.) the world's most demanding and second most valuable spice in Sri Lanka. Qualitative and economical potting mixture is a prerequisite in production of quality black pepper plants. Both cow dung and coir dust in recommended potting mixture (cow dung: top soil: sand: coir dust: 1: 1: 1: 1) and in an alternative potting mixture (Top soil: sand: coir dust in 2: 1: 1 + 1 g of Di-ammonium Phosphate (/pot) are expensive and scarce. Therefore, this experiment was conducted to find out alternatives for both cow dung and coir dust. Coir dust of recommended potting mixture (Treatment 1) was replaced by partially burnt paddy husk in Treatment 3 whereas decomposed saw dust in Treatment 5. Coir dust of alternative potting mixture (Treatment 2) was replaced by partially burnt paddy husk in Treatment 4 and decomposed saw dust in Treatment 6. Two nodal black pepper cuttings were planted in pots and arranged as Randomized Complete Block Design inside a shade (60%) house for 11 weeks. Plant survival (%), shoot length (cm), intermodal length (cm), number of leaves and roots, Shoot and root dry weights (g), root volume (ml), root length (cm) were recorded. Potting mixture was analyzed for pH, EC, total Nitrogen (%), available P (ppm), exchangeable K (ppm), and organic C (%) at the end of the experiment. Survival percentage of all treatments was more than 97%. Neither growth parameters of plants nor chemical properties of potting mixtures showed significant differences ($P>0.05$) among treatments compared to alternative and recommended potting mixtures. It reveals that partially burnt paddy husk and decomposed saw dust are alternatives for coir dust in black pepper nursery mixture. Same time di-ammonium phosphate is also applicable with those alternatives. However, further experiment should be repeated and continued in order to confirm results.

Keywords: *alternative potting mixture, black pepper, diammonium phosphate*

Plant Breeding and Biotechnology (PB)

Early Detection of High-Yielding Rubber Genotypes (*Hevea brasiliensis*) Based on the Expression of Rubber Elongation Factor (*Ref*) Gene

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Sri Lanka is one of the leading natural rubber producers in the world. However, in 2021, Sri Lanka's rubber production declined from 78.2 million kilograms (2020) to 76.9 million kilograms (2021). Therefore, the development of high-yielding clones for rubber cultivation is essential to enhance the productivity of *Hevea*. As a solution for the lengthy breeding program, molecular approaches are essential for the early identification of high-yielding clones. Rubber Elongation Factor (*Ref*) protein is a major factor in the natural rubber biosynthesis in *Hevea brasiliensis,* and the genomic sequence of the *Ref* gene is 1367bp long. Previous studies have proven a positive relationship between *Ref* gene expression and latex yield performance. In this study, three genotypes from the Estate collaborative Trial, HP 95-55, HP 95-41, and HP 95-01, along with control clone RRISL 203 were used to study *Ref* gene expression and the latex yield performances. The Livak method ($2^{-\Delta\Delta CT}$) was used to analyse quantitative gene expression, and it proved that the three genotypes' *Ref* gene expression was significantly higher than the control clone RRISL 203. According to the latex yield of three months from September to November 2022, the mean yields for HP 95-55 HP 95-41, and HP 95-01, and the control clone RRISL 203 is reported as 9.12 g/ t/ t, 5.51 g/ t /t, 6.95 g/ t/ t and 3.93 g/ t/ t respectively. When comparing the results of the quantitative gene expression and the mean yields, it proved that the yield is increased according to the *Ref* gene expression. Therefore this study concludes that there is a potential for selecting high-yielding genotypes by using *Ref* gene expression at an early stage of the rubber breeding cycle.

Keywords: *natural rubber yield, quantitative PCR, rubber cultivation, rubber elongation factor (Ref) gene*

Encourage Synchronize Flower Bud Initiation of Soursop (*Annona muricata L.*) by Using Synthetic Plant Growth Regulators

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Low Soursop production in Sri Lanka is mainly due to asynchronized blooming, less fruit setting, and a prolonged time for fruit maturation. Therefore, encouraging synchronized flowering is essential to obtain high yield of soursop. The objective of this study is to encourage synchronized flower bud initiation of soursop by using synthetic plant growth regulators. Field trial was conducted at the Fruit Research and Development Institute, Horana, Sri Lanka. Synthetic plant growth regulators, namely; gibberellic acid, salicylic acid, paclobutrazol, and ethereal were used as treatments under three concentrations [T1 (Salicylic acid 200 ppm), T2 (Salicylic acid 300 ppm), T3 (Salicylic acid 400 ppm), T4 (Ethereal 100 ppm), T5 (Ethereal 150 ppm), T6 (Ethereal 200 ppm), T7 (Gibberellic acid 100 ppm), T8 (Gibberellic acid 150 ppm), T9 (Gibberellic acid 200 ppm), T10 (Paclobutrazol 1000 ppm) T11 (Paclobutrazol 2000 ppm), T12 (Paclobutrazol 3000 ppm) T13 (Ethanol 50% solvent, control 1) and T14 (No treatment, control 2). The experiment was laid out in Randomized Complete Block Design (RCBD) with three replicates. The number of flowers that bloomed after treatment applications were counted at weekly interval. Pollen viability and stigma size were checked 15 weeks after treatment application. Data were analyzed through Kruskal–Wallis test and ANOVA. Results revealed that foliar application of 400 ppm salicylic acid had given more flowers (51) than other treatments T1 (37), T11 (34), T1 (30), T4 (24), T10 (23), T7 (20), T12 (17) T13 (15), T6 (11), T9 (10) T5 (7), T14 (2). Moreover, pollen viability and stigma size were not significantly different between treatments. Thus, the study concludes that salicylic acid 400 ppm concentration is a viable option for synchronised flowering of Soursop.

Keywords: *foliar applications, plant growth regulators, soursop, synchronize flowering*

Development of Efficient *In Vitro* Regeneration Protocol for Transgenic Papaya (*Carica papaya* L.)

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Papaya (*Carica papaya* L.*)* is a fast-growing semi-woody tropical herb that belongs to the family Caricaceae. *Papaya ring spot virus* is a serious disease that affects papaya production in most countries in the world including Sri Lanka. The development of transgenic papaya through *Agrobacterium*-mediated transformation of somatic embryos is a successful method to control the damage of *papaya ring spot virus* disease. Optimization of *in vitro* regeneration protocol is essential for the effective regeneration of transgenic papayas. The present investigation aimed to develop an efficient *in vitro* protocol for the regeneration of transgenic papaya (*Carica papaya* L.) using somatic embryogenesis. Three-week-old embryogenic callus was used for *Agrobacterium-mediated* callus transformation and co-cultivation. The transformed callus was selected with Kanamycin 50 mg/ L in a co-cultivation medium. Then the co-cultivated callus was inoculated on new Murashige and Skoog medium with different concentrations of polyethylene glycol (60 mg/ L, 50 mg/ L, and 40 mg /L), Kanamycin 50 mg/ L, Cefotaxime 500 mg/ L. Another experiment was done using embryogenic calluses with matured somatic embryos. After *Agrobacterium-mediated* callus transformation and co-cultivation, the callus was inoculated into MS medium with different concentrations of polyethylene glycol (60 mg/ L, 50 mg/ L, and 40 mg/ L), Kinetin 2 mg/ L and antibiotics. The number of highest transformed calli was obtained from embryogenic calli which have matured somatic embryos. The highest callus area was recorded in MS medium which contained PEG 60 mg/ L with an average of 28.55%. The highest numbers of regenerated calli were recorded in MS medium which contained PEG 60 mg/ L. In conclusion, a protocol for *in-vitro* regeneration of putative transgenic papaya was developed. Polyethylene glycol 60 mg/ L is the most suitable concentration for somatic embryogenesis. Embryogenic callus which has matured somatic embryos are more suitable for *Agrobacterium*-mediated co-cultivation.

Keywords: *Agrobacterium-mediated, polyethylene glycol, regeneration, transgenic papaya*

Early Characterization of Selected *Hevea* Genotypes Using Morphological and Physiological Parameters to Accelerate the Clone Recommendation

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Rubber, *Hevea brasiliensis* is a perennial crop grown for latex. The long breeding cycle of rubber (25-30) years is the major limiting factor for genetic improvement. The objective of this study was to analyze morphological and physiological parameters to perceive the precise selection of genetically superior genotypes at an early stage of the *Hevea* breeding cycle. Genotypes, 2011HP 42, 2011HP 202, 2011HP 297 and 2011HP 300 were obtained from a 2011 hand pollination programme and planted at Eladuwa Estate, Kalutara as an Estate Collaborative Trial. The recommended clone RRISL 2006 was taken as a reference clone. Girth, bark thickness, first branching height, photosynthesis rate, chlorophyll content, stomatal conductance and leaf area were measured in 12 randomly selected plants from each genotype. The principal component analysis and cluster analysis were performed to identify the diversity and promising parameters, respectively. The clusters showed over 70% of similarities. Accordingly, 30% of the variation among the genotypes indicated substantial diversity among the selected genotypes. Three potential parameters (girth, bark thickness, stomatal conductance) were identified as early selection criteria. Two genotypes, 2011HP42 and RRISL 2006 were significantly different from the rest of the other genotypes. The precise selection at an early stage is supported and confirmed by adding more yield parameters to the evaluation process.

Keywords: *breeding, early selection, genotypes, Hevea*

Impact of Above Ground Morphology of Cinnamon Plant on Yield and Processing: Traits Desirable for Variety Improvement

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Cinnamomum zeylanicum Blume, commonly known as Ceylon cinnamon or true cinnamon is the most important traditional spice crop in Sri Lanka which has a vital demand especially in the international market. Thus, identification of high yielding cinnamon cultivars is a crucial requirement in the present scenario to fulfil the annual demand. However, there is limited information available to select high yielding cinnamon accessions based on morphological characteristics. Considering this aspect, the study was conducted to investigate the impact of above ground morphology of cinnamon plant on bark yield and processing. Forty-five cinnamon accessions were selected for this study and leaf surface area, canopy spread, branching habit, shoot angle, stem straightness, internodal length, number of nodes in the stem were considered as morphological characteristics. Simultaneously, dry bark weight, peel ability, and peeling time were considered as yield parameters. Data were collected on a weekly basis throughout the experiment period. Data were analyzed through multivariate analysis using ANOVA, whereas Pearson correlation analysis was performed to identify correlations between morphological characteristics with yield followed by cluster analysis. According to the results, morphological characters; internodal length, stem straightness, canopy diameter and number of nodes in stem were given significant impact on final bark yield at $p<0.05$ probability level. The morphological characteristics, stem straightness, shoot angle, number of nodes in stems were given significant impact on peeling time and stem straightness showed significant impact on peelability. Three clusters were identified and cluster number three (representing accessions CH 11-1, CH12-1, CH 6-1, CH 26-1, CH 24-1) showed superior morphological characteristics by revealing high potential to utilize for future cinnamon improvement programs.

Keywords: *bark yield, cinnamon accessions, Cinnamomum zeylanicum, morphological characteristics*

Study on the Effect of Gamma Irradiation on Turmeric (*Curcuma longa* L.) Callus Cultures as an Approach for Inducing Mutagenesis

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Turmeric (*Curcuma longa* L.) is a perennial rhizomatous herb, which propagates vegetatively. Therefore, limited genetic variation observed among the local germplasm hence inducing genetic variations is essential for crop improvement. Mutagenesis is used for achieving genetic variations in order to overcome such limitations. Gamma irradiation has been widely tested in mutagenesis. This study focused on identifying the effect of gamma irradiation-induced mutagenesis on turmeric callus cultures. Shoots with developed callus which were cultured in hormone-free MS medium exposed to gamma radiation from Co-60 (dose rate 5.1 kGy/ h) at 0, 40, 50, 60, 70 and 80 Gy and samples were maintained under *in vitro* conditions and net house conditions. The molecular variation caused by gamma irradiation was analyzed by two SSR (Simple Sequence Repeats) markers. DNA was extracted by following a modified CTAB extraction procedure. Under the lab experiment, all the plants were shown a 100% survival percentage where the number of shoots and the number of leaves were shown no significant difference ($P>0.05$). Under the net house experiment turmeric callus exposed to the gamma radiation dose 60 Gy & 70 Gy showed a significant difference compared to the control. All treatments showed significant difference in leaf area compared to the control at ($P<0.05$) and the number of shoots, MDA content showed no significant difference at ($P>0.05$).Chimeras in the leaf were observed at 50 Gy whereas lobular development was at 70 Gy. According to this study, slight morphological changes were observed at and above 50 Gy hence; 50 Gy is the minimum effective dosage of gamma radiation that needs to initiate an effect from irradiation. Further research with a bulk population is needed to be carried out on the effective and lethal dosage of mutagenesis.

Keywords*: crop improvement, gamma irradiation, lipid peroxidation, mutation, SSR markers*

Screening the Molecular Diversity of Selected Interim Clones of Rubber (*Hevea brasiliensis*) Using SSR Molecular Markers

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Rubber, *Hevea brasiliensis* gene pool of Sri Lanka has been based on two foundations as Wickham and non-Wickham genetic base. Most parental lines utilized in the on-going breeding programs belong to Wickham genetic base. The genetic diversity of rubber in Sri Lanka is considerably narrow and has reached its threshold level for economically important characteristics. The expansion of the genetic diversity of the local breeding pool is important. Therefore, the present study was conducted to study the genetic diversity of selected interim clones using Simple Sequence Repeats (SSR) molecular markers. Selected six interim clones MT 11-76 I, MT 11-76 II (Non-Wickham genetic base) HP 91-57, HP 91-58, HP 95-55, and HP 2002-201 (Wickham genetic base) were subjected to this study. DNA extraction was done by the SDS extraction method. DNA samples which appeared as a single intact band in agarose gel quantification were selected for Polymerase Chain Reaction (PCR) amplification. DNA samples then screened with eleven SSR primers (HB1, HB2, HB4, HB6, HB8, HB11, HB27, HB28, HB29, hmac4 and hmct1). Among those, HB6, HB28, HB29, hmac4, and hmct1 SSR primers produced clear and detectable bands while HB4 and HB8 primers failed to produce detectable bands. However, all the DNA bands were monomorphic, indicating a higher degree of similarity among the interim clones. This molecular analysis revealed that both Wickham and non-Wickham genetic bases in the Sri Lankan breeding pool showed narrow genetic diversity. However, further molecular screening with different primers is needed to reveal the genetic diversity of recommended interim clones.

Keywords: *genetic relationship, germplasm, interim clone, polymorphism, SSR markers*

Analysis of the Gene Expression Profiles of Oxidative Stress Tolerant Genes in Newly Developed Rubber (*Hevea brasiliensis*) Genotypes

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Sri Lanka is renowned for producing quality latex products to the global rubber market. Rubber (*Hevea brasiliensis)* is considered as one of the major export agricultural crops in Sri Lanka. A physiological disorder termed Tapping Panel Dryness (TPD) is considered as a crucial constraint to the industry which severely reduces yield by 15% - 20% annually. Over production and over accumulation of Reactive Oxygen Species (ROS) in cells under oxidative stress contribute to the occurrence of TPD. Accumulated ROS are detoxified by the antioxidants present in cells. Current research was performed to study the expression of CAT and GPX genes responsible for producing two such antioxidants, catalase and glutathione peroxidase respectively. Four genotypes of 2011 HP selections were selected for the experiment which were established in 2018 at Eladuwa estate, Kalutara as an Estate Collaborative Trial. RRISL 2006 recommended clone was selected as the control. RNA extraction and cDNA synthesis were done in order to perform the quantitative PCR. The $2^{-\Delta\Delta C_T}$ method was used to analyze the quantitative gene expression. According to the quantitative PCR data, both CAT and GPX genes were upregulated in all the selected genotypes (2011 HP 42, 2011 HP 202, 2011 HP 297 and 2011 HP 300) with reference to the control clones under low soil moisture conditions. The two genes were up-regulated in several *Hevea* clones which are less susceptible for TPD. As the gene expression studies facilitate the early selection of promising clones expediting the conventional breeding, the obtained gene expression profiles provide a unique opportunity for early screening of genotypes that are capable of self-recovering and less susceptible to TPD incidence. Altogether, the study provides insights on features of CAT and GPX genes in rubber, which might be utilized for additional functional analysis to extrapolate their precise involvement in abiotic stress responses.

Keywords: *antioxidants, quantitative PCR, reactive oxygen species, tapping panel dryness*

Livestock Production, Aquaculture and Food Safety (LAF)

Biofilm Formation by *E.coli, Proteus* and *Salmonella* isolated from Pork, Beef and Broiler Chicken and their Significance as Mono and Dual Species

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Biofilm formation by many foodborne pathogens remained a serious concern for public health and food safety. Compared to mono-species biofilms, multi-species biofilms are more common in natural settings and in places where food is produced. This study was conducted to assess the biofilm formation by *E. coli, Proteus, and Salmonella* as mono and dual-species. The biofilm forming ability of the *E. coli, Proteus, and Salmonella* isolates which were isolated from three meat types *viz* pork, beef and broiler chicken were quantified at five different time durations of incubations (24 hrs, 48 hrs, 72 hrs, 96 hrs, and 120 hrs) by using microtiter plate assay. This study revealed that *E. coli* monocultures isolated from pork showed significantly lowest biofilm-forming ability at all tested time points and it has a gradual increment with the extended time points. Among all the tested time points, *Salmonella* isolated from pork in its monoculture status showed the highest biofilm formation at 48 hrs. *Proteus* and *Salmonella* isolated from beef have not shown any significant difference in their biofilm-forming abilities as monocultures in all the tested time points except 48 hrs. In relevant to isolates derived from broiler chicken meat, *Proteus* has enhanced its biofilm formation ability as monoculture from 24 hrs to 96 hrs. In all tested time points, *Proteus* interaction with *Salmonella* was significantly lesser than the *Proteus* biofilm formation ability in its monoculture status. This study concluded that there is a diversification in the biofilm formation abilities of different bacterial isolates and their combinations when they formed mono biofilms and dual biofilms at different time points.

Keywords: *dual biofilms, E. coli, Proteus, Salmonella*

Effect of Essential Oils on Biofilms Formed by *Salmonella Spp*. Isolated from Broiler Chicken Meat

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Bacterial biofilm poses a greater health risk in clinical environments as well as in food industries due to the persistence of biofilms on surfaces and their recurrent contamination. Microbes in biofilms are more resistant to biocides including cleaning agents and antibiotics. This has led to a search for natural effective alternatives for the control of biofilms. In this aspect, essential oils (EOs) are considered promising natural compounds for the food industry due to their preservative and antimicrobial nature. This study investigated the effect of three EOs *viz,* Cinnamon leaf oil, Cinnamon bark oil and Clove oil on biofilms formed by *Salmonella* spp isolated from broiler chicken meat. Sixteen *Salmonella* isolates have grown on 96 wells of microliter plates and the effectiveness of EOs was carried out using the biofilm quantification method of crystal violet staining. This study revealed that all the tested EOs have anti-biofilm activity when compared to the non-treated *Salmonella* biofilms. All three tested EOs showed similar effectiveness against biofilms formed by 11 *Salmonella* isolates (11/ 16). Biofilms formed by four isolates (4/ 16) showed higher inhibition with cinnamon bark oil and clove oil compared to cinnamon leaf oil. Biofilm formed by one isolate did not show an inhibitory effect with cinnamon bark oil when compared to the untreated control, but it was significantly reduced by the other two EOs. Further, the study showed that biofilms formed by different *Salmonella* isolates have different anti-biofilm capacities. This study concluded that Cinnamon leaf oil, Cinnamon bark oil and Clove oil have anti-biofilm activity against *Salmonella* isolates tested. The findings of this study will provide valuable information for improving EOs for controlling and preventing biofilms in food industries as well as in the medical and veterinary fields.

Keywords: *biofilm, effectiveness, essential oils (EOs), Salmonella*

Influence of Breeder Age and Egg Weight on Hatchability and Chick Quality of Cobb 500 Broiler Breeders

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For hatcheries as well as broiler producers, the quality of day-old chick is very important. This study was conducted to compare chick quality indicators such as Tona score, chick weight, and incubation parameters among two different breeder ages and three egg weight categories. Hatching eggs from two flocks of Cobb 500 broiler breeder (36 and 49 week of age) at three egg weight categories; A (58-63 g), B (64-69 g), and C (70-75 g) were obtained. A total of 600 hatching eggs were selected from all two breeder age groups for the six treatments. Incubation and chick quality parameters were measured and egg breakout analysis was done. Data were processed with the online statistical software package, SAS Demand for Academic, version 9. The result of the study showed that the main effect of breeder age and egg weight on chick quality parameters was not significant ($p>0.05$). Also, the interaction effect of the flock age and egg weight was not significant ($p>0.05$). Chick weight was influenced by egg weight and higher chick weights were resulted from birds of 49 week age. Thirty six week old breeders showed a higher hatchability and hatch of fertile compared to 49 week age group. The highest hatchability and hatch of fertile was resulted in 36 week old 58-63 g weight group. Moisture loss was increased with the egg size and flock age. Embryonic mortality and infertile egg number were higher in 49 week old age group. In conclusion, age group difference of broiler breeders and weight group difference of eggs are fair predictors of incubation and chick quality parameters while 36 week old aged flock and 58-63 g weight group showed the best hatchability among all groups.

Keywords: *broiler breeder, chick quality parameters, cobb 500, hatchability, incubation parameters*

Effect of Egg Storage Period on Maternal Antibody Level against Newcastle Disease in Cobb 500 Broiler Chicks

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Newcastle disease is one of the most common poultry diseases in Sri Lanka and has been successfully controlled. The purpose of this study was to ensure the success of the vaccination program and to identify the effect of the pre-incubation egg storage period on maternal immunity levels in Cobb 500 broilers for Newcastle disease (ND). Hatching eggs were collected and randomly assigned for each treatment (n=40 eggs) and eggs were stored for the period of 1 day, 5 day, 10 day, and 15 day at 18°C and 70% RH before incubation. The maternal antibody levels of day old chicks (DOCs) were determined by an ELISA test using 30 blood samples obtained separately from layers and DOCs of each treatment. The experimental design was a complete randomized design. The results revealed that the maternal antibody (anti-ND) levels at 1 day, 5 day, 10 day, and 15 day treatments were 53%, 65%, 96%, and 54% respectively. This indicates that the pre-incubation period had a significant difference ($P<0.0001$) in the chick maternal antibody levels against Newcastle disease. According to this study for Cobb 500 broilers, a 10-day storage period in a cool room at 18°C and RH 70% resulted in a higher level of transferred maternal antibody (anti-ND).

Keywords: *cobb 500, maternal antibody, newcastle disease, pre-incubation storage period*

Effect of Environmental Enrichments on Lameness and other Welfare Indicators of Broiler Chickens

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In Sri Lanka the present broiler chicken industry is moving towards more intensive with closed house systems. This study was conducted to assess the effect of environmental enrichments [elevated platform, hanging compact discs (CDs), straw bales and paddy husk area for dust bathing] on behaviour, lameness, welfare [footpad dermatitis (FPD), hock burns, plumage cleanliness and litter quality] and body weight of broiler chickens. Day-old 240 Indian River commercial broiler chicks were randomly allocated into four pens (n=60) including four replicates per treatment (with enrichments) and control (without enrichments) groups. Data were collected up to 35 days of age. Behaviour was recorded using the scan sampling method by live observations. Other welfare parameters were assessed using scoring systems. A generalised linear model, Mann-Whitney U test and ANOVA were used to analyse the treatment effects (SAS 9.0/IBM SPSS Statistics 25). Prevalence of FPD was lower ($P<0.05$) in the treatment group in all four weeks. The severity of hock burns was also lower in the treatment group except in the first week ($P<0.05$). Gait score results revealed better walking ability in the treatment group birds. Plumage cleanliness and litter quality were ($P<0.05$) better (except in the first week) in the treatment group. The latency to lie test revealed that birds in the treatment group had long-standing ability in the water ($P<0.05$). Overall, 11 birds with leg deformities were found only in the control group. There was no effect of environmental enrichment on the injuries of the birds. Body weight was significantly higher ($P<0.05$) in the treatment group in all four weeks. The frequency of preening and dust bathing behaviours was higher ($P<0.05$) in the treatment group while the frequency of resting was higher ($P<0.05$) in the control in both day and night in all four weeks. In conclusion, provided environmental enrichments reduced lameness while enhancing broiler chickens' overall welfare and body weight under closed-house conditions.

Keywords: *behaviour, broiler chickens, environmental enrichments, lameness, welfare*

Determination of the Most Suitable Spawning Substrate for Neon Tetra (*Paracheirodon innesi*, Myers 1936) in Captive Conditions

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Neon tetra (*Paracheirodon innesi*) is one of the most popular freshwater ornamental fish species, which is highly demanded in the ornamental fish trade. However, these fish can be very difficult to spawn if environmental conditions are not ideal. The production of Neon tetra in Sri Lanka is inadequate to fulfill the demand in the export market. Development of captive breeding and larval rearing techniques are found as an effective strategy to increase commercially available stocks, which will also lead to ensure the sustainable utilization as a valuable resource. Hence, the objective of this study was to determine the most suitable substrate for successful breeding of Neon tetra in captivity. Four types of substrate materials; pebbles, synthetic net, aquatic plant (*Cabomba* spp) and coconut fiber were provided with still water in 15 inches × 8 inches × 6 inches size indoor glass tanks and four replicates for each treatment were used. Selected individuals were introduced into each tank at 1:1 male to female ratio. Completely Randomized Design was used as the experimental design and produced fry number was counted. Data were analyzed using Microsoft excel. Better fry number was observed in the substrate of aquatic plant net (233 ± 6) when compared to the other three (synthetic net 220 ± 18, pebbles 144 ± 10, coconut fiber 108 ± 18). Similar results were observed in the hatchability and the survival rate. Results of this study revealed that the most suitable breeding substrate for the Neon tetra in indoor glass tanks was the substrate of aquatic plants.

Keywords: *captive breeding, Neon tetra (Paracheirodon innesi), spawning substrate, hatchability, survival rate*

The Influence of Stocking Density on Growth Performances of Neon Tetra (*Paracheirodon innesi*, Myers, 1936) Under the Aquarium Conditions

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Neon tetra (*Paracheirodon innesi*) is one of the most valuable fish species in the ornamental fish trade and they have a high demand in local and foreign markets. Also, Neon tetra is an expensive community fish whose stocking densities are not yet optimized for commercial rearing under controlled conditions. Therefore, this study was carried out to determine the best stocking density for Neon tetra under controlled conditions. Four different stocking densities, namely 2 fry/ L, 3 fry/ L, 4 fry/ L and 5 fry/ L were tested for a period of six weeks for growth parameters. Depending on the stocking densities, fish were stocked into glass tanks (2 feet × 1 feet × 1 feet). Four tanks were used as replicates. Each experimental tank was filled with the equal amount of water (45 Liter) and height of the water level was 10 inches. Proper aeration was given to each tank and one leaf of *Terminalia catappa* is placed in each tank for minimizing the ammonia level in the water. A total of 2520 of *P. innesi* fry (Total Body Length = 1 ± 0.00046 cm) were collected, weighed, measured their total length and stocked in glass tanks. Fish fry were fed with formulated powdered feed at a rate of 10% of the body weight. Further, the feeding amount was increased weekly at a rate of 25%. Every day in the morning and evening after the feeding the glass tanks were cleaned and 25% of water was replaced with fresh water. Uniform management practices were done to all treatments and replicates throughout the experimental period. Also, body weight, total body length and water quality parameters (pH, dissolved oxygen level, temperature and ammonia level) were measured throughout the experimental period. No mortality was recorded during the whole experimental period within treatments and replicates. At the end of the experiment, 2 fry/ L and 3 fry/ L showed a significantly higher value in body weight, total body length, weight gain, length gain, specific growth rate and condition factor (K-factor). Best growth performances resulted in 2 fry/ L and 3 fry/ L stocking densities in Neon tetra under the culture conditions given in the study. However, according to this study, for aquaculture purposes, 3 fry/ L is the best stocking density for Neon tetra fry.

Keywords: *controlled conditions, growth performances, Neon tetra, Paracheirodon innesi, stocking density*

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Efficiency in Use of Packing Materials and Employees' Perceptions of Failures in Grain Flour Production Line: A Case Study

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The Companies with grain mills have critical problems related to the efficiency of production process due to the failures and defects. This research aims to study the employees' perceptions on factors affecting failures by identifying them in the section. PDCA (plan-do-check-act) cycle is being used in the industry to overcome these failures successfully. The data which were collected by a questionnaire has been utilized in this study. The data were collected through 50 workers who were working in the grinding mill production line in Harischandra Mills PLC, Matara. Data were analyzed using descriptive analysis, multiple regression, failure mode and effect analysis (FMEA) and Pareto analysis. Resources and education background of the employees have negative relationship with complaints on production. Working stress and lack of experience showed positive relationships (Y= 4.775 – 1.131 X1 + 0.857X2+ 0.658X3 – 1.453X4 where Y= complaints on production failures, X1= resources, X2= working stress, X3= lack of experience and X4= education background). Packing material (polythene packing materials) wastage was a serious burden in the production line. High percentages of packing material wastage were reported in Kurakkan flour (28.52%) and Ulundu flour (28.42%) production. According to the results of FMEA, incorrect labeling, poor sealing and incorrect gas filling inside the package were shown high Risk Priority Number (RPN). Critical value of RPN was 107 and failures which greater than critical RPN value showed a high risk. Incorrect labeling had the highest RPN value as 160. Other failures had RPN values as follows. Poor sealing 150, incorrect gas filling inside the packets 120. Packing material wastage percentages in Kurakkan flour and Ulundu flour were decreased by 13.38% and 10.91% respectively, after implementing PDCA cycle procedures. These methods are suitable to apply in any production mills to minimize the wastage and the failures.

Keywords: *failures, grain flour, packing material, plan-do-check-act cycle, risk priority number*

Impact of Sudden Banning of Chemical Fertilizers and Other Agrochemicals on Smallholders' Tea Production in Ratnapura District

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The government banned chemical fertilizers and other agrochemicals at once in April 2021, in order to save Sri Lanka's agricultural sector, especially farmers and consumers from various health problems and environmental issues. Therefore, it is high time to assess the impact of banning chemical fertilizers and other agrochemicals on smallholders' tea production in the country, smallholders' awareness about agrochemicals and their attitude on moving towards organic farming, as they are essential for many aspects of the economy. Ratnapura district was selected as the research area, in which tea cultivation has been conducted in many Divisional Secretariat (DS) divisions. 120 tea smallholders were randomly chosen as the sample from three DS divisions (Balangoda, Opanayaka, Imbulpe) representing the whole district that supplies green leaves to the ABC tea factory in Balangoda. Data were collected using a field survey from September to November 2022. Descriptive statistics and paired t-tests were used to analyze the data. T-test was used to analyze the cost of production of tea and tea production before and after the fertilizer policy. According to the results, most of the tea smallholders have a significant level of education. Also, the majority have tea lands in between ½-1 Acre. The majority of them have a good understanding of the positive and negative aspects of agrochemicals. Results indicate that there is a significant increase in the cost spent for chemical fertilizers and agrochemicals and the cost of production and there is a significant decrease in tea production after the fertilizer policy. However, when farmers' attitudes are taken into account, they wish to move away from inorganic farming gradually, if they have suitable alternatives. However, at the moment, they are facing various problems due to the unavailability of effective alternatives for agrochemicals. Therefore, finding better alternatives for chemical fertilizers and other agrochemicals is a felt need.

Keywords: *agrochemicals, chemical fertilizers, environmental pollution, organic farming, tea smallholders*

Pre-Tree Shaping Embedded Novel Agri-Tourism Venture: Evaluation of the Potential through a Case in Ingiriya Area

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In this study, the opportunities for Agri-Tourism and also tree shaping model were studied taking a case in Ingiriya area of Sri Lanka. This study was carried out considering the behavior of tourists and the importance of providing them with new experiences. The objectives of this study were to establish tree shaping models to create a new agribusiness venture, to investigate the applicability of tree shaping to create a new agribusiness venture, to explore the ways that value addition could be done to the traditional agri tourism concept through tree shaping and to find out the main attributes, and important issues and challenges of the Agri tourism sector in Ingiriya. In the selected site, tree shaping models such as "live fence", outdoor living room with Kumbuk, Mayila and Kohmba tree were established. Population of this study was about 500 tourists who visited this area per week and stayed in this area for more than a day. Sample of the study was 100 tourists and selection was done by the simple random sampling technique. The researcher collected data from structured questionnaire and analyzed the data to attain research objectives. Data analysis techniques used were descriptive statistics, frequencies statistics and principal component analysis. According to the principal component analysis, most of the tourists chose tree shaping cabana due to the Tree Therapy, mental relaxation, and the nature of the trip. Most of the tourists make choice of accommodation in Ingriya area due to the price of the accommodation place. The feasible attributes of Ingiriya area were, easy reach to the main city Colombo and easily accessible for guides. According to the principal component analysis, strong issues of Ingiriya area were limited transportation facilities, minimum biodiversity and limitation of access to ICT facilities. The researcher recommends for novel Agri-Tourism ventures to improve relax environment in tree shaping cabana and differentiate cabana for nature of the trip of tourist. According to the survey results, value addition to agri-tourism is a new opportunity in the sector to create a novel venture.

Keywords: *agri-tourism, cabana, tree shaping, venture*

An Assessment of Factors Influencing Tea Factory Productivity: A Case Study at Kahawatte Plantations PLC

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Tea is the most prominent plantation crop in the Sri Lankan agricultural sector contributing heavily to the development of the Sri Lanka economy by generating foreign exchange. Productivity is considered one of the main indicators that measure the efficiency of an individual, institution, or state in general. In recent years, falling international tea prices and the rising cost of tea production have made the market highly competitive. Kahawatte Plantation PLC is a leading agribusiness company in the plantation industry in Sri Lanka. Pelmadulla estate belongs to the low country region of the Kahawatte Plantation PLC. Crops such as tea, rubber, and cinnamon are cultivated in the Pelmadulla estate, and the case study was conducted in the Neelagama tea factory of Kahawatte Plantation PLC. The purpose of the study was to determine the tea factory productivity level, trends, and the factors influencing productivity. The study used a questionnaire as the primary data collection instrument. Secondary data related to the factory was collected for three years period from 2020 to 2022. Mainly factors related to the factory productivity such as labour, electricity usage, firewood usage, green leaves, and refused tea were collected. SPSS was used to perform the statistical analysis. The results revealed that factory productivity measured in terms of the out-turn of made tea to-green leaf was determined by rainfall, labour, and the ratio of factory running capacity to full capacity. Analysis of production data revealed that made tea per man day varied significantly from a maximum of 51 kg to a minimum of 8 kg. This variation can be attributed to the quality of green leaves delivered to the factory. Refused tea percentage too varied significantly from 4% to 43%. This also can be attributed to the quality of green leaves. The climatic factors especially, the precipitation affected the factory productivity by impacting the green leaves quality. The factory running capacity was 32% which is far below the potential capacity. The case study results revealed that the low factory productivity was due to the inferior quality of the green leaves, shortcomings in the production process, defects in the machinery and a shortage of skilled labour. This in turn contributed to high electricity and firewood consumption. Based on findings of the case study, an operational manual was developed to enhance the factory productivity.

Keywords: *electricity, factory productivity, firewood, kahawatte plantation plc, labour, tea*

Impacts of Changing the Policy on Fertilizers and other Agro -Chemicals during 2019 - 2022 for the Paddy Cultivation in Imbulpe DS Division in Sri Lanka

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In many Asian countries, paddy cultivation plays an important role in social and economic development. In Sri Lanka, paddy is cultivated in almost all districts of the country as a wetland crop. Rice is the staple food of the people of Sri Lanka. Supplying the nation's rice requirement is the first and leading role of domestic paddy cultivation. However, compared to the year 2019, Sri Lanka's paddy production has fallen by 13.9% in 2021-22 (April-March) and the average yield per hectare by 14.4%. Thus, imports have soared to a five-year high. This could be due to the banning of chemical fertilizer and agrochemicals imports on May 6, 2021. This study was conducted to assess the impact of the sudden banning of chemical fertilizers and other agrochemicals on the paddy cultivation in Imbulpe DS Division in Rathnapura District. A sample of 120 paddy farmers was randomly selected from three Grama Niladhari divisions namely Muththettuwegama, Seelagama and Kubalgama. Data collection was done using a household survey from October to November 2022. Descriptive statistics and paired t-tests were used to analyze the data. According to the results, male farmers were more prominent in paddy cultivation than females. Farmers belonging to the 56-65 years age group have highly participated in paddy cultivation. The majority of farmers had senior secondary education. The size of most of the paddy lands was between 0.5-1 acre. The average paddy production before the banning of chemical fertilizer was 1106.875 Kg per acre. However, at present average paddy production is 434.79 Kg per acre. The majority of the farmers (73.3%) had an average seasonal income of LKR 101332.50 per acre before the ban. Although, at present average seasonal income is LKR 75,120.33, the average seasonal cost of production before the banning of chemical fertilizer was LKR 25,550.00 per acre. However, at present, the average seasonal cost of production is LKR 55,891.66 per acre. According to the review of overall findings in the current situation, the farmers' income has decreased significantly compared to the previous situation. As a result, food safety issues have arisen among the farmers in this DS division. Therefore, the situation needs to be remedied by a systematic use of chemical fertilizers and agrochemicals or some suitable alternative instead. These findings will help the government and other responsible parties to implement measures to overcome this problem.

Keywords: *agrochemicals, chemical fertilizers, paddy cultivation, Rathnapura district*

Food Processing and Post- Harvest Technology II (FPT-II)

Development and Quality Evaluation of a Wood Apple *(Limonia acidissima* L.) Powder-based instant Beverage Mix

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The study was conducted to develop a wood apple powder-based instant beverage mix with the best organoleptic qualities. 'ANK wood apple 01', 'ANK wood apple 02' varieties and Accession No-17 were evaluated with and without seeds to select the best physical, nutritional and health properties for dry powder preparation. Using an electric dryer, fully ripe wood apple pulp was dried for around 12 hours at 60°C before being ground into powder in a blender. The final product was made by blending the powder with sugar and table salt and it was packaged in selected packaging materials namely, Kraft paper pouch, Silver laminated sealed pouch, and transparent polythene pouch and kept in ambient temperature to evaluate its shelf life. Yield of the dry powder using fresh fruits was 15%. From both categories, Accession No-17 was chosen as the best for dry powder preparation. In comparison to wood apple dry powder without seeds, higher nutritional, physical and health parameters such as moisture %, crude fat %, crude protein %, ash %, pH, Brix (1:2), Acidity %, Solubility %, water activity , lightness and total phenolic content were at 15.89 ± 0.31, 5.44 ± 0.24, 12.09 ± 0.45, 5.97 ± 0.43, 3.05 ± 0.01, 7.66 ± 0.58, 12.74 ± 0.39, 44.56 ± 0.93 ,0.49 ± 0.01 , 25.69 ± 0.74 and 386.59 ± 0.01 mg of GAE/ 100 g, respectively in wood apple dry powder with seeds. Two hedonic tests selected the treatment (T5) which was made by blending 15 g of powder with 10 g of sugar and 1 g of table salt from both categories as the best recipe to develop wood apple powder-based instant beverage mix by evaluating color, texture, taste, aroma and overall acceptability. T5 with seeds was confirmed by the paired preference test as the best formulation to develop the final product. Nutritional properties of final product such as (dry weight basis) moisture, protein, total fat and ash were 10.24%, 5.17%, 3.25% and 7.32% respectively. The water activity, pH and brix of the final product with three packing materials varied between 0.51- 0.54, 2.64 - 2.76 and 7- 11 (1:2 dilution), respectively. The results express a lot of promise of commercializing wood apple powder-based instant beverage mix.

Keywords: *formulation, hedonic tests, shelf-life, wood apple powder-based beverage*

Effect of Marination Method and Holding Time on Physicochemical and Sensory Characteristics of Breast Meat from Spent Laying Hens

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The study described herein investigated the effect of the marination method and holding time on the physicochemical and sensory attributes of spent hen breast meat. A total of 60, 90-weeks old Shaver Brown spent hen breast meat samples (average weight ± SD, 20 ± 5 g each) were used. The experimental design was 4 x 3 factorial with four marination methods (unmarinated control, tumbling, injection and immersion) and three holding times at 4°C (4 hrs, 8 hrs and 12 hrs) combinations. Meat samples marinated using a commercial marinade mixture were analysed for marinade uptake, pH, cooking yield, cooking loss, hardness, and external and internal colourimetric parameters (Lightness: L*, Redness: a* and Yellowness: b*). A sensory evaluation was carried out using 30 untrained panellists. Injection marination ($P<0.05$) resulted in the highest marinade uptake. Meat held for 8 hrs after tumble marination resulted in the optimal and the highest pH. A method x holding time interaction ($P>0.05$) was not observed for cooking yield. Marinated meat when held for 4 hrs resulted in the highest ($P<0.05$) cooking loss. Increasing holding time from 4 hrs to 8 hrs yielded a similar cooking loss in tumble-marinated meat. Holding tumble marinated meat for 12 hrs and immersion marinated meat for 4 hrs resulted in soft textured meat ($P<0.05$). Method x holding time interactions ($P>0.05$) were not observed for external and internal L* values of uncooked meat. Holding meat for 12 hrs after immersion marination reported the highest scores for aroma, colour and overall acceptability. By considering all positive two-way interactions of the physicochemical parameters tested, the present study concluded that, holding meat at 4°C for 8 hrs after immersion marination is the best in developing breast meat quality of spent hens. Spent hen breast meat when held at 4°C for 12 hrs after immersion marination attracts panellists the most.

Keywords: *immersion, injection, marination, spent hens, tumbling*

Present Status of Postharvest Practices of Guava (*Psidium guajava*), Bitter Gourd (*Momordica charantia*), and Long Bean (*Vigna unguiculata ssp. sesquipedalis*) in Anuradhapura and Kurunegala Districts

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Guava, bitter gourd, and long bean are economically important crops in Sri Lanka. Anuradhapura and Kurunegala districts significantly contribute to commercial production of these commodities. Improper post-harvest management practices result in qualitative and quantitative losses in the supply chain. The present study was conducted to investigate the current status of post-harvest practices and propose measures to minimize post-harvest losses of these commodities. Based on the cultivation extent and market size, 213 stakeholders including 148 from Anuradhapura and 65 from Kurunegala were selected as the sample. Farmers were randomly selected from 3-4 divisional secretariat divisions of each district. Other stakeholders were selected randomly from major market places and economic centers in respective districts. According to the study, most guava, bitter gourd and long bean farmers in both districts consider maturity indices. The harvesting method and time of the day are more or less similar in each district. Some farmers transport their own commodities. Most of the collectors act as transporters as well. As the means of transportation, closed trucks/ lorries, open trucks, and three-wheelers are commonly used. Most commonly used packaging materials are net bags, plastic crates, and cardboard boxes. Although the usage of packaging materials among stakeholders in Anuradhapura district is significantly different, in Kurunegala district it is not. When comparing the two districts, packaging materials used by farmers, wholesalers and retailers are significantly different but not the packaging materials used by collectors and transporters. Most of the stakeholders do not use plastic crates as a safe packaging method due to handling difficulties, absence of a proper method for returning, high cost and less availability of plastic crates. Instead, they use net bags for packaging. According to the study, it is essential to conduct training and awareness programs about post-harvest handling, transporting and safe packaging. Further, it is also important to promote and facilitate the use of plastic crates and bring legislation to make the use of plastic crates mandatory.

Keywords: *maturity indices, post-harvest losses, stakeholder, safe packaging, supply chain*

Comparative Assessment of the Effectiveness of Fresh Coconut Paste over Conventional Coconut Milk for Domestic Usage

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A study was carried out to explore the suitability and consumer acceptability of fresh coconut paste (FCP) as a coconut milk substitute compared with conventional coconut milk (CCM), to reduce the consumption of coconuts in Sri Lankan households and increase the availability of nuts for the coconut-based industry. FCP was produced by the scraped coconut meat into a fine particle paste through a colloid mill. The proximate composition of FCP was determined and the sensory evaluation was carried out with dhal curries prepared with FCP and CCM by using a five-point hedonic scale. The consumer survey was conducted with 150 consumers from the Gampaha and Colombo districts, instructing them to prepare dhal curry using FCP packets. The storage stability of FCP at refrigerator condition, coconut savings, and cost-benefit of using FCP over CCM was evaluated. Moisture, fat, crude fiber, protein, ash, and carbohydrate of the FCP were 67.46 ± 0.72%, 27.89 ± 0.40%, 1.29 ± 0.04%, 1.27 ± 0.01%, 0.73 ± 0.08%, and 2.63 ± 0.44%, respectively. There was a significantly high crude fiber content in FCP compared to coconut cream (undiluted coconut milk) (0.01%). The sensory evaluation resulted in higher scores for the appearance, color, mouth feel, and overall acceptability of CCM compared to the FCP curry. However, the taste and odor of CCM and FCP curries were not significantly different ($p>0.05$). According to the consumer survey, 61% preferred to buy FCP if it is in the market. The most preferred quality of the product was the ease of usage. FCP can be stored in low-density polyethylene for up to 2 weeks at 4°C. The actual amount contained in 50 g of FCP is 16.27 g, and when using 150 g of FCP per day per household, 274 of nuts and Rs. 28,680/= can be saved per year compared to hand-squeezed coconut milk.

Keywords: *coconut milk, coconut saving, consumer acceptability, fresh coconut paste*

Plant Protection (PP)

Field Evaluation of Plant Extracts against Rice Sheath Blight (*Rhizoctonia solani*) Disease

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Sheath blight caused by *Rhizoctonia solani*, is a major fungal disease that has been recorded in all major rice-growing areas in Sri Lanka. Due to the lack of resistant rice varieties, the management is accomplished by the application of synthetic fungicides. Continuous inappropriate usage of chemicals causes undesirable effects on the environment and human health. Therefore, alternative methods for disease management have become more important. Plant extracts become vital among the alternative methods, as it is an environmentally safe biocontrol method. The present investigation was conducted to screen the efficacy of several plant extracts against *R. solani* under field conditions. Aqueous plant extracts of bulbs of garlic (*Allium sativum*), plant extract combination of bulbs of garlic and leaves of clove (*Syzygium aromaticum*) and plant extract combination of bulbs of garlic, leaves of clove, leaves of *hulanthala* (*Ageratum conyzoides*) along with carbendazim as (50% WG) fungicide (positive control) and water (negative control) were used in the experiment according to the results of *in vitro* test. After the isolation of the pathogen, mass preparation of the pathogen was done using a mixture of rice bran and rice husk (1:1) and agar. The media with *R. solani* was kept at room temperature for about one week and inoculated between the leaf sheaths of the rice plant. Selected plant extracts were sprayed on the plants at 100% concentration. The highest disease severity was observed in water (39.28%) treated pots whereas the lowest disease severity (26.67%) was observed in carbendazim treated pots. The aqueous plant extract combination of *A. sativum, S. aromaticum* and *A. conyzoides* was showed the highest disease severity (33.29%) against *R. solani*, followed by the plant extract combination of *A. sativum* and *S. aromaticum* and plant extracts of *A. sativum* 29.88 % and 26.67% respectively. Therefore, out of these plant extracts, *A. sativum* was proved to be the most effective in inhibiting the growth of *R. solani* which can be introduced as a possible alternative method with further evaluation.

Keywords: *disease control, plant extract, rice, sheath blight*

Effect of Seed Kernel and Leaf Extracts of Neem (*Azadirachta indica*) on Selected Sap-sucking Insect Pests of Sugarcane

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Many insect pests are associated with sugarcane plants in Sri Lanka including sucking pests causing a heavy economic loss and requiring the control of pest populations. The study was conducted with the objective of determining the effect of neem seed kernel and leaf extracts on sap-sucking insect pests in sugarcane cultivation. Sugarcane Woolly Aphid (SWA) (*Ceratovacuna lanigera*), Pyrilla Plant Hopper (PPH) (*Pyrilla perpusilla)* and Sugarcane Pink Mealy Bug (PMB) (*Saccharicoccus saccharin*) were used as test insects on variety SL 96 128. Ethanol and aqueous extracts were prepared with the neem seed kernel or leaf powder added in concentrations of 50g/300 mL of distilled water and ethanol separately and stirred for two hours continuously, and then each extract was allowed to stand for another hour. The extracts were prepared in 2%, 5% and 10% (W/ V) concentrations for the bioassay. For each pest, mortality tests were conducted to study the toxicity effect of the extracts and feeding tests were conducted to measure the anti-feeding effect using the parafilm sachet technique and erythrosine dye test. Percentage mortality for toxicity effect and amount of honey dew-stained area and the number of salivary flanges on the leaf for anti-feeding effects were recorded. Treatment means were compared using one-way and two-way ANOVA with Tukey's multiple mean comparison test. The effective time period for all four extractions for each pest was recorded as 72 hours. Ethanol extract of neem seed kernel was significant ($p<0.05$) for SWA and PPH compared to the aqueous extracts for mortality and anti-feeding tests. The best concentration of ethanol extract of neem seed kernel is 10% (W/ V). Mortality percentages of SWA, PPH and PMB for neem seed kernel ethanol extraction were 100%, 76.66%, and 20% at 10% (W/ V) respectively. None of the tested extraction was effective against PMB.

Keywords: *ceratovacuna lanigera, neem, pink mealy bug, plant extract, Pyrilla perpusilla*

Mortality and Phytotoxic Effect of Selected Biopesticides on Plesispa Beetle (*Plesispa reichei*) Under Laboratory Conditions

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Plesispa beetle (*Plesispa reichei* Chapuis) is one of the serious insect pests found in coconut nurseries in Sri Lanka. Both adults and larvae cause damage by feeding on the folded blades. The test compounds were BioSolex (Neemsal (2.5%), Organic acids (0.5%), Camper (2%), and other ingredients (95%)), Flipper (Fatty acids, C14-20, Potassium salts 479, 8 GLI), and Agro Safe Liquid (ASL) (liquid extracts of Neem, Ginger, Tobacco, and Garlic). Carbosulfan 20% was the positive control and distilled water was the vehicle control. Adult and larval stages were tested for mortality at the exposure of 24, 48, and 72 hours. The biopesticide concentrations which showed 90% lethality interpolated from concentration inhibition curves were tested for phytotoxic effects by the affected leaf area percentage out of the whole leaf area. Data on mortality and phytotoxic effects were statistically analyzed by one-way ANOVA and Dunnet's multiple mean comparison test. The lethal concentration of 50% and 90% were interpolated from a non-linear regression curve fit model. Three biopesticides showed concertations and a time-dependent increase in mortality. The lowest LC_{50} value was exhibited by the BioSolex compared to Flipper and ASL (BioSolex LC_{50} = 1.43 x 10^4 ppm < Flipper LC_{50} = 19.42 x 10^4 ppm < ASL LC_{50} = 39.59 x 10^4 ppm for the adult at 48 hours exposure and BioSolex LC_{50} = 0.03 x 10^4 ppm < Flipper LC_{50} = 15.60 x 10^4 ppm < ASL LC_{50} = 36.71 x 10^4 ppm for larvae at 48 hours exposure). BioSolex does not show any phytotoxic effect. A cost-benefit analysis should be conducted before suggesting any recommendations, and BioSolex is effective on Plesispa beetle compared to Flipper and ASL.

Keywords: *biopesticides, coconut, LC_{50}, plesispa beetle*

The Potential of Using Pesticidal Plant Extracts in Managing Termite Damage in Sugarcane Buds and Setts at Planting

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Subterranean termites affect the sugarcane crop through germination, shoot emergence and cane quality. Many plant components have been discovered to contain compounds that are toxic to termites, conferring their biological insecticidal properties. Therefore, the objective of the study was to screen potential plant extracts that have insecticide properties and the lethal dosage (LC_{50}) to manage termite damage during germination and the early plant growth phases of sugarcane. A preliminary choice test was conducted using eight plant species with an insecticidal effect. Three plant species were selected for the field study depending on the results of the choice test, i.e., *Leucaena leucocephala* (Ipil - Ipil) pods and leaves, *Gliricidia sepium* (Gliricidia), and *Lantana camara* (Gandapana). Mature leaves and pods of the selected plants were collected, cleaned and dried at room temperature and ethanol extractions were prepared. Three-budded sets of SL 96 128 sugarcane variety were planted in 3 plots with 18 rows, 5 m length and 1.37 m spaced after soaking in the respective extract. In each raw, 20 sets were planted and maintained according to the standard management practices. The number of germinated buds, damage and growth parameters were recorded. The lowest sett damage (10.33 ± 2.85) was recorded from *L. camara-treated* seed setts. The highest (LC_{50}) value was recorded in *L. camara* leaf extract exposed to the different time periods (3.97 ± 0.70 – 6 h, 0.48 ± 0.53 – 24 h, 0.084 ± 0.45 – 48 h, 0.00033 ± 0.0004 – 72 h). There was no significant effect of ethanolic extract of tested plant parts on sugarcane sett germination and plant growth parameters except *L. camara* leaf extract ($p<0.001$) on the average root mass of sugarcane. Therefore, out of these plant extracts, the ethanolic leaf extract of *L. camara* is the best extraction for sugarcane sett treatment over termites.

Keywords: *damage, effect, pesticidal plants, termites, sugarcane*

Bio-efficacy of *Lantana camara* Leaf Extracts on White Leaf Disease Vector; *Deltocephelus menoni*

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Sugarcane White Leaf Disease (WLD) is a phytoplasma disease that causes severe losses to the sugar industry by reducing sugar recovery and production in Sri Lanka. WLD is secondarily transmitted by leafhopper vector; *Deltocephalus menoni*. Therefore, this study was designed and conducted with the objective of evaluating the efficacy of *Lantana camara* leaf extract on the WLD vector. Four extractions of *L. camara* leaves i.e., two aqueous extractions (decoction and maceration methods), ethanol and methanol extractions were considered for the study. Nine individuals of adult females (2 day old), 1st, 2nd and 5th level instar nymphs were used for the study and 3 months old plants of variety SL 96 128 were taken as host for the pest and plants were arranged as 2 plants/ sq. feet. The original four extracts were prepared with different concentrations of 10 g/ l, 15 g/ l and 25 g/ l for the study. Ten millilitres of each concentration of each treatment is sprayed for bioassay. Actara (5 g/ 16l) and distilled water were used as positive and negative controls respectively. The results of the experiment demonstrated that efficacy of *L. camara* extraction depends on the concentration of the extract, method and type of extraction, life stages and time of exposure *D. menoni*. Ethanolic extract displayed significant mortality on adult stage and fifth instar nymph while decoction and methanolic extracts showed higher toxicity on second and fifth instar nymphs ($p<0.05$). All extracts induced mortality of all life stages in a time dependent manner. When considering the concentrations, 15 g/ l and 25 g/ l of ethanolic extract induced significant mortality in adults and whereas all concentrations of methanolic extract induced significant mortality in the second and fifth instar. Significant anti-feeding effect was recorded for adults by ethanolic extract and methanolic extract for second and fifth instar ($p<0.05$). Thus, ethanolic extracts methanolic extracts and decoction extraction method have repellent properties against *D. menoni.*

Keywords: *Deltocephalus menoni, Lantana camara, plant extract, vector, white leaf disease (WLD)*

Screening of Antagonistic Fungi against *Rigidoporus Microporous* Causing White Root Disease in Cinnamon

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The telluric fungus, *Rigidoporus microporous* causes white root disease in cinnamon (*Cinnamomum zeylanicum* Blume), one of the valuable spice crop in Sri Lanka. The pathogen has the ability to degrade wood by decomposing lignified cell walls using hydrolytic and oxidative enzymes. Despite the significant economic loss caused by white root disease in cinnamon, adequate in depth studies have not yet been conducted. Control of the disease by applying systemic fungicides is expensive, pollutes the environment, and poses health risks. Hence this study was conducted to identify the morphology of *R. microporous* and *in vitro* screening and evaluation of effective *Trichoderma* spp. for biocontrol of the causative agent of white root disease in cinnamon. The pathogen was isolated from the infected roots of cinnamon. Isolated fungus was cultured on Potato Dextrose Agar at 28 ± 2^0C and the morphological characteristics were observed after 7 days of incubation. Two *Trichoderma* species isolated from forest soils by serial dilution method and the old culture received from the soil division at the National Cinnamon Research & Training Center were subjected to an antagonisms assay against the two strains of *R. microporous.* The Mycelium of the fungus was noted to be white in colour and fibrous with numerous branching-like structures. Under the compound microscope, a thread-like network of hyaline septate hyphae with no clamp connections was detected. Both *Trichoderma* spp. exhibited antagonistic activities against the two strains of *R. microporous* with *Trichoderma* strain 2 inhibiting the growth of *R. microporous* strain 1 by 79.58% and strain 2 by 76.08%, respectively. Further research is needed to evaluate the effectiveness of antagonistic *Trichoderma* against the causal organism of white root disease in field conditions.

Keywords: *antagonistic, cinnamon, Rigidoporus microporous, Trichoderma, white root disease*

Agri- environmental Modelling(AEM)

Evaluation of Fabricated Fuel Briquettes Made out of Agricultural Waste in Coconut Industry

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Most of the energy sources used in the world is not economically feasible and affordable and most of these are non-renewable sources. Developing countries and poor countries need alternative energy source. Therefore, biomass energy sources are good substitutes for this crisis. Combinations of agricultural wastes that give better heating values compared to its individual performance. Hence, the present study aims to compare and analyze the properties of fuel briquettes fabricated at varying proportions of coconut shells, coconut sheaths, and coconut petiole charcoal using extraction of "Dawul kurundu" (*Neolitsea cassia*) leaves extraction (DKLE) and "Habarala" (*Alocasia macrorrhiza*) tuber extraction (HTE) as a binding agent as a sustainable approach to fulfill the energy needs. 100% coconut shell, 50% coconut shell mixed with 50% coconut petiole and 33.33% coconut shell, 33.33% coconut petiole and 33.33% coconut sheath compositions were used. The produced briquettes were evaluated for their physical and combustion properties using standard methods. Calorific value, burning rate, ignition time and cooking efficiency were evaluated under combustion properties and moisture content, ash content, volatile matter content, fixed carbon content, and shatter index were examined to compare the performance of treatments. Combination of 100% coconut shell charcoal with the HTE and DKLE yielded the highest calorific values at 28675.39 J/ g and 28604.21 J/ g respectively. The highest shatter index was examined in 100% coconut shell charcoal with HTE (0.55 ± 0.55). Moreover, the best cooking efficiency was also given in 100% coconut shell charcoal with HTE (17.19min ± 0.56). Coconut shell charcoal with HTE treatment showed favorable physical and combustion characteristics compared to that of other treatments. Meanwhile, HTE resulted in better binding properties compared to the DKLE. Therefore 100% coconut shell charcoal with HTE can be efficiently used as an alternative energy source for the future energy demand.

Keywords: *biomass energy, calorific value, charcoal briquette, shatter index*

Land Suitability Assessment for Hemp (*Cannabis sativa* L.) Cultivation in Sri Lanka

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Cannabis sativa L., also known as hemp, is a versatile industrial crop. Despite being the most widespread illegal narcotic crop in the world, it has great potential as an economic crop. In Sri Lanka, hemp production is currently illegal and discussions are taking place to ease the restrictions on hemp legality by granting authorization to export-oriented cultivation to address the current crisis. In this study, suitability assessment (climate and soil), crop modelling, carbon footprint, and economic analysis including net present value (NPV), net present value benefit (NPVB), and benefit-cost ratio (BCR) were assessed. The yield and water productivity simulations were done using the calibrated and validated AquaCrop model. According to the land suitability evaluation, more than 70% of Sri Lanka is categorized as "highly suitable" in terms of overall climate and soil suitability. The simulated average potential seed and fiber yield at ten locations between 1990 and 2019 was 1.42 ± 0.24 t ha^{-1} and 2.41 ± 0.38 t ha^{-1}, respectively. The highest and lowest water productivity for seed production was reported as 0.38 kg m^{-3} and 0.28 kg m^{-3} respectively, and for fiber production, it was 0.25 kg m^{-3} and 0.17 kg m^{-3}. Using five general circulation models (GCMs) simulations, yields under future climates in Sri Lanka demonstrated an increment in most of the locations. The highest NPVB for seed and fiber under baseline climate conditions was reported as 13,875 USD ha^{-1} (BCR of 2.83) and 5,627 USD ha^{-1} (BCR of 1.65) respectively. Under future climatic conditions for both seed and fiber production, the average NPVB values are positive for all locations. According to the results, hemp cultivation is economically feasible in Sri Lanka. The findings of the study would help in understanding the potential of hemp cultivation in Sri Lanka and its economic sustainability.

Keywords*: AquaCrop, carbon footprint, land suitability assessment, water productivity*

Maturity Determination of Plant and Ratoon Crops of Sugarcane (*Saccharum officinarum*) Plantations Based on Unmanned Aerial Vehicle (UAV) Images

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Determination of the maturity of sugarcane is mainly influenced by Agronomic, visual observation, and weather conditions. Conventional maturity determination indices are time and labor-consuming. Hence, with the advanced technology of the world, Unmanned Aerial Vehicle (UAV)-based Multispectral Imagery is widely used for plant monitoring. This study focuses on determining the maturity state of the sugarcane fields in order to optimize the yield by timely harvesting. NDVI (Normalized Difference Vegetation Index), GNDVI (Green Normalized Difference Vegetation Index), and NDRE (Normalized Difference Red Edge) Vegetative Indices which are derived from the UAV images were used and they mainly represent the greenness or chlorophyll activity of the crop. Recovery Cane Sugar (RCS) (%) amount was obtained from the milling section of the Pelwatte Lanka Sugar Company (Pvt) Limited and related NDVI, GNDVI, and NDR indexes were acquired from 9–12 month age ratoon crops in the intermediate zone at the Pelwatte. According to the results NDVI, GNDVI, and NDRE were not significantly different from the crop age. RCS (%) showed a positive correlation with the NDVI, GNDVI, and NDRE values. The correlation coefficient values were respectively 0.33, 0.35, and 0.73. According to the results, RCS (%) had a strong positive correlation with the NDRE. The data which gathered earlier using the same methodology were used as secondary data which derived from the sugarcane plant crops in the intermediate zone. The results of RCS (%) showed a strong negative correlation with the NDVI, GNDVI, and NDRE. The correlation coefficient values were respectively, -0.92, -0.98, and -0.90. Though the relationship between RCS (%) with the Vegetative Indices show a positive relationship in ratoon crops, plant crops displayed a negative relationship. Further, study is required to confirm the relationships between VIs and sugar recovery. This study requires more data to identify the most fitted VI for the estimation of the maturity of sugarcane cultivations.

Keywords: *green normalized difference vegetation index, multispectral imagery, normalized difference red edge, normalized difference vegetation index, unmanned aerial vehicle*

Assessing Soil Erosion and Carbon Storage in Agricultural Soils: A Case Study in Ceylon Orchard Agro (Pvt) Ltd.

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Soil erosion is a major environmental issue in the world that affects soil quality, soil health, and productivity of agricultural lands. Detection of soil erosion and quantification of soil loss is crucial for effective land management in plantations. The study was conducted in Ceylon Orchard Agro (Pvt) Ltd in Udugama which belongs to the low country wet zone of Sri Lanka. The main objectives of the study were to estimate the soil erosion and carbon storage in the Ginganga Estate under current and future climate scenarios employing a modelling approach. Integrated Valuation of Ecosystem Services and Trade-offs (InVEST 3.12.0), InVEST Sediment Delivery Ratio (SDR) and InVEST Carbon models developed by Natural Capital (NatCap) Project, in partnership with Stanford University were used to assess soil erosion and carbon storage. Soil erosion assessment was conducted within the baseline period (2001-2021), mid-century (2040-2069), and end-century (2070-2099). Results show that for baseline period, mid-century, and end-century total soil loss ranges from 0 to 188 t ha^{-1} $year^{-1}$, 0 to 157 t ha^{-1} $year^{-1}$, 158 t ha^{-1} $year^{-1}$ with an annual average of 10 t ha^{-1} $year^{-1}$, 8 t ha^{-1} $year^{-1}$, 8 t ha^{-1} $year^{-1}$ respectively whereas, predicted mean annual soil loss ranges from 242 t ha^{-1} $year^{-1}$, 202 t ha^{-1} $year^{-1}$, and 205 t ha^{-1} $year^{-1}$ respectively. According to the rainfall data obtained, the baseline period received the highest rainfall. Therefore, in baseline period results shows the highest predicted mean annual soil loss and total soil loss. According to the carbon storage assessment total carbon storage map shows an average of 60 t ha^{-1} $year^{-1}$. According to the results, aboveground biomass is the dominant source of carbon among the main carbon pools. The findings of the current study will be useful in developing agricultural soil conservation practices that will mitigate the present situation of soil erosion and improve soil quality and agricultural productivity.

Keywords: *carbon storage and sequestration, future climate, InVEST carbon, InVEST SDR, soil erosion*

Crop Production Technology (CPT)

Effect of Some Selected Plant Extracts on Rooting and Early Growth of Salvia (*Salvia splendens*), Henckelia Hybrid II and Impatiens (*Impatiens walleriana*) Stem Cuttings

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Salvia splendens and *Impatiens walleriana* are widely used bedding and border plants in landscaping. Rapid propagation is very important to fulfill landscaping requirements. Both of these plants are propagated by using seeds and cuttings. But there are limitations to seed propagation. Henckelia plant is an endemic wild flowering plant in Sri Lanka that is close to extinction due to indiscriminate collection from natural habitats. This is normally propagated by using stem cuttings. It needs to be propagated in large quantities, especially for biological conservation. Since the rooting hormones are costly and less available, the present study was carried out to find an effective plant extract to increase the rooting of these three plant cuttings. This experiment was conducted according to One Way Analysis of Variance with eight treatments replicated three times. The effect of Moringa leaf extract with 3, 6, and 9 g/ L (dry weight), garlic clove extract with 15, 20, and 25 g/ L (fresh weight) and commercially available rooting hormone were tested in this study. Distilled water was the control treatment. In this experiment, the number of leaves shoot length, number of roots, root length, shoots and roots dry weights were measured. Root and shoot characteristics responded differently against different treatments. Both Moringa and garlic extracts performed well in root length and 20 g/ L garlic extract performed well in shoot length of Salvia. Moringa extract showed better performances in all root and shoot parameters in Henckelia except shoot dry weight. The highest root length and shoot length were observed in 9 and 6 g/ L Moringa extracts, respectively in Impatiens. 15 g/ L garlic extract recorded the highest shoot dry weight in Impatiens. The results suggest that both plant extracts have the potential in substituting commercially available rooting hormones in the propagation of Salvia, Henckelia and Impatiens stem cuttings.

Keywords: *cuttings, garlic clove extract, moringa leaf extract, root characteristics, rooting hormone*

Comparison of the Impact of Pedotransfer Functions on Simulated Crop Yield: A Case Study with Agricultural Production Systems Simulator

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The determination of soil hydraulic properties is a difficult, time-consuming and laborious process. The pedotransfer functions are developed as an alternative method for estimating the hydraulic parameters based on existing soil measurements. Hydraulic properties that can be estimated from pedotransfer functions can be used for environment and crop models. However, the impact of hydraulic property values derived from different pedotransfer functions on the growth and development of crops in crop models was not assessed in detail. In this study, the weight of rough rice (WRR) was simulated and measured and pedotransfer function-derived soil hydraulic parameters that include permanent wilting point (LL15) and field capacity (DUL) from15 pedotransfer functions were used. The Oryza model in Agricultural Production Systems Simulator (APSIM) was used as the test model and simulations were conducted for thirty years (1980-2010) in 43 locations in Sri Lanka. Furthermore, the global sensitivity analysis was performed using the gaussian emulation machine for sensitivity analysis to identify the most sensitive soil parameter to yield, which was estimated by each pedotransfer function. The results showed a significant ($p<0.05$) difference in the yield prediction maps generated using PTFs-based hydraulic properties and the yield prediction map generated using the observed hydraulic parameters. In the correlation analysis, PTF 8 is not significant. The statistical analysis confirmed yield generated using hydraulic parameters estimated by PTF 8 had a poor agreement and PTF 12 had good agreement with the observed yield. The DUL and LL15 are the most sensitive parameters on WRR value estimated from different PTFs.

Keywords: *APSIM, ArcGIS, sensitivity analysis, soil hydraulic properties*

Effect of Different Mulches on Water Conservation in Carrot (*Daucus Carota* L.*)* Grown in Disturbed and Undisturbed Soils

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Carrot (*Daucus carota* L.) is a biennial plant, grown annually and belongs to the Apiaceae family. An experiment was conducted at the research field of the Agricultural Research Station in Seetha Eliya, Nuwara-Eliya, Sri Lanka, from September - December 2022 to evaluate the effect of different mulching materials on soil water conservation and thermal regulation in disturbed and undisturbed carrot grown soils. Different mulching materials such as gliricidia (*Gliricidia sepium* L.) leaves, citronella grass (*Cymbopogon nardus* L.) leaves, paddy husks, sawdust, black polythene, and transparent polythene were introduced to the disturbed and undisturbed soil to evaluate water retention ability in rooting zone of carrot. The experiment was set up under a split-plot design with three replicates. The effect of ploughing and mulching was dominant on soil water retention and that significantly influenced ($P<0.05$) all the studied parameters in carrots. Significantly higher cumulative water retention in the disturbed soils was found in the carrot plots, mulched with citronella grass leaves (116.7%). According to the analysis, no significant difference between citronella grass leaves and paddy husk mulch was discovered ($P>0.05$). Moreover, significantly higher soil water retention in the treatment of mulching with paddy husk promoted thermal dynamics (maximum 18.9^0 C and minimum 17.4^0 C) in the active root zone of carrots. According to the yield parameters, the maximum mean root length and diameter were found in disturbed soils than in undisturbed soils. Similarly, a significantly higher plot yield was recorded with paddy husk mulch in disturbed (33.5 t/ ha) and undisturbed soil (29.5 t/ ha). A significantly similar forking root percentage was also found in all the mulching treatments in undisturbed soil. Results generated from the study are beneficial to formulate soil water conservation packages to recommend farmers for sustainable carrot cultivation.

Keywords: *disturbed and undisturbed soils, mulching material, soil water retention, thermal dynamics*

Effectiveness of Different Wrapping Materials for Grafting of Ber (Masan) (*Ziziphus jujuba* Mill.)

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In Sri Lanka, Ber (*Ziziphus jujuba* Mill.) is an underutilized fruit crop that is rich in beta-carotene, vitamins B, and C. The main barrier to the cultivation of Ber is the lack of superior varieties and high-quality planting materials. Ber is typically reproduced by seeds. Ber cross–pollinated fruit crop therefore vegetative propagation is highly recommended. Grafting is the most common method of vegetative propagation of Ber. This study was carried out at the Fruit Crop Research and Development Station, Gannoruwa, Peradeniya to find out the best and most effective wrapping material for the grafting of Ber (*Ziziphus jujuba* Mill.) by comparing the successfulness of the grafting. Four types of wrapping materials were tested in Complete Randomized Design (CRD) with four replicates. Scion of *Ziziphus jujuba* Mill. was grafted on six-month-old *Ziziphus mauritiana* Lam rootstock. Following wrapping tapes were used to wrap the grafted plants: polythene tapes, grafting tapes, para film grafting tapes, and poly sac tapes. Parameters that were measured in the experiment included: bud emergence with time, percentage of bud emergence, total number of leaves, total number of shoots, shoot height, and average shoot growth. The results expressed that the type of wrapping tape significantly affected the bud emergence with time, the percentage of bud emergence, the total number of leaves and the total number of shoots. Average shoot height showed no significant difference among different wrapping materials. After two weeks of grafting, the highest percentage of buds was recorded when the wrapping was done using polythene tape (68.75%). Wrapping using a poly sac tape showed the second highest value (58.75%). The percentage of bud emergence using grafting tape was 45%. The lowest percentage (42.5%) of bud emergence was recorded with para film. According to this study, polythene tape and poly sac tape can be used to wrap wedge-grafted Ber plants successfully.

Keywords: *success rate, vegetative propagation, wedge grafting, Ziziphus mauritiana*

Effect of Selected Commercial Rooting Hormones on Air-Layering of Jackfruit (*Artocarpus heterophyllus* Lam.)

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Jackfruit (*Artocarpus heterophyllus* Lam.) belongs to the family Moraceae and is the most important, popular, and functional tree in tropical home gardens. Vegetative propagation is an asexual method of plant reproduction. Air layering is a plant propagation technique in which a plant stem is wounded with a girdle stem and enclosed the wounded stem with a moist rooting medium until adventitious roots develop from the wounded area. Therefore, this experiment was conducted to find out the effect of commercially available rooting hormones on air layering of three jackfruit varieties "Fartherlong", "Hirosa" and "Maharagama". The Plant Fix® 122.22 ppm (2.5 mL+ 1 L of distilled water), Roocta® 1.75 ppm (0.5 g + 1 L of distilled water) and control (1 L of distilled water) were the treatments used for all three varieties. The experiment was carried out at Fruit Crops Research and Development Station, Gannoruwa, Peradeniya. Three treatments were tested (including the control with distilled water) in a Randomized Complete Block Design (RCBD) with three replicates. Callus diameter (mm), callus weight (g), root primordia weight (g), diameter of root primordia (mm), number of root primordia and survival percentage (%) were measured after eight weeks. The diameters of root primordia of "Hirosa" and "Maharagama" displayed a significant difference under Plantfix. Diameter of root primordia of "Fartherlong" revealed a significant difference under control treatment. All the parameters displayed significant differences against the Plant Fix in "Hirosa". Significant difference in number of root primordia resulted in "Fartherlong" and "Maharagama" treated with Plantfix. On the contrary, it was significant in "Hirosa" treated with Roocta. Both callus diameter and callus weight of "Fartherlong" displayed significant differences in control and Plant Fix treatments. Root primordia weight and diameter of root primordia of "Fartherlong" expressed significant differences against the control. It is concluded that Plant Fix can be recommended for "Maharagama", "Fartherlong" and "Hirosa" varieties.

Keywords: *adventitious rooting, air-layering, jackfruit, rooting hormones, vegetative propagation*

Poster Presentations (PO)

Small-Scale Farmers' Perception and Willingness to Application of Organic Fertilizer in Marassana Administrative Area of Kandy District

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Farmers encounter a significant challenge now that the Sri Lankan government has enacted new legislation prohibiting synthetic fertilizers and recommending using the 100 percent organic fertilizer. Therefore, it is essential to find a solution to the problem regarding organic fertilizer. Given this, the study examined farmers' willingness to apply organic fertilizer as an alternative to inorganic fertilizer, with the specific goals of determining small-scale farmers' awareness and perception of organic fertilizer and identifying factors that influence farmers' willingness to buy organic fertilizers. Willingness to application and farmers' commitment to organic fertilizer will provide the necessary ideas for entrepreneurs to reach decisions on how the substitute products for synthetic fertilizer can be made more user-friendly. However, to produce organic fertilizer at a commercial level, it is necessary to reveal the farmers' attitude towards organic fertilizer and the factors influencing their purchase behavior. A simple random sampling procedure was used to collect data from 228 small-scale farmers who are growing up-country vegetables in Marassana administrative area using a structured questionnaire which was analyzed using descriptive statistics (frequency counts, mean and standard deviation) and binary logistic regression to determine the factors which influenced willingness to buy organic fertilizers, perception, and awareness on organic fertilizer. Farmers' awareness of the use of organic fertilizer was assessed using a four-point Likert scale. The study's main results indicate neutral awareness and perception of farmers of the use of organic fertilizers and the qualities of organic fertilizers. These findings highlight the need for organic fertilizer awareness, training, and education in this area. Gender, awareness of organic fertilizer, farmland extent, and farmers' education level were significant factors for willingness to buy organic fertilizers. A better understanding of the organic concept by farmers can potentially increase the commercial production of organic fertilizer.

Keywords: *farmers' perception, organic fertilizer, willingness for application*

Effect of Biofertilizer on Growth and Yield of Tomato (*Solanum lycopersicum*) in Greenhouse Condition

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Biofertilizers have a greater potential to enhance agriculture productivity as they are enriched with plant growth promoting microorganisms. Bionutri® is a newly introduced bio fertilizer, recommended for horticultural crops. Hence, a pot trial was conducted to evaluate the impact of Bionutri® fertilizer on growth and yield of tomato under the greenhouse conditions, at the Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka. The experiment was laid out in a Completely Randomized Design (CRD) with tri-replicates. Six treatments; T1- Bionutri® only, T2- DOA recommendation, T3- Organic (compost) only, T4- Bionutri® + Organic (compost), T5- DOA 50% + Bionutri®, and T6 - DOA recommendation + Bionutri® were assessed and compared for plant height, number of leaves per plant, and days taken for flower bud initiation as growth parameters and total number of flowers per plant, total fruit yield per plant, and average fruit weight as yield parameters. One-way ANOVA and Kruskal–Wallis tests followed by planned parametric contrast and non-parametric comparisons by Mann-Whitney-Wilcoxon U test were done. The significantly ($P<0.05$) highest value for plant height (34.5 ± 0.4 cm), number of flowers per plant (median 103; min (95) and max (105)), average fruit yield per plant (3.3±0.03 kg), and average fruit weight (98.5 ± 1.25 g) resulted in T6. Hence, this study concludes that foliar application of Bionutri® fertilizer with DOA recommendation enhances the plant growth and yield of tomato.

Keywords: *Bionutri®, chemical fertilizers, foliar application, sustainable agriculture*

Factors Affecting Smallholder Coffee Production: A Study in Kandy District, Sri Lanka

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With the re-emergence of coffee farming, coffee can be a significant source of export earnings to the Sri Lankan economy. This study was focused on determining the factors affecting smallholder coffee production in Kandy district and to identify the problems faced by smallholder coffee producers. Primary data were generated from 139 randomly sampled coffee farmers. Data were gathered via an interviewer administered structured questionnaire through the telephone. Multiple linear regression was used to analyze the data. This study considered socio demographic characteristics, farm characteristics, production factors, and marketing factors as independent variables and smallholder coffee production as a dependent variable. According to the regression results, annual coffee income, land capacity, number of coffee trees and harvesting at the right stage had unstandardized coefficients 0.003, 165.114, 0.581 and 74.220, respectively. Moreover, all these factors positively affected the coffee production. Coffee farmers were mainly constrained with labour supply, provision of capital and climate changes. They were further challenged by the market access issues and lack of technology. It was further revealed that farmers were using stripping techniques to harvest coffee berries. As a result, the quality of the coffee beans was affected negatively. The severe damage caused by monkeys during harvest was another problem that was revealed from the study. As identified, the government and other concerning bodies should give emphasis and encouragement to harvest at the right stage of coffee berries. It is recommended to establish a reliable, fair, and transparent price regulation between smallholder coffee farmers and intermediaries.

Keywords*:* *coffee, constraints, factors affecting, kandy district*

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