Proceedings

Faculty of Agriculture Undergraduate Research Symposium

FAuRS – 2021/22

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Faculty of Agriculture
University of Peradeniya

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Message from the Vice Chancellor

It is with great pleasure that I forward this message on the occasion of the Undergraduate Research Symposium (FAuRS - 2021/22) of the Faculty of Agriculture. I'd like to greet and thank all of the undergraduates who are attending this symposium.

It has been known for a long time that science and technology must help agriculture grow. This notion facilitated the transformation of traditional agriculture into industrial agriculture. In the last decades of the 20th century, national and international research institutes focused on agriculture helped speed up the change. Sri Lanka is no exception.

Even though agricultural innovation and the use of technology have gotten better in Sri Lanka over the years, less attention has been paid to the agricultural transformation that focuses on how science, agriculture, and society all work together. As a comprehensive university, the University of Peradeniya has everything needed to undertake research in a way that draws on many different fields.

Undergraduates who undertake research advance their ability to learn, think critically, and solve problems. Furthermore, the ability to communicate is an important attribute of a university's output. I'm hopeful that this symposium will be a great place for undergraduates in agriculture to share their research findings with the scientific community, industry, and policymakers. It will also help them learn how to do research that will be useful in the future.

I take this opportunity to congratulate the Dean of the Faculty of Agriculture, the Coordinator FAuRS, the Organizing Committee, and all other staff for their untiring efforts in organizing this calendar event.

I wish the FAuRS - 2021/22 a great success.

Professor M.D. Lamawansa
Vice Chancellor
University of Peradeniya

28th December 2022

Message from the Dean

It gives me great pleasure to provide this message to the FAuRS - 2021/2022 when we plan to celebrate our 75 years of contribution to the Country's higher education system. The Faculty's journey since its inception in 1948 has been marked by countless innovations that have drastically changed the trajectory of the Country's higher education sector, particularly in the agriculture and allied fields. Thanks to our forefathers for laying the foundation and creating a conducive culture that has become a breeding ground for scientific discoveries while gifting generations of scientists to society with an excellent aptitude for engaging in research, development and outreach.

A significant milestone of the Faculty was introducing the research component to the undergraduate curriculum in 1975, which allowed undergraduates to sharpen their research skills while grooming them as young scientists. Since then, a few academic Departments have organized research symposia at departmental levels to communicate student research findings, culminating in a faculty-wide undergraduate research symposium, *i.e.* the Faculty of Agriculture Undergraduate Research Symposium (FAuRS) in 2014. Since then, FAuRS has become a key event in the Faculty's calendar. FAuRS provides the Faculty's final-year students with a platform to showcase their research findings and helps them develop their confidence through engaging in numerous healthy competitions and sharpening their organizing skills by volunteering to be a part of the FAuRS organizing committee. The FAuRS - 2021/2022 has taken a novel step forward to widen its scope of student engagements by opening some contests to students of other local and foreign universities to further challenge our students and to make them more attuned to future challenges.

As the dean of the Faculty, I take this opportunity to congratulate the FAuRS coordinator and the Organizing Committee for making the FAuRS - 2021/2022 a great success amidst numerous challenges imposed by the Country's ongoing economic crisis situation. While inviting you to witness the talents of our students, I wish you all a Prosperous 2023 and a Happy Diamond Jubilee Year!

Professor Sarath S. Kodithuwakku
Dean
Faculty of Agriculture

28th December 2022

Message from the Coordinator

On behalf of the organizing committee, it is my great pleasure to provide this message to the Faculty of Agriculture Undergraduate Research Symposium 2021/22 (FAuRS - 2021/22). Over the years, the undergraduate Research Symposium has gradually evolved into being the main glamorous event of the Faculty of Agriculture and has become a main event of the annual calendar of the Faculty. This year we are organizing FAuRS for the 8th consecutive time.

The FAuRS provides a platform for the final year undergraduate students of the Faculty, to blend with the local and international professionals and students, and showcase their talents while improving knowledge, skills and attitudes during the process. We have lined up a series of exciting activities at FAuRS - 2021/22 that will allow our students to reflect upon and celebrate their accomplishments, explore born and learned talents, extend their networks, and jointly explore current and future research directions. As the Faculty, we expect that this symposium will set stage to improve themselves, build professional linkages, impress potential employers and exchange ideas on how to chart their journey forward to reach new heights.

Agriculture has gained unprecedented prominence than ever today due to the necessity of assuring food security of the nation amidst many challenges presented by climate change, socio-political instabilities, fuel crisis, pandemics and natural disasters, etc. around the world. As the pioneer in Agriculture higher education and research in Sri Lanka, the Faculty of Agriculture, University of Peradeniya, is very much concerned about the connection between tertiary agricultural education and the needs of the country. Thus, FAuRS - 2021/22 will receive much attention from the local and international professional bodies, industry, government authorities and the general public.

I am confident that the FAuRS - 2021/22 will fulfill the expectation of the Faculty of Agriculture. I wish all the students who are taking part in FAuRS - 2021/22 all the success in their future endeavors.

Professor Warshi S. Dandeniya
Coordinator
FAuRS - 2021/22

28th December 2022

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Agricultural Production and Productivity Improvement

A Comparison of Productive and Reproductive Performance of Jersey and Jersey×Friesian Crossbred Cows of a Large Scale Dairy Farm in the Dry Zone, Sri Lanka

Nimeshika I.L.S., Deshapriya R.M.C.[*] and Ranasinghe R.M.S.B.K.[1]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Productive and reproductive performances are the economically most important parameters of dairy cattle industry. Breed performance comparison studies help to determine the most suitable genotypes for different conditions. This study was undertaken to compare the productive and reproductive performances of Jersey and Jersey×Friesian crossbred cows in an intensively managed dairy herd in the dry zone of Sri Lanka. Lactation length (LL), lactation milk yield (LY),305 days milk yield (305Y), daily average milk yield (DY), peak milk yield (PMY) and peak day (PD) were the productive parameters considered while services per conception (SPC), age at first calving (AFC), calving interval (CI), percentages of stillbirths (SB), percentage of abortions (AB) were collected as reproductive parameters from 924 cows (Jersey: n=342 and Jersey×Friesian crosses: n= 582).The means of different parameters for each breed were compared using a t-test and frequency data were compared using chi square test in the R programme and also SPC was analysed using Mann-Whitney U test in SPSS. The mean 305Y and LY of Jersey×Friesian crossbred cows (3560.77±1807.01L and 4347.93±1854.40L. respectively) were significantly (p<0.05) greater than Jersey cows (3231.26±1534.05L and 3937.92.94±1491.87L respectively). Jersey×Friesian crossbred cows showed a significantly (p<0.05) longer LL compared to Jersey cows (386.44±115.38 days vs. 368.15±102.46days, respectively). The highest DY was given by Jersey×Friesian crossbred cows (11.44±3.71L.) compared to Jersey cows (10.46±3.33L.) and also the mean PMY of Jersey×Friesian crossbred cows (22.76±5.45L) were significantly (p<0.05) greater than Jersey cows (21.10±3.96L). Jersey cows had a significantly (p<0.05) shorter calving interval (495.40±134.70 days) compared to Jersey×Friesian crossbred cows (513.35±136.58 days). Furthermore, PD, SPC, AFC, AB%, and SB% were not significantly (p<0.05) different between the two breeds. In conclusion, Jersey×Friesian crossbred cows seem to produce more milk but their calving interval is longer compared to Jersey cows. Thus, Jersey×Friesian crossbred cows showed better productive performance in the Dry zone.

Keywords: Jersey, Jersey×Friesian crossbred, Productive & reproductive, Performance

[1]Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]cdeshapriya@agri.pdn.ac.lk

A Review of Cerebrospinal Nematodiasis in Goats Caused by *Setaria digitata*

Nethmini A.K.T.S. and Wijayagunawardane M.P.B.[*]

Department of Animal science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Among filarial worms, the *Setaria* is a heteroxenic parasite that lives in the peritoneal cavity of bovines as definitive host and the invertebrate mosquito act as the intermediate host. These microfilariae, in turn taken up by mosquito species such as *Aedes*, *Anopheles, Culex* during blood feeding, and grow them to the infective stages. However, when the erratic larvae enter in to an intermediate host, such as goats, the larvae may migrate along the nerves, and cause substantial damage the central nervous system (CNS). Cerebrospinal nematodiasis is results from aberrant migration of nematode larvae within the spinal cord of many ruminant species**.** Laval migration in CNS in neurological system and host immune response elevate the intensity of clinical disease indirectly by toxins or unknown methods. Symptoms includes complete or incomplete posterior paralysis, reduced cutaneous sensation, proprioceptive deficits as well as cranial nerve reflexes deficits. Diagnosis is based on the detection of microfilariae in blood which can be confirmed by stained blood smears. Many ordinary anthelmintics are not effective against adults or larvae of *Setaria*. Some reports indicates that some macrocyclic lactone are partially effective against microfilariae of certain *Setaria* species. Biological control of *Setaria* worms is currently not practicable. Although antifilarial drugs are effective for circulatory larval stage they are not effective in CNS because drugs cannot cross blood brain barrier. Although it may be feasible against mosquitoes control in some areas. A key preventative measure to prevent or at least to reduce cattle infestation with *Setaria* worms by controlling the mosquito bites.

Keywords: Goats, Nematodiasis, *Setaria digitata* central nerves system

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[*]missaka@agri.pdn.ac.lk

Assessing Morphological Responses of Greenhouse Tomatoes to Varying Nitrogen Levels using Manual and Image-Sensing Methods

Bandara R.M.D.M., Weerakkody W.A.P.[*] and Bandaranayake P.[1]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Protected agriculture (PA) is a solution for overcoming conventional agriculture issues and thus for feeding the rising world population. Hence soilless culture has become an integral part of PA and managing plant nutrition in PA is important. Therefore, innovative intellective diagnostic systems for diagnosing nutrient deficiency symptoms are a timely need. Hence this experiment was conducted to test the effectiveness of "image sensing" as a diagnostic tool for nitrogen deficiency in a fully intensive greenhouse located in WM2b (Mid-country Wet zone). Study was conducted to detect growth response of tomato, variety 'Sylviana' to varying nitrogen levels using manual and image sensing methods. In this study, five nitrogen fertilization levels were established. Of them, T1 was 200% N of the recommendation, T2 (control) was 100% N, and T3, T4, and T5 with 50%, 25%, and 12.5 % N levels respectively. The results showed that stem thickness, leaf area, plant height, and leaf number were significantly different within treatments ($p<0.05$) after 5th weeks after transplanting (WAP). At 7WAT, the leaf dry weight was significantly different between T2, T3, T4, and T5. For detecting leaf color, leaf images were processed in "ImageJ software" to determine the green color intensity. Image analysis results showed that there was a significant difference among treatments since the 3rd WAT. The option of "use of Leaf color chart" for this purpose was found less effective. According to the results, diagnosis of N deficiency in tomato leaves could be effectively done with the use of image sensing much earlier without waiting for morphological changes. The positive results found with the image sensing method for detection of N deficiency of tomatoes would be used to develop an effective and efficient method for leaf color-based diagnosis of nutrient deficiencies in large-scale cultivations.

Keywords: Image analyzing, Nitrogen deficiency, Plant growth characters, Protected agriculture, Tomato

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[1]Agricultural Biotechnology Center, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]wapweerakkody@agri.pdn.ac.lk

Investigation of Morphological and Molecular Marker Segregation of an F2 Population of Coconut (*Cocos nucifera* L.) and Deriving Marker-Trait Associations

Kumarasinghe D.A.J., Dissanayaka H.D.M.A.C.[1], Meegahakumbura M.K.[1], Herath N.B.[1] and Perera S.A.C.N.[*]

Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Investigations based on segregating populations such as F_2 are essential for genome mapping and QTL analysis of crops. Deriving an F_2 population of coconut is difficult due to the long generation interval. The objectives of the current study were to investigate two F_2 populations of coconut for morphological and molecular segregation and to derive marker-trait associations. The study was done using 80 individuals of 2 five-year old F_2 populations derived from crosses; Red dwarf × Brown dwarf (RDBD) and Green dwarf × Yellow dwarf (GDYD) planted at Middeniya Research Station, Coconut Research Institute. The populations were phenotyped considering 16 quantitative and qualitative parameters, followed by genotyping based on 6 SSR marker loci. Descriptive statistics were generated for morphological data and genotypic data were analyzed by Powermarker software. Marker-trait associations were derived by single marker analysis. High values of standard deviation, variance and range of quantitative traits and the presence of different categories of qualitative traits indicated high levels of phenotypic segregation within the populations. Of the 6 SSR loci, only 5 were polymorphic and revealed 20 alleles in 2 populations reporting 2-6 alleles per marker. Mean values of gene diversity, heterozygosity and polymorphic information content for RDBD were 0.64, 0.62 and 0.57, while the same for GDYD were 0.60, 0.60 and 0.54, respectively. Significant associations (P<0.05) were identified for; leaflet number at *CnCirB12*; petiole width at *CnCirB12* and *CnCirE10*; number of leaflets at *CnCirB12*; petiole length at *CnCirC3*, *CnCirE10*; leaflet length at *CnCirE10* and pollination behaviour at *CnCirG11* marker loci. Accordingly, the two populations were identified to be highly segregating, facilitating their use in QTL analysis. The revealed marker-trait associations can be used for parental selection in coconut breeding. Detailed genotyping and phenotyping is recommended for comprehensive QTL analyses.

Keywords: Coconut, F_2 population, Morphological analysis, QTL analysis, SSR markers

[1]Coconut Research Institute, Lunuwila, Sri Lanka
[*]chandrikaperera@agri.pdn.ac.lk

Analysis of Soil Organic Matter Content in Paddy Lands in the Kurunegala District of Sri Lanka

Kumararathna R.D.C.Y., Rathnayaka W.M.U.K.[1], Suriyagoda L. and Marambe B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Soil organic matter (SOM) is an important soil physical property to determine the land productivity for successful crop production. There is a growing concern to study the temporal and spatial variability of SOM in agricultural ecosystems. Kurunegala district is one of the main areas of paddy cultivation in Sri Lanka. This study assessed the variability of the SOM content in paddy lands in the Kurunegala district, covering the three climatic zones (wet, dry and intermediate), eight agro-ecological regions (AERs), eight soil types, three irrigation systems (major, minor and rainfed), four cropping patterns (rice-rice, rice-fallow, rice-other field crops, and rice -vegetables), and in 30 Divisional Secretariat Divisions (DSDs). Already collected 902 soil samples from the paddy lands within the Kurunegala district were used. Loss on ignition (LOI) method was used to analyze the SOM content. The highest average SOM content was reported from the paddy lands in WM3b (2.9%) and in immature brown loam soils (4.2%). Further, the highest average SOM content (3.1%) was reported in the Bingiriya DSD. There was no significant difference (*P>0.05*) in SOM in paddy lands in the Kurunegala district among the three climatic zones, irrigation systems, and the cropping patterns practiced. However, the SOM content in paddy lands in the Kurunegala district showed a significant difference (*P<0.05*) with the soil type, agro-ecological region and the DSD. The resulted also revealed that the SOM content in most of the paddy soils in Kurunegala district of Sri Lanka was not at a satisfactory level of 3%. These factors should be considered in fertilizer application and in other management practices in the paddy lands within Kurunegala District to improve the soil quality.

Keywords: Kurunegala district, Loss on ignition, Paddy soils, Soil organic matter, Spatial distribution

[1]Rice Research and Development Institute, Bathalagoda, Ibbagmuwa, Sri Lanka
[*]bmarambe@yahoo.com

Application of Hydrogel and Urea in Paddy Cultivation to Overcome Low Soil Moisture Stress and to Increase Fertilizer Use Efficiency

Dulangani, R.A.R., Ratnasekara, D.[1], Gunawardana, M.[2] and Marambe B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Soil moisture is an essential factor for urea hydrolysis and hence, water-limiting conditions would hinder the uptake of nitrogen by plants. Hydrogel can be used as a potential solution for this problem due to its ability to absorb significant amounts of moisture and uniformly release 95% of the stored moisture in dry soil conditions. Hydrogel can also release soil-dissolved nutrients slowly to the plants. However, application of urea could lower the efficiency of the hydrogel. Therefore, this study evaluated the efficacy of application of Hydrogel and urea in paddy cultivation under water deficit conditions. A pot experiment was conducted using *Oryza sativa* var. Bg300 as the test plant, in a completely randomized design with 6 replicates under greenhouse conditions. Treatments T1 and T2 were maintained without Hydrogel but with urea only (0 and 100% of recommended level, respectively). Treatments T3 to T7 consisted of Hydrogel incorporated into top 5 cm of soil at 1.5 g/kg soil dry weight, and urea mixed to the same soil depth at 0, 25, 50, 75 and 100% of the recommended level, respectively. All plants were subjected to moisture stress by complete withholding of irrigation at 25 days after planting (DAP). Plant growth and soil conditions were measured from 4 weeks after planting (WAP). The highest plant growth was observed in T7 and the lowest in T1. Nitrogen uptake efficiency (NUpE) was low in T1 and T2 and the highest in T3 ($P<0.05$). Similar NUpE was recorded in T4 to T7, which was higher than T1 and T2 but, lower than T3 ($P<0.05$). Hydrogel increased soil moisture levels and NUpE of paddy plants compared to the control, although urea reduced its moisture retention efficiency. Hydrogel could be an effective tool in conserving soil moisture and increasing NUpE in paddy cultivation under low moisture conditions.

Keywords: Hydrogel, Moisture stress, Nitrogen uptake efficiency, Urea

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[1]Faculty of Agriculture, University of Ruhuna, Sri Lanka
[2]Ceylon Graphene Technologies, Homagama, Sri Lanka
[*]bmarambe@yahoo.com

Assessment of the Effect of Inclusion of Hybrid Napier, Gliricidia and Pureria in Maize Silage

Jeromy K., Kumara Mahipala M.B.P.[*] and Weerasinghe W.B.M.P.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The influence of inclusion of hybrid Napier (*Pennisetum perpureum* x *P. americarnum* va. CO3), Pureria (*Pureria phaseoloides*) and Gliricidia (*Gliricidia sepium*) on the quality of maize (*Zea maize* cv. Veera) silage was assessed. The experiment was performed as a randomized complete block design with five forage inclusion levels in maize silage (0%, 27% Napier, 50% Napier, 29% Pureria, 40% Gliricidia) and two ripening periods (35 days, 45 days). Maize, Napier, Pureria, and Gliricidia had 23.54, 17.06, 18.40, and 27.49dry matter (DM) and 9.73, 8.04, 16.05, and 20.16 percent crude protein. Experimental silage bales (25 kg, 485-587 kg/m^3) were assessed for pH and DM, lactic acid, soluble carbohydrates, and ammonia nitrogen contents. The level of inclusion of forage and ripening period significantly ($P<0.05$) influenced silage quality. The DM content of 50% Napier included silage was significantly low (17.40% - 19.94%) and thus is not suitable. A very low level of soluble carbohydrate in Pureria and Gliricidia included silage at 45 days (0.24% and 0.26%, respectively) is an indication of the completion of ensiling before 45 days of ripening. Pure maize and 27% Napier included silage took 45 days to achieve the minimum acceptable level (10%) of lactic acid (10.25% and 18.11%, respectively). Corresponding with the lactic acid level, pure maize and 27% Napier included silage recorded low ($P<0.05$) pH at 45 days (3.24% and 3.45%, respectively). The ammonium nitrogen contents in Pureria and Gliricidia were higher at 45 days (0.327 and 0.132, respectively) probably due to the fermentation by clostridium. The study recommends the inclusion of Napier, Pureria, and Gliricidia in maize silage at 27%, 29%, and 40%, respectively. Further, the adoption of 45-day ripening period is beneficial for pure maize and 27% Napier included silage. However, 29% Pureria and 40% Gliricidia included silage should be ripened for only 35 days.

Keywords: Ammonia nitrogen, Dry matter, Lactic acid, pH

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[1]Veterinary Research Institute (VRI), Gannoruwa, Peradeniya, Sri Lanka
[*]pmahi@agri.pdn.ac.lk

Assess the Nitrogen Use Efficiency of Maize (Zea mays L.) Cultivated with Different Nitrogen Fertilizer Rates, Combinations, and Stabilized Methods

Kularathna A.G.P.D., Gunawardana M.[1] and Nissanka N.A.A.S.P.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Nitrogen use efficiency (NUE) of Maize cultivation is about 33%, and the remaining 67% of applied Nitrogen is lost, causing severe monetary loss and environmental pollution. Different Urea fertilizer rates combined with Urea stabilizers, Bio-char compound fertilizers, and super absorbent polymers (SAP) have the potential to enhance the NUE. A field experiment was conducted at the Experimental Station of the University of Peradeniya at Dodangolla to evaluate the growth and production of maize, Agronomic NUE (AE_N), and Ammonia emission under eight treatment combinations. There were four urea fertilizer rates (T1-0%; T2-75%; T3-100%; T4-125% of Department of Agriculture recommendation [DOA] of 315 kg/ha), two urea fertilizer rates amended with SAP (T5-100%; T6-75% of DOA), T7-75% DOA amended with DCD/NBPT, and T8-Bio-char compound fertilizer (Bio-Carbon Hybrid [BCH]). The DCD 15%, NBPT 30% commercially available stabilizer was used with the rate of 2 ml per 1kg of urea in the T7. The result showed that cumulative Ammonia Nitrogen loss was below 2% of the applied Nitrogen amount. The highest ammonia emission was observed in T2, T3, and T5. The T6, T7, and T8 reported more than a 50% reduction in Ammonia emission compared to T2, T3, T4, and T5. The DOA-recommended Nitrogen fertilizer rate amended with SAP (T5) gave the highest AE_N. There was no significant difference (p <0.05) in AE_N among T2, T4, T6, and T7. The green cob yield did not show a significant difference (p <0.05) among 100% (T2) 125% DOA recommendation (T3), 100% DOA recommendation with SAP (T5), 75% of recommended Nitrogen rate amended with DCD/NBPT (T7) and BCH (T8). Results suggest that the DOA-recommended urea rates could be reduced by 25% without yield reduction by amending urea with SAP, DCD/NBPT, and BCH.

Keywords: Agronomic efficiency of nitrogen, DCD, NBPT, SAP, Urea stabilizers

[1]Ceylon Graphene Technologies, Homagama, Sri Lanka
[*]spn@agri.pdn.ac.lk

Assessing Quality Variation of Tea and Ammonia Emission from Tea Fields with Different Fertilizer Management Methods

Thathsara.Y.K.R. and Nissanka N.A.A.S.P.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Nitrogen (N) is the main element of the tea sector that affects the tea yield. Fertilizer costs represent 8-12% in the tea sectors and the nitrogen use efficiency (NUE) of applied fertilizer in tea is less than 40% and the rest being lost to the environment. Therefore, it is essential to find ways to improve NUE while enhancing the green leaf production. This study was initiated to investigate the impact of different fertilizer mixtures on the productivity and quality of green leaves and the emission of ammonia. A field experiment was conducted in VP tea fields of TRI 2025 (*Camellia sinensis* L. (Kuntze)) in Diyanillakale Estate, Lindula, Nuwara-Eliya. Five fertilizer treatments (T1- No Nitrogen; T-2 TRI recommended 100% U709 (200kg /ha/3 months); T3-75% of TRI recommended nitrogen portion; T4-75% of TRI recommended nitrogen portion + CIC Bio-carbon Hybrid (40kg/acre/3 months); T5-75% of TRI recommended nitrogen portion + DCD+NBPT) were assessed. Growth and yield production of green leaves and ammonia emission was measured about three months after applying the fertilizer treatments in August 2022. Results showed that there was no difference (P>0.05) in Ammonia emission among treatments and the overall emission was around 2% of the total N applied. Cumulative green leaf production for the study was higher in TRI 100% (T2) and TRI 75% of N portion + CIC Bio-carbon Hybrid (T4) treatments. The SPAD meter readings were higher in TRI 100% treatment. There was no difference (P>0.05) in leaf Polyphenol content, leaf photosynthetic efficiency and Banji weight among treatments. Overall results suggest that N requirement could be reduced by 25% with amending the U709 with CIC Bio-carbon Hybrid.

Keywords: Nutrient use efficiency, Nitrogen losses, Tea, Tea Research institute, upcountry

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[*]spn@agri.pdn.ac.lk

Assessment of Diversity of Entomopathogenic Fungi Associated with Cabbage Caterpillars

Randunu U.D.S.S., Warnasooriya P.G.A.S.,* and Hemachandra K.S.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Biological control is a trending solution for insect pest control around the world. Use of entomopathogens as a biological control agent is recognized as a promising strategy. In Sri Lanka, research on entomopathogens is scant. Therefore, this research study was planned with the objective of identifying and determining the bio-efficacy of entomopathogenic fungal species associated with cabbage caterpillars. In order to fulfill this requirement a survey of cabbage ecosystems and a series of laboratory experiments were conducted. During the survey, *Metarhizium* sp. was identified in a sample collected from an ecological farm at Bandarawela as a potential biological control agent for cabbage caterpillars. The performance of the fungal species was evaluated by conducting a bioassay using cabbage cluster caterpillar (*Crocidolomia pavonana* (F.)). A pure culture of *Metarhizium* sp. was obtained and the fungal inoculum was prepared from spores harvested from two week old cultures. As treatments, three different concentrations of spore suspension; 1×10^2, 1×10^4, 1×10^6 spores/mL, and distilled water was used as a control. Five healthy second-instar larvae were used, each with four replicates. Direct spraying method and leaf dip method were used as application methods. In both application methods, all the spore concentrations gave significantly ($P<0.05$) higher mortality than the control. In direct spraying method, the spore concentration of 1×10^6 spores/mL produced 50% mean mortality, while lower concentrations produced lower mortality (20%). In the leaf dip method, a similar mortality trend was observed. The spore concentration of 1×10^6 spores/mL produced 65% mean mortality, while the lower spore concentrations produced 20% mortality. *Metarhizium* sp. significantly ($P<0.05$) reduced larval growth and the durations of larval instars and pupal stage. The research outcomes indicate that the entomopathogenic fungus *Metarhizium* sp. was pathogenic to cabbage caterpillars and has the potential to develop as a microbial pesticide.

Keywords: Bioassay, Cabbage caterpillars, Entomopathogens, *Metarhizium* sp., Mortality

*ayeshasw@agri.pdn.ac.lk

Assessment of Major Reproductive Disorders of Dairy Cattle in Vavuniya Veterinary Range

Kabiluxan P. and Wijayagunawardane M.P.B.[*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

A study was conducted to assess the prevalence of major reproductive disorders and to evaluate the reproductive performance of dairy cattle in the Vavuniya veterinary range. Out of 924 dairy cows that were investigated, 193 cows (20.89%) had encountered at least one major reproductive disorder. Repeat breeding (8.66%), abortion (5.41%) and dystocia (3.57%) were recorded with high prevalence, whereas retained fetal membrane (1.62%), stillbirth (1.41%), and uterine and vaginal prolapse (0.22%) were recorded with lower prevalence. The overall incidence of reproductive disorders showed statistical significance ($P<0.05$) with respect to the age of the animals and production system. There was no statistically significant difference in the incidence of reproductive disorders with respect to the breed of the animals. The prevalence of reproductive disorders in the semi-intensive system (23.14%) was higher than in the extensive system (11.05%). Moreover, the prevalence was higher in 5-7 years (34.68%) than in 3-5 years (28.40%), and 7 years (25.83%) age groups. The overall mean±standard deviation for age at first service, calving to first service interval, calving to conception interval and calving interval were 27.05±5.58 months (n=90), 52.30±14.86 days (n=240), 109.62±29.70 days (n=240) and 13.02±1.16 months (n=165), respectively. The first service conception rate was 28.75% (n=240). In conclusion, it can be recommended that the improvement in the management system, proper selection of bull or timing of AI, accurate heat detection, routine and periodical reproductive examinations of cows have to be conducted to minimize the incidence of reproductive disorders and associated risk factors.

Keywords: Dairy cattle, Reproductive disorders, Vavuniya

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[*]missaka@agri.pdn.ac.lk

Assessment of the Diversity of Selected Jackfruit (*Artocarpus heterophyllus* Lam.) Accessions in Gannoruwa and Horana Field-Gene Banks

Wijekoon H.M.B.A., Sirimalwatta V.N.S.[*] and Thamali K.I.S.

Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Jackfruit (*Artocarpus heterophyllus* Lam.) is a tropical, evergreen tree that belongs to the family Moraceae. Mainly it is grown in Asian, African, and South American regions of the world. Jackfruit needs minimum inputs and thrives well in marginal environments making it an ideal crop to cater to the increasing demand for food with the population expansion, yet it is an underutilized crop in Sri Lanka. Identification of accessions with elite characters is important to select superior cultivars. Hence, this study was conducted to explore the diversity of selected jackfruit accessions in Gannoruwa and Horana field genebanks using morphological and molecular characters and to check the suitability of jackfruit across Sri Lanka. Morphological diversity was assessed by scoring seven traits. The Principal Component Analysis (PCA) of morphological data was conducted in R programming language. More than 40% variation existed between the first two principal components. A dendrogram with nine clusters was obtained for the selected 21 accessions. PCR primers for four genes (*adh1, AMY1, G3pdh,* and *PEPC*) were designed using the jackfruit genome sequence available in the Online Resource for Community Annotation of Eukaryotes (ORCAE) database. One accession from each cluster was then used for molecular characterization. The Polymerase Chain Reactions (PCR) were done to *adh1, rbcL,* and *matK* gene regions. But all the PCR failed thus, molecular characterization was discontinued. The suitability of the environment was tested using ENMTools implemented in the R program. This study showed the selected jackfruit accessions possess sufficient morphological diversity, hence, nine clusters were obtained. All of Sri Lanka seems fairly suitable for the cultivation of jackfruit. For future direction, it is suggested to carry out an analysis of genetic diversity by optimizing the DNA extraction protocol and using better molecular markers. The morphological dataset must be expanded by including more useful characters.

Keywords: Cluster dendrogram, Genetic diversity, Jackfruit, Molecular data, Morphological data

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[*]nipuni.siri@agri.pdn.ac.lk

Assessment of Yield Trends of Major Rice Varieties in Different Locations in Sri Lanka

Sudusinghe S.K.M.N. and Suriyagoda B.M.L.D.B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Grain yield of rice in Sri Lanka has increased from 1.5 t ha^{-1} in the 1950s to 4.3 t ha^{-1} in 2010, and this is mainly due to the improved management and genetic makeup of the rice crop. Despite this increase, the rate of increase in productivity has declined or almost plateaued in recent years. It is not yet clear whether the improved management over the years has significantly affected on improving grain yield of rice. In order to test this, data collected from one rice variety grown continuously over the years in one location is needed. Therefore, this study was conducted to test the effect of improved management on improving grain yield of rice in Sri Lanka. Data were collected from the check/standard varieties (i.e. Bg300, Bg352, Bg358 and At362) used in the National Coordinated Rice Varietal Trials (NCRVT) available at the Rice Research and Development Institute (RRDI) at Batalagoda, Sri Lanka. Data on yield, planting date, harvesting date and weather for crop duration were recorded from 1998 to 2020 for both *Yala* and *Maha* seasons. Results revealed that the productivity has not changed over the years in most of the locations, seasons, or varieties, with few exceptions, i.e. over the years, productivity has decreased in Ambalanota and Sammanthurai, increased in Girandurukotte, Bentota, and Labuduwa, and shown both changes in Bombuwala. The average seasonal maximum temperature, average seasonal temperature difference, and total seasonal rainfall were found to have significant positive correlations with crop productivity. In contrast, the average seasonal minimum temperature had a negative correlation with crop productivity. Results of this study indicate that the crop management practices adopted with time have not affected to improve rice crop productivity. Therefore, it is necessary understand promising crop management practices to improve crop productivity and break the yield stagnation in rice.

Keywords: Productivity, Rainfall, Temperature

Crop data were obtained from the Rice Research and Development Institute, Batalagoda, and weather data from the Natural Resources Management Centre of the Department of Agriculture

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[*]lalith.suriyagoda@agri.pdn.ac.lk

Bioaccessibility of Lead in Organic Amendments and Lime Incorporated Acidic Soil

Rajapaksha N.M.P.M. and Attanayake C.P.[*]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Lead (Pb) is one of the most common contaminants in soils. The most significant transfer pathway of Pb from soils to humans is via direct soil ingestion, which can be assessed by in-vitro bioaccessibility tests. Incorporation of organic amendments and liming materials has shown potential to reduce Pb bioaccessibility in soils. This study evaluated the effectiveness of incorporating organic amendments and $CaCO_3$ on reducing the bioaccessibility of Pb in an acidic soil. The field experiment was conducted in Hawa Eliya (6.968263°N,80.787415°E). The amendments were arranged in randomized complete block design with 4 blocks. The risk of direct ingestion of soil Pb was assessed by the standard simplified physiologically based extraction test at pH 2.5. Soils were passed through 250μm sieve prior to analysis to represent the fine soil fraction that could adhere to skin and potentially transfer to humans via soil ingestion. Initial total Pb concentration ranged from 98 to 296mg/kg and the initial pH of the soil was 6.25. The amendments were diluted soil total Pb concentration by 5 to 20% when compared with the unamended control. The bioaccessible Pb concentration of the soil was low and ranged from 1 to 3.5 mg/kg and it was 1.5 to 5% from the total Pb concentration. None of the amendments significantly ($P<0.05$) reduced the bioaccessible Pb concentration, but lime-added soils had the lowest bioaccessible Pb, which was 48 to 50 times lower than the control. A significant negative correlation was observed between bioaccessible Pb concentration and pH of the remaining soil-gastric after the in-vitro extraction. Lime reduced the acidity of the gastric solution and consequently it reduced the bioaccessible Pb. Incorporation of lime had potential to reduce the transfer of soil Pb to humans via direct soil ingestion.

Keywords: Bioaccessibility, Lead, Lime, Organic manure, Soil ingestion

[*]chammiatt@agri.pdn.ac.lk

Can Inhibition of Soil Nitrification Increase Potato Crop Growth in an Ultisol Under Plant-house Conditions?

Ranabahu S.A., Dandeniya W.S. [*], Nissanka S.S.P.[1] and Abethilakerathne P.D.[2]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

A study was conducted to assess the effect of nitrification inhibition on potato crop growth and nitrate leaching from the soil under plant-house conditions. First, cinnamon leaf powder (CLP), cinnamon oil (CO), Venivelgeta powder (VP) and dicyandiamide (DCD) were added separately to a soil (Ultisol soil order) collected from a potato grown field and their impact on potential nitrification rate (PNR) was assessed. Application of CLP resulted in significantly ($P<0.05$) low PNR (1.12 µg/ml/day) followed by VP (6.84 µg/ml/day) and CO (10.46 µg/ml/day). Comparable PNR were observed for the DCD-applied treatment and soil-only control (13.30 and 12.01 µg/ml/day, respectively). Secondly, a pot experiment was conducted in a plant house in Nuwara-Eliya, where potato was grown with seven N-treatments; zero urea (T1), urea applied at 100% recommended rate (T2), T2+DCD (T3), T2+CLP (T4), T2+VP (T5), and T2-25% urea (T6) T2+25% urea (T7). Leachates was collected from pots after each irrigation event that allowed free drainage and measured for NO_3^- concentration. At 70 days after planting crop was harvested and yield and plant dry-biomass were recorded. Cumulative NO_3^- leached was significantly ($P<0.05$) different between treatments and the lowest was observed in T1 (29.4±1.25 mg). Cumulative NO_3^- leached from T3 and T4 were comparable to T1. The highest values were observed for T2 (45.7±3.47 mg) and T7 (46.9±3.54 mg). Potato yield was significantly affected ($P<0.05$) by treatments. The highest yield was recorded in T4 (311±4.1g) and the lowest was in T3 (203±20.7g). Potato yields for T7 (287±29.1g) and T5 (253±29.1g) were comparable. Results indicated that the CLP, VP, and CO are effective in suppressing nitrification in the studied potato-grown soil while DCD did not show strong effective nitrification inhibition. Further, CLP was effective in improving growth of potato.

Keywords: Cinnamon, DCD, Nitrification inhibitors, Venivelgeta

[1]Dept. of Crop Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[2]Agricultural Research Station, Seetha-Eliya, Sri Lanka
[*]warshisd@agri.pdn.ac.lk

Can Intercropping Maize with Mung Bean Provide Sufficient Nitrogen to Maize When Inorganic Nitrogen Supply is Reduced by 50%?

Rambadagalla R.T. and De Costa W.A.J.M.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

An adequate Nitrogen (N) supply is a requirement for maize to achieve its yield potential. Recent shortages of inorganic nitrogen fertilizer in Sri Lanka have prompted search for alternative means of nitrogen supply to maize crops. Intercropping with a legume is one such pathway, as the nitrogen fixed via biological fixation could be made available to maize. Study was conducted to determine whether intercropping maize with mung bean could compensate for a reduced supply of inorganic nitrogen. The field experiment was done at the Dodangolla Experimental Station during *Maha* 2022-23 in a randomized complete block design in three blocks. Maize was cultivated as the main crop in sole and mixed stands with mung bean, at 100% and 50% of recommended external nitrogen levels. At 50% flowering of maize (two months after planting) soil available nitrogen (NO_3^- fraction) and leaf nitrogen concentrations were significantly ($p<0.05$) greater in intercropped plots at 50% nitrogen levels, compared to sole maize with 50%N. Total nitrogen uptake of intercrops at both N levels was not significantly different from their respective sole crops at 50% flowering of both crops and it was significantly lower at 50%N in both stands. Intercrop maize yield was not significantly ($p>0.05$) different from its respective sole crop yield at both N levels. Reduction of N supply reduced maize yield in both crop stands. Similar patterns were observed for total plant biomass of maize at one and two months after planting. The intercrops had land equivalent ratios of 1.19 (100%N) and 1.21 (50%N) which demonstrated an increased land productivity at both N levels. This additive population mixtures of intercropping increases land productivity, even at sub-optimal external nitrogen supply. Continuous intercropping of maize with mung bean over several seasons may ultimately compensate for the yield loss due to reduced nitrogen supply.

Keywords: Legume-maize intercropping, Nitrogen availability, Nitrogen fixation, Nitrogen in plants, Nitrogen quantification

[*]janendramg@agri.pdn.ac.lk

Can Moisture Content Affect the Growth, Bioconversion Performance and Nutritional Quality of Black Soldier Fly Larvae Reared on Different Substrates?

Perera L.R.N., Perera W.N.U.[*], Weththasinghe P., Jayasinghe W.H.[1] and Perera W.L.B.[2]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Black soldier fly larvae (BSFL) are a potential feed ingredient, because of their high protein and fat contents. Considering the critical impact of substrate moisture content (MC) on BSFL production, the effect of substrate MC on performance and nutritional quality of BSFL reared on various substrates was evaluated. This study was composed of two experiments (Exp.1 & Exp. 2). In Exp. 1, BSFL were reared on five substrates; layer chicken feed (control), cattle manure, poultry manure (PM), swine manure, and vegetable waste (VW), and four MCs; 45%, 65%, 75%, and 85%. Based on the bioconversion performance of Exp. 1., two optimum substrates; VW and PM, and two optimum MCs; 75% and 85% were selected for Exp. 2. Subsequently, five substrate compositions (0%VW+100%PM, 25%VW+75%PM, 50%VW+50%PM, and 75%VW+25%PM, 100%VW+0%PM) were prepared. Two MCs (75%, and 85%) were maintained to evaluate varying MC on different substrate compositions for rearing BSFL. Both experiments were conducted as two-factor factorial, completely randomized designs (Three replicates/treatment and 80 BSFL/replicate). Based on the results of Exp. 2, the bioconversion of substrates by BSFL and total pre-pupal weight per replicate were higher (P<0.05) in 85% MC than 75% MC for all substrate combinations except 0%VW+100%PM. Despite the lower amount of provided total nitrogen through the substrate, a higher (P<0.05) nitrogen conversion ratio was reported for 100%VW+0%PM. Based on the results, the optimum substrate composition and MC for BSFL production were 100%VW+0%PM and 85%, respectively. Hence, this operation would be most profitable to be practiced in a vegetable-livestock integrated farming system allowing the utilization of VW to produce a valuable protein source for feeding animals.

Keywords: Bioconversion, Black soldier fly larvae, Crude protein, Moisture content, Substrate compositions

[1]Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[2]New Bernards Animal Feeds (Pvt) Ltd, Newakade road, Udubaddawa, Sri Lanka
[*]nipunap@agri.pdn.ac.lk

Characterization of Yard Long Bean [*Vigna unguiculata* ssp. *Sesquipedalis*] Germplasm for Future Breeding Programs

Kapukotuwa R.M.P.U.B., Eeswara J.P.,* and Edirisinghe S.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Yard Long Bean (*Vigna unguiculata* ssp. *sesquipedalis*) belonging to family Fabaceae is a very popular leguminous vegetable crop grown and consumed in Sri Lanka. Plant Genetic Resources Centre (PGRC) at Gannoruwa, Peradeniya has conserved 728 accessions of yard long bean (YLB) in Sri Lanka. This experiment was conducted at the open field of PGRC, Gannoruwa, Peradeniya to characterize 42 uncharacterized accessions and one recommended variety; Gannoruwa A9 was used as the check variety with reference to characterization catalogue of YLB (PGRC, 1999). The characterization catalogue has a 29 qualitative and quantitative morphological character list. According to the results, only 19% were dwarf and 81% showed twining growth habit with four types of twining variations. Accession 19 had the minimum number of days for floral initiation and accession 1605 showed the minimum days for harvesting of green pods. Accessions 1094, 1141, 2352, 289, 1165 and 1298 had red to violet colour pods and 29% of the accessions had variegated pods. Gannoruwa A9 showed maximum values when considering pod length, pod width and pod weight. There were only three types of seed shapes as Kidney (74%), ovoid (17%) and Rhomboid (9%). The accession 1094 had the maximum value for hundred seed weight. The dendrogram obtained using morphological characters separated four major clusters at the distance of 1.5. The first cluster contained only 3 accessions 1356, 344, 1150. The second cluster contained 7 accessions. The third cluster was the largest with 30 accessions. And the fourth cluster was the smallest with only 2 accessions; Gannoruwa A9 and accession 689. According to the results obtained for Principal Component Analysis (PCA) at least 10 PCs were required to explain 78.9%-character variation among accessions. These results are very much important for systemic germplasm conservation and utilization of prominent traits for crop varietal improvement programs.

Keywords: Accession, Crop improvement, Diversity, Morphological characters, Yard long bean

[1]Plant Genetic Resources Centre, Gannoruwa, Sri Lanka
*jpeeswara@agri.pdn.ac.lk

Co-inoculation of Arbuscular Mycorrhizae Fungi (AMF) and Phosphate Solubilizing Bacteria (PSB) to Enhance Growth and Yield of Potato (*Solanum tuberosum* L.)

Ariyasena G.G.D.K., Rajapaksha R.M.C.P.[*] and Edirisinghe E.S.S.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Potato is a main tuber crop grown in soils with high phosphorous (P) reserves in the up country of Sri Lanka. A field experiment was conducted to assess the effectiveness of seed inoculants of Arbuscular Mycorrhizal Fungi (AMF) and Phosphate Solubilizing Bacteria (PSB) in mobilizing of P reserves from soils in a randomized complete block design with seven treatments; no fertilizer (T1), recommended NPK fertilizers (T2), recommended N+K+½P (T3), T3+PSB (T4), T4+AMF strain 1 (T5), T4+AMF strain 2 (T6), T4+AMF strain 3 (T7) with three replicates. Plants were uprooted in 6 weeks after planting (WAP) and 9 WAP. Shoot, root and tuber weights were recorded at both sampling whereas tissue N, P and Zn concentrations and root infection of AMF were assessed at 6 WAP. Tissue P content was significantly higher in T5 (1517 g/kg) than in T2 (1190 mg/kg). Treatment with only PSB showed a significantly higher Zn accumulation in tissues (47.8 mg/kg) than in all other treatments (6.5-36.0 mg/Kg). Inoculation of AMF resulted in significantly higher root infections of hyphae (74 -79%) and arbuscules (24 - 37%) than non-inoculated treatments (15-56 % and 2-14%, respectively). Significantly higher shoot dry weights were reported in T5 (52.7g) than in T2 (33.4g) at 9 WAP. Tuber weights per plant was significantly higher in T5 (162 g) than in other (99-146 g) at 6 WAP but on par with T2 (T2=421 g; T5=423 g) at 9 WAP. Correlation analysis indicated that tuber weights depend on tissue P (r=0.60, P<0.05), tissue Zn (r=0.66, P<0.01), hyphae infection (r=0.67, P<0.01) and shoot (r=0.67, P<0.01) and root (r=0.63, P<0.01) weights. Results suggest that co-inoculation of AMF strain 1 and PSB could effectively enhance P and Zn uptake and thereby growth and yield of potato irrespective of 50% cut down of TSP.

Keywords: Arbuscular mycorrhizae fungi, Phosphate solubilizing bacteria, Phosphorous, Plant uptake, Potato

[1]DIMO Plantchem (Private) Limited, Plantseeds (Private) Limited, No: 01, Industrial Zone, Dambadeniya, Sri Lanka
[*]chandir@agri.pdn.ac.lk

Compare the Impact of Oil Palm and Rubber Cultivations on Soil Physical Properties

Lakshan K.U., Vidana Gamage D.N.[1] and Nissanka N.A.A.S.P.[*]
Department of crop science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Oil palm and rubber are major plantation crops in Sri Lanka. Oil palm has been cultivated in the Low-Country Wet-Zone region of Sri Lanka. However, in 2021 government banned the cultivation of oil palm due to the complains made by the public indicating that oil palm cultivation depletes soil properties, biological diversity, and water table without any scientific evidence. Thus, this experiment was conducted to investigate the impact of 10-12 years old oil palm and rubber-cultivated lands in Nakiyadeniya and Sapumalkanda estates on soil properties. Soil physical properties of two soil depths (0-15 and 15-30 cm) from 3m (inter-raw spacing) and 1m distance from the tree bases of representative oil palm and rubber trees were assessed. Soil samples taken from 1m away from the tree-base showed that the dry-aggregate stability was higher in oil palm compared to rubber lands (P<0.05). However, the wet aggregate stability, hydraulic conductivity, gravimetric water content at saturated level, gravimetric water content in field capacity, volumetric water content in saturated and volumetric water content in field capacity, organic carbon content, and bulk density were not significantly different (P>0.05) between tree types. Soil properties of inter-rows indicated that, dry aggregate stability, gravimetric water content at saturated level, and volumetric water content at saturated level were greater in Oil palm (P<0.05), but the wet aggregate stability, hydraulic conductivity, gravimetric water content at field capacity, volumetric water content in field capacity, organic carbon content, and bulk density were not significantly different (P>0.05) between tree types. Overall, it could be concluded that, except the lower dry aggregate stability in rubber, all other soil physical properties were similar in oil palm and rubber-cultivated lands of the age category of 10-12 years old, where optimum canopy coverage could be observed.

Keywords: Bulk density, Hydraulic conductivity, Oil palm, Organic carbon content, Rubber

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[1]Department of Soil Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]spn@agri.pdn.ac.lk

Comparison between Three and Four Rounds of Tea Harvesting per Month: The Case of Annfield Estate, Hatton

Karunathilaka P.M.P.P. and Hitinayake H.M.G.S.B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Different tea estates practice different harvesting intervals ranging from seven to ten days. Harvesting operation have a high impact on the productivity of a tea land, the cost of production and the quality of harvested leaf. The objective of the present study was to compare three to four rounds of harvesting of tea per month. Two factor factorial was used as the experimental design. Those two factors were plucking frequency (7 and 10 days) and cultivars of tea (DYN, DT1, N2, and Old Seedling Tea). A schedule was made and data of leaf yield, leaf standard, and severity of plucking and total cost was calculated. Results showed that monthly leaf yield is higher under 10 day plucking interval than 7 days plucking interval in both October and November months. However, the gap tends to get narrower in November month. This can be attributed heavy rain occurred in November month and the fact that the estate has been practicing 9 day plucking interval. When consider leaf standard as fine plucking, it was significantly higher in October month with 7 day interval when compared to 10 day interval. But the differences were non-significant in November. However, when we consider fine and medium plucking together (*i.e.,* good leaf standard) mean differences in leaf standard was non-significant even in October. This could be attributed to heavy rains occurred during November where the yields were dropped significantly. The drop was high as 60% with some cultivars. When consider the monthly cost, 10 day harvesting cost was significantly higher than 7 day harvesting cost among all cultivars except OST during October. This study shows some insights about the impact of changing plucking intervals on the green leaf yield and cost of harvesting. A long-term study is required to understand the yield differences under different harvesting intervals.

Keywords: Number of plucking, Plucking interval, Plucking standard, Tea harvesting

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[*]gaminih@pdn.ac.lk

Comparison of Broilers and Naked-Neck Indigenous Chickens: Influence of Black Soldier Fly Larvae as a Protein Supplement Replacing Soybean Meal in Poultry Diets on Growth Performance, Protein Digestibility, Meat Quality and Intestinal Morphometry

Wijethunga W.T.S., Perera W.N.U.,[*] Silva G.L.L.P., Perera W.L.B.,[1] and Wickramasuriya S.S.[2]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The influence of three levels of black soldier fly larvae (BSFL) inclusion (0, 15 and 30% of soybean meal [SBM]) was tested for Cobb-500 broilers and naked-neck (NN) indigenous chickens in a 2×3 factorial arrangement. Isoenergetic and isonitrogenous experimental diets were formulated to meet the nutrient requirements by Cobb-500 for the grower (14-21d) and finisher phases (22-35d). A total of 7d-old 180 birds (90 broilers and 90 NN) were randomly distributed into 30 cages (five replicates/treatment, six birds/replicate). Birds were acclimatized for live feeding of BSFL from 7 to 14d and fed experimental diets from 14 to 35d. Based on growth performance (14 -35d), the responses of body weight gain (BWG), and feed conversion ratio (FCR) to bird type interacted with BSFL inclusion level (P<0.05). Both BWG and FCR of Cobb-500 were higher in 0% and 15% BSFL compared to 30% BSFL in the diet. However, BWG of NN was not influenced by the increasing dietary inclusion of BSFL. Compared to the control diet (100% SBM), BSFL inclusion at 15 and 30% of SBM increased the FCR of NN. Comparing only Cobb-500 broilers, the apparent ileal crude protein digestibility was higher (P<0.05) in 30% BSFL than in the control diet. Irrespective of the bird type, 15% and 30% BSFL reduced the gizzard pH (P<0.01) compared to the control. Considering meat quality, water holding capacity was not influenced by tested parameters (P>0.05). Cooking loss was influenced by both bird type and BSFL inclusion level (P<0.05). The relative weights of heart, liver and gizzard were higher (P<0.05) in NN compared to broilers. Based on growth performance, BSFL could replace up to 15 and 30% of SBM for broilers and NN, respectively, without comprising the BWG.

Keywords: Black soldier fly larvae, Broiler, Cobb-500, Growth performance, Naked-neck

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[1]New Bernards Animal Feeds (Pvt.) Ltd, Newakade Road, Udubaddawa, Sri Lanka
[2]Animal Bioscience and Biotechnology Laboratory, United States Department of Agriculture, Agricultural Research Service, Beltsville, MD 20705, USA
[*]nipunap@agri.pdn.ac.lk

Comparison of Processed Waste Coir Fiber Based Growing Media for Young Plant Propagation of Selected Greenhouse Vegetable Crops

Manodya J.A.U., Weerakkody W.A.P.[*], Gunasena A.[1]
and Samita S.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The present study was carried out under greenhouse conditions at Jiffy Pvt. Ltd., Kobeigane, Sri Lanka (IL_3). Plant growth performance of three vegetable species (*Solanum melongena L., Solanum lycopersicum* L., and *Capsicum annuum* L.) in three different substrates, comprised of processed waste coir fiber (2 mm) + standard coir fiber pith (20%:80%) (T1), processed waste coir fiber (2 mm) + standard coir fiber pith (40%:80%) (T2), and standard coir fiber pith medium (T3-control) were investigated. The plant growth and substrate parameters were measured. Results showed that particle composition in the substrate treatments affected the morphological traits and the plant growth rate. The germination percentages of each of the three crop species grown in the three treatment mixtures were not significantly different ($p > 0.05$). During the majority of the weeks, all three crop species grown in T1 and T3 growing media showed significantly higher ($p < 0.05$) plant growth with respect to shoot length, fresh weight, plant dry matter, and also without showing any deficiency symptom. The mixture, T2 showed lower plant growth while resulting in leaf yellowing. The overall results indicated that the growth performance of T1 and T3 growth media was not significantly different ($p > 0.05$), and the performance of T2 was significantly ($p < 0.05$) lower than T1 and T3 media. Hence, growth media T1 could be selected as a cost-effective alternative growth media to replace the standard coco peat medium used for raising hydroponic vegetable crops at a reduced cost of cultivation.

Keywords: Coco pith, Greenhouse vegetables, Particle composition, Processed waste coir fiber

[1]Jiffy Pvt. Ltd, Mirigama Export Processing Zone, 31A, Mirigama, Sri Lanka
[*]wapweerakkody@agri.pdn.ac.lk

Comparison of Yield and Quality Parameters between Organically and Conventionally Grown Tea

Madusanka M.W.N.[1], Rathnayaka, R.A.A.S.[2], Mohotti K.M.[3], Sivananthawerl, T.[1] and Mohotti A.J.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Tea yield and made tea quality may be different in organic and conventional systems due to different inputs and quantities. This study was conducted in the *Uva* region of Sri Lanka on organically and conventionally managed smallholder and medium/ large tea estates during September to December 2022. Monthly yield records from 2016 to 2022 (except December 2022) were collected from the selected tea lands. The percentage of shoots containing a *banji* apical bud with a single adjoining leaf and shoots containing an active apical bud with two or three adjoining leaves were considered as the plucking standard. Sensory evaluation was conducted by five independent, professional tea tasters and samples were rated based on infused leaves, colour, strength, quality, and flavor of the liquor. Total nitrogen content of the made tea was determined using Kjeldahl method. Data were considered as a nested factorial (cultivation system and land category). Parametric data were analyzed by repeated measures ANOVA and sensory evaluation data were analyzed using Friedman's test. Results showed that the conventional smallholder fields had consistently, significantly higher ($p < 0.05$) yields, followed by organic smallholders. Further, the yields of medium/ large scale plantations in both cultivation systems were not significantly different ($p < 0.05$) from each other, but lower than the smallholders of both systems. Large/ medium scale and smallholder organic farmers maintained a significantly higher ($p < 0.05$) plucking standard compared to all conventional farmers. The total nitrogen contents of the made tea from conventional system were significantly higher ($p < 0.05$) than in organic system. The ratings of the tea taster's evaluations were inconsistent between the cultivation systems, but dust-1 grade of conventional and BOP of organic lands had consistently higher ratings from the tea tasters.

Keywords: Conventional, Organic, Plucking standard, Tea, Tea taster's evaluations

[1]Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

[2]Department of Agricultural Engineering and Soil Science, Faculty of Agriculture, Rajarata University of Sri Lanka

[3]Tea Research Institute, Thalawakele, Sri Lanka

[*]mohottij@agri.pdn.ac.lk

Crop Productivity and Irrigation Water-Use efficiency of Rice Cropping Systems in Sri Lanka

Wijesooriya S.S. and Suriyagoda B.M.L.D.B.[*]
Department of Crop Science,
Faculty of Agriculture University of Peradeniya, Peradeniya, Sri Lanka

Rice (*Oryza sativa* L.) is the staple food for Sri Lankans as well as for more than two-fifths of the world's population. Rice is grown in all the districts in Sri Lanka with varying productivity and cultivation extents. Even though, rice crop productivity and the cultivation extent over the years have changed, the degree of change in the recent past has not been studied. Therefore, this study was conducted with the objectives of (i) examining the trends of rice crop productivity and harvested extent over the years in different districts of Sri Lanka, and (ii) estimating the irrigation water-use efficiency of rice cropping systems in *Mahaweli* areas in Sri Lanka. Crop productivity and harvested extend data from different districts, seasons, and water management schemes in Sri Lanka during the period from 1979-2021 were used. Irrigation water-use efficiency of rice was calculated for *Mahaweli* systems B, C, H, and *Udawalawa* for *Yala* and *Maha* seasons for the period from 2014-2020. Results revealed that, rice crop productivity has increased significantly with time. Productivity increment ranged from 10.2-50.5, 13.6-56.2, 11.1-54.9 kg ha^{-1} year^{-1} for *Maha* season, and –104.3-65.2, 22.1-57.4, 10.5-63.1 kg ha^{-1} year^{-1} for *Yala* season, respectively for major, minor and rainfed water management systems. Harvested extend increased in the range of (–10.7)-798.6, (–113.1)-606.3, (–285.1)-369.3 ha year^{-1} for *Maha* season and (-7.7)-818.5, (–88.7)-367.2, (–359.4)-19.8 ha year^{-1} for *Yala* season, respectively for major, minor and rainfed water management systems. Irrigation water-use efficiency in *Maha* season resulted higher value (0.45 kg m^{-3}) than that in *Yala* season (0.32 kg m^{-3}). *Mahaweli* system 'H' had the highest (0.38 kg m^{-3}) irrigation water-use efficiency during *Yala* season. This information would be useful when making administrative decisions when improving rice farming and Agriculture sector in Sri Lanka.

Keywords: Efficiency, Extent, Harvested, Productivity, Rice

[*]lalith.suriyagoda@gmail.com

Determination of Optimum Stocking Density for Pearlspot (*Etroplus suratensis*) (Bloch. 1790) for Aquarium-Keeping

Jayasundara R.P.E., Athauda A.R.S.B.[*], Walpita C.N.[1] and Mudalige A.R.[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

In ornamental aquaculture, best stocking densities of a species for aquarium keeping is needed in order to maintain a better survival of aquarium fish. Pearlspot (*Etroplus suratensis*) is a popular food fish. Its' vibrant colors and similar shape to "discus" fish make them a formidable candidate for aquarium keeping, though no studies were done in this regard. The aim of this study was to estimate optimal stocking density for pearlspot in captive conditions. The effects of 3 stocking densities were evaluated on growth and survival during 50-day experimental period in captivity. The experiment had 3 stocking densities as: Low Stocking Density (LSD- 0.13 fish/L), Medium Stocking Density (MSD-0.16 fish/L) and High stocking density (HSD-0.2 fish/L) in triplicates. Adult fish (total length range from 8.11±0.35 cm to 11.8±0.67 cm) were stocked in experimental tanks (Length*Breadth*Height: 86*70*25 cm) and fed with a commercial diet containing 40% crude protein. Survival Rate (SR) and growth parameters such as body weight gain (BWG), body length gain (BLG), average daily weight gain (ADWG), average daily length gain (ADLG) and specific growth rate (SGR) were calculated during the experiment period. The experimental design was Complete Randomized Design. The result of BWG, ADWG and SGR were significantly different ($P< 0.05$) among treatments. The BLG and ADLG were not significantly different ($P<0.05$) among treatments. The Highest BWG was reported by fish raised at HSD (2.27±0.45 g) than MSD (1.64±0.64 g) and LSD (1.20±0.899 g). There were no mortalities found in any experimental tanks, hence, the survival rate for all the treatments was 100%. The result from this study revealed that the stocking density of 0.2 fish/L can be used as the optimum stocking density for rearing pearlspot in tanks under captivity and this can be further studied to introduce pearlspot as an aquarium fish.

Keywords: Aquarium fish, *Etroplus suratensis*, Growth, Stocking density, Survival

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[1]Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, PO Box 02, Belihuloya, Sri Lanka
[2]National Aquaculture Development Authority of Sri Lanka, Aquaculture Development Center, Dambulla, Sri Lanka
[*]sbathauda@agri.pdn.ac.lk

Development of an Acclimatization Medium for Tissue Cultured Dendrobium Orchid Plants

Kapuhennayake K.M.L.K.[*] and Eeswara J.P.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Floriculture sector is the one of the popular sectors all over the world. Cut flowers, bedding plants, potted plants, cut foliage dried flowers are major product in floriculture sector. Sri Lankan cut flower industry has a limited type of flowers. Orchid flowers have high demand in the Sri Lankan floriculture sector. Among orchids dendrobium is one of the potential cut flowers in flower industry. It is belonging to family Orchidaceae which is mainly use for decorative purposes. There are number of colors and hybrids. However, unavailability of quality planting material is the major constraint for its use among the local growers. Success of in vitro propagation experiment based on plant material which can tolerate adverse condition. Therefore, efforts were mainly focused on the production of in vitro plants, which show higher survival rate in the field condition. This study was undertaken to find out the best acclimatization medium for tissue cultured dendrobium orchid plants. The effect of different acclimatization media including, charcoal (T1), charcoal: brick (1:1) (T2), Charcoal: brick: coconut chips (1:1:1) (T3), and metal chips: coir dust (1:1) (T4) on tissue cultured dendrobium orchid plants were investigated. Plants were placed inside the propagator. Two weeks after planting acclimatization was done by gradually opening the polythene covers. Then two months after planting plants were remove from the propagator and placed inside the plant house. The highest survival rate (65%) as well as most of the growth parameters was observed in the charcoal: brick (T2). Therefore, charcoal: bricks (1:1) (T2) can be recommended as the best medium for the survival of the plants after acclimatization.

Key words: Acclimatization medium, Dendrobium, Floriculture, Orchids

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[*]jpeeswara@agri.pdn.ac.lk

Do Tea Plants Physiologically Benefit from The Shade Cast by Shade Trees? A Case Study from the Mid-Country Wet Zone in Sri Lanka

Makuloluwa M.W.L.B., Hitinayake G.S.B. and Benaragama C.K.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Sri Lanka

Shade trees in tea lands are expected to provide required shade levels to tea plants. Shade cast by shade trees supports several physiological processes that help tea maintaining its health, yield, and quality of the finished product. The effect of shade on changes in physiological processes in various plants is well documented. Therefore, in the present study, we hypothesized that shade alters the physiological process of tea plants. To test the hypothesis, two tea fields from an estate in the mid-country wet zone with high- and medium-shade trees were selected for the study. On bright sunny days, the shade-cast area was measured and modeled in the East-West direction in the morning, noon, and evening. Four points in the shade-cast area and two points from the un-shaded area were selected, and the light intensity and the spectrum in the range of 320-850 nm were measured using a spectroradiometer. At each point, the chlorophyll content (Ch. A, Ch. B., and Total chlorophyll) was also measured spectrophotometrically and soil nutrients were measured. The shade-casted area was significantly different ($P<0.05$) depending on the shade tree and the time of the day. The soil nutrients in all fields measured were also different ($P<0.05$), especially higher in medium-shade trees. The light spectrum at each point measured was also different ($P<0.05$), especially with high-shade trees. Although there were differences in shade-casted area and light spectrum (red: blue and red: far-red ratios), there was no significant difference ($P>0.05$) in the leaf chlorophyll content and yield in all the points measured under the selected shade-casted area, compared to that of the leaves in un-shaded areas. These findings alarm us to revisit the real purpose of having shade trees in tea fields. However, further studies along an altitudinal gradient are also suggested.

Keywords: Chlorophyll content, Light intensity, Photosynthesis, Shade trees, Soil nutrients, Yield

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[*]chalindab.agri.pdn.ac.lk

Effect of Pruning and Paclobutrazol on Flowering of *Jasminum sambac*

Thashmila S.M.M., Senarathna, M.M.D.H.[1] **and Eeswara J.P.**[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Jasminum sambac is grown worldwide for the extraction of jasmine essential oil from flower buds. This study was conducted to increase the flower bud production. Effect of tip pruning (T1), pruning 15 cm above the ground (hard pruning) (T2), pruning 15 cm above the ground (hard pruning) followed by tip pruning (T3), and pruning the excess lengthy branches followed by 230 ppm paclobutrazol application (T4) or without paclobutrazol application (T5) on flowering and branching of *J. sambac* was investigated using 2.5 years old plants. As jasmine flowers are produced at the terminals of the shoots, by increasing the number of secondary shoots, flower bud yield can be increased. There is a significant difference of cumulative number of secondary shoots per primary shoot in hard pruning (T2), (P<0.05) and it changed at an increasing rate over the time. Pruning of the excess lengthy branches followed by the application of 230 ppm paclobutrazol (T4), showed the best results with regards to the cumulative number and cumulative weight of flower buds (P<0.05). However, the application of paclobutrazol (T4), reduced the diameter of the flower buds. Changes in the yield parameters were observed within 1-3 weeks of paclobutrazol application. Overall, 6-9 weeks after tip pruning (T1), hard pruning (T2) and hard pruning followed by tip pruning (T3), produced better yields. Hard pruning (T2) is effective for increasing the number of secondary shoots, while pruning of the lengthy branches followed by paclobutrazol application (T4) increases the flower yield. Pruning of the excessively lengthy branches (T5) was not an effective practice. The combination of hard pruning and paclobutrazol is best for increasing yield.

Keywords: Hard pruning, Lengthy branches, Paclobutrazol, Tip pruning

[1]Royal Botanic Gardens, Peradeniya, Sri Lanka
[*]jpeeswara@agri.pdn.ac.lk

Effect of 2b Protein of Cucumber Mosaic Virus on Life History Traits of *Myzus persicae*

Nanayakkara N.H.K.L.U.C. and Jayasinghe W.H.[*]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Cucumber mosaic virus (CMV) causes significant losses in many crops, and one of the key vectors of CMV is *Myzus persicae* Sulzer (Aphididae). CMV 2b protein is a counter-defence factor and symptom determinant. Effect of the 2b protein on aphids was well investigated using 2b deleted mutant viruses. However, the detailed description of the dynamic change in aphid performance in 2b expressing transgenic plants has not been reported. We investigated the effect of 2b protein on aphid vectors using 2b transgenic *Nicotiana benthamiana*. The estimated survival percentages of aphids 30 days after the introduction to 2b transgenic and wild-type plants were 60% and 22.5%, respectively. Even though early reproductive maturity of aphids was reported on wild-type plants, the total population over a 30-day period was significantly ($P=0.00$) higher in aphids on 2b transgenic plants compared to that of wild-type plants. The mean fecundity over a 30-day observation period was 24.5 and 10.4 for aphids grown on 2b transgenic and wild-type plants, respectively. However, there was no significant difference ($P=0.117$) in the intrinsic rate of increase (m_r) of the aphids grown on 2b transgenic plants and wild-type plants. The longevity of aphids was significantly higher on 2b transgenic plants compared to that of wild-type plants ($P=0.012$). Similarly, 2b transgenic plants are significantly more susceptible to *M. persicae* in terms of time for 1st probing ($P=0.004$) and duration of phloem sap-feeding ($P=0.011$). According to our results, we conjecture that the CMV 2b protein plays a significant role in modification of life history traits of *M. persicae.*

Keywords: 2b protein, Cucumber mosaic virus, *Myzus persicae*

[*]whj@agri.pdn.ac.lk

Effect of Climatic Parameters and Temperature - Humidity Index on Milk Production of Imported Dairy Cattle in Ridiyagama NLDB Farm, Sri Lanka

Sankalpa D.V., Silva G.L.L.P.[*], Samaraweera A.M.[1] and Vidanapathirana T.[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The objective of this study was to assess the effectiveness of in-house temperature regulation via humidifiers and fans on the daily milk production in temperate dairy cattle breeds managed in Ridiyagama National Livestock Development Board (NLDB) farm. Daily milk yield records of 3154 Jersey and Jersey x Friesian crossbreds in their first lactation were collected. Daily in-house milking parlor minimum and maximum temperature and relative humidity were collected for the same period from 2016 to 2017 to derive the Temperature Humidity Index (THI). The data cleaning and analysis were performed using the R programming language. The mean THI was 80.21 and 78.22 during 2016 and 2017, respectively, and daily THI ranged from 71.81 to 85.88. A linear mixed effects model was fitted with THI, breed, days in milk, season, and milking duration as fixed effects, and animal as the random effect. All fixed effects including the THI were significant ($P<0.05$). The Jersey-Friesian crossbreds produced 1.2 L more than the Jersey cows. The daily milk yield was decreased by 0.03 L with one unit increase in THI. Even though the daily This were within the accepted range for temperate dairy cattle breeds according to the literature, the association between THI and daily milk yield suggests that cows were prone to heat stress. In conclusion, the THI within the milking parlour is a significant determinant of cows' daily milk production, and Jersey-Friesian crossbreds outperformed Jersey cows under heat stress. Improving the THI prior to milking might reduce the heat burden and loss of milk yield thereof.

Keywords: Heat stress, Daily milk yield, Temperature humidity index, Temperate dairy cattle, Dry zone

[1]Angus Australia, 86 Glen Innes Road Armidale NSW, Australia
[2]National Livestock Development Board Farm, Ridiyagama, Sri Lanka
[*]pradeepas@agri.pdn.ac.lk

Effect of Different Color Shade Nets on Growth and Development of Acclimatized Tissue Cultured Anthurium Plants

Narasinghe N.H.A. and Eeswara J.P.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Floriculture is divided into four groups depending on the production. The usage of floriculture products varies with the countries. Anthurium is a popular genus that belongs to the family Araceae. Anthurium plants used as a cut flower as well as an ornamental pot plant and require shady, humid conditions for the growth. In tropical climate, anthurium plants are unable to grow under natural light conditions without shade. Shade nets are widely used to protect crops from wind, rain, hail and excessive radiation. The photo selective netting concept was studied in anthurium plants using three different coloured shade nets. Black, red and aluminet shade nets and expose to full sunlight (control) were used as the treatments. Plant growth parameters, chlorophyll fluorescence data, and light parameters were measured. Light intensity, photosynthetically active radiation, spectrum irradiance was measured under each shade net. Highest spectrum irradiance was measured outside and then followed by black shade net, aluminet and red net. As plant growth parameters, plant height, number of newly emerged leaves, shoot and root dry weight and chlorophyll content were measured. Major parameters derived from OJIP analysis, including Performance Index (PI), Photochemical efficiency (FV/FM), Effective antenna size (ABS/RC), Electron transport per reaction centre (ET0/RC), Electron transport efficiency (ET/TR), Heat dissipation per reaction Centre (DI0/RC), Trapping per reaction centre (TR0/RC) were recorded. Plant survival rate was measured at each shade nets and control environment. Highest plant survival rate was observed in black shade net. Lowest plant survival rate was observed in aluminet shade net. Therefore, black color shade net can be recommended for a better growth and development of anthurium plants.

Key words: Anthurium, Chlorophyll fluorescence, Colored shade nets, Floriculture

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[*]jpeeswara@agri.pdn.ac.lk

Effect of Different Fertilizer Practices on Availability of Potentially Toxic Elements (PTEs) in Coconut Growing Soils in Sri Lanka

Nawanjana H.B.J., Dissanayake P.D.[1] and Igalavithana A.D.[*]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Continuous application of organic and inorganic fertilizers can cause environmental risk associated with the pollution of soils with potentially toxic elements (PTEs). Therefore, this study was conducted to assess the effect of different fertilizer practices on availability of PTEs in coconut growing soils in Sri Lanka. A pot experiment and a field survey were conducted. The pot experiment was performed with sandy regosols (20 kg of soil/pot). The treatments were 1) No fertilizer (Control), 2) inorganic fertilizer (IF), 3) cattle manure (CM), 4) goat manure (GM) and 5) poultry manure (PM). Three replicates were used in a completely randomized design. Fertilizers and manures were applied based on the recommendation rates. Pots were maintained at 60% water holding capacity. Soil samples were collected at 2 and 16 weeks after treatment application (WAT). In the field survey, soil samples (at 0-25 cm depth; n=…) were collected from the manure circle of the coconut plantations with different types of organic amendment application history. Soil samples from both studies were analyzed total and EDTA extractable PTEs concentrations (i.e., As, Zn, Cu, Cd, Cr, Pb and Ni). The PM applied soils had significantly higher EDTA extractable Zn (11 ± 0.07 mg/Kg), Cd (0.02 ± 0.00 mg/Kg) and Cu (1.7 ± 0.02 mg/Kg) concentrations compared to other treatments at 16 WAT. Cattle manure has caused high Pb (i.e., 0.36 ± 0.02 mg/Kg) and Ni (i.e., 0.11 ± 0.06 mg/Kg) concentrations at 16 WAT. EDTA extractable Pb concentration (mg/Kg) in PM application has a significant reduction from 2WAT (i.e., 0.37 ± 0.03mg/Kg) to 16WAT (i.e.,0.32 ± 0.01mg/Kg). All the PTEs concentrations were below the maximum permissible levels for agricultural soils imposed by the European Union implying that there is no ecological risk of short-term application of organic or inorganic fertilizers for coconut.
Keywords: Inorganic fertilizers, Organic fertilizers, Potentially toxic elements

[1]Coconut Research Institute, Lunuwila, Sri Lanka
[*]adigalavithana@agri.pdn.ac.lk

Effect of Different Rain Shading Methods on Seed Germination, Seedling Survival, and Growth Performance of Mulato II (*Brachiaria* hybrid)

Tharinda G.S. and Ekanayake W.E.M.L.J.[*]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Mulato II (*Brachiaria* hybrid) is a herbage known for its higher digestibility and nutritional quality, and thus, recently introduced to Sri Lanka. This study aimed to determine the effect of different rain shading methods on seed germination, seedling survival, and the growth performance of Mulato II hybrid growing in the up-country wet zone, in Sri Lanka. The experiment was conducted with three treatments for shading: fern (T_2), shade net (T_3) polythene (T_4), and control with no shading (T_1) with three replicates in three blocks. A hundred seeds were planted in each replicate. Seed germination and seedling survival were measured two weeks and four weeks after planting, respectively. Plant height, leaf length, number of leaves, and number of tillers were measured four and six weeks after planting in randomly selected plants (n=12) from each replicate. Soil pH, soil moisture, available N, P, K, and electrical conductivity were measured. Seed germination under laboratory conditions in Peradeniya and Watawala was 84% and 80%, respectively. Collected data were analyzed using two-way ANOVA in Minitab 21. Results indicated that different rain shading methods significantly ($p<0.05$) affected the seed germination, seedling survival, and growth performance of plants. The highest seed germination ($68\pm5\%$) and seedlings survival ($64 \pm 6\%$) were found in polythene shaded beds but similar to shade net shaded beds. A significant difference was observed between all treatments for plant height and leaf length. The highest average values for plant height and leaf length were 14.3 ± 0.6 cm and 10.1 ± 0.6 cm respectively after one month and 18.9 ± 0.2 cm and 13.5 ± 0.3 cm respectively after 1.5 months in polythene shaded beds. There was no significant difference between the number of leaves and tillers in all treatments. Results indicate that polythene shading is effective to improve seed germination and seedling survival Mulato II.

Keywords: Leaf length, Mulato II, Plant height, Seed germination, Seedling survival

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[*]jayekn@agri.pdn.ac.lk

Effect of Different Shade Levels and Paclobutrazol on Growth and Flowering of Parrot Impatiens (*Impatiens niamniamensis*)

Thamarsha A.K.A.N.W.M.R.K.[*], Senaratne M.M.D.J.[2] and Eeswara J.P.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study was conducted with the aim of developing *Impatiens niamniamensis* (Parrot impatiens) as a dwarf attractive pot plant with more flowers. Stem cuttings consisting of three nodes were planted and kept for two weeks under a polythene propagator. They were gradually exposed to sunlight and then transferred to different shade levels (0%, 50%, 70%, and 80%). Each group of plants were subdivided into two parts, and one part was treated with 25 mL of 5 mg/L paclobutrazol in the sixth week. Plants that were exposed to 0% shade died within one week after planting. This treatment was not considered for further analysis. According to the results, the interaction effect of different shade levels and the application of paclobutrazol significantly affected on plant height ($P<0.0001$). But, it was not significant for internodal length ($P>0.05$). Chlorophyll fluorescence was lower in 70% shade level with the application of paclobutrazol. Furthermore, there was no significant difference in maximum quantum yield (Fv/Fm) ($P>0.05$), absorption in active reaction center (ABS/RC) ($P>0.05$), and trapped energy flux (ET_0/RC) ($P>0.05$) due to different shade levels and application of paclobutrazol. The number of flower buds were high in paclobutrazol-treated plants than that kept under 70% shade. There was a significant interaction effect of different shade levels and the application of paclobutrazol on the number of flower buds ($P<0.0001$). Color intensity of the flowers were different ($P<0.05$) while the length in not significantly different ($P>0.05$). There was a significant effect on the number of days taken to flowering among treatments ($P<0.0001$). The 70% shade level and application of paclobutrazol can be recommended as the best treatment combination for both growth and flowering of *I. niamniamensis*.

Keywords: Floriculture, *Impatiens niamniamensis*, Paclobutrazol, Shade levels

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[1]Department of crop science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[2]Royal Botanic Gardens, Peradeniya, Sri Lanka
[*]kasunithamarsha@gmail.com
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Effect of Environmental Enrichments on Behaviour and Welfare of Broiler Chickens

Wickramasinghe W.A.D.C., Samarakone T.S.* and Bandara R.M.A.S.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

At present broiler chicken industry in Sri Lanka is moving towards more intensive closed-house systems. This study aimed to assess the effect of providing environmental enrichments(elevated platforms, hanging compact discs, straw bales, and paddy husk area for dust bathing) on behaviour, fear level, welfare(footpad dermatitis, hock burn, plumage cleanliness ,and litter quality)and body weight of broiler chickens. On the 10th day of age, 240 Indian River commercial broiler chicks were randomly distributed into four pens (n=60). Two replicates per control (no enrichment) and treatment groups were allocated and the study was carried out in two batches. Data were collected during a four-week period. Behaviour was assessed by scan sampling method using live observations. The tonic immobility and novel object tests were performed to measure the fear level of broiler chickens. Welfare parameters were assessed using a scoring system. The generalized linear mixed model, Kruskal-Wallis and one-way analysis of variance tests were used to analyze treatment effects. The frequency of preening behaviour was significantly higher ($P<0.05$) in treatment groups than control groups in the daytime and the resting behaviour was lower($P<0.05$) in treatment groups than control groups in day and night in all weeks. The fear level was higher ($P<0.05$) in control groups than in treatment groups. The footpad score, hock burns (except the first week), plumage cleanliness (during the last two weeks) and litter quality (except the first week) was better ($P<0.05$) in the treatment groups compared with control groups. Growth rate of birds was also improved in treatment groups. Overall, the results indicated that providing environmental enrichments enhanced behaviour, welfare and growth performance of broiler chickens under closed-house systems.

Keywords: Behaviour, Broiler chickens, Environmental enrichments, Fear level, Welfare

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[1]Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, Sri Lanka
*thusiths@agri.pdn.ac.lk

Effect of Increased Growth Temperature and Soil Moisture Stress on Chlorophyll Fluorescence in Two Pioneer Tree Seedlings Used in Land Restoration

Piyarathna M.N.S., Weerasinghe L.K.[*], Geekiyanage N.[1] and Sivananthawerl T.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Sri Lanka

Chlorophyll measurements are frequently used in plant stress physiological investigations because they allow for the measurement of chlorophyll fluorescence from intact plants and improve understanding of potential alterations in leaf fluorescence features related to physiological condition. Pioneer tree species, which frequently encounter stress from the atmosphere's temperature and soil moisture, such in-depth knowledge is constrained. The most common early successional plant species are *Macaranga peltata* (*Kanda*) and *Neolitsea cassia* (*Dawul kurundu*), especially in the low country and mid country wet zone. Two pioneer plant species, *Kanda* and *Dawul Kurundu*, were grown at two thermal environments (26.0 ± 0.2 °C and 29 ± 0.5 °C) under field capacity (FC) and soil moisture stress condition (WS, i.e. 50% of the available water), and chlorophyll fluorescence in fully expanded recently mature leaves was measured at 28°C and 32°C, respectively, to examine how the above stress conditions alter the specific components of the higher proficiency. The results showed that at 32 °C leaf temperature as compared to 28 °C under water stressed conditions, water splitting activity was affected in both *Kanda* and *Dawul kurundu* plants. Furthermore, regardless of the water treatment, the maximum quantum yield of primary photochemistry significantly ($P<0.05$) reduced in both plants when leaf temperature increases from 28 °C to 32 °C. However, both plants showed a significant ($P<0.05$) decline in Performance Index at 32 °C leaf temperature compared to 28 °C under FC and WS conditions. *Kanda* and *Dawul kurundu* plants are particularly vulnerable to the combined effects of soil moisture and temperature stress when grown together. Chlorophyll fluorescence offers a thorough grasp of the fundamental phases of photosynthesis.

Keywords: Chlorophyll fluorescence, Restoration, Temperature

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[1]Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka
[*]lasanthaw@agri.pdn.ac.lk

Effect of Paclobutrazol, Gibberellic Acid and Pinching on Growth and Flowering of *Chirita* Royal Queen

Thilakarathne M.A.V.K.[*], Senarathne M.M.D.J.[1] and Eeswara J.P.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Chirita Royal is a hybrid perennial flowering plant produced by Royal Botanic Garden, Peradeniya by crossing *Chirita mooni* and *Chirita zeylanica*. The present study was conducted with the objective of introducing it as a potted flowering plant to the floriculture industry in Sri Lanka. Effects of Paclobutrazol (5 mg/L), GA3 (50 mg/L), combination of PBZ (5 mg/L) and GA3 (50 mg/L) and without growth regulators were investigated on growth and flowering of pinched and non-pinched plants. Each treatment was replicated 3 times and each replicate consisted of 10 plants. The experiment was arranged as a Complete Randomized Design (CRD). Plant height, number of days taken to branching, number of days taken to first flowering, number of branches, number of flower buds, corolla length, corolla width and spikelet length were measured at 11th week after planting. Plant height was reduced significantly ($P<0.0001$) in pinched plants. Combination of pinching and paclobutrazol reduced the plant height and produced a bush type *Chirita* Royal Queen plant. There were significant differences between pinching and non-pinching for number of days taken to first flowering and number of days taken to branching. Pinching significantly increased number of lateral branches ($P<0.005$). Number of flower buds also significantly increased by pinching ($P<0.0001$). Combination of pinching and paclobutrazol produced highest number of flower buds. GA_3 did not affect the flowering of *Chirita* Royal Queen. As per the results of the study, combination of pinching and paclobutrazol 5 mg/L can be recommended for producing an attractive *Chirita* Royal Queen Plant.

Keywords: *Chirita* Royal Queen, Flowering, GA3, Growth, Paclobutrazol, Pinching

[1]Royal Botanic Gardens, Peradeniya, Sri Lanka
[*]ag16179@agri.pdn.ac.lk

Effect of Phosphorus and Zinc Interaction on Vegetative Growth of Rice Grown in an Alfisol

Madhushika S.S.I., Dharmakeerthi R.S.[*] and Munasinghe S.T.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Growth and yield response of rice plants (*Oryza sativa*) to phosphorus (P) application is very low in P deficient Alfisols of Sri Lanka. Applied P could become unavailable by interacting with Zinc (Zn) in soil could be one reason. A net house experiment was conducted to study the effect of combined application of P and Zn fertilizers on their availability in soil and response of rice plant in a flooded Alfisol. Soil (Typic Rodaqualf) was collected from a lowland rice growing field in the dry zone of Sri Lanka. An availability study was conducted by applying combinations of P (0, 11, 22 and 33 mg/kg) and Zn (0, 1.1 and 2.2 mg/kg) to soil and measuring the Mehlich-3 extractable P and Zn contents. Same rates of P and Zn were applied to 5 kg of soil filled pots as triple super phosphate and zinc sulfate and planted with four germinated rice seeds. Growth parameters and P and Zn uptake were measured in 8 weeks. Zinc availability increased in soil but P availability decreased significantly ($P<0.05$) as rate of Zn application increases. Application of P reduced Zn availability in soil without increasing the P availability. However, none of these rates were able to increase the available P and Zn contents in the soil up to optimum rates. Plant height, number of productive tillers per plant and shoot dry matter content were not significantly ($P>0.05$) affected by P and Zn interaction. Application of P significantly ($P<0.05$) increased in shoot P concentration while application of Zn at 2.2 mg/kg significantly reduced shoot P concentration. However, these changes did not affect shoot P and Zn uptake significantly at rates used in this experiment. Further studies are required to study the effects of higher rates of P and Zn on their availability and plant responses.

Keywords: Alfisol, Nutrient availability, Nutrient uptake, Phosphorus, Rice, Zinc

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[1]Rice Research station, Ambalantota, Sri Lanka
[*]dharmakeerthirs@agri.pdn.ac.lk

Effect of Some Partial Processes Related to Photosynthesis on Peelability of the Cinnamon Bark

Perera K.A.K.S. and Mohotti A.J.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The peelability (detachability) of cinnamon bark changes with weather, maturity of the stem and growth stage of the plant. However, the physiological reasons behind the peelability is not understood. The present study was conducted as two experiments. Experiment I determined the relationship between peelability of cinnamon, and some related physiological and partial processes of photosynthesis. Following stages of cinnamon were considered as treatments: fruiting plants with dark green leaves, fruiting plants with light green leaves, flowering plants with dark green leaves, flowering plants with light green leaves, flowering plants with dark green leaves (but no flowers in the given branch), plants with no flowers or fruits. Peelability of cinnamon stems (measured as the force required to remove bark), fluorescence parameters, leaf water potential, hydraulic conductivity of the cinnamon sticks and mucilage content of cinnamon barks were measured. Experiment II examined the relationship between the leaf anthocyanin content and some fluorescence parameters in cinnamon leaves of different growth stages. There were significant ($P<0.05$) differences between the treatments in the force required for peeling the bark, fluorescence parameters, mucilage content, hydraulic conductivity and leaf water potential. The force required to detach bark had significant ($P<0.05$), positive correlations with fluorescence parameters (Performance index ($R^2=0.7552$), Fv/Fm ($R^2=0.6367$)) and mucilage content ($R^2=0.645$) and significant ($P<0.05$) negative correlation with the leaf water potential ($R^2=0.3421$), but no significant correlation ($P<0.05$) with the hydraulic conductivity. Leaf anthocyanin content positively correlated with absorbance, trapping, and electron transport per reaction center, while light green leaves appeared to be more efficient photosynthesizers. Cinnamon bark peelability appears to be negatively correlated with primary metabolism and the products, indicating possible involvement of secondary metabolic products such as mucilageinpeelability.

Keywords: Hydraulic conductivity, Leaf water potential, Mucilage content, Peelability of cinnamon, Photosynthesis

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[*]mohottij@agri.pdn.ac.lk

Effect of Panchagavya on Insect Populations Associated with Cabbage and Cabbage Plant Growth

Senevirathne R.M.S.T. and Hemachandra K.S.[*]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Panchagavya is an organic formulation, prepared using cow milk, curd, ghee, cow urine, and cow dung. It is sprayed on crops with the expectation of suppression of pest populations and promotion of plant growth. This study was conducted with the objective of assessing the insecticidal properties and plant growth properties of panchagavya application on cabbage. The treatments included: 5% concentrated panchagavya applied at four day intervals (T1), eight day intervals (T2) and DOA recommended insecticide: chlorantraniliprole 200 g/LSC (Coragen) (T3) with untreated control. The growth of cabbage plants and population dynamics of cabbage-associated insects were recorded. In addition, laboratory experiments were conducted to assess antifeedant activity and toxic effects of punchagavya. There were significant ($P<0.05$) differences among treatments in relation to all growth parameters and a comparatively high performance was observed in T1. Mean stem height, fresh weight of open leaves, fresh weight of unopened leaves (head), and root weight were 12.13 ± 0.18, 292.34 ± 3.46, 76.69 ± 2.58 and 36.14 ± 1.33, respectively in T1. The mean larval populations of *Spodoptera litura* (7.25 ± 1.23), *Crosidolomia binotalis* (7.25 ± 1.86) and *Trichoplusia ni* (8.57 ± 1.604) per plant were found to be the lowest in T3 where insecticide was applied, followed by T1. The mean population of the above insects over six weeks in T1 were 11.38 ± 1.72, 11.63 ± 2.18 and 11.85 ± 1.60, respectively. In laboratory tests, a significant ($P<0.05$) difference was observed in leaf feeding area between punchagavya-treated (6.25 cm$^2\pm0.23$/larva) and untreated control (11.60 ± 0.37 cm^2/larva). The mean larval mortality was $60\pm5.61\%$ in punchagavya-treated samples and no mortality in the control. With these results, it can be concluded that the use of punchagavya on cabbage at four day intervals is beneficial.

Keywords: Cabbage caterpillars, Contact toxicity, Panchagavya, Repellent effect

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[*]ks_hemachandra@agri.pdn.ac.lk

Efficacy of Indole-3-Butyric Acid (IBA) and Rooting Media on Stimulating Adventitious Rooting in Croton (*Codiaeum* 'Aucubaefolia')

Dasanayaka Y.M.H.M., Attanayake R.M.T.D., Wickramasinghe P.A.S.C.[1], Sandarenu K.M.S.D., Gamage S.N.W., Hettiarachchi W.A.B.H., Dilshan H.K.L.[1], Dayarathna C.R.[1] and Kumarihami H.M.P.C.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Codiaeum variegatum 'Aucubaefolia' (Baby Croton) has a higher demand as an ornamental foliage plant in the export market. Rooted and unrooted stem cuttings of croton are exported. The research was conducted to evaluate the effectiveness of rooting media and Indole – 3 – Butyric Acid (IBA) concentrations on the rooting performance of *C. variegatum* 'Aucubaefolia' stem cuttings under the production of rooted cuttings and unrooted cuttings for the export market. Two different rooting media (coir dust and jiffy pellet) and four different concentrations of IBA (0 mg·L^{-1}, 250 mg·L^{-1}, 500 mg·L^{-1}, and 1000 mg·L^{-1}) were tested. In experiment one, the effect of rooting media and IBA was evaluated to produce rooted cuttings. In experiment two, the rooting performances of unrooted cuttings after an export simulation (48 hours of cold storage at 21°C) were tested. Rooting of croton stem cuttings was significantly affected by rooting media. Jiffy pellet medium recorded the highest number of roots per cutting, root-to-shoot ratio, cumulative and root length. Minimum days for root initiation were observed in the coir dust rooting medium. In experiment one, early rooting and a higher number of roots were observed in the jiffy pellet medium with 500 mg·L^{-1} IBA application, while 250 mg·L^{-1} IBA application was effective in root initiation and 500 mg·L^{-1} IBA promote the highest number of roots in coir dust medium. Application of 250 mg·L^{-1} IBA promoted early rooting and 500 mg·L^{-1} IBA promote the highest number of roots in jiffy pellet medium, while 1000 mg·L^{-1} IBA application was effective in root initiation and 500 mg·L^{-1} IBA promote the highest number of roots in jiffy pellet medium after 48 hours export simulation. The appropriate rooting media and optimum concentration of IBA would stimulate the rooting of *C. variegatum* 'Aucubaefolia' stem cuttings.

Keywords: Croton, Cuttings, IBA, Propagation, Rooting media

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[1]Mike Flora (Pvt) Ltd., Rambukkana, Sri Lanka
[*]prathibhani@agri.pdn.ac.lk

Estimation of Consumptive-Use of Tomato Grown in Tropical Greenhouse Conditions using Evapotranspiration Models

Koswatta.D.D.K., Weerakkody W.A.P.[*], De Silva S.H.N.P.[1] and Bandaranayake P.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The crop water requirement during different growing periods may vary significantly depending on management practices and growth stages. Generally, evapotranspiration (ET) estimation is a reliable measure to maintain the water uptake and thus an efficient translocation of plant nutrients. However, direct measurements of the water requirement (consumptive-use; CU) is less accurate. Under this backdrop, an attempt was made to validate the available mathematical models for estimating ET of tomato with the aim of selecting the most appropriate estimation model/s for tropical greenhouse conditions. In literature, several mathematical models have been introduced for estimating ET, and compared with actual ET measurements, made using mass difference within a time gap. In this experiment, tomato plants were grown in coco-peat-bag culture under greenhouse conditions for making direct ET measurements and gathering climatological data and plant characteristics (i.e. leaf area) as parameter estimates of models. The latter were used to estimate ET using two simulation models, and also using the famous Penman-Monteith (PM) equation. The leaf area of tomato ranged from 0.00189 to 1.3665 m^2 plant^{-1}, while ET varied from 0.175926 to 1.5238 L m^{-2} day^{-1} during the two-month period. LAI varied from 0.0035 to 2.53 during the same period. Model validation resulted best values for R^2 (0.8692 and 0.8145), for RRMSE (5.9 and 15.98 %), and for ME (0.99 and 0.82) for the simplified model 1(SM1) and PM, respectively. The mean temperature, mean solar radiation and mean relative humidity prevailed during data collection were 24.5-29.5 °C, 5.03 -30.6 w m^{-2} and 66% - 88.1%, respectively. The results showed that the SM1 and PM model fitted well with the actual evapotranspiration values. However, based on the results of the model validation, SM1 could be selected better than PM model and the simplified model 2 for the test conditions with respect to crop and environment.

Keywords: Evapotranspiration, Leaf area, Relative humidity, Solar radiation, Temperature

[1]Agricultural Biotechnology Centre, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]wapweerakkody@agri.pdn.ac.lk

Evaluating the Morpho-Agronomic Characteristics of Two Locally-Developed F1 Brinjal Hybrids with an Imported and Market-Leading Variety

Alahakoon A.H.M.Y.T., Fonseka H.D. and Weerarathne L.V.Y.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Annual demand for brinjal (*Solanum melongena* L.) hybrids exceeds the local supply along with a huge vacuum in the continuous seed production. The lack of knowledge on the morpho-agronomy of local F1 hybrids may be one of the reasons why the locally-bred hybrids are less popular compared to the imported hybrids. This experiment was carried out to evaluate the major morpho-agronomic characteristics of two local brinjal F1 hybrids namely, 'EGH-79 (V2)' and 'HORDI Lena Iri 1 (V3)' against that of the market-leading variety 'Raveena (V1)' in a field trial. The final germination percentage (GP) and mean germination time (MGT) were recorded for a representative set of seeds of all three varieties. Agronomic data on plant height (PH), leaf blade length and width (LL and LW, respectively), leaf area (LA), number of branches (NB), canopy diameter (CD), plant dry weight (DW), number of flowers (NF), number of fruits (NP), fruit yield (FY), average fruit weight (WF), fruit length and width (FL and FW, respectively), browning time (BT), and keeping quality (KQ) were recorded at the vegetative (S1), 50% flowering (S2), 50% fruiting (S3), and full maturity (S4) stages. Morphological measurements included leaf lobbing pattern, flower/ inflorescence angle, stem color, fruit and flower color, shape, and size. V3 showed the highest PH, LL, LW, LA, NB, CD, DW, NF, NP, FY, WF, FL, and FW at all sampling stages and the lowest BT at S3 and S4 ($P<0.05$). Physiological data that included net photosynthesis, stomatal conductance, and intrinsic water-use efficiency supported the agronomic data while morphological measurements showed minor differences between the varieties. Results concluded that V3 was the best competitor for V1. However, V3 showed poor seed germination (i.e. 48% GP and MGT 18 days) and KQ characters compared to V2 and/ or V1 and that warrants further research.

Keywords: Brinjal, F1 hybrids, Germination, Morpho-agronomic traits, Yield

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[*]vishnaweerarathna@gmail.com

Evaluation of Different Liquid Organic Fertilizers on Growth and Yield of Lettuce (*Lactuca sativa* L.)

Keragala K.A.I.S. and Hitinayake H.M.G.S.B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Lettuce (*Lactuca sativa* L.) is among the most used leafy vegetables in Sri Lanka. Albert solution and other inorganic fertilizers are heavily used in lettuce cultivation. There is an increasing demand for organically grown lettuce because of human health concerns and environmental hazards due to the overuse of inorganic fertilizers. This study was conducted to evaluate the use of liquid organic fertilizers (LOF) on the growth and yield of lettuce. The experiment was laid out using a randomized complete block design (RCBD) with 5 replicates in a protected plant house at the Agricultural Experimental Station in Dodangolla, Kundasale. Organic liquid fertilizers, fish tonic, gliricidia leaf extract, cow dung slurry, jeevamrutha, and Albert's solution (the control) were used as the treatments. Two soil types, Immature Brown Loam (IBL) and Reddish Brown Latosol (RBL) were used as the growing media. The number of leaves, leaf area index, plant height, plant diameter, chlorophyll content, and leaf nutrients were taken as the growth and yield parameters, and soil nutrient contents were measured. The results showed that mean differences in all parameters evaluated were significant among treatments ($p <$ 0.05). Overall growth and yield performances were high in Albert's solution. The lettuce yield under Albert's solution was 24% (dry weight basis) more than with the fish tonic treatment. Among the LOF, fish tonic and gliricidia mixed with cow dung gave the highest growth and yield. The chlorophyll content of leaves was high in cow dung enriched with sugar treatment. Plant nutrient analysis showed that the nutrient content of lettuce plants has enhanced under the fish tonic and jeevamrutha treatments. The highest soil nutrient increase was observed under the fish tonic treatment. All the measured parameters were found high under the IBL medium when compared to the RBL medium.

Keywords: Growth, Inorganic fertilizers, *Lactuca sativa* L., Liquid organic fertilizers

[*]gaminih@pdn.ac.lk

Evaluation of Nutrient Values of Selected Native Fish Species in Sri Lanka

Ranasinghe H.M.K., Madhubhashini E.T.S. and Wijesinghe M.G.C.R.[1*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Fish is an important source of animal protein and other essential required nutrients in human diets. According to the current nutritional status of Sri Lanka with regards to eliminating malnourished status, introducing a lower-cost nutrient-rich diet is a must. With the presence of available resources, freshwater fisheries show great potential to address the nutrition status in rural communities. The consideration given to the native fish species in Sri Lanka is comparatively low. Determination of the proximate composition of fish meat is necessary to prove that it meets requirements for food regulation and commercial designations. This study was conducted to determine the moisture, ash, protein, and fat content of selected 05 native fish species in the North Central province of Sri Lanka. The proximate data were assessed through Analysis of Variance (ANOVA) with a significance level used for all the tests at 95% ($p<0.05$). Sampled fish include wild captured, *Angula nebulosi* (Mottled Eel), *Heteropneustes fossilis* (Asian Stinging Catfish), *Channa striata* (Stripped Snakehead), *Anabas testudineus* (Climbing Perch), *Eutroplus Suratensis* (Green Chromide). The moisture content ranged from 69.43±1.14% to 82.62±1.77%, ash content varies from 0.94±0.08% to 1.04±0.28%. The mean protein content of Mottled Eel was 18.29±2.09%, Stinging Catfish; 16.69±2.09%, Climbing Perch; 18.45±1.56%, Stripped Snakehead; 17.94±1.55% and Green Chromide; 16.18±1.47%. The fat contents were 11.14±2.09%, 0.81±0.16%, 0.85±0.22%, 0.5±0.22% and 0.33±0.04%, respectively. Ash and Protein contents were not significantly different ($p>0.05$) within the groups. The obtained protein values were compared with the secondary data of reservoir-grown Tilapia (*Oreochromis niloticus*) in which the highest mean protein value was 16.14±0.01%, and was lower than the Climbing Perch, Mottled Eel, and Stripped Snakehead. Tilapia's fat content was lower than Eel's fat content and higher than the other four species. The present study demonstrated that the flesh of all studied species is rich in nutritional values.

Keywords: Evaluation, Freshwater fish, Malnourish, Nutrient, Proximate analysis

[1]National Aquatic Resources Research and Development Agency, Mattakkuliya, Colombo 15, Sri Lanka
[*]chinthaka.nara@gmail.com

Characterization of Okra Germplasm for Future Breeding Programs

Windula E.P.C.[*], Edirisinghe E.S.C.[1] and Eeswara J.P.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Okra (*Abelmoschus esculentus* (L.) Moench) is a crop belongs to family Malvaceae. Plant Genetic Resources Centre (PGRC), Peradeniya maintain and conserves 531 okra accessions collected from different locations of the country. In the present study characterization 25 of the 531 accessions including a recommended variety "haritha" was done using 26 morphological characters listed in the descriptors for vegetables and condiments. The results showed that, minimum average fruit length was 16.2 cm in accession 793 at table use maturity while maximum average was 30.8cm in accession 3108. Average number of fruits per plant, was maximum 31.6 in accession 1888 and minimum was 11.4 in accession 3091. Maximum average weight of fresh fruit at table use maturity was 72.62 g in accession 3094 minimum was 23.62 g in accession 1503. The dendrogram obtained using morphological characters separated 5 major clusters at a euclidean distance of 9.04. Cluster 2 was the largest and contained 14 genotypes under sub clusters. Cluster 5 contained only recommended variety "haritha". The first two principal components (PCs) calculated for all characters explained 88.3% of the morphological variation among the 25 okra accession and recommended variety. Maximum plant height recorded the highest loading with a positive correlation for PC1. Number of seeds per fruit and weight of fresh fruit at table use maturity with a positive loading accounted for a major portion of PC2. According to dunnett multiple comparison with control 95% confidence level, accessions 3108 and 3094 had P>0.05 than the recommended variety with regard to fruit length at table use maturity, Fruit width at table use maturity, Number of fruits per plant, Weight of fresh fruit at table use maturity.

Keywords: Accession, Cluster, Morphological characters, Okra

Evaluation of Some Methods Used for Rapid Compost Production

Sooriyaarachchi S.A.P.J. and Hitinayake H.M.G.S.B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Increase of soil productivity through the use of organic fertilizers has gained great importance in organic food production since soil is the basis of management in sustainable food production. The composting is an aerobic, microorganism-mediated, solid-state fermentation process by which different organic materials are transformed into more stable compounds. The product obtained is the compost, which contributes to the improvement of physical, chemical and microbiological properties of the soil. However, the compost usage in agriculture is constrained because of its long-time action and reduced supply of nutrients to the crops. This study was carried out to evaluate the quality of compost produced using some rapid composting methods using different materials. Eight compost formulations containing combinations of ingredients such as inoculant (mature compost), animal dung (cow dung and poultry manure), green leaves; (*Gliricidia* leaves and *Tithonia* leaves), Eppawala rock phosphate (ERP), saw dust, biochar, banana stems and straw were prepared under aerobic and anaerobic condition, separately. Total nitrogen and available phosphorus contents, temperature fluctuation with time and phytotoxicity of compost were studied. Final compost yield was nearly 1/3 of initial weight and compost prepared under anaerobic condition performed better compared to aerobic treatments. Available phosphorous and total nitrogen were higher in compost prepared using poultry manure as animal dung. pH and electrical conductivity were in acceptable range for almost all compost formulations. The compost prepared using poultry manure, *Glyricidia* without turning produced the best quality in relation to evaluated parameters. The phytotoxicity of compost was reduced with time. Nearly 50% of nitrogen loss observed in all mixtures as reported in similar studies conducted elsewhere.

Keywords: Compost, Fertilizer, Organic agriculture, Quality

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[*]gaminih@agri.pdn.ac.lk

Evaluation of Variations in Water and NPK-Use Efficiency of Selected Three Hybrid Capsicum Varieties When Grown in Three Different Media Compositions under a Controlled Environmental Conditions

Kankanamge P.S., Fonseka H.D.[1] and Weerarathne L.V.Y.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Selection of a conducive growth medium is indispensable for facilitating the optimal utilization of nutrients and water for capsicum plant growth and development in grow bag culture. This pot experiment had three hybrid capsicum varieties namely, "Muria (V1)", "Parthana (V2)", and "CH-19 (V3)" established in three different media compositions (MC); MC1 (Top Soil: Half Burned Paddy Husk (HBPH): Sand =2:1:1/2), MC2 (HBPH: Compost: Sand=1:1:1/2), and MC3 (Coconut husk pieces: Compost: HBPH= 1/2:1:1) from the seedling stage to maximum flowering under optimum growth conditions. Measurements and analyses included plant height (PH), leaf area index (LAI), number of flowers and pods (NF and NP, respectively), average pod weight (APW), plant dry weight (DM), plant nitrogen (Np), phosphorus (Pp), potassium (Kp), soil nitrogen (Ns), phosphorus (Ps), potassium (Ks) and NPK and water-use efficiency (N*UE and WUE, respectively). Results from the statistical data analysis revealed that the treatment combination effect was significant only for Np ($p<0.05$), Pp ($p<0.0001$), and Kp ($p<0.05$) amongst all measurements taken. The highest plant NPK were recorded for V1MC2, V2MC3, V3MC2 (Np), V2MC3 (Pp), and V3MC2, V3MC3 (Kp), respectively. DM of different plant parts were not significantly different between the MCs or varieties ($p>0.05$), except for DM of roots ($p<0.05$) where MC2 showed the highest amongst all. However, PH, LAI, FN, PN, APW, DM partitioning and Ns, Ps, and Ks economy showed complex treatment combination effects. Results concluded that WUE of plant vegetative plant parts, PN, and nitrogen use efficiency were the highest in MC2 and then in MC3 (soil less MCs) for all three varieties. When the cost of production and handling feasibility are also considered, MC3 was selected as the best MC for V1, V2, and V3 under the conditions tested.

Keywords: Capsicum, Cost of production, Media composition, Nutrient use efficiency, Water-use efficiency

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[1]Onesh Agriculture (Pvt.) Ltd., Colombo, Sri Lanka
[*]vishnaweerarathna@gmail.com

Feasibility of Clove (*Syzygium aromaticum* (L.) Merr. & L.M. Perry) Cultivation in Gampaha District

Alagiyawanna A.M.A.A.M., Hemachandra E.M.G.P.[1], De Silva S.H.N.P. and Ranil R.H.G.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Cloves are important as a spice, medicine, flavoring, or fragrance in consumer products. Though Sri Lanka is the 8th largest exporter of cloves, the cultivation is basically confined to 7,618 ha in *Kandy*, *Kegalle*, and *Matale* districts. Clove has proven to be a successful crop in home gardens with its ability to provide income to families during two seasons per year at a minimum cost. The lack of suitable lands with the required soil and climatic conditions is the major constraint to further expanding the commercial cultivation of cloves in Sri Lanka. Therefore, this study aimed to study the feasibility of commercial clove cultivation in *Gampaha* district. The study was conducted in 13 Divisional Secretariat Divisions (DS). Ninety home gardens were selected for the study of which, questionnaire survey was conducted in selected 50 home gardens and soil samples were also collected for the analysis of major soil properties. Interpolated surfaces were developed for specific climatic parameters and land suitability map for Clove was developed using Geographic Information System (GIS). Results revealed that clove cultivation is feasible as monocrop, intercrop, or home garden crop in *Gampaha* district except in areas close to the coastal belt. Based on the developed climatic and soil maps, *Mirigam*a and *Dompe* are the most suitable areas for clove cultivation. *Negambo, Waththala,* and *Katana* areas are not suitable due to their close vicinity to the coastal belt. Other DS divisions have moderate suitability for clove cultivation on a commercial scale. According to cost-benefit analysis, clove cultivation is profitable in *Gampaha* district mainly as a home garden crop, and its contribution is significant on the family income. With support from relevant government authorities and adopting good management practices, clove can be successfully cultivated in the *Gampaha* district except in areas close to the coastal belt.

Keywords: Clove, Clove farming, Distribution of clove, Feasibility, GIS, *Syzygium aromaticum*

[1]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]rrajapaksha@agri.pdn.ac.lk

Genetic Parameter Estimation for Some Production and Reproduction Traits in a Large-Scale Dairy Farm in WL1 Agro-Ecological Zone

Ravihansa B.K. and Dematawewa C.M.B.[*]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Estimation of genetic parameters of production and reproductive traits is a pre-requisite for genetic selection and improvement of dairy herds. The objective of this study was to determine the factors affecting production and reproductive performance of crossbred cows raised under semi-intensive management system in the WL1 agroecological zone. Performance records of 100 cows in 5 parity groups from a large-scale Government farm in Siringapatha were selected after screening for missing information. The cows were from four crossbreds genotypes, i.e. Jersey cross, Sahiwal cross, Australian Friesian Sahiwal cross, and Girolando cross. The traits studied were lactation yield (LY), lactation length (LL), age at first calving (AFC), number of services per conception (NoS), calving interval (CI), age at sexual maturity (ASM) and calf birth weight (CBW). Analysis of variance (ANOVA) procedure was carried out using crossbred genotype, parity, LL, LY, AFC, NoS, CI, CBW and ASM of cow as fixed effects, and Duncan's Multiple Range Test was used for mean comparison. ANOVA based half sib analysis method was used for heritability estimation. The mean performance values of LY, LL, AFC, NoS, CI, CBW and ASM of the farm were 958.04 liters, 199 days, 58 months, 1.44 services, 13 months, 18.98kg, and 27.60 months, respectively. There was no significant effect (P>0.05) of cow genotype on any of the traits owing to greater within breed variability observed. Cows in the fourth and later parities had significantly higher LY and CBW than those of lower parities (P<0.05). CI increased significantly with NoS (P<0.05). ASM had a significant (P<0.05) but weak positive correlation with AFC (r = 0.22). The heritability estimates of CBW, LL, LY, NoS and AFC were 0.07, 0.24, 0.22, 0.80 and 0.05, respectively showing the evidence of genetic variability existing within the herd for selection. Improved management conditions could enable revealing of true differences among the genotypes.

Keywords: Breed Comparison, Dairy cows, Heritability estimation, Performance evaluation.

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[*]dematawewa@agri.pdn.ac.lk

Genotyping and Phenotyping of Selected Resistant Rice Germplasm for Blast Disease under Local Conditions

Ruwanthika A.M.C., Jayawardane N.U., Dissanayaka D.M.H.R., Bulathsinhalage V.N.D. and Ariyarathne H.A.C.K.[1]*

Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Magnaporthe oryzae, the causative organism of rice blast disease, causes 10-30% annual yield losses worldwide. Panicle blast is the most severe form, causing 100% yield losses. This study aimed at identifying blast resistant genes/QTLalleles in selected rice germplasm and screening the same for leaf and panicle blast resistance in local environments. *Magnaporthe oryzae* strains, isolated and Koch's postulated previously, were sub-cultured and identified by *Pot2* based PCR before inoculation. Two local Mega rice varieties Bg352 and At362, and international germplasm Usen, Zenith, and Raminad were studied. Pachchaperumal was used as the susceptible control. Potted rice plants at seedling (21 days) and heading stages were screened in triplicate for leaf and panicle blast. Rice plants inoculated by spraying a mycelium suspension of the two-pathogen isolates were kept in humid chambers to facilitate disease development. Rice varieties were genotyped using gene-specific markers or linked SSR markers for *Pita/Pita-2, Pi54* and *Pikh* genes/QTL alleles. Optimum growth of *M. oryzae* was observed on oatmeal plates containing 7.5 g/L of glucose. Upon inoculation, panicle blast symptoms were observed on Bg352 and At362, however, no symptoms were observed on Usen, Zenith, Raminad and Pachchaperumal. Symptom development was not consistent in the replicates in any of the varieties, therefore, these observations need to be verified. *Pita/Pita-2, Pi54* and *Pkih* resistance genes/QTLs were observed in Usen, Raminad, and Zenith respectively. *Pita/Pita-2*, and *Pi54* were amplified in At362 and Bg352. Bg352 predicted allelic variation in *Pikh* but the QTL was not amplified in At362. Sequencing of these genes/QTL from the local varieties could reveal further allelic variations. Verification of resistance phenotypes of Usen, Raminad and Zenith and identification of allelic variations will assist in identifying potential donor parents for blast resistance in rice crop improvement.

Keywords: *Magnaporthe oryzae,* Panicle blast resistance, *Pi54, Pikh, Pita/Pita-2,*

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[1]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya,Sri Lanka
*chandimaa@sci.pdn.ac.lk

Seed Germination and Early Growth of Major Weed Species in Paddy Cultivation in Sri Lanka at Elevated Temperature and Carbondioxide Levels

Amarasinghe A.M.C.S., Herath H.M.S.[1] and Marambe B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The photosynthetic mechanism of crops and weeds will determine their competitiveness and level of resilience in a changing climate. The study assessed the impact of climate change on the germination and growth performance of *Oryza sativa* (var. Bg300; C3) and major weed species in paddy cultivation, *i.e. Echinochloa crus-galli* and *Ischaemum rugosum* (C4 grasses), and *Cyperus iria* and *C. difformis* (C3 sedges). Elevated temperature (T1: day/night 35/33 °C), elevated CO_2 concentration (T2: 550 ppm at day/night 28/26 °C) and the combination of temperature and CO_2 concentration (T3: 550 ppm at day/night 35/33 °C) were imposed separately in a growth chamber, coupled with parallel experiments in the laboratory (CO_2 440 ppm; day/night 26/22 °C) and field conditions (CO_2 440 ppm; day/night 28/23 °C). At 3 days after sowing (DAS), seed germination of paddy and grass weeds showed 100% germination, while the sedges showed about 90% germination in T1, T2, and T3 compared to laboratory and open field conditions. The growth parameters such as plant height, root length, number of leaves, and plant dry weight of paddy plants and sedge weeds were higher at 21 DAS of seed paddy in T2 with a high leaf greenness (SPAD reading) compared to T1, T3, laboratory, and field conditions. In a similar comparison, C4 grass weeds performed better ($p < 0.05$) in T3 with a high SPAD value compared to the rest. The highest leaf area per plant of *O. sativa* and sedge weeds was recorded in T2, while that of grass weeds was recorded in T3, at 21 DAS. The results revealed that C4 grass weeds could pose a severe threat to paddy cultivation in a changing climate.

Keywords: Climate change, Elevated CO_2 concentration, Elevated temperature, Plant growth, Seed germination

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[1]Rice Research and Development Institute, Bathalagoda, Sri Lanka
[*]bmarambe@yahoo.com

Growth and Development Responses of Tomato to Varying Nutrient Regimes in Different Growth Environments

Kumarasiri S.P.A.M., Bandaranayake P.[1], Dewapriya I.G.N.S.[1], Weerakkody W.A.P., Beneragama C.K. and De Costa W.A.J.M.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study was conducted to evaluate the effects of different nutrient regimes on the growth and development of the local tomato variety Thilina. The experiment was carried out in three environments: a controlled greenhouse, an uncontrolled greenhouse, and an open field at the Agricultural Biotechnology Center, Meewathura, from September to November 2022, as separate Randomized Complete Block Designs. Tomato plants were treated with the Department of Agriculture's recommended nitrogen fertilizer amounts as a control (T1), 80% nitrogen from the recommendation (T2), and 60% nitrogen from the recommendation (T3) in each environment separately. Results revealed that the highest day (30.8°C) and night (23°C) temperatures were observed in the uncontrolled greenhouse and the lowest day (27.8°C) and night (19.5°C) temperatures were observed in the open field environment. The highest relative humidity (81.7%) was observed in the controlled greenhouse and the lowest (62.2%) was observed in the open field environment, and the highest incident radiation (7.2 mol $(PAR)m^{-2}d^{-1}$) was observed in the open field environment, while the lowest (2.3 mol $(PAR)m^{-2}d^{-1}$) was observed in the controlled greenhouse. Sub-optimal nitrogen supply did not show a significant ($P<0.05$) effect on all measured growth development and yield parameters in the uncontrolled greenhouse. Treatment effects were significant for some parameters in the controlled greenhouse and open field. Total plant dry weight and total plant nitrogen increased under 60% nitrogen, the efficiency of photosynthetic light reaction as measured by chlorophyll fluorescence and total plant nitrogen was higher under 80% nitrogen compared to the control (100% nitrogen) in the controlled greenhouse. In the open field environment, both 80% and 60% nitrogen reduced photosynthetic efficiency, whereas 80% nitrogen reduced the height increase rate compared to the control. It is concluded that the sensitivity of tomato sub-optimal nitrogen supply varies with the growing environment.

Keywords: Growth parameters, Nitrogen stress, Temperature stress, Tomato, Yield parameters

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[1]Agricultural Biotechnology Center, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]janendrad@gmail.com

Growth and Development Responses of Tomato to Varying Water Regimes in Different Growing Environments

Priyadarshani A.G.H., Bandaranayake P.[1], Dewapriya I.G.N.S.[1],
Weerakkody W.A.P., Beneragama C.K. and De Costa W.A.J.M.[*]
Department of Crop Science,
Faculty of agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study was conducted to evaluate the effects of water stress on selected growth and development parameters of tomato (variety Thilina). The experiment was carried out in three environments: a controlled greenhouse, an uncontrolled greenhouse and an open field at the Agricultural Biotechnology Center, from September to November 2022, as separate Randomized Complete Block Designs with five replicates. The plants were grown in pots under three water regimes, namely, well-watered (80% field capacity, FC), 60% and 40% FC. The three environments differed significantly ($p<0.0001$) in terms of incident radiation, day and night air temperature and relative humidity. The highest day (30.8°C) and night (23°C) temperature was observed in the uncontrolled greenhouse whereas lowest day (27.8°C) and night (19.5°C) temperatures were observed in the open field environment. The highest relative humidity (81.7%) was observed in the controlled greenhouse and the lowest (62.2%) was in the open field environment. The highest incident radiation (7.2 mol (PAR)m^{-2}d^{-1}) was observed in the open field environment and the lowest (2.3 mol (PAR)m^{-2}d^{-1}) was observed in the controlled greenhouse. Water stress did not show significant ($P<0.05$) effects on all measured growth, development, and yield parameters except leaf temperature 36 days after transplanting in the uncontrolled greenhouse. Both 60%FC (T2) and 40%FC (T3) increased the leaf surface temperature compared to the well-watered control (T1) in the uncontrolled greenhouse. Rate of fruit initiation increased under 60%FC and 40%FC, while 40%FC decreased the leaf area per plant in the controlled greenhouse. Severe water stress decrease root dry weight and rate of height increase was decreased under 40%FC, whereas 60%FC decreased the root dry weight in the open field environment. It is concluded that tomato plants in the different growing environments show varying sensitivity to water stress.

Keywords: Growth parameters, Temperature stress, Tomato, Water stress, Yield parameters

[1]Agricultural Biotechnology Center, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]janendrad@gmail.com

Growth and Yield Performance of Selected Sesame Varieties and Breeding Lines under Drought Stress

Lakmali K.M.N., Perera U.I.P.[1] and Dissanayaka D.M.S.B.[*]
Department of Crop science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Drought has been a significant challenge to crop production worldwide, affecting a wide range of crops via yield losses and crop failures. The aim of the present study was to investigate the growth and yield performance of selected sesame varieties and breeding lines cultivated under moisture-stress conditions. A pot experiment was conducted as a Completely Randomized Design (CRD) in a rain shelter. Two commonly grown sesame varieties (Uma and Malee) and two promising breeding lines (Ye An and Yupung) were grown under well-watered and moisture-stressed conditions. All pots were maintained at 80% field capacity until the drought treatment was imposed. The moisture stress was imposed by drying out the soil without irrigation for several days until leaf wilting symptoms appeared and then re-watered with half the amount of water to that of 80% field capacity. Plant growth, uptake of nitrogen (N), phosphorus (P) and potassium (K) and their use efficiency were measured. Drought had a significant impact on accumulation of biomass of Malee and Yupung varieties. N uptake of Malee was greatly reduced under drought and was unable to increase the use efficiency of acquired N under drought. Although P uptake of Uma was reduced under drought, the use efficiency of acquired P was greatly enhanced. K uptake of Malee and Yupung was significantly reduced *(P<0.05)* under moisture stress, and those cultivars were unable to utilize the acquired K more efficiently in biomass formation under drought stress. There was a greater tendency to reduce the pod number of Uma and Malee grown under drought stress compared to well-watered condition. Drought, on the other hand, had no effect on the pod length and width of the tested varieties and breeding lines. Uma and Ye An seem to be more drought tolerant in biomass formation compared to Malee and Yupung.

Keywords: Biomass accumulation, Drought tolerance, Moisture stress, Sesame

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[1]Grain Legume and Oil Crops Research and Development Centre, Angunakolapelessa, Sri Lanka
[*]samanthad@agri.pdn.ac.lk

Growth and Yield Responses in Finger Millet-Mung Bean Intercropping under Moisture-Limited Conditions

Senevirathna A.G.U.N., De Silva S.H.N.P. and Dissanayaka D.M.S.B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Finger millet (FM/ *Eleusine coracana* (L.) Gaertn.) is widely grown in arid and semi-arid regions around the world to ensure future food and nutritional security as well as a potential crop for drought-prone cropping lands. FM can be intercropped with legumes such as green gram (GG/ *Vigna radiata* L. Wilczek) to enhance the productivity in the cropping system. This experiment was conducted to investigate the productivity performance of FM-GG intercropping system under drought stress. In a pot experiment, two crop species were grown as monocropping and intercropping under two moisture levels (well-watered and drought). Soil moisture in well-watered condition was maintained in 80% field capacity whereas drought-stress was imposed with 40% moisture. Plant dry weight, uptake of nitrogen (N), phosphorus (P), and potassium (K) and use efficiency of those nutrients, root length, available soil P in rhizosphere soil were measured. FM produced similar shoot and root dry weight irrespective of the moisture treatment and cropping system. However, intercropping had no yield advantage either in well-watered or moisture-stressed condition. Drought stress significantly ($P<0.05$) decreased the panicle dry weight of FM. Irrespective of the moisture treatment, FM grown with GG accumulated more N than those cultivated in monocropping system. There was no intercropping advantage for P and K accumulation of FM both in drought and well-watered conditions. From the results, it can be concluded that, FM-GG intercropping provides only N uptake advantage for FM. However, N uptake advantage could not translate into yield advantage of FM either in well-watered or moisture-limited condition.

Keywords: Drought, Finger millet, Green gram, Intercropping, Nutrient uptake

[*]samanthad@agri.pdn.ac.lk

Growth and Yield Responses of Maize (*Zea maize*) to Inoculants of Plant Growth Promoting Rhizobacteria under Field Conditions

Weerasekara W.M.A.W.Y.C., Rajapaksha R.M.C.P.[*] and Edirisinghe S.S.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Rhizobacteria with abilities to solubilize phosphate, fix atmospheric nitrogen and produce growth hormones enhance growth and yield of crops. A field experiment was conducted to assess the effectiveness of a rhizobacterial inoculant comprising three phosphate solubilizing bacteria (PSB) and a diazotroph (*Azospirillum* sp.) on growth and yield of maize under field conditions. The inoculant was added either to seeds (SI) or to compost pellets (ICP) and evaluated along with a fertilizer mixture containing urea and triple super phosphate at 2/3 and 3/4 of recommended rates, respectively and compared with recommended fertilizer (RF) and non-fertilized treatments. Nitrogen and P concentrations in leaves and available N and P in soils were analyzed and shoot height and biomass were recorded at the vegetative growth stage. Cob weights were recorded at the milky stage. Leaf N and P concentrations of SI and ICP treatments varied from 46 to 52 mg g^{-1} and from 1.6 to 1.7 mg g^{-1} dry matter, respectively and comparable to RF treatment. The same trend was observed for shoot biomass in inoculated (53-64 g) and RF (59 g) treatments. Plant dry weights correlated with leaf N concentrations (r= 0.68, P<0.05). Fresh cob weights of inoculated treatments (0.21 – 0.25 kg) were significantly higher than that of RF treatment (0.2 kg) implying that N and P were not limiting in the inoculated treatments. A positive correlation between cob weight and soil available P (r=0.83, P<0.01) and high root infection by arbuscular mycorrhizae resulting in > 78% of arbuscules implied that yield was limited by the P. Both SI and ICP effectively enhanced growth and yield of maize irrespective of fertilizer cut down and optimum soil P levels for maize should be identified.

Keywords: *Azospirillum* sp., Growth, Maize, Phosphate solubilizing bacteria, Yield

[1]DIMO Plantchem (Private) Limited, Plantseeds (Private) Limited, No:01, Industrial Zone, Dambadeniya, Sri Lanka
[*]chandir@agri.pdn.ac.lk

Growth Enhancement of *Aglaonema maria* using Compost Fortified with Beneficial Fungi

Athuluwage S.D., Rajapaksha R.M.C.P.,[*] and Dayarathna C.R.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Aglaonema maria, or "Chinese Evergreen," is an ornamental foliage plant that has high demand in the export market. The unavailability of a suitable growing medium for large-scale production is a limitation. A net house experiment was conducted to assess the effectiveness of adding two types of compost fortified with selected fungal strains to the existing growth medium at Mike Flora (Pvt.) Ltd., Rambukkana. Four treatments: non-fortified control (T1), non-fortified compost (T2), *Trichoderma harzianum* fortified compost (T3), and compost fortified with a combination of three fungal strains (T4) were arranged in a completely randomized design. The treatments were added to plant stocks that had one-month-old healthy plants, and one-year-old and two-year-old plants with retarded growth. The number of replicates for each treatment was ten. Plant height and number of leaves per plant were recorded at monthly intervals for two and half months in 40 representative plants from each plant stock. Both one-month-old and one-year-old plants showed the highest mean increase in plant height: 33.5 cm and 25.8 cm, respectively. No significant growth enhancement was observed in two-year-old plants. Two-year-old plants in *T. harzianum* fortified compost showed the highest increase in leaf number due to releasing significantly higher K (404.6 mg kg^{-1}), P (1383 mg kg^{-1}), NO$_3^-$ (330.1 mg kg^{-1}), and NH$_4^+$ (1097 mg kg^{-1}) by *T. harzianum* over 30 days period. This study provided evidence that the compost fortified with *T. harzianum* could increase the growth of *Aglaonema maria* by providing nutrients over non-inoculated compost and has the potential of being used at a commercial scale.

Keywords: *Aglaonema maria*, Compost, Growth enhancement, Nutrients, *Trichoderma harzianum*,

[1]Mike Flora (Pvt) Ltd, 'Siri Niwasa', Rambukkana, Sri Lanka
[*]chandir@agri.pdn.ac.lk

Growth Performance of Endemic Freshwater Fish *Systomus spilurus* (Sri Lankan Olive Barb) Under Different Stocking Densities from Post Larvae to Advanced Fry Stage

Dissanayake D.K.S.D., Athauda A.R.S.B.[*], Walpita C.N.[1] and Mudalige A.R.[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Systomus spilurus (Mas Pethiya) is an endemic freshwater food fish in Sri Lanka. Due to its taste and high nutritional value, *S. spilurus* has been heavily consumed and its natural population has been declined mainly due to anthropogenic reasons. Though captive breeding seems a promising method for stock enhancement, larval rearing protocols; stocking densities in particularly were not tested and optimized under Sri Lankan conditions. Therefore, the objective of this study was to determine the most suitable stocking density in captivity for *S. spilurus* for introduction of them to culture-based fishery. In this study, five-day-old *S. spilurus* Post Larvae (PL) were stocked in 86 cm × 70 cm × 25 cm cement tanks, and tanks were filled with water up to the height of 10 inches (150 L). There were 4 treatments with different stocking densities of *S. spilurus* as 0.75 PL/L (T_1), 1.25 PL/L (T_2), (T_3) 1.75 PL/L (T_3) and 2.25 PL/L (T_4). All PLs were fed using Artemia & chicken egg mixture in the first two weeks followed by a formulated commercial feed (40% crude protein) at levels of 10% and 25% of the body weight, during the 56-days of experimental period. The mean final weight & length, average daily weight and length gain, and specific growth rate among treatments were significantly different ($P<0.05$). The highest final mean length (3.3±0.01 cm) & weight (0.464±0.013 g), the highest average daily weight gain (0.0083±0.0002 g/day) & length gain (0.049±0.0002 cm/day) and the highest specific growth rate (10.96±0.005 %/day) were observed in T_1 where the stocking density was lowest at 0.75 PL/L. The lowest growth performance was observed in the T_4 treatment where stocking density was at 2.25 PL/L. These results conclude that the stocking density of 0.75 PL/L can be used as the best stocking density for rearing *Systomus spilurus* PLs in captivity.

Keywords: Advanced fry, Growth performance, Post larvae, Stocking density, *Systomus spilurus*

[1]Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, PO Box 02, Belihuloya, Sri Lanka
[2]National Aquaculture Development Authority of Sri Lanka, Aquaculture Development Center, Dambulla, Sri Lanka
[*]sbathauda@agri.pdn.ac.lk

Health Safety of Guava Produced in Selected Guava Production Systems

Archchi U.E., Weerakkody W.A.P.,[*] and Gunawardane C.R.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Guava (*Psidium guajava Linn.*) is one of the principal tropical fruits which is largely consumed in Sri Lanka in the fresh form. It is also one of the fruits that has a high export potential. Addressing the question of "health safety of guava fruits" under different crop management conditions was found to be a timely important topic because consumer concerns over the fresh fruit quality and health safety have increased substantially in recent years. Therefore, this study was conducted to determine whether there is a correlation between crop management intensity level (High, Medium, Low) and the fruit qualities and pesticide residue levels of guava. For the qualitative assessments, guava samples were collected from farmer fields at harvesting maturity stage. Total Soluble Solid (TSS), titratable Acidity (TA), fruit volume, fruit weight, fruit diameter, fruit firmness, L*, a*, b* values, and residue levels of commonly used pesticides were quantified in fresh samples. Residues of pesticides were analyzed by Gas chromatography-Mass Spectrometry. The results indicated that the residues of common pesticides were not detected in any of the samples. Meanwhile, the crop management intensity level (High, Medium, Low) was found to be not significant ($P<0.05$) on the selected quality parameters of fresh guava. Low rate of application of pesticides due to high cost and adhering to safety guidelines were found to be the most probable reasons for this situation. It can be concluded that the present-day crop management in guava cultivations does not have any harmful effect on fresh fruits with respect to pesticide residues. However, this conclusion needs verification through repeated studies using a better sampling strategy, before recommending the health safety of fresh guava fruits in Sri Lanka.

Keywords: Crop Management, Gas chromatography-Mass Spectrometry, Guava, Pesticide residue

[1]National Institute of Post-Harvest Management, Jayanthi Mawatha, Anuradhapura, Sri Lanka
[*]wapweerakkody@agri.pdn.ac.lk

Identification of Mother Plant Selection Criteria of Gliricidia (*Gliricidia sepium* (Jacq.) Kunth ex Walp

Samarakkara S.T.A., Madhushankha H.V.L.L. and Pushpakumara D.K.N.G.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

A multipurpose leguminous tree species native to Mexico known as Gliricidia (*Gliricidia sepium* (Jacq.) Kunth ex Walp) has traditionally offered goods and services to the farming people of tropical nations like Sri Lanka. Early on after its introduction in 1700, its primary purposes included defining fences in farmlands and backyard gardens, providing shade for coffee, cocoa, and tea cultivation, and providing support for a variety of climbing crops like pepper, vanilla, yams and vegetables. Gliricidia is currently plays a significant part of Sri Lanka's agriculture, livestock, and green energy sectors. Since Sri Lanka has very few prospective hydro-generating sites that are now available for development, non-traditional renewable energy generation represents a promising option. To meet future electricity demand, Gliricidia can be used as a biomass energy source, although there is no proper selection methods for mother plants for higher wood biomass production. Therefore, the present study was conducted to make Gliricidia mother plant selection criteria aiming for high amount of fuelwood yield. Out of 12 variables recorded over 100 Gliricidia trees, only leaf weight, stem girth and average branch girth were shown positive linear relationship with the wood weight. Relationships between wood weight (Y1) and leaf weight (X1), stem girth (X2) and average branch girth (X3) are identified as $Y1 = 2.46558\ X1 + 7.56337$ ($R^2=72\%$), $Y1 = 5.5036\ X2 - 10.19207$ ($R^2=31\%$) and $Y1 = 6.80236\ X3 - 6.78043$ ($R^2=27\%$), respectively. According to multiple linear regression X2 and X3 relationship with Y1 was $Y1 = 3.85472\ X2 + 4.06939\ X3 - 20.06631$ ($R^2=36.9\%$), whereas the relationship of all three variable was $Y1 = 2.08909\ X1 + 1.57609\ X2 + 1.87959\ X3 - 10.55528$ ($R^2=77.7\%$). Based on the results and practicality, it can be concluded that the better approach for selection of mother plants will be obtaining of wood weight after harvesting.

Keywords: Branch girth, Dendro power, Fuelwood, Leaf weight, Mother plant, Wood weight

[*]ngpkumara@agri.pdn.ac.lk

Identification of Seed Dormancy Period of Popular Rice Varieties in Sri Lanka

Gunasekara R.S.M.[*], Priyantha M.G.D.L.[1], Jayathilaka R.M.S.P.[2], Samaranayake J.W.K.[3], Ariyaratne M. and Rankoth L.M.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Seed dormancy is the ability of seeds to delay their germination even under favourable conditions. Dormancy affects the cultivation and production of rice. This experiment was conducted to identify the variation of dormancy period of 14 popular rice varieties grown in eight locations in Sri Lanka. Seeds taken immediately after harvesting were tested for germination. The stage at which the seeds show 85% of germination was taken as the dormancy breaking point as per the International Seed Testing Association (ISTA) guidelines. The experiment was conducted at Seed Certification Service, Gannoruwa, Peradeniya. The initial moisture content of the seeds (%), thousand seed weight (g), days taken for 85% germination, days taken for 50% germination, thousand seed dry weight (g), and shoot and root length of seedlings (cm) were measured. According to the results of the study, the mean seed dormancy period varied from variety to variety within a range of 19-85 days after harvesting. Location-wise difference in dormancy period was also observed for a given variety. Different varieties grown in the same location also showed differences in the dormancy period. Thousand seed weight and thousand seed dry weight of varieties varied from location to location but did not show any relationship with the dormancy period. Mean seedling vigor index (SVI) significantly varied (*p=0.05*) among varieties, locations as well as the days after harvesting within each variety. Seeds just after harvesting had a lower SVI indicating poor seedling quality and reached the maximum at the dormancy breaking period. Therefore, the study found that the seed dormancy period of paddy varies among varieties as well as the cultivating area of Sri Lanka. Moreover, the quality of seedlings is better after the dormancy breaking point.

Keywords: Dormancy period, Germination, Rice, Seedling vigor index, Thousand seed weight

[1]Seed Certification Service, Department of Agriculture, Gannoruwa, Sri Lanka
[2]Seed Health Testing Laboratory, Department of Agriculture, Gannoruwa, Sri Lanka
[3]Central Seed Testing Laboratory, Department of Agriculture, Gannoruwa, Sri Lanka
[*]sandanigunasekara4@gmail.com

Identification of Tree Diseases and Their Probable Causal Organisms in Forest Cover of the University of Peradeniya

Chamara W.M.A.S., Rienzie K.D.R.C.[*] and De Costa D.M.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The rich floristic diversity of the University of Peradeniya (UoP) has been threatened by unidentified tree diseases. The present study was undertaken to identify diseases and their probable causal organisms. Using a map, the total land area of the UoP was divided into 40 blocks (200 x 200 m), and 10 randomly selected blocks were used for purposive sampling. Identification was performed using signs and symptoms on diseased plants, as well as the colony and spore morphology of isolated microorganisms. Leaf spots on *Mangifera indica*, *Couroupita surinamensis*, *Michelia champaca*, *Bridelia retusa*, *Polyalthea longifolia*, *Mangifera zeylanica*, *Ervatamia divaricata*, *Coffea canephora* and *Alstonia macrophylla* were caused by *Colletotrichum* spp.. *Lasiodiplodia* sp. was isolated from *Ricinus communis* and *Pinus caribaea* leaf spots, while *Pestalotiopsis* spp. were reported from *Lagerstroemia* sp. and *Mesua nagassarium* leaf spots. *Neopestalotiopsis* sp. was identified from leaf spots on *Phyllanthus* sp.. *Diaporthe* sp. and *Mycospherella* sp. were isolated from leaf spots of *Ficus religiosa* and *Durantha repens*, respectively. *Nigrospora* sp., *Pseudopeziza* sp. and *Cephaleuros virescens* were identified, respectively from *Polyalthea longifolia*, *Pongamia pinnata* and *Magnolia grandiflora*. *Botrytis* sp. from *Nyctanthes arbor-tristis*, *Lasiodiplodia* sp. from *Pinus caribaea*, *Colletotrichum* sp. from *Tabebuia guayacan* and *Neopestalotiopsis* sp. from *Phyllanthus* sp. were isolated from leaf blights. From stem cankers of *Neolitsea cassia* and *Punica granatum*, *Lasiodiplodia theobromae* and *Phoma lingam* were isolated, respectively. *Cryptovalsa* sp. was identified in the stem decays of *Delonix regia*, and the black crust-causing *Phellinus noxius* was identified from *M. indica*. *Agrobacterium* sp. was isolated from *F. benjamina* stem galls. Basidiocarps of *Ganoderma* spp. were identified in *D. regia*, *Phyllanthus emblica* and *Cassia fistula*. *Haxagonia discopoda*, *Fomes* sp. and *Introfuscus petch* basidiocarps were identified on the stems of *Samanea saman* and *Neolitsea cassia*. The findings provide a wealth of information to manage the tree diseases in the UoP.

Keywords: Floristic diversity, Forest cover, Tree diseases, University of Peradeniya

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[*]ryanrienzie@agri.pdn.ac.lk

Identifying the Best Soil Incorporation Stage of Horse Gram [*Macrotyloma uniflorum* (Lam.) Verdc.] as a Green Manure Crop

Dissanayake D.M.R.L., Ranil R.H.G., De Silva S.H.N.P. and Rankoth L.M. [*]

Department of Crop Science,

Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Horse gram [*Macrotyloma uniflorum* Lam. (Verdc.)] is a legume which can be easily grown in Sri Lanka. However, long life cycle duration and poor productivity due to lower flowering in some growing areas of the country are some of the restrictions in horse gram cultivation. Due to the higher growth rate of the plant, there is a high potential of horse gram to be used as a green manure. Therefore, identification of the correct soil incorporation stage of horse gram as a green manure under Sri Lankan conditions is very important. With that objective, the experiment was conducted at the University Sub-campus, Mahailluppallama and horse gram seeds were broadcasted evenly over nine plots at the rate of 25 Kg ha^{-1}. Then, the plants were cut and biomass was mixed into soil at three treatment stages as; 6 weeks after sowing (WAS, T1), 8 WAS (T2) and 10 WAS (T3). Soil samples were collected at treatment imposition and, in one-week intervals after treatment imposition in three replicate plots per treatment at 0-15 and 15-30 cm depths and analyzed for nutrients. Simultaneously, plant biomass samples were collected every week in three replicates. Results revealed that, plant drymatter, N, P and K additions to the soil with values of 2839.6, 32.15, 6.25 and 24.06 kg ha^{-1} respectively were significantly greater ($P<0.05$) in T3 compared to T1 and T2. The N, P, K levels at the 0-15 and 15-30 cm depths of soil were greater compared to the initial soil nutrient levels in the T3 treatment during the period from zero to four weeks after soil incorporation. Therefore, according to the overall results of the study, 10 WAS can be recommended as the best stage to incorporate horse gram into soil to get the maximum benefits as green manure.

Keywords: Biomass addition, Cover crop, Green manure, Soil improvement, Sustainable agriculture

[*]lalithrankoth@agri.pdn.ac.lk

Immunostimulatory Effect and Disease Resistance against *Aeromonas hydrophilla* in Koi Carp, *Cyprinus carpio*(L) of Dietary Supplements of Coriander Seed (*Coriandrum sativum*), Heen Bovitiya Leaf (*Osbeckia octandra*) and Hathawaria Leaf (*Asparagus racemosus*)

Namithra M., Madhubhashini E.T.S., Rajapakshe A.D.W.R.[*1] and Rupika G.R.H.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The ornamental fishery is a developing sector in Sri Lanka. High cost of production and loss due to disease conditions are major constraints of the aquaculture sector. Many chemical compounds including antibiotics are used by farmers to control disease conditions that are not environmentally sound and cause drug resistance bacteria. The occurrence of bacterial disease in fish fingerlings is found due to various pathogenic bacteria and the majority were identified as *Aeromonas sp.* The application of native herbal plants in the aquaculture sector is an effective and environmentally friendly method for enhancing fish immunity and growth. This study was conducted to investigate effective immunostimulant for koi carp fingerlings among *Coriandrum sativum* (Coriander seeds), *Osbeckia octandra* (Heen bovitiya leaf), and *Asparagus racemosus* (Hathawaria leaf). Three feeds were produced by incorporating each plant's dry powder with Growfin commercial feed as Feed TK (1% of Coriander seed), Feed TA (1% of Hathawaria), and Feed TH (1% of Heen bovitiya). Growfin feed was used as the control Feed (C). The feeding period was six weeks. Growth performance and feed performance were at the estimated. Blood sampling and a challenge study using *Aeromonas hydrophilla* were carried out at the end. In terms of hematological parameters, Red blood cell count and White blood cells were significantly ($p<0.05$) higher in Hathawaria leaf compared with the control. Hathawaria leaf showed significantly ($p<0.05$) the highest specific growth rate (SGR%) and feed conversion ratio FCR 1.8. The hepatosomatic index (HSI) was significantly ($p>0.05$) smaller among the treatment groups and the control showed the highest HSI. In the challenge study, treated groups showed a high survival rate compared to the control. Among them, Hathawaria treatment showed the highest survival rate (83.3%). The results showed that the dietary supplement of Hathawaria can enhance immunity, growth, and resistance against *Aeromonas hydrophilla*.

Keywords: *Aeromonas hydrophilla, Asparagus racemosus, Coriandrum sativum,* koi carps*, Osbeckia octandra.*

[1]Inland Aquatic Resources and Aquaculture Division, National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka
[*]wrajapakshe@gmail.com

Impact of SLGAP-Certification Process on Growth, Yield and Disease Incidence of Chilli

Madushani P.N.N. and Hitinayake H.M.G.S.B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Assuring the nation's food quality and safety is of utmost importance. Sri Lanka Good Agricultural Practices (SLGAP) is identified as one of the important steps in achieving it. SLGAP standards address the food quality and safety, environmental sustainability, social acceptability and economic viability. However, good agronomic performance is needed to attract farmers to the SLGAP. The objective of this study was to compare chilli grown under SLGAP directives and conventional chilli cultivations established in both lowland rice fields and uplands. Hence, chilli established under 4 treatment combinations was evaluated. They included SLGAP cultivations in lowland rice fields, conventional cultivations in lowland rice fields, SLGAP cultivations in uplands and conventional cultivations in uplands. Each treatment was evaluated using ten cultivations (replicates). Cultivated chilli variety in all the cultivations was MICH HY1. Agronomic performance was measured using plant height, yield and disease incidence with special reference to Leaf Curl Complex (LCC) and Narrow Leaf Disorder (NLD). In both cultivations the SLGAP-certification and conventional, the recorded yields were high ($p<0.05$) under upland conditions when compared to lowland rice fields. The yield differences between SLGAP and conventional cultivations were non-significant ($p>0.05$) under upland conditions. SLGAP cultivations recorded significantly high ($p<0.05$) yields when compared to conventional cultivations when grown in the lowland rice fields. It was observed that LCC was high ($p<0.05$) under conventional cultivations when compared to SLGAP cultivations both under upland conditions and lowland rice fields. The NLD incidence was high ($p<0.05$) in lowland rice fields when compared to uplands in both SLGAP and conventional cultivations. Hence it is apparent that practicing SLGAP standards is beneficial to obtain high agronomic performances and low disease incidences with reference to LCC and NLD when establishing chilli cultivations in uplands in the DL1b agro-ecological region of Sri Lanka.

Keywords: Chilli, Good agricultural practices, Leaf curl complex, Narrow leaf disorder, SLGAP

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[*]gaminih@agri.pdn.ac.lk

In vitro Flowering of Exacum trinervium

Thurairajasingam T. and Eeswara J.P.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Exacum trinervium is a small flowering herb and an endemic to Sri Lanka. *In vitro* flowering provide the opportunity to study flowering requirements of a given species which can be used to overcome problems associated with flowering. In the present study effect of 3 different concentrations (3%, 6% and 9%) of sucrose, medium strength (half and full strength MS) and paclobutrazol (0.1 mg/l) on *in vitro* flowering of *E. trinervium* was investigated. Shoot length, leaf numbers, fresh and dry weight of the shoots and chlorophyll content were measured for10 week period. Results showed a significant variation between some treatments. Sucrose concentration affected on shoot length, leaf number and chlorophyll content of the shoots. The highest ($P<0.05$) shoot length, leaf number and chlorophyll content were obtained in the plants grown on 3% sucrose concentration. Different sucrose concentrations had no effect on the fresh and dry weights of the shoots. The application of paclobutrazol reduced shoot length, internode length and leaf area significantly ($P<0.05$) compared to the plants grown without it. Half strength had no significant effect on shoot growth. High sucrose concentration (9%) was not favorable for *in vitro* growth of *E. trinervium* and 0.1 mg/L paclobutrazol application reduced the shoot length of *E. trinervium*. None of the treatment used in this study not induce *in vitro* flowering of *E. trinervium* until 11 weeks after initiation of the experiment.

Keywords: *Exacum trinervium*, Half MS and full MS, *In vitro* flowering, Paclobutrazol sucrose

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[*]jpeeswara@agri.pdn.ac.lk

In Vitro Cultivation of *Gracilaria canaliculata* for Conservation and Commercial Production

Sewwandi W.H.R.M., Liyanage N.M.N., Perera S.A.C.N. and Bandaranayake P.G.C.[1*]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The current project is aimed at developing a micropropagation protocol for *Gracilaria canaliculata,* an economically important red algae for mass rearing of propagules for conservation and commercialization. Specimens were collected from Dondra Bay, Sri Lanka. Explants with meristematic growth were identified by macroscopy and microscopy; by studying cross-sections of young tips and mature stems to identify meristematic tissues. The experimental design was a CRD, with a minimum of ten replicates. Two previously recorded sterilization protocols for other seaweeds were tested with six modifications (T1-T6) under different betadine, ethanol, antibiotics, fungicide concentrations and incubation periods. Survival rates and pigment retention were recorded for 30 days. Data at ten day intervals were analyzed by a Chi-square test using SAS package. Pigment retention rate was graphically illustrated with a heatmap done using R software. A three-factor factorial experiment was designed for regeneration using previously utilized two protocols with four modifications (M1-M4) for Provasoli's enriched seawater and full MS media under different light-dark conditions, agar levels (1.5%, 0.75%, 0%) and hormones (NAA: BAP; 1:1, 2:1). Distal immature tips with meristematic growth were selected as explants. Overall, 0%, 75%, 55%, 34%, 35%, and 38% survival rates were recorded for T1 to T6, respectively and T6 (1-hr incubation in 0.5% Thiram fungicide and antibiotic mixture; 100 mgL^{-1} Streptomycin, Penicillin and 15% ethanol) was identified as the best. Explant survival rates significantly (P≤0.05) differed among sterilization methods on the 10th and 20th days after culturing. Explants of M4 (Full MS, 0.75% agar, light:dark; 16:8) regenerated from the meristematic regions five days after culturing. However, photosynthetic pigments of explants depleted over time resulting in a colorless but live explant in cultures. Our results revealed the possibility of micropropagation of *G. canaliculata*. Further improvements recommended for commercialized regeneration and conservation.

Keywords: Carrageenan, *G. canaliculate*, *In vitro* cultivation, Red-algae, Rhodophyta

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[1]Agricultural Biotechnology Centre, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]pradeepag@agri.pdn.ac.lk

Influence of Long-Term Application of Organic Amendments on Soil Thermal Properties in Tea Grown Soils

Peiris T.T.K., Vidana Gamage D.N.,* and Mohotti K.M.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Long-term application of organic amendments to soil may alter soil thermal properties, modifying soil's ability to buffer against extreme temperature changes. The long-term effects of application of organic amendments on thermal properties of tea-grown soils, particularly the impact of different types of organic amendments compared to conventional synthetic fertilizer application, remain unstudied. Therefore, this study compared soil thermal properties in tea grown soils treated with Tea waste (TW), Compost (COM), and Neem oil cake (NOC) and only conventional synthetic fertilizers (CONV) in a twenty-five-year-old experimental site ("TRI-OR-CON") at St. Coombs estate of Tea Research Institute Thalawakale. In total, 48 intact soil core samples and 48 minimally disturbed samples were collected from the surface (0-15 cm) and the subsurface (15-30 cm). Soil samples were analyzed for soil thermal properties, bulk density, aggregate stability, volumetric water content at saturation and field capacity, and soil organic carbon. The incorporation of tea waste and compost into soil over a period of 25 years resulted in significant ($p<0.05$) improvements in soil aggregation and a decrease in bulk density, leading to substantial reductions in soil thermal conductivity and thermal diffusivity of surface soil compared to conventional synthetic fertilizer application. Further, soil volumetric heat capacity slightly increased in tea waste and compost applied soils due to their significantly high soil organic carbon and water storage. Results of this study suggested that the long-term application of tea waste and compost has increased soil's ability to buffer against extreme temperature changes and thereby to keep temperature of soil more stable favoring increased microbial activity and an overall healthy tea soil ecosystem. Future studies should consider monitoring the soil temperature at multiple depths at seasonal to annual temporal scales along with physiological responses of the tea plants.

Keywords: Heat conduction, Organic amendments, Soil thermal properties

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[1]Tea Research Institute, St Coombs Estate, Thalawakale, Sri Lanka
*dumindavidana@agri.pdn.ac.lk

Initial Growth and Nutrient Content of Recently Introduced Hybrid Napier and Sorghum Cultivars in Mid Country, Wet Zone

Dissanayaka D.M.U.S.K., Kumara Mahipala M.B.P.[*], Weerasinghe W.B.M.P.[1] and Abeysinghe A.M.N.D.B.[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Several hybrid fodder sorghum and Napier cultivars have been recently introduced to Sri Lanka for dairy cattle feeding. Present study investigated the initial growth and nutrient contents of two hybrid Napier cultivars and a hybrid sorghum cultivar in the mid country, wet zone during Maha season. The land was prepared, and the experimental plots (25 m^2) were arranged in to a Randomized Complete Block Design with 4 replicates. Double-node stem cuttings of CO-5 (*Pennisetumglaucum x P. purpureum*Schumach) and Red Napier (*Pennisetum purpureum*cross) were planted in 30 x 30 x 30 cm holes (2 cuttings per hole) at 1 x 1 m spacing. Sugargraze (*Sorghum bicolor* cv. Sugargraze) seeds were planted (2 seeds/ hole) at 2 cm depth at 15 x 45 cm spacing. The height and density of plants/ shoots and the length, width and density of leaves were measured, weekly. When Sugargraze reached 25% flowering stage (9th week) all fodder cultivars were harvested. The yield and nutrient contents of the harvest was estimated using randomly selected samples. The effect of variety, age and their interaction were significant (P<0.05) on growth parameters. At 9th week, the height, plants/ shoots density and leaf density were the highest (P<0.05) for Sugargraze (113.74 cm, 33.00, 251.25, respectively) followed by CO5 and Red Napier. The effect of variety was significant (P<0.05) on yield and composition of the harvest. Sugargraze harvest had higher(P<0.05) dry matter (15.44 %) and organic matter (90.32 %) contents than those in CO5 and Red Napier. Further, Sugergraze recorded the highest (P<0.05) fresh matter and dry matter yields (22.08 MT/ha, 3.43 MT/ha, respectively) owing to high plant and leaf densities observed. Harvesting Red Napier and CO5 cultivars after 9 weeks age with greater dry matter content may result in higher dry matter yield.

Keywords: Composition, Dry matter yield, Fresh matter yield, Leaf density, Plant/shoot density

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[1]Veterinary Research Institute (VRI), Gannoruwa, Peradeniya, Sri Lanka
[2]Pinnawala Elephant Orphanage, Dept. of National Zoological Gardens, Pinnawala, Sri Lanka
[*]pmahi@agri.pdn.ac.lk

Investigating the Water Usage of Oil Palm (*Elaeis guineensis*) and Rubber (*Hevea brasiliensis*) Trees in the Low Country Wet Zone of Sri Lanka

Perera. L.D.P., Vidana Gamage D.N.[1] and Nissanka N.A.A.S.P.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The cultivation of oil palm (*Elaeis guineensis*) in Sri Lanka has been criticized for its higher water consumption and drying out of the landscape, depletion of soil properties, and loss of biodiversity. The government banned the cultivation of oil palm in 2021 due to public pressure without proper scientific investigation. Thus, this experiment was conducted to compare the crop water usage of 10-12 years old oil palm and rubber (*Hevea brasiliensis*) plantations at Nakiyadeniya and Sapumalkanda Estates in the Low Country Wet Zone of Sri Lanka. The Implexx Sap Flow Sensors (ISFS) that employs the heat pulse technique to assess sap flow and plant water relations of perennial plants were established in 3 leaf bases (from the top, middle and lower leaf layers of the canopy) of oil palm and in stem around 1.6 m height from tree-base of rubber plants in the same location. The water usage was recorded continuously for one week period simultaneously in both oil palm and rubber trees during October – November 2022 in both estates. The daily water usages of the oil palm and rubber trees in Nakiyadeniya Estate were 239.49 L/day and 42.17 L/day, respectively, while in Sapumalkanda Estate it was 277.94 L/day and 53.07 L/day, respectively. Though the daily water usage of a single oil palm and a rubber tree was significantly different ($p<0.05$), the water usage per unit land area for oil palm ranged from 31,070-36,000 L/ha/day while that for rubber ranged from 22,000 – 27,825 L/ha/day. At the time of measurements, the canopy of the rubber plants had not reached the fully mature state after re-foliation and were also infested with PESTA leaf disease. Therefore, the water usage values obtained for rubber may be an underestimation which need to be repeated before any generalization is made.

Keywords: Crop water usage, Implexx Sap Flow Sensor, Oil palm, Sap flow thermometric sensor

[1]Department of Soil Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]spn@agri.pdn.ac.lk

Investigation of Calving Performance of Crossbred Murrah Buffaloes in a Large-Scale State Farm in Polonnaruwa District

Perera W.D.A.L. and Dematawewa C.M.B.[*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Calving performance of dairy buffalo is crucial for productivity of the dairy industry. The objectives of this study were to evaluate the calving performances of crossbred Murrah buffaloes under large scale semi intensive management conditions in the Dry Zone and to estimate heritability for calving traits of such a herd for genetic selection. A crossbred Murrah herd (≥50% Murrah) in a large-scale Government farm in Polonnaruwa district was selected for the study. The records on animal ID, birth date, parity group (PG = 1, 2, 3, 4, >4 parities), age at first calving (AFC), calf birth weight (CBW), sex of calf (SOC), birth month and calving interval (CI) were collected on 298 Murrah crossbred buffalo cows covering the calf birth year period from 2017 to 2021. Mean values (±SE) of CBW, AFC and CI of the herd were 24.79±0.09 kg, 88.67±1.36 months, and 457.50±6.17 days, respectively. ANOVA procedure followed by Duncan's Multiple Range Test showed significant differences ($P<0.05$) in CBW between male calves (25.48kg) and female calves (24.81kg). The CBW of fourth and fifth parity groups were significantly ($P<0.05$) higher (25.62 and 26.33kg, respectively) than those of first, second and third parities (24.36, 24.85, and 25.23 kg, respectively). There was no significant effect of parity of the cow or SOC born on subsequent CI of cows ($P>0.05$). Chi square analysis showed that calf birth type (normal, abortions and still birth) was not significantly associated with PG ($P>0.05$). December-May season had significantly higher calving than June-November season ($P<0.05$). Half sib analysis showed that heritability estimates for CBW and CI were 0.46 and 0.47, respectively. These results show the existence of sufficient additive genetic variation to launch within herd selection and the potential to enhance the performance further through improved management conditions.

Keywords: Age at first calving, Birth weight, Calving interval, Heritability, Murrah buffalo

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[*]dematawewa@agri.pdn.ac.lk

Investigation of Semen Production and Quality Characteristics of Breeding Bulls

Jenat Janany A.K., Dematawewa C.M.B.* and Ramanayake U.D.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Semen produced by the breeding bulls in the Central Artificial Insemination Station (CAIS), Kundasale, Sri Lanka is widely used for Artificial Insemination (AI) throughout the country. Thus, it is crucial to analyze the quality of semen of those bulls as it affects the number of straws produced from one ejaculate and conception rates at the field level. The objective of this study was to evaluate and compare AI sires, sire breeds, seasons, calendar years, and months of semen collection with respect to semen quality characteristics. Records on a total of 8436 semen samples of 23 AI bulls collected between 2018 and 2021 were obtained from CAIS. Volume of semen (mL), sperm concentration (millions/mL), initial motility (%) and post-thawing motility (%) were analyzed using Analysis of variance procedure with Duncan's Multiple Range Test for mean comparison. The overall means of semen volume, sperm concentration, initial motility, and post-thawing motility were 5.11 mL, 734.24 millions/mL, 75.73%, and 56.70%, respectively. Semen volume was significantly ($P<0.05$) affected by AI sire, sire breed, season, year, and month of semen collection. Significant ($P<0.05$) differences were observed among AI sires, years, seasons, and months for sperm concentration. Sperm concentration had a significantly ($P<0.05$) negative correlation with semen volume (r =0.1). Maha (October-March) season recorded significantly ($P<0.05$) a higher mean semen volume (5.36 mL) and a lower mean concentration (710.1 millions/mL) than Yala (April-September) season (4.88 mL, and 756.1 millions/mL, respectively). Initial motility was significantly influenced by all of the factors considered above. The difference among seasons was not significant ($P<0.05$) for post-thawing motility. Post-thawing motility had a significantly ($P<0.05$) positive correlation with initial motility (r=0.36). This study revealed that although the semen quality- parameters of all sires considered were above the minimum standards required, potential exists to improve sire performance further by providing better management conditions.

Keywords: Artificial insemination, Initial motility, Semen volume, Sperm concentration, Post-thawing motility

[1]Animal Breeding Division, Department of Animal Production & Health, Getambe, Peradeniya, Sri Lanka
*dematawewa@agri.pdn.ac.lk

Iron Toxicity-Related Morphological and Biochemical Variations of Selected Rice Varieties (*Oryza sativa* L.) in Sri Lanka

Dilhani T.N., Wickramasinghe K.V.[1] and Suriyagoda B.M.L.D.B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Iron (Fe) toxicity is recognized as one of the widely observed soil nutritional disorders, which lowers rice yield, especially in the low country wet zone (LCWZ) of Sri Lanka. This experiment was conducted to study the morphological and biochemical characteristics of selected rice varieties, recommended to be grown in LCWZ, under variable Fe concentrations in the growing media. The experiment was conducted at the Regional Rice Research and Development Center at Bombuwala, Sri Lanka (6°57'' N, 80°.01'' E) as a hydroponic system from September to December 2022. This trial was laid out in a Completely Randomized Design. There were two factors. Factor one was the iron concentration with 4 levels; 0 mg L^{-1}, 100 mg L^{-1} (1.79×10^{-3} mol L^{-1}), 300 mg L^{-1} (5.372×10^{-3} mol L^{-1}), and 500 mg L^{-1} (8.953×10^{-3} mol L^{-1}). The second factor was varieties with 4 levels; Bw 267-3, Bw 272-6b, Bw 372, and Bg 359. There were 15 plants from each treatment combination. Iron toxicity of plants was scored on 0 to 9 scale according to the standard evaluation system. Bw 372 and Bw 267-3 did not show bronzing symptoms in any iron concentration. When increasing Fe concentration in the growing medium, concentrations of Fe and Co were increased in the shoots of all varieties. However, the concentrations of Cd and Mn were decreased in all varieties. Reduction in shoot dry weight (SDW) and root length (RL) was the lowest in Bw 372 (33% for SDW and 40% for RL), and highest in Bw 272-6b (64% for SDW and 52% for RL). When comparing varieties, the concentration of Fe in Bw 372 was the lowest and Bw 272-6b was the highest. These traits have contributed Bw 272-6b to be susceptible, and Bw 372 to be tolerant to Fe toxicity.

Keywords: Adaptations, Heavy metals, Leaf bronzing score, Minerals

[1]Regional Rice Research and Development Institute, Bombuwala, Sri Lanka
[*]lalith.suriyagoda@agri.pdn.ac

Isolation and Screening of Effective Native *Rhizobium* Strains for Soybeans Grown in the Dry Zone of Sri Lanka

Sasanjalee K.M.D., Rajapaksha R.M.C.P.[*] and Edirisinghe S.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Soybean is cultivated worldwide using *Bradyrhizobium* inoculants with low nitrogen inputs. This study aims to identify indigenous *Bradyrhizobium* strains to be used as effective inoculants for soybean. Four strains of indigenous *Bradyrhizobium* (T5-T7) isolated from root nodules and rhizosphere soil of soybean were assessed under field conditions with 50% urea cut down and compared with no fertilized control (T1), non-inoculated fertilized control (T2), and farmer practice (T3). Plant samples were taken on the 4th, 6th and 8th weeks after seeding and assessed for dry weight, shoot nitrogen uptake, and nodules. Data were subjected to Analysis of variance using SPSS statistical software. Shoot dry weight was significantly higher in treatment added with inoculant 4 (T7) at the 4th (13.10g) and 6th weeks (25.21g) of seeding than other treatments. The same treatment showed significantly higher total nitrogen in the shoot (66.41 g kg^{-1}) at 4th week and weight of fresh nodules (0.69 g) at the 6th week over other treatments. The dry weight of pods was significantly higher in T7 (12.84 g) compared to the other treatments. Correlation analysis indicated that the shoot and root growth depend on total N uptake (r = 0.81 and r= 0.85 respectively) and spade meter readings (r = 0.60). At the 6th week, shoot growth was correlated with the weight of good nodules (r=0.81) and dry weight of pods (r=0.76). Results indicated that four *Bradyrhizobium* isolate survived in the experimental field and developed effective root nodules contributing to a significant increase in N uptake, growth, and yield enhancement of soybean with a 50% cut down of urea. There is a high potential to use the seed inoculant at a commercial scale following testing at farmer fields.

Keywords: *Bradyrhizobium*, Inoculants, N$_2$ fixation, Screening, Soybean

[1]DIMO Manager-Products Development & Regulatory Affairs, Plant seeds (Private) Limited, No:01, Industrial Zone, Dambadeniya, Sri Lanka
[*]chandir@agri.pdn.ac.lk

Isolation and Characterization of Root Nodule Rhizobia from Non-Edible Legume Crops in Anuradhapura District to Formulate Bio-Fertilizer for Edible Legume Cultivation

Wijenayake W.P.T. and Hemachandra P.A.I.U.*
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

There is a wide variety of edible and non-edible legumes in Sri Lanka which perform symbiotic Nitrogen (N) fixation with native rhizobia. There are only a few studies that have been reported on non-edible legume - rhizobia systems in Sri Lanka. The main objective of the current study is to isolate and screen native rhizobia species which are well adapted to local climatic and soil conditions from the root nodules of non-edible legumes to formulate efficient and robust N biofertilizers for edible legume cultivation in Sri Lanka. Root nodules were collected from seven different non-edible legume plants (Buffalo clover, Sickle Senna, White lead tree, Wild Indigo, Sleeping Grass, Tick-trefoil, and Jewel Vine) from seven different locations in Anuradhapura district (Thambuttegama, Thalawa, Anuradhapura New Town, Mihinthale, Mahailluppallama, Galnewa, and Kekirawa). Sixteen rhizobial strains were isolated. Nine of them demonstrated capability of N fixation, inorganic phosphate solubilization, and indole acetic acid production. These nine strains were tested for their tolerance to adverse environmental conditions, such as extreme pH, salinity, drought, and high temperature. Three isolates (TBII-1, TBAS-2, and KEPT-1) had the highest tolerance to extreme saline (5.0%) conditions. TBII-1 and KEPT-1 grew well at 45 ^{0}C due to their tolerance to higher temperatures. KEPT-1 had the best survival at 0.1%, 0.2%, and 0.4% of PEG concentration. Most of the isolates showed optimum growth in the range of pH 5 to 8. Out of the 16 rhizobial strains isolated, 3 strains (TBII-1, TBAS-2, and KEPT-1) showed the best survival under the tested extreme environmental conditions and possessed growth-promoting abilities. Therefore, these 3 strains can be concluded as possible candidates to produce biofertilizers for edible legume cultivation in Anuradhapura district of Sri Lanka upon testing of competency in host plant infectivity, nodulation and plant growth promotion.

Keywords: Biofertilizers, Non-edible legumes, Plant growth promotion, Rhizobia, Stress tolerance

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*ishankah@agri.pdn.ac.lk

Isolation and Characterization of Salt Tolerant Soil Bacteria from Selected Locations in the West Coast of Sri Lanka

Senarath G.L.C.N.T., Edirisinghe R.[1*], Hemachandra P.A.I.U., Somaratne Y. and Jayawardana N.U.

Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Soil salinity is one of the inherent problems in coastal soils. Increased soil salinity in coastal soils results in low bacterial diversity. However, the salt tolerant bacteria have the ability to survive in saline soils because of their unique salt tolerant mechanisms. The current study was focused on identifying salinity tolerant bacteria in the West coast of Sri Lanka. Four soil samples each were collected from three locations; Negombo lagoon, Balapitiya coastal area and Beruwala coastal area. From 12 soil samples, 20 bacterial isolates were obtained, namely NE01 to NE09 (Negombo lagoon), BA01 to BA07 (Balapitiya coastal area) and BE01 to BE04 (Beruwala coastal area). The isolates were characterized based on bacterial colony morphology, Gram's stain and biochemical tests namely, catalase test, modified oxidase test, hemolytic reaction on blood agar and growth on MacConkey agar. All the bacterial isolates were screened for salt tolerance at different concentrations of NaCl ranging from 3 dS/m to 18 dS/m. All 20 bacterial isolates were found to be salt tolerant upto the highest NaCl concentration tested (18 dS/m). The salinity tolerance behavior of selected five isolates were observed by enumerating the number of colony forming units per milliliter (CFU/mL) with increasing salinity. Molecular identification of these five isolates were carried out by sequencing the 16S rRNA gene. It is recommended to screen the identified salt tolerant bacterial isolates for their plant growth promoting rhizobacterial (PGPR) activities such as phosphate solubilization, indole acetic acid and ammonia production. The findings reveal a potential of using these isolates through biotechnological applications with the aim of increasing the productivity of saline affected soils of Sri Lanka.

Key words: 16S rRNA, Balapitiya, Beruwala, Negombo, Salt tolerance, Soil salinity

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[1]John Keells Research, Nanotechnology & Science Park, Mahenwatta, Pitipana, Homagama, Sri Lanka
[*]roshanie.jkh@keells.com

Management of Southern Blight of Watermelon Caused by *Sclerotium rolfsii* using Fragmented DNA and Non-Viable Mycelia of the Pathogen

Inuri H.D.O.P. and De Costa D.M.[*]

Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Southern Blight (SB) is caused by the soil-borne fungus *Sclerotium rolfsii*. As a biological control strategy, host plant immunity can be triggered by exogenous application of molecular patterns associated with pathogens. Such Pathogen Associated Molecular Patterns (PAMPs) act as biological elicitors in inducing host plant immunity. The present study aims to determine the potential of DNA and non-viable mycelial fragments of *S. rolfsii* to manage SB and synthesize host defense enzymes towards induced plant immunity. Genomic DNA of *S. rolfsii* was fragmented by chemical and physical methods and the viability of the pathogen was inactivated by dry heat, moist heat, UV radiation and freezing. Loss of viability of *S. rolfsii* was confirmed *in vitro* and *in vivo*. Watermelon seedlings (var. Sugar baby) were treated with non-viable mycelial fragments (0.1 g/seedling) of *S. rolfsii*, subsequently inoculated with *S. rolfsii* and after seven days, percentage disease incidence (DI) was calculated. Separate sets of seedlings were applied with suspensions of DNA and non-viable mycelial fragments, having concentrations of 784 ng/µL and 0.04 g/mL, respectively. Activity of defense enzymes (i.e. peroxidase, polyphenol oxidase and chitinase) was quantified four days after the treatment. Pathogen-inoculated seedlings treated with DNA or mycelial fragments, reported less than 22% DI in comparison to 60% DI in seedlings only inoculated with the pathogen. Defense enzyme activity is significantly higher ($P<0.05$) in seedlings treated with DNA and mycelial fragments than the untreated controls. The highest chitinase activity was reported by the seedlings treated with fragmented DNA and frozen mycelial fragments. Fragmented DNA and dry-heated mycelial fragments, respectively resulted in the highest peroxidase and polyphenol oxidase activities. Results revealed the possibility of using DNA and non-viable mycelial fragments of the *S. rolfsii* to reduce SB of watermelon and enhance plant defense enzymes.

Keywords: Elicitors, Fragmented DNA, PAMP, Pathogen-triggered immunity

[*]dmdcosta@agri.pdn.ac.lk

Mitigation of Ruminal Methane Production in Non-Lactating Purebred Holstein Friesian Heifers: Dietary Inclusion of *Gliricidia sepium* and Brewer's Yeast (*Saccharomyces cerevisiae*)

Basnayake B.V.R., Vidanarachchi J.K.[*], Silva G.L.L.P., Karunarathna A.K.[1] and Alahakoon A.M.Y.W.[1]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Methane is a major greenhouse gas (GHG) produced by ruminants, which affects the world climate change with a global warming potential (GWP) of 25 CO_2 equivalents. This study assessed the ability of *Gliricidia sepium* (GS) and Brewer's yeast (*Saccharomyces cerevisiae*) (SC) in mitigating the enteric methane production in Holstein Friesian heifers. The experiment was conducted as a 4×4 Latin square crossover design, using four non-lactating purebred Holstein Friesian heifers of the same age with an initial body weight of 370.5±13.2 kg. Four dietary treatments: (A); basal total mixed ration (TMR), (B); TMR+10 g of SC, (C); TMR replaced by 30% of GS and (D); TMR replaced by 30% of GS+10 g of SC were fed to the four heifers in a rotational manner during four test periods. Methane measurements were taken on the first and the seventh day of test periods, using the Syngas Analyser Gasboard-3100P. Significantly lower (P=0.007) methane emissions were showed by heifers fed with diets B, C and D. Moreover, total methane emission was reduced by 81.07%, 65.05% and 54.88% in treatments B, C and D, respectively compared to the treatment A. No significant difference (P=0.16) in dry matter intake (DMI) by heifers was observed among the treatments. Treatments B, C and D showed significantly higher apparent dry matter digestibility (ADMD) (P=0.009), apparent crude protein digestibility (ACPD) (P=0.005), apparent neutral detergent fibre digestibility (ANDFD) (P=0.009) and apparent soluble carbohydrate digestibility (ASCD) (P=0.025). A significantly higher (P=0.018) apparent acid detergent fibre digestibility (AADFD) was observed in heifers with diets B and D. Strong negative correlation coefficients were detected between methane emission percentages of dietary treatments with ADMD (r=-0.98), ACPD (r=-0.96), ANDFD (r=-0.98), ASCD (r=-0.98) and AADFD (r=-0.92). This study manifests the potential of dietary inclusion of GS and SC to mitigate the enteric methane production in non-lactating purebred Holstein Friesian heifers.

Keywords: Brewer's yeast (*Saccharomyces cerevisiae*), *Gliricidia sepium*, Global warming, Holstein Friesian heifers, Methane mitigation

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[1]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]janakvid@agri.pdn.ac.lk

Mobility of Phosphorus from Fertilizer Source to Soils under Submerged Condition

Rathnayake R.M.A.U. and Attanayake C.P.[*]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Plant available P remains low in rice-grown paddy soils regardless of phosphorus fertilizer application. Mobility of P from fertilizer source to soils under submerged condition is not well understood. We investigated the availability and mobility of P from triple super phosphate (TSP) and Eppawala rock phosphate (ERP) in three soils, Alfisol, Entisol and Ultisol under submerged conditions using soil columns. Fertilizer granule/pellet equivalent to 10 mg of P was incorporated at the middle 1 cm below the surface of soil column. (A control without fertilizer incorporation was maintained for each soil.) The soil columns were submerged for five weeks with 1 cm water head. The redox potential (Eh) of the soils were measured weekly. At the end of the submergence period, soil samples were collected at 0-1, 1-2 and 2-3 cm away from the point of P application horizontally and at the same depths. Soils were analyzed for pH, soil P fractions extracted by distilled water, 0.5M $NaHCO_3$, 0.1M NaOH and 1M HCl, and residual. The Eh was -150, 265 and 465 mV at the end of submergence for Ultisol, Alfisol and Entisol, respectively. Entisol and Ultisols had similar amount of labile P (~30%) and Alfisols had the lowest amount of labile P (24%) released / mobilized from TSP within 3 cm depth. The labile P fraction was less than 5% in ERP-added soils. Labile P concentrations within/at the three depths were not significantly different. During submergence, Fe associated P reduced and Ca associated P increased in all three soils regardless of P source, and it was more prominent in Ultisol. About 70-76 % of P in TSP and >95 % in ERP were either remaining in the fertilizer source without releasing to the soils or immobilized in soil. Developing methods to increase mobility of P from fertilizers and soils is crucial to increase P fertilizer use efficiency.

Keywords: ERP, Labile fraction, Phosphorus, Submerged condition, TSP

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[*]chammiatt@agri.pdn.ac.lk

Modelling of Lactation Curves Based on Daily Milk Yields of Crossbred Murrah Buffaloes in Polonnaruwa NLDB Farm

Kajanan S. and Dematawewa C.M.B.[*]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Lactation curve modelling is useful for obtaining complete 305-day lactation yields from incomplete lactation records. The objective of this study was to determine the most suitable lactation model, out of three widely used models, for the crosssbred Murrah buffaloes in the North Central Province and thereby to estimate mature equivalent factors for different parities. A set of 10,563 daily milk yield records were collected from 93 crossbred Murrah buffaloes in a semi intensively managed NLDB farm (Polonnaruwa farm) in DL_1 agro-ecological zone. Three popular mathematical models selected from the literature namely Gaines (GN), Wood (WD), and Brody2 (BD2) were fitted to daily milk yield (dependent) and days-in milk (independent) data using non-linear regression procedure (PROC NLIN) in SAS software, for individual parity groups (1, 2, 3, 4, and >4 parities). The model parameters a, b and c were determined when the convergence criterion was met under the Gauss-Newton iterative procedure. Coefficients of determination (R^2) as well as Mean Square Error (MSE) were used as the selection criteria in selecting the best model. All three models showed reasonable fits to all parities ($R^2 > 0.78$), however, WD model fitted early lactation data poorly by overestimating them, which may be partly due to lack of early lactation yield records in the data set. Based on the lowest MSE and highest R^2 values recorded, BD2 model was found to provide the best fits for all parity groups. Subsequently, mature equivalent factors were calculated based on the total 305-day predicted yields obtained from the BD2 model. The mature equivalent factors for the five parity groups were 0.73, 0.86, 1.0, 0.89, 0.77, respectively showing that third parity cows providing the highest yields. According to the results, BD2 model could be recommended as a suitable formula for lactation curve modelling in the present farm and for farms with similar climatic and management systems.

Keywords: Murrah Buffaloes, Lactation Curve, Mathematical Modelling, Milk yield

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[*]dematawewa@agri.pdn.ac.lk

Molecular Identification of Endemic Medicinal Herb *Rhinacanthus flavovirens* based on Chloroplast DNA Barcodes

Sisirakumara M.R.C.D., Pathirana B.G. and Somarathne Y.[*]

Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Rhinacanthus is an important genus that belongs to the family Acanthaceae. Species in this genus are used in traditional medicine to treat a variety of disease conditions. However, the presence of similar morphological characters makes identification and recognition of endemic *R. flavovirens* from *R. nasutus* difficult at an early stage. Therefore, the objective of this study was to construct an efficient DNA barcode that could discriminate *R. flavovirens* from the closely related species, *R. nasutus*. In this study, we used the chloroplast DNA marker *rbc*L to distinguish these two species. As genomic DNA from *Rhinacanthus* leaves indicated contamination of secondary metabolites that prevented PCR, this study attempted to optimize CTAB-based and SDS-based DNA isolation protocols. The CTAB method with few modifications yielded high-quality DNA in sufficient quantities for PCR. The PCR program was optimized to produce robust and reproducible amplicons using specific primers from the *rbc*L region and subsequently the PCR products were sequenced through Sanger sequencing. The *rbc*L sequence of *R. flavovirens* was compared with the *rbc*L sequences of *R. nasutus* retrieved from NCBI GenBank, and the efficacy of barcoding was evaluated. The results revealed only 2 variable sites between *R. flavovirens* and *R. nasutus* at *rbc*L marker. The smallest pairwise distances (0.0095) were found between *R. flavovirens* and *R. nasutus* voucher PS0730MT01 and *R. nasutus* CHULA-065. Phylogenetic analysis showed a sister relationship between *R. flavovirens* and *R. nasutus* vouchers, however the complete phylogeny of *Rhinacanthus* species could not be resolved. Overall, our results indicated that the universal barcoding region *rbc*L does not discriminate *R. flavovirens* from its close relative *R. nasutus*.

Keywords: Cetyltrimethylammonium Bromide (CTAB), DNA barcoding, Polymerase Chain Reaction (PCR), *rbc*L, *Rhinacanthus*

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[*]yamunas@agri.pdn.ac.lk

Morpho-physiological Characterization of Three Selected Potato Varieties for Drought Tolerance between Tuber Initiation and Tuber Bulking Phase

Madhavi R.A.D.U., Abeythilakarathne P.D.[1] and Weerarathne L.V.Y.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Productivity of most potato (*Solanum tuberosum* L.) varieties are compromised in drought resulting the research need for investigating the drought tolerance properties of potential varieties in order to expand the cultivation extent in future. A pot experiment was conducted to evaluate the morpho-physiological responses of the most popular local potato variety against the 2 imported drought-resistant varieties during the early tuber bulking stage in both the optimum and imposed drought conditions. Sprouted seed potatoes of 3 varieties (Granola; V1, Prada; V2, Royal; V3) were established in UV treated polythene bags filled with soil less media (Compost: Half-burnt paddy husk: sand=1:1:1/2) and arranged in a completely randomized design with 3 replicates in a polytunnel. Water treatments were started at the fourth week or at the peak stolon initiation stage (Control; T1; 40%-60% field capacity; FC and Drought; T2; 20-40% FC). Morphological (i.e. plant height; PH, leaf area; LA), physiological (i.e. gas exchange; GE, leaf relative water content; RWC, chlorophyll content; Ch, chlorophyll fluorescence; CF), and agronomic (i.e. plant dry weight; DM, water-use efficiency; WUE, Stolon and tuber number; STN and TN, respectively) data were recorded and statistically analyzed. In results, V2 and V1 had the highest PH, LA, GE, RWC, DM, WUE, STN, and TN in T1 and T2, respectively, at $p < 0.05$. For all the measurements taken, V3 exhibited a moderate level of responses to that of V1 and V2 in both T1 and T2. For Ch, and CF, all 3 varieties responded equally in both T1 and T2 ($p > 0.05$). V1 had the lowest percentage reduction for tuber and stolon DM and the highest increase for WUE at T2 compared to that at T1. Results concluded that V1 is a promising drought-tolerant potato variety compared to that of the designated drought-resistant varieties; V2 and V3.

Key words: Drought tolerance, Morpho-physiology, Potato, Tuber bulking, Water-use efficiency

[1]Agricultural Research Station, SithaEliya, NuwaraEliya, Sri Lanka
[*]vishnaweerarathna@gmail.com

Morpho-Physiological Characterization of Three Selected   Potato Varieties for Drought Tolerance from Tuber Bulking to Maturity

Madara G.V.R., Abeythilakarathne P.D.[1] **and Weerarathne L.V.Y.**[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Sustainable production of potato (*Solanum tuberosum* L.) is threatened due to the occurrences of frequent drought spells under the consequences of climate change. Therefore, it is a must for potato breeders to look for drought-tolerant varieties for future purposes and that may help potato farmers with expanding the cultivation areas, seasons, and productivity. This pot experiment was conducted to evaluate the promising morpho-physiological responses of the most popular local potato variety (Granola; V1) against that of two imported drought-resistant varieties (Prada; V2, Royal; V3) during the late tuber bulking stage in both the optimum (Control; T1; 40-60% field capacity; FC) and imposed drought (Drought; T2; 20-40% FC) conditions. Sprouted seed potatoes were established in black polythene bags filled with soilless media (Compost: Half-burnt paddy husk: sand=1:1:1/2) at FC and arranged in a completely randomized design with three replicates. Treatments were started at the peak of the stolon initiation stage and morphological (i.e. plant height; PH, leaf area; LA), physiological (i.e. mid-day leaf water potential; LWP, leaf tissue osmolality; OS, leaf relative water content; RWC), and agronomic (i.e. plant dry weight; DM, harvest index; HI, water-use efficiency; WUE, Stolon and tuber number; STN and TN, respectively, volumetric soil moisture content; SMC) data were recorded and statistically analyzed. Results showed that V3 and V1 had the highest PH, LA, DM, WUE, STN, and TN in T1 and T2, respectively ($p<0.05$). For RWC, LWP, OS, and SMC, all three varieties responded equally in T2 compared to that in T1 ($p>0.05$). Overall, V1 had the lowest degree of reduction for DM, HI, and growth physiology, and the highest increase for WUE in T2 compared to that in T1. Results concluded that V1 carries better drought tolerance properties compared to that V3 or V2 under the conditions tested.

Keywords: Drought tolerance, Morpho-physiology, Potato, Tuber bulking, Water-use efficiency

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[1]Agricultural Research Station, Sitha Eliya, Nuwara Eliya, Sri Lanka
[*]vishnaweerarathna@gmail.com

Neem, Mahua and Sesame Seed Cakes, and Tamarind Husk Powder on Improving Nitrogen-Use Efficiency in Rice Variety Bg 300 Grown in Reddish-Brown Earth Soil

Thananseyan C., Ariyaratne W.M.T.P. and Suriyagoda B.M.L.D.B.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The rate of nitrogen (N) fertilizer application depends on the crop species and expected yield. When applying N fertilizers, it is important to improve N-use efficiency (NUE) and minimize the negative impacts to the environment. Therefore, this experiment was conducted to examine the possibilities of improving NUE of rice variety Bg 300 when grown in reddish brown earth (RBE) soil after mixing urea with plant-based by-products. For this, field and pot experiments were conducted in a randomized complete block design at Mahailluppallama, Anuradhapura. The treatments were, control without urea application (C), urea alone (U), urea + neem (UN), urea + mahua (UM), urea + sesame (US) and urea + tamarind (UT). Neem, mahua and sesame seed cakes, and tamarind husk powder were mixed with urea at 1:5 ratio (w/w) for each application. Fertilizer application was made according to the recommendation of the Department of Agriculture. Soil and plant samples were collected at three, five, seven and nine weeks after broadcasting. Results revealed that plants receiving UN had a higher shoot dry weight, shoot N concentration, and shoot N content compared to other treatments. After the nine weeks of growth the NUE of UN, UM were 9.3%, 9.1% respectively while that of U was 7.8% at the latter part of vegetative stage. Soil N concentration was similar among treatments in most of the tested time points. In the pot experiment, plants in the control treatment had higher root DW than most of the other treatments at third week after seeding, while the root lengths and root diameters were similar among other treatments. Use of soil amendments, particularly neem seed cake shows promise in improving growth and nitrogen nutrition of Bg 300 rice variety.

Keywords: Leaching, Neem seed cake, Nitrification inhibitor, Nitrogen-use efficiency, Urea

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[*]lalith.suriyagoda@agri.pdn.ac.lk

Nitrogen Use Efficiency of Paddy Husk Biochar-Based Organic Fertilizers Applied to Capsicum Plants Grown in an Entisol

Karunasekara H.M.U.G.A.R., Dharmakeerthi R.S.[*] and Silva N.R.N.[1]

Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Use efficiency of N fertilizers (NUE) in vegetable cultivation is very low. Effectiveness of organic fertilizers made using rice husk biochar to increase the NUE was evaluated. Fish tonic and cattle slurry were impregnated into rice husk biochar separately and pelletized together with K-Humate to produce two N enriched organic fertilizers (BOF_{FT} and BOF_{CS}, respectively). Their effectiveness on improving growth, N uptake and NUE of Capsicum (*Capsicum annum*) grown in an Entisol (Reddish Brown Latosols) were compared against urea only, urea enriched rice husk biochar (SRF_U) and no N control treatments under greenhouse condition. Rates of N applied to all treatments, except the control treatment, were 106 mg N /kg soil and was based on the recommended level. Total N content of BOF_{CS} and BOF_{FT} were 1.1% and 2%, respectively while that of SRF_U were 23%. Application of SRF_U significantly ($P<0.05$) improved the greenness (2-7%) and the plant growth (60%) when compared with the currently practiced urea only treatment. Application of BOF_{FT} significantly ($P<0.05$) improved the greenness and the plant growth when compared with no N control and were not different from those of SRF_U. Apparent recovery of N and agronomic efficiencies were significantly ($P<0.05$) improved by SRF_U (73% and 15 kg/kg, respectively) and BOF_{FT} (38.8% and 7.8 kg/kg, respectively) when compared with the urea only treatment (35.7% and 6.59 kg/kg, respectively). Organic fertilizer made using cattle slurry (BOF_{CS}) did not improve any parameter measured and was comparable to the control treatment. Poor performance of the two novel organic fertilizers when compared to SRF_U could be due to the very slower release of organic N during the growing period that could not synchronize with the plant demand. However, BOF_{FT} has a better potential to be used as an organic N fertilizer than BOF_{CS} with further modifications.

Keywords: Nitrogen use efficiency, Organic fertilizer, Rice husk biochar, Slow release fertilizer, Urea

[1]Horticultural Crop Research and Development Institute, Gannoruwa, Sri Lanka
[*]dharmakeerthirs@agri.pdn.ac.lk

Nutrient Availability in Acid Sulfate Soil as Affected by Phosphorous Source and Biochar under Different Water Management Regimes

Hettihewa G.D., Sandamali T.G.I.[1], Sandanayake S.[2], Vithanage M.[2] and Dissanayaka D.M.S.B.[*]

Department of Crop science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study was conducted aiming at investigating the changes of nutrient availability in Acid Sulfate Soil (ASS) in relation to addition of different phosphorus (P) sources and biochar under two water management regimes. An incubation soil experiment was conducted as a two-factor factorial experiment in a complete randomized design with 3 replicates for a period of one month. Treatments comprised of application of Triple Super Phosphate (TSP) to the recommendation of the Department of Agriculture, Sri Lanka for rice crop, Rock Phosphate (RP) as the same rate of P_2O_5 of TSP application, 5% rice husk biochar application as per the dry weight of soil and unamended control soil. All treatments were evaluated under two water management regimes, continuous flooding (2-cm water level above the soil) and alternate wetting and drying (2-cm overlying water for one-week, removed and kept drying during succeeding week). After one month, soils were sampled and analyzed for pH, electrical conductivity, available P, Potassium (K), total Nitrogen (N), and bioavailable concentrations of Aluminium (Al), Iron (Fe), Zinc (Zn), Manganese (Mn), Copper (Cu) and Cobalt (Co). Biochar addition significantly ($P<0.05$) increased soil pH, K, and Mn concentrations in soil and there was no significant influence on the availability of other metals in ASS. Across both water management regimes, Al concentration of soil amended with biochar was reduced by 64% and 49% respectively compared to those of soils amended with TSP and RP. The results indicate the potential of amending ASS with biochar to increase pH and alleviate Al toxicity which should be further confirmed by a long-term experiment in the field.

Keywords: Acid sulfate soil, Aluminium toxicity, Biochar, Phosphorous deficiency

[1]Regional Rice Research and Development Centre, Bombuwela, Sri Lanka
[2]Ecosphere Resilience Research Center, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[*]samanthad@agri.pdn.ac.lk

Optimizing the Growth Performances of Selected Ornamental Plants Using an IoT-based Greenhouse Environment.

Dahanayaka P.D., Bandaranayaka A.U.[1] and Beneragama C.K.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The quality and productivity of floriculture plants highly depend on the surrounding environmental conditions. Greenhouses can provide suitable microclimatic conditions for floriculture plants. "Internet of Things (IoT)" is a next-generation automated system that is used in greenhouse agriculture. Monitoring, data collection, and output generation are done through this system. This experiment was carried out to study how the use of IoT-based greenhouses affects the performance of floriculture plants. *Codiaeum variegatum* "Croton", *Torenia fournieri* "Torenia blue river", and *Euphorbia hypericifolia* "Diamond frost" plants were used in this experiment. IoT-based fully intensive greenhouse, a Glasshouse with the timer-based system, and a naturally ventilated greenhouse were used as treatments. Plants were arranged according to a Completely Randomized Design in the greenhouses. Plant dry weight, leaf area, plant height, and root length were measured as growth measurements, and chlorophyll content, leaf color, and chlorophyll fluorescence were also measured as quality and physiological measurements. There were significant differences among treatments for some measurements. In all three species, especially, the leaf area and root growth were found to be better in IoT-based greenhouses. Chlorophyll fluorescence data were collected at 9 am, 12 noon, and 3 pm on bright sunny days. Fluorescence transient (OJIP) curves that were generated according to those data also show a significant difference among treatments. The IoT-based greenhouse environment keeps photosynthesis of croton leaves at a higher level than the other two greenhouses. The plants in the glasshouse displayed photo-inhibition at noon. Torenia plants showed a more sensitive relationship with IoT treatment because Torenia keeps photosynthetic performance relatively constant throughout the day in the IoT-based Greenhouse. With these results, it can be concluded that, there is a positive impact of IoT system-based applications on the performance of tested floriculture plant species.

Keywords: Greenhouse cultivation, Floriculture, Internet of things, IoT, Protected culture

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[1]Department of Computer Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka
[*]chalindab@agri.pdn.ac.lk

Phosphorus Deficiency Tolerance Mechanisms of Selected Sri Lankan Rice Varieties

Herath H.M.K. and Suriyagoda B.M.L.D.B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Phosphorus (P)-deficiency in soil is one of the major problems in rice (*Oryza sativa* L.) cultivation. Modern improved high-yielding rice varieties are highly responsive to P and rely on high input of P fertilizer. Genetic variation is responsible for the differences in tolerance to P-deficiency. The gene, PSTOL1 is known to improve P-deficiency tolerance in rice, particularly in upland conditions. It has been found that some of the Sri Lankan rice varieties carry the PSTOL1 gene. However, the effect of PSTOL1 gene on improving P nutrition of Sri Lankan rice varieties with (+) and without (−) PSTOL1 background under lowland conditions is not known. Therefore, this study was conducted to examine the P nutrition of selected PSTOL1 (+) and (−) Sri Lankan rice varieties to take-up and use P under low-P soil conditions. Study included eight local (Bg94-1, Bg300, Bg304, Bg358, At402, Bw400, Bg450 and Bw272-6B) and two international standard varieties (Kasalath and Nipponbare with PSTOL1 (+) and (−) backgrounds, respectively). Results revealed similar P-use efficiency and root diameter among the varieties at low-P condition. Shoot P content, shoot dry weight, photosynthetic rate, and total root length of the plants were higher in PSTOL1 (+) varieties (Bg94-1, Bg300, Kasalath, Bg304) and PSTOL1 (−) rice varieties (Bw400 and Bw272-6B) at low-P condition. Moreover, when comparing varieties, Bg94-1, Bg300 and Bw400 well performed at low-P condition. The results conclude that the PSTOL1 gene may not be a major contributor to take up and/or use P efficiently at low-P lowland soil conditions of tested Sri Lankan rice varieties.

Keywords: Adaptations, PSTOL1

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[*]lalith.suriyagoda@agri.pdn.ac.lk

Phytoavailability of Lead for Two Radish Varieties in Lime and Organic Amendments Incorporated Acidic Soil

Nawarathna H.A.I.M. and Attanayake C.P.[*]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Phytoavailability of lead (Pb) could be high in acidic soils and it can cause significant Pb transfer to humans, especially via root crops. Accumulation of Pb is dissimilar among different varieties. The objective of this study was to assess the effect of incorporation of poultry manure, cattle manure, municipal solid waste compost, and lime on phytoavailability of Pb in soil for two radish (*Raphanus sativus*) varieties (*i.e.*, Beeralu and Japan ball). A field experiment was conducted in an agricultural field located within a residential area in HawaEliya. The total Pb concentration in soil was 98-297 mg kg^{-1} and soil pH was 6.25. Organic amendments and lime were added at the rate of 2 kgm^{-2} and 0.75 kgm^{-2} respectively. Plants were harvested 56 days after seeding. The Pb concentrations in peeled-roots, peels and leaves were analyzed. None of the amendments significantly ($P<0.05$) reduced the Pb accumulation in roots or leaves. Lime showed the highest potential to reduce the phytoavailability of Pb for radish. It was less than 10-15% reduction compared to control. The Beeralu variety had a higher Pb concentration in the peeled-root and leaves compared to that in Japan Ball variety. The Pb concentration in the peels was lower in the Beeralu variety compared to the Japan Ball variety. The maximum daily Pb intake was 1.4 times higher than what is allowed by the CODEX safe limits when consuming the peeled-roots of the Beeralu variety. Consumption of Radish Leaves of both varieties and peeled-roots of Japan ball variety did not exceed the CODEX safety limit of Pb intake. Reduction of soil acidity and selection of variety with low Pb accumulation can reduce the phytoavailability of Pb in contaminated acidic soils.

Keywords: CODEX standards, Lead, Phytoavailability, Radish varieties

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[*]chammiatt@agri.pdn.ac.lk

Potential of Nutrient Return to the Soil through litterfall in Selected Agroforestry Systems: A Short-Term Study

Senavirathna W.M.A.S., Ranil, R.H.G., Sivananthawerl T., Nissanka S.P. and Dissanayaka D.M.S.B.[*]

Department of Crop science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Litterfall and subsequent decomposition is a fundamental process underlying the input of nutrients to the soil in terrestrial ecosystems. The aim of this study was to investigate the litterfall and its potential nutrient return to soil in three agroforestry systems; homegardens, gliricidia-coffee mixed and teak monoculture plantations. The study was conducted at the University of Peradeniya Experimental Station at *Dodangolla* during a four-month period from September-December 2022. Litters were collected into 2m×2m litter traps established from 1m above the ground level in each agroforestry system. Initial soil samples were collected from 1m distance away from the downside of litter trap at two soil depths (0-15 cm and 15-30 cm). An ingrowth core (15 cm diameter and 30 cm depth) was established at 1m distance from the litter trap. Amount of litterfall, Nitrogen (N), phosphorus (P), and potassium (K) contents of the litter, and N, P, and K contents of soil collected from two soil depths, and root growth into the ingrowth core were measured. There were no significant difference of soil nutrients in two soil depths except increased P contents in the homegarden at 0-15 cm depth compared to the gliricidia-coffee and teak plantations. The highest total litterfall was recorded in teak plantation followed by homegardens and gliricidia-coffee mixed plantation. The greatest root growth into ingrowth core was observed in gliricidia plantation whereas homegarden showed the lowest. Gliricidia-coffee plantation produced litters with the highest N content and return of N through litterfall was also the highest, while homegarden and teak plantation had the highest K and P return respectively. Species composition and the temporal variation of litterfall in different agroforestry systems could determine the type and the amount of nutrient return to the soil through litterfall.

Keywords: Home garden, Litterfall, Nutrient cycling, Root growth, Soil nutrients

[*]samanthad@agri.pdn.ac.lk

Prevalence of Footpad Dermatitis and Hock Burns in Broiler Chickens in Three Different Types of Rearing Systems

Dissanayake D.M.I.G., Samarakone T.S.[*], Bandara R.M.A.S.[1] and Chathuranga T.G.S.[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The most common lesions observed in commercial broiler farms are footpad dermatitis and hock burns, defined as necrotic lesions on the plantar surface of the footpads and in the hock of growing broiler chicken which compromises welfare. However, there are no studies done on the prevalence of footpad dermatitis and hock burns in broiler chickens in Sri Lanka. This study aimed at identifying the prevalence of footpad dermatitis and hock burns and the relationship between footpad dermatitis and hock burns in broiler chickens reared under three different housing conditions. Overall, 32-38 days old 1680 broiler chickens from three different commercial broiler housing systems were observed (Closed house: n=400, Open-sided house: n=320, Buy-back system: n=960). The plantar surface of the footpads and the hocks of the broiler chickens were macroscopically scored by using 0-3 and 0-2 scale systems respectively observing right and left foot separately. The litter quality of all three systems was also observed. Data were analyzed using Wilcoxon Signed Rank, Kruskal-Wallis and Spearman's correlation tests. According to the results, there was no difference(P>0.05) between the severity of footpad dermatitis and hock burns in the left and right feet in chickens in the three rearing systems. The prevalence of footpad dermatitis and hock burns were high in the buy-back system and low in the closed-house system (P<0.05). Correlation coefficient(r=0.276-0.322) revealed a moderately positive relationship between the severity of footpad dermatitis and hock burns within the three rearing systems (P<0.01). There was a difference (P<0.05) among the litter quality of all three rearing systems where closed-house system had the best and buy-back system had a poor litter condition. In conclusion, the closed-house system was better compared with open-sided and buy-back broiler rearing systems in prevalence of footpad dermatitis, hock burns, and litter quality.

Keywords; Footpad dermatitis, Hock burns, Litter, Poultry, Welfare

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[1]Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka
[2] New Anthony's Farms (Pvt) Ltd, Thittapattara, Hanwella, Sri Lanka
[*]thusiths@agri.pdn.ac.lk

Production of Silage Inoculant using *Lactobacillus* Species

Devindi K.M., Kumara Mahipala M.B.P.[*], Priyantha M.A.R.[1], Liyanagunawardena N.[1], Weerasinghe W.M.P.B.[1]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Favorable lactic acid bacteria (LAB) inoculants are used to enhance forage ensiling. The present study attempted to produce freeze-dried LAB inoculants from *Lactobacillus plantarum*, *L. rhamnosus* and *L. oris* which were isolated from maize, sorghum and guinea grass silage, respectively. The LAB isolates were inoculated into skim milk broth (10 %) and incubated at 37º C. Their growth kinetics were studied. All species exceeded 10^9 CFU/mL by 24 h and reached 3.92 – 4.11 pH by 72 h. Therefore, skim milk (10 %) broth was chosen as lyophilization media for making freeze-dried LAB inoculants. The LAB isolates were inoculated separately into MRS broth, incubated at 37º C for 18 h and pelleted. The pellets were dissolved in skim milk broth (10 %) and the suspensions were freeze-dried in vials (LAB inoculant). The ensiling ability of LAB inoculants were compared by inoculating maize, sorghum and guinea grass forage at 3 inoculation rates (0, 10^4 and 10^6 CFU/g fresh forage) and ensiled them for 14 days. The experiment was conducted as a complete randomized design. The effect of forage, LAB species and inoculation rate was significant (P<0.05) on the pH and lactic acid, soluble carbohydrate and ammonia nitrogen contents of silage at 14 days ripening. All LAB inoculants recorded high (P<0.05) lactic acid contents in silage at 10^6 CFU/g inoculation rate. The pH of both maize and sorghum silage was the lowest (P<0.05) when fresh forage was inoculated with *L. rhamnosus* (3.43 and 3.48, respectively) or *L. oris* (3.41 and 3.45, respectively) at 10^6 CFU/g inoculation rate. However, the pH of guinea grass silage was the lowest (P<0.05) when the fresh forage was inoculated with *L. oris* (4.87) at 10^4 CFU/g inoculation rate. The study confirmed the ability of using the newly produced freeze-dried LAB inoculants in enhancing the quality of maize, sorghum and guinea grass silage.

Keywords: Inoculation, *Lactobacillus oris, L. plantarum, L. rhamnosus*

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[1]Veterinary Research Institute (VRI), Gannoruwa, Peradeniya, Sri Lanka
[*]pmahi@agri.pdn.ac.lk

Production of Agarwood Fragrance Compounds by Elicitation of Shoot Cultures of *Gyrinops walla* by Salicylic Acid

Sunethra K.A.S. and Eeswara J.P.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Gyrinops walla (*Walla patta*) is an evergreen non-timber forest tree which produce agarwood similar to the other species in family Thymelaeaceae. Due to the high economic value of agarwood products, illegal harvesting of the trees reported highly. The present study was conducted to find the effect of different concentrations of salicylic acid (SA) on growth and the chemical composition of *G. walla* shoot cultures with the objective of producing fragrance compounds under in-vitro condition. *Gyrinops walla* shoots were grown in full strength MS (Murashige and Skoog) medium supplemented with 1 mg/L of BAP+ 0.1 mg/L of IBA without solidifying agent and the effect of three concentrations of SA (0, 100, 1000 µmol/L) on growth and product synthesis was investigated. Hexane and dichloromethane extracts of wood, control and elicited shoots and growth medium were analyzed for their chemical composition using Thin Layer Chromatography (TLC). Medium supplemented with 1000 µmol of SA showed significantly ($p<0.05$) slowest growth (0.0395 and 0.041 g per day in dry and fresh weight basis) and highest cell doubling time (16.11 and 17.54 days in fresh and dry weight basis) compared to the control (0.0507 g per day and 12 days of growth rate and cell doubling time respectively). TLC results revealed that the synthesis of chemical constituents is higher in elicited shoots compared to non-elicited shoots while 1000 µmol concentration of SA released higher amounts of chemicals into growth medium compared to other two treatment. Therefore present study show the possibility of producing fragrance compounds from shoot cultures of *G. walla* under in-vitro condition.

Keywords: Agarwood, *Gyrinops walla*, Phytochemicals, Salicylic acid

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[*]jpeeswara@agri.pdn.ac.lk

Productive and Reproductive Performance of Dairy Cattle Herd in Melsiripura Farm with Special Reference to Girolando Crossbreds

Deshapriya H.M.C.B., Silva G.L.L.P.[*]**, Fernando P.R.M.K., Kuruppuarachchi N. and Bandara N.M.S.N.**[1]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Productive and reproductive performances of dairy cattle are crucial in profit maximization of dairy operations. Crossbred dairy cattle herd in National Livestock Development Board (NLDB) farm in Melsiripura was evaluated to determine the effect of their genotype on growth, productive and reproductive performances. Records of 44 crossbred cows (Jersey x Sahiwal (JxS), Jersey x Friesian (JxF), and Jersey x Australian Friesian Sahiwal (JxAFS) crosses), and weight records of 17 Girolando crossbred calves and 23 other crossbred calves were included in the study. The parameters assessed for the study were milk yield (MY), lactation length (LL), standardized (305 days) milk yield (SMY), daily milk yield (DMY), age at first calving (AFC), number of inseminations per conception (NIC), calving interval (CI), dry period (DP), and calf birth weight (CBW). The daily weight gain (DWG) and growth rate (GR) of Girolando crossbred calves were evaluated separately. General Linear Model and Duncan's New Multiple Range Tests were employed for data analyses and comparison. There was no significant effect of cow genotype on MY, LL, SMY, DMY, AFC, NIC and CBW (P>0.05). JxAFS cross had significantly (P<0.05) lower DP (71.59±41.14 days) than all the other crosses, and lower CI (13.84±2.09 months) than JxS cross (20.25±5.38 days). Moreover, crossbred calves of Girolando x (JxF) cross, reported significantly (P<0.05) lower DWG (0.29±0.02 kg/day) than the other Girolando crossbred calves. There was a significant (P<0.05) effect of calf genotype of Girolando crossbreds on GR. Furthermore, calves of Girolando x (JxF) cross reported low mean GR (13.62 kg/month) compared to other Girolando crossbred calves. It was concluded that there was a significant effect of the type of crossbred on reproductive performance of cows. The best growth performance was shown by Girolando x (JxAFS) and Girolando x (JxS) crossbred calves.

Keywords: Breed effect, Crossbred cattle, Girolando calves, Productive performance, Reproductive performance

[1]National Livestock Development Board Farm, Melsiripura, Sri Lanka
[*]pradeepas@agri.pdn.ac.lk

Photosynthetic Light and CO₂ Response Parameters of Two Pepper (*Piper nigrum* L.) Varieties Ready for Field Planting

Malawisinghe M.M.G.S., Weerasinghe L.K.[*], Piyarathne P.N.M.S.[1] and Geekiyanage N.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Sri Lanka

Recent research on pepper is mostly focused on improving agronomic management and productivity, however, less attention is given for understanding the underlying physiological basis of dry matter production. Since photosynthesis plays a key role in determining how much dry matter is produced by plants, quantification of CO_2 (A-Ci) and light (A-I) response curve parameters is a better way to understand photosynthesis and dry matter production. Thus, this study focused on two currently popular black pepper varieties (Dingirala and Panniyur-1) that were ready for field planting, with the objective of determining varietal variation in photosynthetic light and CO_2 response parameters. The pepper plants were arranged according to a Completely Randomized Design (CRD) then the A-Ci and A-I curve data collected were fitted to an asymptotic exponential model by non-linear regression using *R* software. According to the results, no significant (P=0.05) difference was found between Dingirala and Panniyur-1 related to light response curve parameters (LSP, P_{max}, AQY, R_D/Ag) except for the light compensation point (LCP) and leaf dark respiration (R_D) (P<0.05). Further, no significant (P=0.05) difference was found between Dingirala and Panniyur-1 related to CO_2 response curve parameters (V_{cmax}, J_{max}, V_{cmax}/J_{max}, CCP, R_L). According to the overall results, both Dingirala and Panniyur-1 nursery plants performed equally in relation to photosynthesis when both varieties are ready for field planting. Furthermore, after field establishment, physiological trait exploration is recommended to investigate potential varietal variation at the field level.

Keywords: Black pepper, CO_2 response curve, Light response curve, Photosynthesis

[1]Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka
[*]lasanthaw@agri.pdn.ac.lk

Quantification of Photosynthetic Light Response Parameters of Four Coconut Seedling Varieties Ready for Field Planting

Kumarathunga W.Y.C., Weerasinghe L.K.[*], Nainanayake A.D.[1] and Chandrathilake T.H.[1]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Sri Lanka has a wide range of coconut varieties that perform differently. The performance of these varieties under different environmental conditions is usually evaluated based on visual scoring or yield data, which takes longer to generate information and also to make selection decisions. Alternatively, physiological traits like carbon assimilation can be used to understand how plants respond to different environmental conditions. Photosynthesis is a key physiological trait that determines carbon assimilation and can thus be used to better understand plant functioning by quantifying photosynthesis light response parameters. Potted four varieties of coconut seedlings (TT (Tall x Tall), DGT (Dwarf Green x Tall), DBT (Dwarf Brown x Tall), and TDB (Tall x Dwarf Brown)) were arranged in a Randomized Complete Block Design (RCBD) to investigate varietal variation in photosynthetic light response characteristics under field capacity. The means of Light-saturated photosynthesis rate (Pmax) for TT, DGT, DBT and TDB varieties were 17.50, 17.03, 13.37 and 14.93 μmol CO_2 m^{-2} s^{-1} while the mean Light Compensation Point (LCP) were 17.92, 15.8, 15.6 and 15.81 μmol CO^2 m^{-2} s^{-1} respectively. Further, the mean Light Saturation Point (LSP) for TT, DGT, DBT and TDB varieties were 630.2, 570.2, 454.8, and 417.3 μmol photons m^{-2} s^{-1} while the mean leaf Dark Respiration rate (R_D) of TT, DGT, DBT and TDB varieties were 0.78, 0.68, 0.66 and 0.81 μmol CO_2 m^{-2} s^{-1} respectively. However, none of the light response curve parameters and concentrations of leaf sugar, starch, nitrogen, and phosphorous, growth measurements, and soil nitrogen and phosphorous varied significantly (P=0.05) among the four varieties tested. Hence, it can be concluded that the four varieties perform similarly in relation to the above parameters at the field planting stage. Further research under soil moisture stress conditions is recommended to identify varietal variation among the same coconut varieties.

Keywords: Coconut seedling, Growth parameters, Leaf functional trait, Light response curves, Photosynthesis

[1]Plant Physiology Division, Coconut Research Institute, Lunuwila, Sri Lanka
[*]lasaanthaw@agri.pdn.ac.lk

Reclamation of Soils Affected by Brass Industry using Lime Incorporation

Wijekoon W.M.P.S. and Attanayake C.P.[*]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Farmers have abandoned the crop-growing lands because of significantly low crop productivity due to soil contamination with toxic trace elements (PTEs) by the wastewater disposal of the brass industry in Pilimathalawa. A preliminary assessment of soil and water was done to assess the basic soil properties and the level of contamination. The soil pH was acidic (6.00±0.4) and highly contaminated with PTEs. The concentration of Cu was 12,548±1,280 mg/kg, Zn was 3,993±1,395 mg/kg, Cd was 0.72±0.46 mg/kg, and Pb was 392±280 mg/kg. The objective of the study was to assess the effectiveness of incorporating lime in reclaiming and increasing the crop productivity of the land. A field study was conducted with lime incorporated and control treatments in randomized complete block design with four blocks. Beans (*Phaseolus vulgaris*) were grown in the plots. Bean pods were produced only in lime-added treatments and were analyzed for the concentration of PTEs. *Ludwigia peruviana* plant (Diya Milla) was analyzed for trace elements to assess its' use in phytoremediation. Liming increased soil pH (8.48 ±0.33) significantly ($P<0.05$). All the growth parameters of bean plants are significantly higher ($P<0.05$) in lime-added treatment than control. The intake of Cu, Zn, and Cd via consumption of beans was lower than what is allowed by the CODEX safe limits. The Pb intake by consumption of beans was similar to the CODEX safe limits indicating potential health hazards. *Ludwigia peruviana* has the potential to be used in phytoremediation of Cu, Zn, and Cd, but not Pb in the considered contaminated soil. Liming showed potential to increase crop productivity, but many crop types should be assessed for PTEs concentrations to assess the health risk of consuming the crops growing in the considered contaminated soil.

Keywords: Brass industry, Lime, Reclamation of soils, Trace elements

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[*]chammiatt@agri.pdn.ac.lk

Regrowth and Nutritive Value of Hybrid Napier and Brachiaria Cultivars Harvested at Sixth and Eight Weeks in Low Country, Dry Zone

Dananjaya U.G.B., Kumara Mahipala M.B.P.[*] and Weerasinghe W.B.M.P.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The influence of harvesting interval on regrowth, yield and nutritive value of Pakchong-1 (*Pennisetum purpureum* cross), Red Napier (*Pennisetum purpureum* cross) and Koronivia grass (*Brachiaria humidicola*) in low country, dry zone was studied. The experimental design was complete randomized design with three replicates. The forage plots (25 m^2) were randomly selected from the forage fields at the Ridiyagama Farm of National Livestock Development Board. An equalization cut was made for selected forage plots at the beginning of Maha season. Plots were manually weeded, and urea fertilizer was applied at 150 kg/ha and 100 kg/ha for Napier and Brachiaria cultivars, respectively. Plant growth of the forage were weekly measured until 8 weeks from the equalization cut and they were harvested at 6 and 8 weeks. The nutritive value and yield were estimated. The height, leaves number and basal node diameter of the forage were increased ($p<0.05$) during the growth period. However, Pakchong-1 and Red Napier reached the maximum ($p<0.05$) number of shoots by 3 and 4 weeks, respectively. The dry matter (DM), organic matter (OM), neutral detergent fiber (NDF) and acid detergent fiber (ADF) contents of the forages were greater ($p<0.05$) at 8 weeks. Contrarily, the crude protein, ash, OM digestibility and metabolizable energy (ME) levels were lower ($p<0.05$) at 8 weeks. As a result, the fresh matter, DM, digestible OM and ME yields were greater when the forage was harvested at 8 weeks. As expected, the DM and OM yields of Red Napier (9.45 and 7.97 MT/ha) and Pakchong-1 (9.20 and 7.69 MT/ha) were greater ($p<0.05$) than Koronivia grass at 8 weeks. Red Napier recorded the highest ($p<0.05$) digestible OM (4.34 MT/ha) and ME (75.12 GJ/ha) at 8 weeks. The study recommends to cultivate Red Napier and Pakchong-1 cultivars and harvest at 8 weeks in the low country, dry zone.

Keywords: Composition, Digestibility, Metabolizable energy, Yield

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[1]Veterinary Research institute, Gannoruwa, Peradeniya, Sri Lanka
[*]pmahi@agri.pdn.ac.lk

Relationships Between Soil pH, EC, and the Concentrations of Essential Macro and Micro Elements of Paddy Cultivated Lowland Soils of Sri Lanka

Thennakoon T.M.D.N. and Suriyagoda B.M.L.D.B.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Fertility of lowland paddy soils is affected by the agroclimatic conditions and agronomic management practices adopted. It is important to know this variation among administrative demarcations for effective decision making. Therefore, the variation of soil pH, electrical conductivity (EC), macro, and microelement concentrations among different administrative demarcations (i.e., districts and provinces) was studied. A total of 1024 paddy soil samples across the country were collected using a stratified random sampling approach. Soil available element concentrations (extracted in 0.01 M $CaCl_2$) were measured using an Inductive Couple Plasma Mass Spectrophotometer, and soil pH and EC were measured using the 1:5 soil: water extraction method. Soil pH of the samples had a mean value of 5.26. Jaffna had the highest pH (6.49) while Galle (4.13) had the lowest. Electrical conductivity had a mean value of 0.18 dS/m. Jaffna had the highest (0.65 dS/m) while Kegalle (0.04 dS/m) had the lowest EC. Mannar had the highest Mg (399 mg/kg) and K (116.2 mg/kg) concentrations. Kalutara had the lowest Mg (27.4 mg/kg), and Colombo had the lowest K (25.5 mg/kg) concentrations. Jaffna had lower concentrations of Zn and Mn while Gampaha had higher Zn, and Trincomalee had higher Mn. Rathnapura had higher Mo. Matale had lower Fe, while the highest Fe concentration was observed in Colombo. Soil pH, Na, Mg, K, Fe, and Mo had a (+) relationship with EC while Al, Co, Zn, and Cd had a (−) relationship. This information would be useful in the sustainable nutrient management of paddy soils in Sri Lanka.

Key words: Electrical conductivity, Microelements, Paddy soil, Soil pH, Sri Lanka

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[*]lalith.suriyagoda@agri.pdn.ac.lk

Repeatability of Seasonal Patterns in Coconut Yield Components

Thennakoon T.M.K.T.S., Samita. S. [*] **and Waidyarathne P.**
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Repeated measurements are often co-related. This co-relation should be taken to account when analyzing such data. Moreover, time cannot be a study factor since time cannot be randomized. Time effect can be studied only by repeated measures analysis. Similarly, precision can be increased. This study was conducted to evaluate the repeatability of the seasonal pattern of yield components during 2013 to 2020 in inter-mediate zoon in Sri Lanka. Wellawa, Malsiripura, and Muruthange estates were used to collect data. Number of bunches, number of female flowers per bunch, percentage setting, and immature nut fall data for each season were recorded for the 8 consecutive years. These repeated measurements were thus used for evaluations. Two-month period was considered as a season as the most common harvesting method of coconut is the bimonthly harvesting. According to the results, the year effect of repeatability on the number of bunches is significant ($P < 0.05$). In addition, season effect and the interaction effect of season and year were significant ($P < 0.05$). When consider the female flowers per bunch too, year effect, season effect and interaction effect of season and year were present ($P < 0.05$). However, with respect to nut setting percentage, the year effect was significant ($P < 0.05$) but the seasons effect ($P > 0.05$) as well the interaction effect of season and year ($p > 0.05$) were not significantly different. When consider the immature nut falling per bunches, the year effect, seasons affect, and the interaction effect of season and year were significant ($p < 0.05$). Accordingly, it is clear that, not only characteristics have been changed with time, but also the season effect has also changed with time.

Keywords: Coconut, Pattern, Repeatability, Season

[*] pramudithawaidyarathne@gmail.com

Response of Different Rice Varieties to Water Stress under Different Nutrient Regimes

Rupasinghe W.H.S.V., Beneragama C.K., Suriyagoda B.M.L.D.B. and De Costa W.A.J.M.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Nitrogen (N) is an essential but limiting plant nutrient. Optimal N supply with crop demand is a crucial factor. Water availability affected by climate change threatens rice production. Rice plant's ability to withstand drought by maintaining optimum functioning is a combined effect of drought tolerance at its growth stages. Recent policy changes and economic crisis has led farmers to limit N fertilizer. The objective of this study was to determine whether susceptibility to drought is greater when rice is grown under sub-optimal nitrogen. The experiment was employed at the plant house of the Department of Crop Science, Faculty of Agriculture, University of Peradeniya. The treatment structure was a three-factor factorial (two varieties × three water regimes × two N regimes) in a randomized complete block design. Three water regimes were well-watered, water-stressed at vegetative and reproductive stages. A standard variety (Bg250) and a drought-tolerant variety (Bg251) were used. Drought reduced grain yield at both 100%N and 50%N in both varieties, with stress at reproductive stage causing a greater reduction (29-66%) than at vegetative stage (15-45%). Yield reductions were lower at 50%N (17-38%) than at 100% (15-66%) and in the tolerant variety (15-46%) than in the standard variety (29-66%). Yield following vegetative stage drought was greater at 100%N than at 50%N. Yield following reproductive stage drought was greater (Bg250) at 50%N than at 100%N or similar (Bg251). After water stress at vegetative stage, nitrogen use efficiency (NUE), defined as the amount of biomass per unit N uptake, was greater under water stress than under well-watered conditions, at 50%N than at 100%N and in Bg251 than in Bg250. After water stress at reproductive stage, NUE did not differ between water or N regimes or varieties. It is concluded that susceptibility to drought in rice is greater at 100%N than at 50%N.

Keywords: Drought responses, Nutrients, Rice, Water stress, Yield

[*]janendramg@agri.pdn.ac.lk

Response of Stomatal Anatomy of Tomato to Sub-Optimal Water and Nitrogen Supply in Different Growing Environments

**Kaushalya D.G.A., Bandaranayake P.[1], Dewapriya I.G.N.S.[1],
Weerakkody W.A.P., Beneragama C.K. and De Costa W.A.J.M.[*]**
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Tomato (*Solanum lycopersicum* L.), which belongs to the family Solanaceae, is a widely grown and consumed vegetable in Sri Lanka. Stomatal anatomy is an important leaf characteristic for exchange of carbon dioxide and water vapour between plant leaves and its environment. Stomata can impact the leaf function, with changes in density and size affecting potential water loss, CO_2 uptake, and leaf temperature. The objective of this study was to determine the interactive effects of water deficits**,** and sub-optimal **water and** nitrogen supply on the stomatal anatomy of tomato (variety Thilina) in different growing environments. Experiments were carried out in the temperature-controlled greenhouse, Uncontrolled greenhouse, and open field environment at the Agricultural Biotechnology Center in Meewathura from September to November 2022. Treatments were laid out in Randomized Complete Block Designs (RCBD) with five blocks in three different environments separately. Three leaflets of the fifth leaf from the top of each of the five plants in each treatment were collected. A stomatal impression was taken and the slide was prepared, and images were taken using a light microscope mounted with a digital camera. Anatomical measurement was made with these images using Image J software. Stomatal density, epidermal cell density, stomatal index, stomatal size, and potential conductance index were taken as anatomical measurements. Abaxial and adaxial stomatal density, adaxial stomatal index, adaxial stomatal size, and adaxial potential conductance index were not significantly different among different water or nutrient regimes ($p>0.05$). Sub-optimal water and nitrogen supply significantly affected epidermal cell density, abaxial stomatal size, abaxial stomatal index, and abaxial potential conductance index ($p<0.05$). However, these differences were not consistent across the three growing environments. It is concluded that stomatal anatomy of tomato has a limited sensitivity to variation in water and nitrogen supply while being under strong genetic control.

Keywords: Nutrient stress, Stomatal anatomy, Tomato, Water stress

[1]Agricultural Biotechnology Center, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]janendrad@gmail.com

Root Growth Dynamics and Nutrient-Use Efficiency of *Grevillea robusta* Grown under Nitrogen and Phosphorus Co-limitation

Wickramasinghe K.G.G.M., De Silva S.H.N.P. and Dissanayaka D.M.S.B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Plants have several adaptations to survive in nutrient-deficient habitats. *Grevillea robusta* which belongs to family Proteacea forms specialized root structures known as "cluster roots" as an adaptive response to P-deficiency. This study was aimed to investigate root growth changes, nutrient uptake and nutrient use efficiency of *G. robusta* grown in N and P-limited conditions during a three-month period. A hydroponic pot experiment was conducted with four different nutrient media conditions; nitrogen (N) and phosphorus (P) sufficient, P-deficient, N-deficient, and (N+P)-deficient in a glasshouse. In nutrient-sufficient medium, all nutrients were supplied in required amounts. In nutrient-deficient medium, N and P concentrations were maintained at 0.25 ppm. The impact of N- or P-deficiency and their co-limitation on cluster root formation, dry weight of different plant organs, N, P, and potassium (K) uptake and use efficiencies were measured. *Grevillea robusta* did not develop cluster roots when it was grown with sufficient nutrient levels. Highest number of cluster roots were formed in P-deficient condition. Although, cluster roots were formed under N- and (N+P)-deficient conditions, it was comparatively lower than that of P-deficient conditions suggesting that P-deficiency is the principle parameter determining cluster root formation of *G. robusta*. There was a tendency to increase the total plant dry weight when cluster roots are present and growth of *G. robusta* was not reduced in the P-deficient treatment. The greatest reduction of plant dry weight was observed under (N+P)-deficient condition. Although the uptake of particular nutrient reduced when the growing solution is nutrient-deficient, use efficiency of the relevant nutrient in biomass formation was significantly ($P<0.05$) enhanced. P-remobilization efficiency was greatly increased both under N- and (N+P)-deficiency indicating the efficient use of acquired P under these nutrient-deficient conditions.

Keywords: Cluster roots, *Grevillea robusta*, Nutrient remobilization, Nutrient uptake, Proteaceae

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[*]samanthad@agri.pdn.ac.lk

Root Morphological Variation and Molecular Screening of *DEEPER ROOTING 1* in Selected Rice Varieties in Response to Drought

Sandeepani R.I., Udawela U.A.K.S.[1], Ariyaratne M., De Silva S.H.N.P., Jayatilake D.V.[2] and Marambe B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Drought is a major abiotic stress that affects all stages of plant growth and development of paddy resulting in large yield reductions, especially in rainfed cultivation. Around 35% of farmers give up cultivation in the *Yala* season especially due to water scarcity. Developing drought-tolerant rice varieties has thus, become essential. *DEEPER ROOTING 1 (DRO 1)* is a Quantitative Trait Loci (QTLs) responsible for deep rooting that helps paddy plant to tolerate drought stress. This research was conducted to study the root morphology in several selected paddy varieties under drought and to develop a molecular marker for screening of *DRO 1* gene in paddy varieties. Seven varieties (local and exotic) selected from previous studies were used in both pot and field experiments. Drought stress was imposed on paddy plants in the pot experiment from 21 days after planting (DAP). Roots with a root angle from 0 to 45° were considered as shallow roots and those with 45-90° as deep roots. For molecular screening, a DNA primer was designed using 1bp deletion of the reference gene of IR64. The designed primer and leaf DNA were used for PCR analysis and the products were separated using 2% Agarose gel. Morphological screening revealed that the percentage of deep roots in Bg 300 and BRRI Dhan 71 were higher ($p < 0.05$) than the other varieties. Deep and shallow rooting was similar ($p > 0.05$) in IRDTN 7-56 and AR 9-3. Dry weight of deep roots were higher than the shallow roots ($p < 0.05$) in Bg 314 (drought-tolerant variety) and Bg 352. Further, the dry weight of deep roots in those two varieties were higher ($p < 0.05$) than the other varieties. The newly designed primer was able to provide the desired PCR product, and it is recommended to be used in DNA sequencing to confirm the presence of *DRO 1*.

Keywords: *DEEPER ROOTING 1*, Drought, Paddy/rice, Root morphology, SSR markers

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[1]Rice Research and Development Institute, Bathalagoda, Sri Lanka
[2]Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya, Sri Lanka
[*]bmarambe@yahoo.com

Screening of Rice Rhizospheric Actinomycetes for Plant Growth Promoting and Plant Disease Suppressing Ability

Weerakkody U.R. and De Costa D.M.[*]

Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The present study was focused on the screening of plant growth promotion and pathogen suppression abilities of 10 isolates of actinomycetes isolated from the rice rhizosphere. Phosphorus solubilizing and nitrogen-fixing abilities were assayed *in vitro* on selective media. Colony growth inhibition of rice pathogens, namely *Rhizoctonia solani* and *Bipolaris oryzae* by the actinomycetes was tested by dual culture plate technique on casein starch medium. Nine and one isolates/isolate respectively, demonstrated moderate and low nitrogen-fixing ability on Ashby's Mannitol agar medium. Nine isolates gave phosphorus solubilization indices ranging from 1.3 – 4. 05 on NBRIP medium. Colony growth of the two pathogens was inhibited (15-71%) by nine isolates. After confirming the compatibility, a consortium was prepared using all the isolates, each having a cell concentration of 1×10^6 cfu/mL. Growth promotion ability of the consortium was evaluated using rice seedlings (var. Bg 360) providing three basal fertilizer levels, namely recommended nitrogen (T1), ½ recommended nitrogen + actinomycete consortium (T2) and actinomycete consortium only (T3). Controls were maintained with no nitrogen fertilizer or actinomycete consortium. Plant height, root and shoot dry weights, number of leaves/seedlings and leaf area were significantly higher ($P<0.05$) in the three treatments than the control. Seedlings treated with T3 reported the highest root dry weight. Plant height, shoot dry weight and leaf area values were significantly higher in T1 ($P<0.05$). The second-highest shoot dry weight and leaf area values were reported by seedlings in T2 and were significantly higher than those in T3 ($P<0.05$). No. of leaves had no significant difference among the three treatments and the control. The tested actinomycetes, as a consortium, can be integrated as a promising biological input in rice cultivation for growth promotion, especially the root growth and suppression of the tested fungal pathogens.

Keywords: Eco-friendly agriculture, Nutrient management, Rice cultivation, Rice rhizosphere

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[*]dmdcosta@agri.pdn.ac.lk

Selection Criteria for Jackfruit (*Artocarpus heterophyllus* Lam.) Improvement and It's Further Utilization

Bandara H.A.D.K. and Pushpakumara D.K.N.G.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Jackfruit (*Artocarpus heterophyllus* Lam.) is a multipurpose tree and one of the most common tree species in Sri Lanka that plays an important role in livelihood of rural and urban people of the country. Even though there are vast numbers of benefits, Jackfruit is still considered as an underutilized fruit species in Sri Lanka, mainly due to unavailability of quality planting materials in the county. This experiment was conducted to evaluate jackfruit local genotypes, with respect to their morphological and physiological characters. One hundred Jackfruit trees were selected in *Dehideniya* (G.N. Division 284) area in *Kandy* district. These genotypes were evaluated using "(IPGRI) 2000 - Descriptors for Jackfruit". Tree characters and fruit characters such as variety, age, height, diameter at breast height, first flowering, fruit bearing pattern and position, number of fruits per tree, fruit clustering habit, leaf blade shape, flesh type, stalk attachment, fruit shape, fruit diameter, fruit length, weight of the fruit, skin (rind) color and texture, number of flakes in the fruit, weight of flakes, shape of flake, color of flake, taste, amount of latex, time of latex flow and uses of fruits (suitability as fresh fruit, as staple food or as *polos* curry or *mallum*) were evaluated under the experiment. Results were analyzed pair wise, using Chi-square test in order to find an association between characters to develop the morphological index. Amount of latex, time of latex flow, taste, color of flakes indicated an association (at $p<0.05$ significant level) with its relevant variable and those characters were used to develop the morphological index.

Key words: *Artocarpus heterophyllus* Lam, Jackfruit, Morphological index, Selection, Tree Improvement

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[*]ngpkumara@agri.pdn.ac.lk

Stimulatory Effect of Indole – 3 – Butyric Acid and Rooting Media on Adventitious Rooting in *Epipremnum aureum* 'Marble Queen' Cuttings

Attanayake R.M.T.D., Dasanayaka Y.M.H.M., Dilshan H.K.L.[1], Hettiarachchi W.A.B.H., Sandarenu K.M.S.D., Gamage S.N.W., Wickramasinghe P.A.S.C.[1], Dayarathna C.R.[1] and Kumarihami H.M.P.C.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Epipremnum aureum 'Marble Queen' is a widely used foliage plant for interiorscape purposes (hanging baskets, dish gardens, and totems). It has high demand in the floriculture industry and is propagated commercially using single nodal cuttings. In floriculture industry, they are exported as rooted and unrooted cuttings. Rooting medium has a decisive influence on rooting of cuttings. This experiment was conducted to optimize the rooting of 'Marble Queen' cuttings using an appropriate rooting medium and an optimum concentration of Indole – 3 – Butyric Acid (IBA). Two experiments were conducted to determine the rooting performance of 'Marble Queen' cuttings under the production of rooted cuttings and unrooted cuttings for the export market. In experiment one, the effect of rooting media and IBA was evaluated to produce rooted cuttings. In experiment two, the rooting performances of unrooted cuttings after an export simulation (48-hour cold storage at 21°C) were tested. Two different rooting media (coir dust and oasis) and four different concentrations of IBA (0 mg·L^{-1}, 250 mg·L^{-1}, 500 mg·L^{-1}, and 1000 mg·L^{-1}) were tested. Rooting media showed the most significant effects on rooting of 'Marble Queen' cuttings. Coir dust medium reported highest number of roots per cutting, roots-to-shoot ratio, and average root diameter. Minimum days to bud and root initiation and a higher number of leaf buds were observed in oasis medium. Early rooting and a higher number of roots were observed with the application of 500 mg·L^{-1} IBA. The use of appropriate rooting media and optimum concentration of IBA would help in the rapid propagation of 'Marble Queen' cuttings. Application of 500 mg·L^{-1} IBA in the oasis medium was more efficient in early rooting and shoot growth of 'Marble Queen' cuttings. Coir dust medium along with 500 mg·L^{-1} IBA was most suitable for the efficient growth and development of 'Marble Queen' cuttings.

Keywords: Cuttings, Indole – 3 – Butyric Acid, Marble Queen, Propagation, Rooting media

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[1]Mike Flora (Pvt) Ltd., Rambukkana, Sri Lanka
[*]prathibhani@agri.pdn.ac.lk

Is Biochar a Panacea for Sustainable Soil Fertility Management? : A Systematic Evaluation of Compost and Biochar Amended Soils

Satharasinghe S.A.D.L., Dharmakeerthi. R.S.,* and Munasinghe S.T.[1]

Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Although short-term impacts of biochar application on soil fertility have been studied extensively, information on their medium- and long-term effects are meager. Hence, it is premature to conclude that biochar application is a sustainable soil fertility management technology. This study was carried out to evaluate medium-term impact of biochar application on soil fertility in a corn growing Alfisol using a systematic approach which integrate nutrient availability, fixation of nutrients and plant growth. Soil (Typic Rhodustalfs) was collected from an ongoing field experiment after three years of its establishment. Four treatments: NPK fertilizers only (CF), single application of 17 Mg of Rice husk biochar (RHBC) or Corncob biochar (CCBC) per hectare with CF, and repeated application of 10 Mg of compost per hectare with CF, were selected for this study. Except Cu and Mg, the availability of P, K, S, and Zn were less than the optimum levels in all treatments. Available Cu contents were significantly ($P<0.05$) higher in RHBC amended treatment. Fixation study revealed that the amount of P added to achieve the optimum levels in CCBC+CF treated soils were high (62 mg/kg) although not statistically different ($P>0.05$) from other treatments (38-46 mg/kg). Sorghum (*Sorghum bicolor* L) plants were grown in small cups using the missing element technique to evaluate the plant availability of nutrients in different treatments. Nitrogen is the most limiting nutrient in all treatments while both P and Zn were deficient in CCBC amended soil. Application of K and S did not significantly increase the plant growth in any treatment, probably due to their marginal deficiency. We concluded that RHBC and CCBC are not capable of increasing plant available nutrient contents more than compost amended or CF applied soils by the end of three years when they are applied at rates used in this experiment.

Keywords: Alfisol, Biochar, Compost, Nutrient availability, Soil fertility evaluation

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[1]Grain Legume & Oil Crops Research and Development Centre, Angunakolapellessa, Sri Lanka
*dharmakeerthirs@agri.pdn.ac.lk

The Prevalence of Antibacterial Resistance and Characterization of Microflora in Cow's Milk Samples Obtained from the Kandy District in Sri Lanka

Madhurekha U.K.P., Madhujith W.M.T.[*] and Wijesinghe P.[1]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Antibiotic resistance has become a global health hazard. Antibiotics are increasingly used in animal husbandry to treat clinical diseases, prevent infections as well as growth promoters. However, overuse and misuse of antimicrobials have led to generation of antibiotic resistant bacteria. Therefore, surveillance of antimicrobial resistance is important. Cow's milk contaminated with antimicrobial resistant bacteria is a serious health issue. In this study, cow's milk samples from bulk tanks were collected from a farm in Uda Peradeniya and 2 farmer managed societies including Orayanwatta and Growhill in the Kandy District. Samples were collected aseptically and screened for the antimicrobial resistant bacteria. Pure cultures of the antimicrobial resistant bacteria were obtained through the pour plate method. Streak plate method was followed for isolating single colonies on nutrient agar containing four antibiotics (amoxicillin, chloramphenicol, cephalexin and ciprofloxacin). Of the four antibiotics used, all samples showed antibiotic resistance to amoxicillin and cephalexin. Milk samples from Orayanwatta showed the resistance only to chloramphenicol. Ciprofloxacin resistance was observed in both Orayanwatta and Growhill samples. Morphological observation along with 3 biochemical tests including Gram stain, spore formation and catalase test were performed on the isolated colonies. A colony PCR was designed to amplify resistant genes. These data suggested that *Escherichia* sp. and *Pseudomonas* sp. showed amoxicillin and cephalexin resistance. Both *Bacillus* sp. and *Streptococci* sp. showed ciprofloxacin resistance while *Staphylococcus* sp. showed chloramphenicol resistance. Milk samples from Orayanwatta contained β-lactamase resistant bacteria. Results from the current study suggested the prevalence of antimicrobial resistant bacteria to 4 antibiotics in farms in the Kandy District. Further investigation is necessary to characterize antibacterial resistant bacteria.

Keywords: Amoxicillin, Antibiotic resistance**,** Cephalexin, Chloramphenicol, Cow's milk

[1]Department of Botany, Faculty of Science, University of Peradeniya, Sri Lanka
[*]tmadhujith@agri.pdn.ac.lk

Thermal Acclimation Potential of Leaf Photosynthesis of Two Pioneer Seedling Species to Increase in Average Growth Temperature

Bandara R.M.C.P., Weerasinghe L.K.[*], Geekiyanage N.[1] and Sivananthawerl T.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Sri Lanka

Climate change has resulted in higher daily, seasonal, and annual mean temperatures. Many plants are known to adjust their photosynthetic characteristics by changing the optimum temperature of photosynthesis (thermal acclimation of photosynthesis) in response to changes in growth temperature. Degraded lands experience high ambient temperatures and moisture stress, and hence, it is important to understand the photosynthetic characteristics of pioneer seedling species used for land restoration, in response to both increases in growth temperature and soil moisture stress conditions. Thus, in this study two pioneer seedling species, namely, *Macaranga peltata* (*Kanda*) and *Neolitsea cassia* (*Dawul Kurudu*), were established in two thermal environments: 24.46±0.11 °C and 27.97±0.16 °C, at field capacity (FC) and water-stress conditions (WS, i.e., 50% of the available water). The temperature response of rate of light saturated net photosynthesis (A_{sat}) was determined at 25-35 °C leaf temperature range. At the FC, both *M. peltata* and *N. cassia* showed a significant increase (P<0.05) in the optimum temperature (T_{opt}) of photosynthesis from a lower thermal environment to a higher thermal environment. This demonstrated the thermal acclimation potential of the two pioneer species to higher average growth temperatures. However, when the average growth temperature increased in water-stress condition, none of the two pioneer species showed a significant increase (P>0.05) in T_{opt}. Rates of light-saturated net photosynthesis (A_{sat}) were significantly reduced (P<0.05) from the FC to water-stress conditions in *M. peltata*, however, not in *N. cassia*. Therefore, *N. cassia* (*Dawul Kurudu*) can be considered a better performing pioneer species at high growth temperatures along with water-stress conditions, when compared to *M. peltata (Kanda)*.

Keywords: Acclimation, Field capacity, Photosynthesis, Restoration, Water stress

[1]Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka
[*]lasanthaw@agri.pdn.ac.lk

Thermal Acclimation Potential of Leaf Dark Respiration of Two Pioneer Seedling Species to Increase in Average Growth Temperature

Gamage I.B.K.W., Weerasinghe L.K.[*], Geekiyanage N.[1] and Sivananthawerl T.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Sri Lanka

Land degradation is growing into a major problem of the 21st century, causing a number of social, economic, and environmental issues. Though such lands can be restored using pioneer species, their physiological traits responsible for acquiring higher net carbon gains under varying climatic conditions remain poorly studied. Thus, in this study two pioneer species, *Kenda* (*Macaranga peltate*) and *Dawul Kurundu* (*Neolitsesa cassia*) were grown at two average growth temperatures: 24.4±0.9 °C (low growth temperature), and 27.9±1.2 °C (high growth temperature), under field capacity (FC) and water stress conditions (50% of the available water), and their leaf respiration and thermal sensitivity (Q_{10}) of leaf respiration were quantified in the 25–40 °C temperature range. When measured at a common temperature (25 °C), both species grown at high growth temperature had significantly lower ($P < 0.05$) rates of leaf R than the same species grown at low growth temperature at FC, exhibiting acclimation of leaf respiration to high growth temperature and reducing carbon loss at high growth temperatures; however, no such difference was observed under water stress conditions. Further, the thermal sensitivity of leaf respiration (Q_{10}) decreased with increasing leaf temperature over the measurement range in both species at both growth temperatures and two soil moisture levels. Moreover, carbon loss occurs at a slower rate in response to increasing leaf temperature in both species grown at high growth temperatures, when compared to both species grown at low growth temperatures. Considering the thermal acclimation potential of leaf respiration, both species can be successfully used as high potential pioneer species for land restoration.

Keywords: Pioneer plant species, Respiration, Soil moisture, Temperature, Thermal acclimation

[1]Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka
[*]lasanthaw@agri.pdn.ac.lk

Use of Maize Crop Residuals for Bale Silage Production

Disanayaka D.M.M.C. and Ekanayake W.E.M.L.J.[*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study investigated the effect of cobs remained in the maize crop residues and different inclusion rates of molasses on the nutritional and sensory quality of maize bale silage. PAC 984 grain maize variety harvested after approximately 75 days was used in preparation of silage. Three sets of bale silage were prepared using 25%, 50% and 100% of cobs remained in the maize crop residues to evaluate the effect of cob percentage. Molasses was incorporated at 3% and 5% to evaluate the quality in silage. There were 5 treatments, each with 2 replicates. After 40 days of ensiling, samples were collected for proximate analysis (Dry matter (DM), crude protein (CP), crude fat (CF), crude fiber (F), organic matter (OM) and pH) and sensory evaluation which was carried out for all the treatments immediately after silage bales were opened. Data were subjected to one-way ANOVA and Tukey mean separation test procedures using SPSS software. Cob and molasses percentage significantly ($p<0.05$) affected on DM, CP, F, and pH of silage but not on CF and OM. Silage prepared with 100% cobs showed the highest ($P<0.05$) DM ($29.45\pm0.07\%$), CP ($6.68\pm0.18\%$), F ($32.65\pm0.15\%$) and the lowest pH (4.46 ± 0.01) compared to the other treatments. Silage prepared with 5% of molasses showed the highest ($P<0.05$) DM ($27.45\pm0.07\%$), CP ($5.53\pm0.14\%$), and the lowest ($P<0.05$) F ($25.66\pm0.06\%$) and pH (4.42 ± 0.01) compared to 3% molasses treatment. The sensory evaluation (color, odor and texture) identified the silage prepared with 5% of molasses as the best. This study revealed that silage prepared with residues remaining with 100% cobs was superior in nutritional composition compared to the silage prepared using residues without cobs but low in quality in comparison to bale silage produced commercially using forage maize.

Keywords; Cob and Molasses percentage, Maize, Silage

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[*]jayekn@agri.pdn.ac.lk

Use of Organic Inputs for Media and Hydroponics in Capsicum Pepper Cultivation

Ayesha K.P.D., Weerakkody W.A.P.[1] and Samitha S.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

All plants require right amount of light, water, nutrients and space for their growth and development. Protected culture and hydroponics provide the best solutions for constraints faced by perishable crops in open-field agriculture. Hydroponics or soilless culture is the method of growing crops indoor without using soil. Drip fertigated coco-peat bag culture is the most widely used aggregate type hydroponics system for protected culture of vegetable crops. However, the availability and cost of imported hydroponic fertilizers under present economic crisis have imposed limitations on conventional hydroponic practices in Sri Lanka. Further, the demand for organic vegetables is yet to explore in local and global markets. Taking these facts into consideration, this research was conducted to investigate the effects of selected organic fertilizer, bio fertilizer and soil conditioner combinations for growth and development of vegetable capsicum grown in phospho-compost medium and coco-peat bag culture under semi-intensive greenhouse conditions. This research was conducted in semi-intensive greenhouse conditions in the mid-country Intermediate Zone (IM3). Organic fertilizer treatments were selected based on the outcome of some previous research. Vermiwash, Jeevamrutham, Biochar, Banana stem extract and Gliricidia leaf extract were used in appropriate combinations and ratios (based on their N, P and K levels) as alternative sources of plant nutrients to be compared with the Albert's fertilizer (control). Agronomy and plant protection of capsicum were done following the standard practices. Growth and yield performances of capsicum plants grown in organic input-based bag culture were significantly higher compared to the control treatment. There was no significant difference in plant growth and yield among different organic input treatments. Therefore, each combination of organic inputs tested in the experiment has shown the potential for replacing inorganic hydroponic fertilizers in coco-peat bag culture grown vegetables in protected culture.

Keywords: Banana stem extract, Hydroponics, Jeevamrutham, Phospho-compost, Vermiwash.

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[1]wapweerakkody@agri.pdn.ac.lk

Utilization of Azolla (*Azolla pinnata*) and Guinea Grass (*Megathyrsus maximum*) to Produce Silage

Gamage S.S.K., Ekanayake W.E.M.L.J.[*] and Atapattu A.A.A.J.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Guinea grass is one of the most abundant and underutilized fodder varieties in Sri Lanka. Azolla is an aquatic fern that is high in protein, therefore, has the potential to be incorporated into grass silages to improve the protein content. This study was conducted to evaluate the nutritional composition and sensory quality of the silage produced using different combinations of Azolla and Guinea Grass. Five different silages were prepared to mix different proportions of Azolla and Guinea Grass: (1) Azolla only (control 1); (2) Guinea grass only (control 2); (3) 25 % of Azolla ,75 % Guinea grass; (4) 50 % of Azolla, 50 % of Guinea grass; and (5) 75 % of Azolla, 25 % of Guinea grass. Silages were analyzed for the crude protein (CP%), crude fibre (CF%), ash (%), ether extract (EE%) and dry matter (DM%). The nutritional composition of all five silages were significantly different ($p<0.05$). CP (18.84%), EE (4.78%), ash (17.52%) and pH (5.33) were higher in the silage produced from 100 % Azolla and these parameters were decreased with the reducing percentage of Azolla in silages. In contrast, crude fibre and organic matter contents were lower in silage produced from 100% Azolla and these parameters were increased with the reduction of Azolla percentage in silage. Color, odor, and texture were best shown in the silage produced using 50% of Guinea grass and 50% Azolla compared to the other silages. Combined all the results suggest that the inclusion of 50% Guinea grass and 50% of Azolla produce the highest quality silage (CP -12.36%, DM – 22.23%, pH – 4.17) compared with the other combinations. A digestibility trial, however, is required to decide the potential use of the Azolla and Guinea grass mixed silages in feeding ruminant animals.

Keywords: Azolla, Guinea grass, Proximate composition, Silage

Variation of Hard Seed Percentage in Local Mung Bean (*Vigna radiata* L.) Varieties between Cultivating Areas in Sri Lanka

Marasinghe M.A.S.[*], Pradeepika K.K.S.D.[1], Ariyarathna R.A.I.S.[1], Suriyagoda L.D.B., Ranil R.H.G. and Rankoth L.M.

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Hardseededness is a major problem in local Mung bean (*Vigna radiata* L.) verities which is mainly governed by both genetic and environmental factors. The objective of this study was to check whether the growing area effects the occurrence of hard seeds in Ari, MI5, MI6, and MI7 Mung bean varieties. The experiment was conducted as a randomized complete block design (nested within location) in three replicates in Gannoruwa, Mahailluppallama and Bataatha post control units, Department of Agriculture, during early September to late November, 2022. Hard seeds were counted at seven different soaking times (8h-T1, 12h-T2, 16h-T3, 24h-T4, 48h-T5, 72h-T6 and, 96h-T7) treatments. Then hard seed percentages (HSP) were calculated. According to the results, MI6 grown in Gannoruwa showed the highest HSP (78%) while MI5 showed the lowest (10%). In Bataatha, the variety Ari had highest HSP (40%) and MI6 had the lowest (2%). In Mahailluppallama, MI6 and MI7 showed highest and lowest HSP respectively as 30% and 18%. As per the location wise comparison, Gannoruwa showed the highest HSP compared to other two locations while Mahailluppallma was having the lowest. To check the hard seed occurrence in consumers' perspective, seeds grown in Gannoruwa were boiled after 8h soaking. There, the variety MI6 showed the highest HSP which was however lower than the HSP at 96h soaking. From the results of this study, it can be concluded that, the HSP of the same Mung bean variety varies depending on the growing area as well as, the HSP varies between varieties within a single location. Also, boiling can reduce the HSP but cannot eliminate.

Keywords: Hard seed percentage, Hard seeds, Mung bean

[1]Seed Certification Service, Department of Agriculture, Gannoruwa, Sri Lanka
[*]marasinghesanjeewani@gmail.com

Yield Response and Quality Traits of Tobacco as Affected by Different Irrigation Regimes

Herath H.M.S.M., Edirisooriya C.[1] and Dissanayaka D.M.S.B.[*]
Department of Crop science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Tobacco (*Nicotiana tabacum*) is an annual cash crop widely cultivated over the world. This study was aimed to investigate the growth, leaf yield and quality characteristics of tobacco cultivated under different irrigation levels. A Randomized Complete Block Design with 3 replicates was laid in a farmer field in Galewela, Dambulla. Furrow irrigation (FI), alternative furrow irrigation (AFI) and bed irrigation (BI) were used as different irrigation regimes in the study. A popular hybrid variety among farmers, Lk-01 was used for cultivation. Water input under different irrigation regimes were measured using a water pump and a water meter. Rainfall during the experimental period was also recorded. Measurements were taken at grand growth stage and leaf maturity stage. Biomass accumulation of all plant organs, leaf number and area, nitrogen (N), phosphorus (P), and potassium (K) uptake and use efficiencies, water productivity and leaf quality parameters were measured. There were no significant variations of measured parameters among three irrigation levels in grand growth stage. However, at leaf maturity stage, FI showed the greater biomass accumulation in all plant organs, leaf area and leaf number, N/P-use efficiencies and water use efficiency (WUE) in biomass formation. The WUE recorded under FI was 39% higher than that in bed irrigation. FI could also contribute more to enhance the final product quality than other two irrigation regimes. For example, leaf chlorine (Cl) content under FI stands closer to recommended level (1%) compared to AFI and BI. Therefore, adoption of FI could have more yield advantage and economic benefits for the growers.

Keywords: Irrigation, Leaf yield, Nutrient accumulation, Tobacco, Water use efficiency

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[1]Ceylon Tobacco Company PLC, Kandy, Sri Lanka
[*]samanthad@agri.pdn.ac.lk

Yield Trends in the Ingestry Tea Estate, Hatton

Rupasinghe B.R.H.D. and Hitinayake H.M.G.S.B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Tea is a major cash crop in Sri Lanka. Predicting the potential effects of many changes on tea crop prompts the user to analyze how the crop responds to many variables. Many plantation companies and their estates maintain highly accurate records on their crops and other aspects. However, they do not conduct proper analysis of these records to understand the yield trends in relation to different variables. Such analysis will allow estates to take management decisions with high accuracy. The objective of the present study was to study the yield trends in the Ingestry estate, Hatton to take better management decisions when conducting field practices. In this regard, the present study was mainly focused on identifying yield trends in pruning cycle, age of the stand, cultivar and rainfall using the records maintained at the estate. In this regard yield records maintained by Ingestre Estate in the Cycle Yield Book, Tea book and Year Budget Book from 2000-2022 were used for the study. The results of the study revealed that the total yield of studied tea fields declined with successive pruning cycles. This may be due to aging of the tea bushes. Yields of different fields were found different despite they were going through parallel in the pruning cycles. This can be attributed to the differences in many factors such as soil conditions, cultivar and age. Second and third years of the pruning cycle produced the highest yields in the VP tea fields whereas OST fields showed relatively even yield patterns throughout the pruning cycle. April to June and September to December produced the highest yield during the calendar year. The annual yield patterns varied among cultivars. A regression analysis showed that relation between tea yield and rainfall was non-significant. This information can be used for better planning field practices.

Keywords: Ingestre estate, Pruning cycle, Tea yield analysis

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[*]gaminih@agri.pdn.ac.lk

Prediction of Crop Nitrogen Status of Banana Using UAV-Based Multispectral Imagery

Perera P.R.K., Vitharana U.W.A.[*] and Haputhantri T.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Banana (*Musa spp.*) is the fourth most consuming food and it provides several nutritional benefits. Nitrogen is essential for banana plant for the growth and development. Application of nitrogen fertilizer on the basis of blanket recommendations may cause over application or under application due to variations in soil properties. Objectives of this study were to evaluate the potential of using unmanned aerial vehicle (UAV) based multispectral imagery to predict nitrogen status of banana crop and study relationship between leaf total nitrogen content and soil properties. Multispectral images were acquired using an agricultural UAV, preprocessed, mosaicked and soil reflections were removed by image classification using iso-cluster unsupervised classification. Multispectral images were used to calculate different vegetative indices and the images of Normalized Difference Vegetation Index (NDVI) was used for further analysis. Jenks natural breaks classification method was used to classify the NDVI values into five classes. Sample points for leaf and soil sampling were identified randomly representing five NDVI classes. Then a leaf sample was taken from banana plant at each sampling locations and SPAD meter reading of the same leaf were recorded at five randomly selected places. Moreover, surface soil sample (0-30 cm) was taken near to the selected banana plant, total nitrogen concentration of leaf sample, pH, Electrical conductivity (EC) and organic matter percentage of soil sample were analyzed. Strong linear regression relationships were observed between NDVI and SPAD meter reading ($R^2 = 0.57$) and leaf total nitrogen ($R^2 = 0.79$). However, leaf total nitrogen did not show strong relationship with soil pH ($R^2 = 0.03$), EC ($R^2 = 0.06$), and organic matter content ($R^2 = 0.25$). A strong relationship between NDVI and leaf total N showed multispectral imagery can be used to predict nitrogen status, thus allowing site-specific N fertilizer management in banana.

Keywords: NDVI, Total Nitrogen Content, Unmanned Aerial vehicle

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[1] Dole Lanka (Pvt) Ltd., Colombo, Sri Lanka
[*] uvithara@agri.pdn.ac.lk

The Effectiveness of a Mixed Culture of Phosphate Solubilizing Bacteria for Improving the Growth of Selected Vegetable Crops Cultivated in two soils under Plant House Conditions

Senevirathne M.L.C., Dandeniya W.S.[*] and Nawaratna K.K.N.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Use of phosphate solubilizing bacteria based biofertilizer is a sustainable approach to increase soil P availability for crops. A study was conducted to assess the ability of phosphate solubilizing bacteria mixed culture inoculum (PSB) to enhance growth of selected vegetable crops cultivated in two soils under plant-house conditions. Firstly, the performance of five vegetable crops (tomato, capsicum, brinjal, beet root, and chili) during the nursery stage was assessed with and without PSB application to nursery potting media. Significant ($P<0.05$) increase (27%) in the number of leaves per plant was observed for brinjal seedlings with PSB application. Chili showed a significant ($P<0.05$) increase (23%) in plant height with PSB application. Phosphate solubilizing bacteria abundance significantly increased ($P<0.05$) with PSB application in beet root (4.6%), brinjal (12%) and chili (12%). A second experiment was conducted focusing on crop performance during the vegetative growth phase of chili cultivated in two soils; *i.e.* an Alfisol and an Ultisol with nine treatment combinations related to N, K and P supply. The treatments were NKP, NK, NK+PSB, NK+75%P, NK+75%P+PSB, NK+Eppawala Rock Phosphate (ERP), NK+ERP+PSB, PSB only, and no fertilizers. The available P content of the Ultisol and alfisol soil were different (178 mg/kg and 9 mg/kg, respectively). Shoot and root biomass of chili was not significantly affected ($P >0.05$) by soil type. Nutrient supply from inoculated treatments significantly affected ($P <0.05$) plant growth parameters. Dry biomass of plants increased significantly ($P <0.05$) with PSB application in Alfisol than in Ultisol. Phosphate solubilizing bacteria abundance significantly increased ($P <0.05$) in Alfisol with PSB application (211%). The results indicated that PSB application increased soil available P in both soils and the response of vegetable plant growth to PSB application differs between high and low P soils.

Keywords: Alfisol, Biofertilizer, Inoculum, Phosphate solubilizing bacteria, Ultisol

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[1]Horticultural Crop Research and Development Institute, Gannoruwa, Sri Lanka
[*]warshisd@agri.pdn.ac.lk

Technological Interventions and Applications in Agriculture

Application of Chlorophyll Fluorescence Transient Analysis to Determine the Photosynthetic Performance of Two Ornamental Foliage Species under Colored Shade Nets

Indramali O.S. and Beneragama C.K.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Qualitative and quantitative changes in exposed light are major factors affecting the photosynthetic efficiency of cut foliage. Although the black shade net is recommended for most ornamental species, the photosynthetic performance under colored shade nets has not been studied sufficiently for such species. In this study, we attempted to investigate the effect of color shade nets (black, red, white and blue) on the photosynthetic performance of *Dracaena sanderiana* (White variety) and *Dracaena surculosa* (Florida Beauty and Japanese bamboo varieties). Chlorophyll fluorescence data were collected through OJIP analysis using a portable fluorometer (Fluor Pen, FP 100). Leaf chlorophyll contents, root: shoot ratio (dry weight basis), and leaf color were measured. The light spectrum under the four color nets changed from 318 nm to 885 nm with contrasting peaks under each net as recorded with a spectroradiometer (Spectrapen mini, PSI). The performance index (PI) which is derived from the absorption per reaction center (ABS/RC), maximum quantum yield of primary photochemistry (ϕPo), and electron transport efficiency (ϕEo) was significantly higher in black shade nets compared to other treatments in *D. sanderiana* (White variety) and *D. surculosa* (Gold dust varieties). There is no significant difference ($p > 0.05$) in the PI of *D. surculosa* (Florida beauty) under different nets. A significant difference in leaf colur among the treatments in all tested species was also not observed. Highest root: shoot ratio was observed in the plants under red shade nets. We conclude that all the colored shade nets can be recommended for *D. surculosa* (Florida beauty) and black shade nets can be recommended for *D. sanderiana* (White variety) and *D. surculosa* Gold dust varieties as revealed by the chlorophyll fluorescence transient analysis.

Keywords: Chlorophyll-fluorescence, Color net, Cut foliage, OJIP transient analysis, Photosynthesis

[*]chalindab@agri.pdn.ac.lk

Bioinformatic Analysis of CRISPR-Cas System in *Enterobacteriaceae*

Nuwan A.P.C., Jayawardana N.U. and Wijesinghe P.[1*]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The clustered regularly interspaced palindromic repeats and associated proteins (CRISPR-Cas) is an adaptive and hereditary immune system which can be found in most species of Archaea and Bacteria. This system provides the protection for these prokaryotes from foreign genetic elements such as bacteriophages and plasmids. CRISPR-Cas system is found in many members of *Enterobacteriaceae* family. This study was conducted to analyze the CRISPR-Cas system of selected strains of *Enterobacteriaceae* using bioinformatic tools and to design a KNIME, The Konstanz Information Miner workflow to analyze available CRISPR-Cas data of this family. In this study, one *Enterobacter cloacae* strain and three *E. hormaechei* strains were used. To detect CRISPR sites in the selected strains CRISPRCasFinder, CRISPROne, CRISPR Recognition Tool (CRT) and Piler-CR tools were used. CRISPRCasFinder tool detected CRISPR arrays and their locations in all selected strains and CRISPROne tool detected Cas genes and types of CRISPR-Cas systems present in these strains. CRISPROne tool identified these detected CRISPR-Cas systems as belonging to Type I-A and IV-A systems. Primers for detected CRISPR arrays were designed using the Primer3Plus tool for future analysis. A workflow was designed using KNIME software to analyze available CRISPR-Cas data for the family *Enterobacteriaceae*. Based on the study, CRISPRCasFinder can be recommended as an accurate bioinformatic tool for the detection of CRISPR arrays, while CRISPROne tool can be recommended for the detection of Cas genes. Though type I-E and I-F CRISPR systems are dominant in this family, the study revealed the possibility of having other types and a diversity among CRISPR-Cas systems within the family.

Keywords: CRISPR-Cas, *Enterobacteriaceae, KNIME*

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[1]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]priyangaw@sci.pdn.ac.lk

Feasibility Assessment of Using *CafLess-TCS1* Marker to Identify Low-caffeine Tea Hybrids

Bandara W.M.D.M., Piyasena K.G.N.P.[1], Jayatilake D.V., Liyanage N.M.N. and Ranatunga M.A.B.[1*]

Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Tea (*Camellia sinensis* (L.) O. Kuntze) is the second most consumed beverage in the world. Caffeine is a purine alkaloid present in tea with known health benefits. However, excessive intake causes negative effects such as palpitations, insomnia, and allergies. Alternatively, low-caffeine tea and decaffeinated tea carry less adverse effects. Decaffeinated tea produced using mechanical methods are low in quality and have poor consumer acceptance, leading to reduced market value. Hence, attempts are made to breed low-caffeine tea cultivars. The current study assessed the feasibility of using the *CafLess-TCS1* marker to identify low-caffeine tea hybrids. Floral assessment was performed to differentiate 36 backcross progenies (BC_1) derived from crosses between the high-caffeine cultivar, TRI3055 and accessions PBGT41, PBGT48, PBGT49, into China (15), Cambod (16) and Assam (5) types. Using a one-way ANOVA and Tukey's mean separation, a selection of 20 hybrid progeny and their parents were evaluated for the caffeine content. Caffeine contents of accession PBGT49, F_1 progeny of TRI3055×PBGT49, and two BC_1 progenies each of the crosses F_1 of (TRI3055×PBGT49) × PBGT49, F_1 of (TRI3055×PBGT48) × PBGT48 and F_1 of (TRI3055×PBGT41) × PBGT41 were not significantly ($P>0.05$) different to the high-caffeine cultivar TRI3055. A PCR fragment of approximately 527 bp was amplified using the *CafLess-TCS1* marker for TRI3055 and selected low-caffeine accessions. The PCR products were resolved on a 8% polyacrylamide gel stained with silver nitrate. The resulted marker profile revealed a unique banding pattern for TRI3055, distinctive from its progeny. However, a clear correlation between the caffeine content and the *CafLess-TCS1* marker could not be derived for the low-caffeine tea accessions used. Hence, it is recommended to adopt a sequence-based approach to identify the variations in these accessions at the *CafLess-TCS1* marker locus and to see if variations observed are specific to any tea type or caffeine level.

Keywords: Caffeine, *CafLess-TCS1, Camellia sinensis*, Low-caffeine

[1]Tea Research Institute of Sri Lanka, St. Coombs, Talawakelle
[*]mahasenab@tri.lk

Co-Pyrolysis of Rice Husk with Nitrogen-Rich Waste to Make Nitrogen Enrich Biochar

Senarath K.K.D.M.D., Alahakoon A.M.Y.W. and Karunarathna A.K.[*]
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Biochar has a growing demand for soil application as a soil amendment that improves the soil's physicochemical and biological properties while sequestering carbon. Conventional biochar is not generally recognized as a potential source of nutrients because most of the nutrients in feedstock biomasses are lost, volatilized, or leached out during the thermochemical conversion process. This research aimed at developing a novel method for manufacturing nitrogen-enriched biochar by pyrolyzing Torrefied Rice Husk (TRH) with three nitrogen-rich waste biomasses: Fish Waste (FW), Chicken Feather (CF), and Human Hair (HH). First, 20 kg of rice husk were torrefied to biochar at 300°C in a double-chamber batch pyrolysis reactor at the Meewatura experimental station. The waste biomasses were air dried and ground into <0.25 mm particles before being co-pyrolyzed with torrefied rice husk. Using the muffle furnace, co-pyrolysis was done in a mini-tubular reactor at six different temperatures, from 300°C to 550°C, by mixing TRH and one of the waste biomasses at a 4:1 ratio. The produced biochar was evaluated for its mass recovery, physicochemical properties, and nitrogen content. Results revealed that co-pyrolysis of TRH with dried biomass increased the biochar yield by 20–30% compared to biochar made from raw rice husk. The total nitrogen content of biochar increased from 0.25% in rice husk biochar to 2.18% in TRH-CF co-pyrolyzed biochar produced at 350°C. The relative nitrate content of all biochar types is reduced with increasing pyrolysis temperatures, while the ammonia content increases. The produced biochar had a slightly elevated pH between 8 and 10, which is an increasing trend with the higher pyrolysis temperatures. The co-pyrolysis of nitrogen-rich waste with torrefied rice husk biochar increased the total nitrogen content of the biochar from 0.22% to 2.18% at the optimum temperature of 350°C. It was also found that the chicken feather co-pyrolysis with TRH at 350°C gave the biochar the highest total nitrogen content. The outcome of this research implies that the co-pyrolyzing of nitrogen-rich organic biomass with torrefied rice husks can be developed into a new method for manufacturing biochar with high nitrogen content.

Keywords: Co-pyrolysis, Nitrogen-enriched biochar, Nitrogen rich waste, Torrefaction

[*]anujica@agri.pdn.ac.lk

Design and Development of Far Infrared Specialty Coffee Roaster

Rathnayaka R.K.A.B.L., Amaratunga K.S.P.[*], Fernando A.J.[1] and Dissanayake T.M.R.[2]

Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Throughout human civilization, coffee has long been consumed as a beverage, brewed from roasted and ground coffee beans taken from an evergreen tropical plant. Due to the micronutrients present in coffee, there are beneficial effects associated with its consumption. Coffee roasting is an important step in developing the aromatic and gustatory qualities of coffee beans using high temperatures. Specialty coffee has recently emerged as a market segment in coffee trade. In this study, a specialty coffee roaster with a far infrared heat source was designed and developed for energy efficiency and better quality roasted coffee beans. The roasting drum and stand of the coffee roaster as well as the control box were designed and developed, with the capacity to roast batches of 200 g to 500 g of coffee beans. Automation was done using Arduino. The pulse width modulation (PWM) method was used with 100%, 85%, 65%, and 50% duty cycles for heating 2000 W infrared heaters. From the results, 65% duty cycle was selected as the most efficient. The first crack can be heard at about 8 ± 2 minutes and the optimum roasting can be achieved in about 15 minutes.

Keywords: Coffee, Coffee roasting, Far infrared, Specialty coffee, Temperature profile

[1]Department of Agricultural Engineering and Soil Science, Faculty of Agriculture, Rajarata University of Sri Lanka, Puliyankulama, Anuradhapura, Sri Lanka
[2]Research Division, National Science Foundation, Colombo, Sri Lanka
[*]sanath.amaratunga@gmail.com

Designing a Mobile-Based Nutrition Education Application Platform for Obese Sub-Fertile Women of Childbearing Age in Sri Lanka

Liyanage K.L.N.U., Somaratne G.M.[*], Chandrasekara A.[1], Jayalath G.K.C.[2], Wijesiri V.T.[3], Bulathwatta A.[4], Bandara U.[5], Subasinghe E.I.W[6]. and Liyanage K.L.B.P.[6]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

According to the research expertise, obesity has a significant negative impact on the subfertility of women of childbearing age. Mobile applications have developed and proven their success in the dissemination of evidence-based scientifically derived knowledge. Sri Lanka has a higher prevalence of subfertility due to obesity and Poly-Cystic Ovary Syndrome (PCOS). Furthermore, within the Sri Lankan context, there is a gap in the dissemination of scientifically proven knowledge to the target population. The incapacity to monitor their dietary patterns and behavioral changes regularly and methodically is a concern. Due to the aforementioned reasons, the awareness among obese women of childbearing age on the effect of nutrition and lifestyle on subfertility is low in Sri Lanka. However, user-friendly communication tools have yet to be developed on dietary behavior, cultural practices, and lifestyle targeting Sri Lankans. Therefore, this research was conducted to address the void in projecting scientific information to the target population. The mobile application: 'Aarya' was developed in two phases. The first phase involved developing the educational content, validation, and verification. Educational content was developed through a literature review, expert consultation, and interviewing thirty women with a history of obesity, subfertility, and successful pregnancy. The second phase involved designing, developing, and evaluating the usability and effectiveness of the application. Evaluation of effectiveness had two stages; pre-evaluation and post-evaluation. 'Aarya' focused on four goals; Body Mass Index (BMI) and Weight, Diet, Physical Activity, and Mindfulness under the categories: Dashboard, Assessment, Diary, Journal, and Reminders. There is a 'Guide' feature to provide the required knowledge. 'Aarya' integrated and disseminated evidence-based scientific information in the digital era sustainably. It has increased knowledge and awareness among selected participants and guided them in self-improvement and self-reflection integrating into daily life.

Keywords: Lifestyle, Mobile application, Nutrition education, Obesity, Subfertility

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[1]Department of Applied Nutrition, Wayamba University of Sri Lanka, Kuliyapitiya
[2]University Hospital Geelong, Geelong, Australia
[3]'Nutriscan' Nutrition Clinic, Pamunuwila, Gonawala, Kelaniya, Sri Lanka
[4]Department of Psychology, Faculty of Arts, University of Peradeniya, Peradeniya, Sri Lanka
[5]Research Institute for Sport and Exercise, Faculty of Health, University of Canberra, Canberra, Australia
[6]Department of Computer Science and Engineering, Faculty of Engineering, University of Moratuwa, Katubedda, Sri Lanka
[*]gsomaratne@agri.pdn.ac.lk

Developing a Soil Moisture Content Monitoring System Based on Internet of Things Technology (IoT)

Kasthuri Arachchi K.A.I.L. and Vidana Gamage D.N.[*]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Soil moisture content (SMC) is an essential parameter which influences the crop growth and ecosystem functions. Measuring the soil moisture content using sensors is advantageous as it allows obtaining SMC measurements at high spatial and temporal resolutions. Soil moisture sensors are costly to purchase and require technical expertise to calibrate. Therefore, this study aimed to develop a low-cost sensing system to measure, transmit, store, and analyze soil moisture content data obtained from field and laboratory experiments. The system consisted of three main components, a sensor component to generate a reading, the component to retrieve and send data to a mobile application and a mobile application to process, manage, and analyze the sensor data. Calibration relationships between soil moisture content measured using the sensor and oven drying method were established using repacked soil containers for four main soil great groups, namely Reddish Brown Latasolic, Immature Brown Loam, Red Yellow Podzolic, and Non-Calcic Brown. Calibration models of great soil groups were validated using an independent set of SMC measurements obtained by the oven-drying method. The high coefficient of determination (R^2) values (0.88 - 0.96) of calibration relationships indicated a strong relationship between the sensor-measured raw values and SMC. Further, new sensor showed less sensitivity for the measurement of SMC in dry soils. Low (<3%) root mean square error values resulted in the validation tests indicated high accuracy of SMC measurements made by the low-cost soil moisture sensor. Further, the low-cost sensor successfully communicated with the mobile application enabling storage, retrieval and analysis of data. It is suggested to test the performance of the low-cost sensor for a wide range of soils and to include a correction factor for saline soils.

Keywords: Mobile application, Sensor, Soil moisture content

[*]dumindavidana@agri.pdn.ac.lk

Development of a Bioplastic Composite as an Alternative for the Conventional Plastic Packaging for Set-Yoghurt

Dilkushi H.A.S., Vidanarachchi J.K.[*], Manipura A.[1], Chamara H.K.B.S.[2], Jayarathna S.[3]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The current study was aimed at developing a bioplastic composite using banana (*Musa* spp.) pseudostem (BP), cassava (*Manihot esculenta*) starch and polyvinyl alcohol (PVA), along with plasticizers to replace the plastic packaging for set-yoghurt and identifying the ideal composition to develop the biocomposite. Banana pseudostems of different cultivars (Sour Plantain, Sugar Plantain, Ash Plantain, *Suwandel* and *Rath Kesel*) were used in the preparation of the biocomposite using the solvent casting method. The proximate analysis, Acid Detergent Fiber (ADF), Neutral Detergent Fiber (NDF) and lignin tests revealed no significant differences ($P>0.05$) in proximate and van Soest constituents among the cultivars. Suitability of incorporating lignocellulosic components as 10%, 15%, 20%, 25%, 30%, 35% and 40% (w/w) was tested using PCS10, PCS15, PCS20, PCS25, PCS30, PCS35, PCS40 and using PCA10, PCA15, PCA20, PCA25, PCA30, PCA35, PCA40 (w/w) treatments respectively for Sour and Ash Plantain cultivars selected based on texture analysis of biocomposites. The bioplastic films were evaluated for the mechanical, chemical, thermal, water absorption, gas permeability and morphological properties. Tensile strength evaluation resulted lower ($P<0.05$) values for PCS25 (1.84 ± 0.08 MPa) and PCA25 (1.26 ± 0.15 MPa) compared to all other treatments. Elongation at break percentages were lower ($P<0.05$) for the same samples compared to all other treatments, with the values of $12.34\pm1.69\%$ and $3.26\pm0.78\%$ respectively. Water absorption percentage at 24 h increased with the lignocellulosic component, recording the highest ($P<0.05$) value ($88.61\pm1.32\%$) for PCS40 biocomposite film. Gas permeability decreased as the percentage of banana pseudostem increased, resulting the highest ($P<0.05$) amount ($21.16\pm0.13\%$) for the PCA10 biocomposite film. Finally, it is concluded that biocomposite with 30% BP incorporation from Sour Plantain or Ash Plantain could provide ideal composition to produce biodegradable packaging for set-yoghurt.

Keywords: Banana pseudostem, Biodegradable composite films, Cassava starch, Food packaging, Polyvinyl alcohol

[1]Department of Chemical & Process Engineering, Faculty of Engineering, University of Peradeniya, Sri Lanka

[2]Department of Biosystems Technology, Faculty of Technology, University of Sri Jayawardenepura, Sri Lanka

[3]Department of Molecular Sciences, Swedish University of Agricultural Sciences, Uppsala, Sweden

[*]janakvid@agri.pdn.ac.lk

Development of a Control System for a Far-Infrared Speciality Coffee Roaster to Optimize Roasting Parameters

Wijesinghe W.M.S.S., Amaratunga K.S.P.[*], Abeyrathna R.M.R.D. and Weerawardena W.M.S.[1]
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Coffee is one of the most traded agricultural commodities in the world. There are several value-added products of coffee. Specialty coffee is one of the most popular and profitable products of coffee. Specialty coffee represents the strong demand for premium coffee. Roasting plays a major role in the production of specialty coffee. There is a lack of a proper roasting machine to produce speciality coffee for Sri Lankan varieties using far-infrared (FIR) radiation. Temperature profiles are specific for the variety, the roasting machine & roasting method. Roasting in bulk roasters is less uniform and it is difficult to follow a temperature profile. This study was conducted to develop a variety specific temperature profile for the developed FIR based roaster which gives speciality coffee with expected quality and to automate the optimum roasting process. A python programme was coded and tested using the developed coffee FIR roaster. It is experimented that 735 s roasting profile gives too dark colour while 360 s roasting profile gives light colour. But 420 s roasting profile gives in between 735 s and 360s profile colour. The roasting profile was successfully followed by the method used in the study. With a proper controlling mechanism to follow the roasting profile FIR coffee roasting would be a better roasting mechanism compared to traditional convective roasting methods.

Keywords: Coffee, Far-infrared radiation, Roasting, Temperature profiles

[1]Tea Research Institute of Sri Lanka, Thalawakelle, Sri Lanka
[*]sanath.amaratunga@gmail.com

Development of a Gas Sensor-Based Low-Cost Device to Estimate the Respiratory Activity of Microbes

Karthikaayan S., Amaratunga K.S.P. and Karunarathna A.K.[*]
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Measuring microbial activities on a substrate is important to select the best microbes for biological reactions, the best substrate for a particular type of microbes, to compare the performance of different types of microbes and different types of substrates for microbes, and also to understand the biochemical kinetics of microbial processors. In this study, a low-cost respirometer was designed and fabricated to measure the respiration activities of microbes on a substrate. The respirometer was designed to measure oxygen concentration, carbon dioxide concentration, and temperature using Figaro KE25 oxygen sensor, Figaro CDM4160H00 carbon dioxide sensor and LM35 temperature sensor, respectively. The sensor responses were fed into an Arduino Uno processor embedded in a circuit board fixed with data logging memory card. The automatic data acquiring, and logging system was designed using pascal programming. The sensors were calibrated using standard and inert gases and trial data logging were conducted to verify the accuracy of logged data. The respirometer testing was done by measuring the oxygen consumption and carbon dioxide emission from a sample of waste with known substrate properties. The results showed that the developed respirometer is capable of accurately measuring oxygen, carbon dioxide and temperature in a closed respirometer assembly which can be used for estimating microbial respiration activity. The used sensors were sensitive to high relative humidity; therefore, the system should be improved to avoid the damage to the system by high relative humidity.

Keywords: Arduino uno, Microbial respiration activity, Respirometer, Sensors

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[*]anujica@agri.pdn.ac.lk

Development of a Liquid Fertilizer by Co-fermentation of Fish Waste and Azolla Biomass

Sutharman N., Alahakoon A.M.Y.W. and Karunarathna A.K.*
Department of Agriculture Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Sustained high rates of growth in organic agriculture have proven the global need to consume less contaminated consumables. In organic agriculture systems, the increase of soil-organic matter to provide a steady release of nutrients to the crops as the organic matter decays is the underlying concept, where mowed or tilled cover crops, organic fertilizers, animal manures, and composts play the key roles. Thereby, this study aimed to produce an organic liquid fertilizer by combining two main biomass sources: fish waste (FW) and Azolla (AZ). To facilitate microbial activities, the co-fermentation media was prepared with sugar and yeast, resulting in final AZ:FW:sugar:yeast ratios of 0:5:5:1, 1:4:4:1, 2:3:3:1, and 3:2:2:1, respectively. Finally, water was added to bring the final mixture's weight up to 3.0 kg. The measurements were taken during the fermentation in terms of gas emission (Eudiometer), NO^{3-} nitrogen, PO_4^{-3}, pH, Electrical conductivity (EC) and solids content (total solids, dissolved solids, and volatile solids). Results revealed that the EC of all treatments increased over time, with the final EC lying between 8 and 11.5 mS/cm. There was an initial decrease in pH at the beginning of the co-fermentation, but all 4 treatments ended with pH values between 4 and 6, making the final solution acidic. The initial total dissolved solids content was 700 to 1,300 ppm, rising to 4,000 to 6,000 ppm. There was a prominent NO^{3-} increase (10.28 ppm) in the first mixture where there was no Azolla added. Also, all the treatments achieved their highest PO_4^{-3} concentrations at the third week of fermentation (235–730 ppm). The cumulative gas emission data showed that the highest gas emission was from the fourth treatment, where the AZ:FW ratio was 3:2. The results of the study support the idea that Azolla and fish waste can be used to make liquid organic fertilizer.

Keywords: Azolla, Co-fermentation, Fish waste, Liquid fertilizer

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*anujica@agri.pdn.ac.lk

Development of an *In-vitro* Gastric Digestion Model with Peristalsis Function for the Analysis of Food Gastric Digestion

Sachinthaka P.P.S., Somaratne G.M.[*], Silva F.H.C.A.[1], How M.S.[2], Amarasinghe A.A.P.S.[1] and Hettiarachchi A.
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

In the human stomach, foods are digested by a combination of physical and biochemical processes. The objective of this research was to develop an *in vitro* gastric digestion model for analyzing the gastric digestion of food. The continuous peristaltic movement of the stomach walls was simulated in the gastric digestion model by using contraction waves that had the frequency of ∼ 3 cycles per min that were similar to those observed *in vivo*. The gastric digestion model mainly consisted of a butyl rubber chamber, simulating the stomach chamber, and 4 nylon half rollers attached to 2 rubber belts that were driven by 2 direct current geared motors and 6 nylon pulleys to create a continuous contraction of the rubber chamber. The model also incorporated gastric sieving, gastric secretion, gastric emptying systems, and a temperature control system that enabled accurate simulation of dynamic gastric conditions. Gastric sieving was done by a 1.5 mm pore size polyester mesh bag. Gastric emptying was done using a 24 V solenoid valve which was operated manually using a toggle switch. A peristaltic pump (12 V) which was programmed using Arduino IDE as the secretion flow rate of 2.5 mL per min was used to deliver the gastric juice into the gastric chamber. Temperature control system was consisted of a 100 W bulb, LM 35 temperature sensor, and Arduino Nano, which were able to maintain the ambient temperature at 37 ℃. The precise control of temperature, gastric secretion, gastric emptying and the adjustable mechanical driving force in the *in vitro* model provide an important tool to analyze food gastric digestion under simulated physicochemical conditions. Future modifications would enhance the performance of this *in vitro* gastric digestion model.

Keywords: Gastric digestion model, Gastric emptying, Gastric sieving, *In-vitro*, Peristaltic contraction

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[1]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Sri Lanka

[2]Department of Process and Food Engineering, Faculty of Engineering, University of Putra, Malaysia

[*]gsomaratne@agri.pdn.ac.lk

Evaluation of Low Cost Growth Media for Mass Culture of Entomopathogenic Fungi - *Metarhizium* sp.

Fonseka G.W.M., Warnasooriya P.G.A.S.[*] and Hemachandra K.S.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Microbial insecticides are considered an effective and environmentally friendly alternative to synthetic pesticides. *Metarhizium* is one of the commonly found entomopathogenic fungal genera and economical mass rearing is essential when formulating as a microbial insecticide. The study was aimed to find more effective and economical media for mass production of *Metarhizium* sp. Further, the optimum temperature for culture growth and the best spore harvesting time were determined. The experiment was carried out to identify the effect of 7 different agricultural byproducts namely, parboiled rice, refused tea, disposable part of the maize cob (chaff, pith, and woody ring), ground maize, straw, saw dust and coir dust for mass culturing. The initial experiment setup was maintained using 25 g of each substrate and at two temperature levels; at room temperature (28 ± 2 ˚C) and 25 ˚C. Prepared fungal spore suspension (2.5 mL, 1.66×10^5 spores/mL) was inoculated into each sterilized substrate and thoroughly mixed and incubated at the two temperature levels. Experiment was continued for 6 weeks and spore concentration and the fungal growth were recorded at a two week interval. There was no significant difference ($P>0.05$) in spore production at 28 ± 2 ˚C and 25 ˚C in all substrates. Spore production was significantly different among the tested media. The highest spore concentration was found in parboiled rice (14.40×10^5 spores/mL) at the 6th week. Refused tea, ground maize and disposable parts of the maize cob showed a mean spore production of 9.14×10^5, 8.38×10^5 and 6.40×10^5 spores/mL, respectively. Maximum spore production was achieved at 28 days after inoculation in all substrates irrespective of the temperature. Based on the findings, the best medium, temperature and spore harvesting time can be identified as parboiled rice at room temperature and at 4 weeks after inoculation, respectively.

Keywords: Agricultural byproducts, Entomopathogenic fungi, Mass production, *Metarhizium* sp., Microbial insecticide

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[*]ayeshasw@agri.pdn.ac.lk

Evaluation of the Effects of Packaging Materials and Storage Temperatures on Quality of Green Chili and Scotch Bonnet Chili

Sandarenu K.M.S.D., Hettiarachchi W.A.B.H., Gamage S.N.W., Dasanayaka Y.M.H.M., Attanayake R.M.T.D. and Kumarihami H.M.P.C.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This research was conducted to evaluate the effectiveness of packaging material and storage temperature in maintaining the quality of green chili (*Capsicum annuum* L.) and scotch bonnet chili (*C. chinense*) during household storage. Chilies were stored at three different storage temperatures, *i.e.,* room temperature (27.7 ºC), refrigeration (7.1 ºC), and clay pot cooler (25.6 ºC), using three different packaging materials (grocery bags, Ziploc bags, and paper bags) for two weeks. The average relative humidity was 76.1%, 58.2%, and 93.6% in room storage, refrigeration, and clay pot cooler, respectively. The average cooling efficiency of clay pot coolers was 66.7%. Soluble solids content (SSC), titratable acidity (TA), physiological weight loss (%), firmness, redness (%), decay (%), and visual quality of chilies were evaluated every other day. The minimum weight loss in green chili and scotch bonnet chili was observed in clay pot cooler storage using Ziploc bags. At all the storage temperatures, the TA increased while SSC was maintained between 1.5 to 3.0%. Firmness and visual quality were well maintained in the refrigerated temperature compared to the other storage temperatures. The % redness and decay of chili were higher *(P≤0.05)* higher in room and clay pot storage temperatures. Chilies in Ziploc bags at refrigerated temperature showed the overall best quality during two weeks of storage. Paper bags were effective in maintaining overall quality of chilies stored at room temperature and in clay pot cooler.

Keywords: Chili, Packaging, Quality, Storage, Temperature

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[*]prathibhani@agri.pdn.ac.lk

Grading of Dry Coffee Beans for Specialty Coffee Using Image Processing Techniques

Kuruppuarachchi C., Amaratunga K.S.P.[*], Bandara D.M.S.P[1]. and Jayakodi J.M.Y.U.[2]

Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Specialty coffee is the highest-quality coffee produced in the coffee industry. Grading coffee beans for the specialty grade is a crucial operation in the production process. All over the world, manual selection is being practiced for green coffee grading and it requires a lot of trained labor. As a solution, Image processing technology can be used effectively to grade coffee beans according to the bean characteristics of specialty grade. In this study, an algorithm was trained to identify specialty-grade beans in *Coffea arabica* using image processing technology. One thousand two hundred images of coffee beans were captured and trained with OpenCV library. Using the trained algorithm, a specialty coffee sorter machine was developed, based on feature identification of beans using a raspberry Pi4 computer and a Pi camera. The sorter machine was specially developed to grade a single bean at a time under artificial light conditions for better clarity and accuracy. The developed sorter can reject deformed beans, inert materials, blacked beans, broken beans, dried cherries, and undersized beans apart from specialty-grade beans. The developed sorter machine was able to separate accepted and rejected beans with an overall accuracy of 86.5% and a rate of 10 beans per minute. The false negative rate of the machine was 0.21. The true positive rate was 0.929, and the false positive rate was 0.06. As further improvements, sorter machine can be developed to grade coffee beans from *Coffea canephora* and *Coffea liberica* by training separate algorithms. Self-learning capabilities also can be included to the sorter machine to grade coffee beans in different stages in processing.

Keywords: Coffee grader machine, Coffee grading, Coffee sorter machine, Image processing, Specialty coffee

[1]Institute of Engineers, Sri Lanka
[2]Department of Food Science and Technology, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila, Sri Lanka
[*]sanath.amaratunga@gmail.com

Hexavalent Chromium Removal from Contaminated Water by Humic Acid-Coated Metakaolin

Nirmani J.K.T., Jayarathne L.[1]*, Igalavithana A.D. and Amarasena R.A.L.R.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Kaolinite is an abundant and low-cost clay mineral that can be used as an adsorbent to remove hexavalent chromium (Cr (VI)) from water. The purpose of this research was to modify the heat-treated kaolinite (metakaolin) with humic acid to produce an effective adsorbent for Cr (VI) removal from wastewater. The Meetiyagoda raw kaolin was purified and characterized using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), and Raman spectroscopy. Strings were prepared from purified kaolin and heated at 400 ºC, 600 ºC, and 800 ºC, respectively. The XRD, FTIR, and Raman spectroscopic analysis conducted on heated kaolin strings revealed that metakaolin is formed at 600 ºC and 800 ºC. In comparison to metakaolin, raw kaolin is easily dispersed in water due to its low physical stability. Based on the adsorption study, physically stable metakaolin produced at 600 ºC and 800 ºC were selected for surface coating with humic acid (HA) and then characterized by FTIR. Isothermal studies for Cr (VI) removal under optimum pH, adsorbent dosage, and contact time were carried out on HA + 800 ºC metakaolin and raw kaolin based on information collected from the adsorption study. The maximum Cr (VI) removal was observed in HA + 800 ºC metakaolin treated water 43.39 ± 2.90% compared to raw kaolin 65.18 ± 4.43%. Adsorption data were well-fitted to the nonlinear Langmuir isotherm. The maximum adsorption capacity of raw kaolin and HA+800 ºC metakaolin were 0.25 ± 0.02 and 0.24 ± 0.03 mg/g, respectively at an equilibrium dosage of 15 g/L, equilibrium time of 4 hrs, and pH of 2. Even though the adsorption capacity results were similar, humic acid-coated metakaolin is a more effective adsorbent than raw kaolin for the removal of Cr (VI) from wastewaters in industrial applications due to its physical stability in water.

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[1]Environmental Science Research Lab, National Institute of Fundamental Studies, Hanthana Rd., Kandy, Sri Lanka
*lakmal.ja@nifs.ac.lk

In Vitro Study of Antibacterial Effects of Selected Plant Extracts Against Bacterial Pathogens of Fish and Shrimp

Madushani K.I.D., Madhubhashini E.T.S. and Heenatigala P.P.M.[1*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Plant derivatives have become a viable alternative to the commercial chemotherapeutics used in aquaculture. A study was conducted to determine the antibacterial activity of 95% ethanol extracts of three aquatic plants and four land-based plants against the selected gram-negative virulent bacterial pathogens in fish and shrimp. Commonly available flowers of *Nymphaea stellata*, leaves of *Salvinia molesta*, and *Bacopa monneiri* were used as aquatic plants, and leaves of *Psidium guajava, Commelina diffusa, Senna alata* and fruits of *Phyllanthus emblica* were used as land-based plants. The ethanol extracts of each plant were prepared in 100 ppm, 50 ppm, and 25 ppm concentrations. The susceptibilities of bacterial suspensions of *Vibrio harveyi*, *Aeromonas hydrophila*, and *Edwardsiella tarda* to the plant extracts were tested using the agar disk diffusion method. Distilled water was used as the control. All the means were compared at 95% confidence level using PROC GLM as a three-way interaction between plant, bacteria and concentration. The results from the study revealed that the five plant extracts show positive results and out of them extracts of *Nymphaea stellata* showed the most pronounced activity ($P<0.05$) with a higher inhibition zone against *Aeromonas hydrophila* (23.50 ± 0.71 mm) and the same in *Vibrio harveyi* (22.50 ± 0.71 mm) and *Edwardsiella tarda* (22.50 ± 0.71 mm) in 100 ppm concentration. *Bacopa monneiri* and *Commelina diffusa* did not show results for any pathogens. The Minimum Inhibitory Concentrations (MICs) varied from 6.25 ppm to 100 ppm in extracts with positive results against all pathogens. The lower MICs were observed in *Nymphaea stellata* for *Vibrio harveyi* (6.25 ppm), *Aeromonas hydrophila* (12.5 ppm), and *Edwardsiella tarda* (50 ppm). Thus, *Nymphaea stellata* extract can be considered as the best potential natural chemotherapeutic that can be used as an alternative to the commercial chemotherapeutic.

Keywords: Bacterial pathogens, Inhibition zone, Minimum inhibitory concentration, Plant extracts

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[1]Inland Aquatic Resources & Aquaculture Division, National Aquatic Resources Research & Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka
[*] prajani@nara.ac.lk

Investigation of Spatial Variability Soil pH in the Wet Zone of Sri Lanka

Dhananjaya R.G.B. and Vitharana U.W.A.[*]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Exploring the spatial variability of soil pH and subsequent mapping are important for soil management and land use planning. This study assessed the spatial variability of surface soil pH of the wet zone of Sri Lanka and external factors determining the variability. Four hundred and three surface soil (0-30 cm) samples obtained across the wet zone were used in this study. Air-dried soil samples were sieved using a 2 mm sieve and analyzed for pH by preparing a 1:5 soil to water ratio suspension. Exploratory data analysis conducted using PASW statistics 18 revealed a large variability of soil pH within the wet zone, which ranged from 3.0 – 8.8 (coefficient of variation = 16.71%). Thus, soils of the wet zone of Si Lanka are varied from strongly acidic to strongly alkaline in pH. Average soil pH revealed that majority of the soils are slightly acidic (pH=5.4). Distribution of soil pH values did not show regional patterns within the wet zone. Among external factors considered in this study, only precipitation showed a negative relationship with the soil pH (r =-0.30). Increased precipitation leads to leaching of basic cations such as Ca^{+2} and Mg^{+2} from the soil system, enriching hydronium ions thus decreasing the soil pH. Other external factors, namely elevation and temperature did not show a relationship with the variability of soil pH (r = 0.04 and -0.007, respectively). Analysis of soil pH within different land uses revealed significantly lower pH values in land uses, namely tea lands, paddy lands, and rubber lands This study revealed considerable variability in soil pH between different great soil groups and agro ecological regions of the wet zone. It was concluded that wet zone of Sri Lanka exemplifies a large spatial variability in pH, which needs site-specific management to enhance crop production.

Keywords: External factors, Land use, Soil pH, Wet zone

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[*]uvithara@agri.pdn.ac.lk

Use of Proximal Sensing and GIS Technologies to Support the Management of a Salt Affected Paddy Growing Soil

Nirmal K.A.D.S., Vitharana U.W.A.* and Matthews N.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Management salt affected soils rely on accurate maps showing spatial patterns of soil salinity. However, spatial characterization of salinity using conventional soil sampling and laboratory analysis techniques are laborious and cost prohibitive. This study attempted to use DUALEM-1S apparent electrical conductivity (ECa) proximal soil sensor and geographic information system (GIS) to map salt affected areas of a paddy tract (16 ha) located in the Nellikkadu in Sammanthurai. DUALEM-1S is an electromagnetic induction based proximal sensor which makes on-the-go measurements of both ECa of surface (ECa-$_{PRP}$) and subsurface (ECa-$_{HCP}$) soils, simultaneously. The sensor was pulled on paddy lands resulting 14272 measurements of ECa. Surface soil samples (0-30 cm) were collected at 25 locations identified based on spatial patterns of ECa and analyzed for EC of saturated soil paste extract (ECe), pH, and Sodium Adsorption Ratio (SAR). Layers of ECa obtained by inverting sensor measured ECa revealed distinct patches of salt affected soils in the study area. ECa-$_{PRP}$ showed a strong linear regression relationship with surface soil ECe (R^2=0.9). This relationship was used to construct salinity map (ECe map) of the study area by combining ordinary kriging and regression prediction approaches. Fuzzy *k*-means unsupervised classification of ECe map of the study area delineated two salinity management zones having high and low levels of soil salinity (HSMZ and LSMZ, respectively). Soil analysis showed that soils in HSMZ are saline sodic while soils in LSMZ are non-saline but with high Na content. High SAR in irrigation water could have contributed for the soil salinity development. Soil pore water samples analyzed for EC, pH, SAR and K^+ showed differences of these properties between the two management zones. This study revealed fusion of proximal sensing and GIS technologies has a large potential to support the site-specific management of soil salinity in paddy grown soils.

Keywords: Apparent electrical conductivity, Proximal soil sensing, Salinity mapping

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[1]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
*uvithara@agri.pdn.ac.lk

Optimizing MS Media and Assessing the Effect on Shoot Multiplication & Growth by Flurprimidol and IBA for *Lomandra Fluviatilis* 'ABU7' PBR

Ranabahu P.S., Dissanayake A.C.[1] and Eeswara J.P.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Lomandra fluviatilis 'ABU7' PBR ('Matt rush') is an Australian native ornamental grass. It is the best among the recently introduced *Lomandra* series to the landscaping industry. However, compared to other *Lomandra* varieties, the multiplication rate of the plant in the currently utilized culture medium is below the productive level in commercial tissue culture. Therefore, in this study, improving the multiplication rate was attempted. The best 6-Benzylaminopurine (BAP) concentration was determined by culturing plants at 0, 0.1, 0.25, 0.35, 0.45, and 0.55 mg/L concentration levels. They were combined with four levels of other growth regulators; control, Flurprimidol 1 mg/L, Indole-3-butyric acid (IBA) 0.1 mg/L & Flurprimidol 1 mg/L + IBA 0.1 mg/L. Flurprimidol was used as a gibberellin inhibitor because in certain cases, gibberellin can inhibit the formation of shoots. The effect of Flurprimidol on *Lomandra fluviatilis* 'ABU7' PBR and the role of IBA in a shoot multiplication medium were also investigated in this study. Flurprimidol improves the shoot induction as well as root induction of 'Matt rush'. Additionally, it increases moisture accumulation inside the plant. Plant height was also controlled by Flurprimidol. It dwarfs the plant and produces a compact plant which is ideal for ornamental grasses. IBA plays no role in improving the shoot induction. However, it improves root induction when combined with Flurprimidol. It does not play a role in controlling plant height or moisture accumulation. All the parameters of the four levels of other growth regulators were significantly different ($P < 0.05$). The negative and positive impacts of both chemicals balanced-out when combined in a single treatment. Lower BAP concentrations combined with Flurprimidol + IBA could be recommended for Matt rush shoot production.

Keywords: BAP, Flurprimidol, IBA, Matt rush, Multiplication rate

[1]Hayleys Agro Biotech (Pvt.) Ltd, Dessford Upper division, Nanuoya, Nuwara Eliya, Sri Lanka
[*]jpeeswara@agri.pdn.ac.lk

Potential of Ultrasound Pretreatment to Improve Rennet-Induced Coagulation Properties of Milk from Thamankaduwa White and Holstein Friesian Cattle Breeds in Sri Lanka

Diddeniya D.G.D., Vidanarachchi J.K.[*], Prasanna P.H.P., Abesinghe A.M.N.L.[1] and Priyashantha H.[2]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Increasing unfavourable health concerns of milk from improved cattle breeds, the popularity for milk of indigenous cattle breeds is increasing. Studies have shown that indigenous cattle milk possesses exceptional milk coagulation properties. However, due to their low average milk yield, the production of coagulated milk products from indigenous cattle milk is unpopular. Ultrasound treatment is an emerging non-thermal technology that can be used to improve milk coagulation properties. In the current study, the effect of ultrasound treatment to improve the rennet-induced coagulation properties were evaluated for milk from an indigenous cattle breed, Thamankaduwa White, and an improved cattle breed, Holstein Friesian. The milk was treated at three ultrasound energy densities 504, 612, and 720 J mL^{-1} using a 20 kHz ultrasonicator, and rennet gels were prepared using Maxiren commercial calf rennet. Water holding capacity, syneresis, and textural parameters of rennet gels were evaluated. Ultrasound-treated samples from both breeds showed higher ($P<0.05$) water holding capacities compared to untreated samples. In Thamankaduwa White, milk samples treated at 720 J mL^{-1} showed the highest ($P<0.05$) water holding capacity (78.74±5.88 %). In both cattle breeds the syneresis was reduced ($P<0.05$) in treated samples compared to untreated samples. Furthermore, Thamankaduwa White cattle milk showed higher water holding capacity and lower syneresis ($P<0.05$) compared to Holstein Friesian milk. In Holstein Friesian milk, the hardness of rennet gels was reduced ($P<0.05$) in ultrasound-treated samples. However, in Thamankaduwa White milk, there was no difference ($P>0.05$) in hardness values for rennet gels in both ultrasound-treated and untreated samples. Accordingly, it could be concluded that ultrasound treatment could be used to improve the rennet-induced coagulation properties of milk from both Holstein Friesian and Thamankaduwa White breeds, and the treatment at 720 J mL^{-1} was more suitable to improve rennet coagulation properties in Thamankaduwa White cattle milk.

Keywords: Holstein Friesian, Milk coagulation, Rennet, Thamankaduwa White, Ultrasound treatment

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[1]Department of Animal Science, Faculty of Animal Science and Export Agriculture, Uva Wellassa University, Passara Road, Badulla, Sri Lanka

[2]Food & Pharma Technology Programme, Folkuniversitetet Uppsala, Uppsala, Sweden

[*]janakvid@agri.pdn.ac.lk

Quality Evaluation of Leathers Manufactured from Goat Skin with Selected Vegetable Tanning Materials

Jayarathna G.L.L.M., Fernando P.R.M.K., Gamage A.T.H.[1], Sujanthan S.[1], Vidanarachchi J. K. and Himali S.M.C.[*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study was conducted to determine the properties of tanned leather from goat skin using locally available plant materials: *Sweietenia macrophylla* (Mahogany), *Garcinia spp* (*Goaraka*), *Pinus caribaea* (Pine), *Camellia sinensis* (Refused tea) and commercially available vegetable tanning materials (Mimosa powder and Black Wattle solid) in Sri Lanka. Tannins from plant materials were extracted using high pressure water extraction, and the amounts of tannin were measured by ultraviolet spectrophotometry. Leather tanning was conducted manually, and the re-tanning was not conducted. The physical properties of the leather were evaluated using the IULTCS (International Union of Leather Technologists and Chemists Scarcities) official methods of analysis for leather. The sensory evaluation was done using a three-point hedonic scale. High pressure water extraction method resulted $6.04 \pm 0.12\%$, $3.34 \pm 0.06\%$, $2.98 \pm 0.01\%$, $3.47 \pm 0.11\%$ tannins, from Mahogany, *Goraka*, Pine, and refused tea respectively. Significantly higher tannin absorption levels were achieved by *Goraka*-tanned goat skin. The physical properties of leathers produced with different tanning materials not differed significantly ($P < 0.05$). The highest thickness (2.68 ± 0.19 mm) was obtained in wattle-tanned leather. The highest apparent density (0.75 ± 0.12 g/cm^3), tensile strength parallel to the backbone (29.61 ± 8.77 N/mm^2) and perpendicular to the backbone (30.01 ± 14.93 N/mm^2) were obtained by Tea-tanned leather. The highest elongation at break parallel to the backbone ($19.70 \pm 1.39\%$) was obtained by Mimosa-tanned leather. Wattle-tanned leather had the greatest elongation at the break perpendicular to the backbone ($23.33 \pm 3.44\%$). Water absorption percentage/day ($171.33 \pm 33.42\%$) was highest in Mimosa-tanned leather. *Goraka*, Mimosa and Wattle tanned leathers tolerated 10,000 flexes compared to others. *Goraka*-tanned leathers had the highest overall preference in sensory evaluation. In International Commission of Illumination (CIELAB) color space, lightness was highest in Mimosa-tanned leathers, and redness and yellowness were highest in Mahogany-tanned leather. In conclusion, all the vegetable tanning materials tested resulted leathers with different favorable properties, and they can all be industrially used to produce various specific products.

Keywords: *Garcinia spp,* Mahogany, *Mimosa*, Pine, Refused tea

Salinity Tolerance of *Dracaena sanderiana* Sander Characterized by the Chlorophyll Fluorescence Transient Analysis Technique

Silva K.S.U.S. and Beneragama C.K.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Dracaena sanderiana Sander is a popular and in-demand cut foliage in the global ornamental industry. It is important to know the performances of these plants under saline conditions as there is a demand for salt tolerance ornamental plants for poolside landscaping due to the high chlorine content in the pool water. This study was conducted to examine the growth performances of 3 varieties of *D. sanderiana* ('Gold, 'White', and 'Victory') under different salinity levels (0, 20, 40, 60, and 80 mmol NaCl) for 10 weeks. Chlorophyll fluorescence (ChlF) transient analysis was used to understand the photosynthetic performances of plants. The ChlF data were collected through OJIP analysis using a portable fluorometer (Fluor Pen, FP 110). Electrical conductivity (EC) of the substrate, relative electrolytic leakage (REL) of roots, shoots, and leaves, total chlorophyll content, and root: shoot ratio (dry weight basis) were measured. EC has increased with increasing NaCl concentrations indicating the salt buildup in the substrate. There was no significant difference in the performance index (PI) which is derived from absorption per reaction center (ABS/RC), maximum quantum yield of primary photochemistry (ϕPo), and electron transport efficiency (ϕEo) of the ChlF transient analysis, within the different salinity levels in variety 'White' and 'Victory'. Variety 'Gold' showed a reduction in PI in high salt concentrations indicating its sensitivity to high saline conditions (60 and 80 mmol). Highest REL was observed in roots, followed by shoots and leaves that explains the protection of leaves from salt stress. We suggest that *D. sanderiana* can be used for poolside landscaping as evidenced by ChlF transient analysis.

Keywords: Chlorophyll fluorescence, *Dracaena sanderiana*, OJIP test, Photosynthesis, Salinity tolerance

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[*]chalindab@agri.pdn.ac.lk

Seed Priming Techniques for Improving Germination in Selected Cucurbits

Yogarasa K.[*], Priyantha M.G.D.L.[1], Athukorala A.R.J.[2], Samaranayake J.W.K.[3], Beneragama C.K. and Rankoth L.M.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Poor germination at final stage of seed certification leads to rejections in seeds produced as planting materials by the Department of Agriculture of Sri Lanka. Seed priming is one possible option to overcome such problem where a pre-sowing treatment is used for improving the germination. In Cucurbit crops, due to hard seed coat, germination is usually low. To identify the suitable priming methods for Cucurbitaceae, to evaluate the effects of various priming treatments and also to reduce the rejection rate in certified seeds, this experiment was conducted in Seed Certification Services Laboratory at Gannoruwa as a two factor factorial experiment in completely randomized design with three different priming treatments (hydro priming, osmo priming and halo priming) with control (non-primed) and two seed types (accepted and rejected) for two crops. bitter gourd (*Momordica charantia*) and snake gourd (*Trichosanthes cucumerina*) belonging to the family Cucurbitaceae. By this experiment, effects of priming treatments were investigated on parameters such as germination percentage, moisture percentage, electrical conductivity, seed microflora, shoot and root length (cm), seedling length (cm) seedling vigor index and chlorophyll fluorescence. According to the statistical analyses, there were no significant differences at level of $P<0.05$ for moisture percentage, shoot and root length and seedling length except for electrical conductivity, germination percentage and seedling vigor index. In accepted seeds of bitter gourd, osmo priming showed the greatest increase in germination whereas in rejected seeds, all three priming methods significantly increased seed germination compared to control. All priming treatments have increased the seedling quality in rejected snake gourd seeds compared to the control. According to the results, all three priming treatments have been able to improve the seed germination in rejected bitter gourd and snake gourd seeds.

Keywords: Bitter gourd, Halo priming, Hydro priming, Osmo priming, Snake gourd

[1]Seed Certification Service, Department of Agriculture, Gannoruwa, Sri Lanka
[2]Seed Health Testing Laboratory, Department of Agriculture, Gannoruwa, Sri Lanka
[3]Central Seed Testing Laboratory, Department of Agriculture, Gannoruwa. Sri Lanka
[*]ykirishala@gmail.com

Simulation of the Temperature Profile of Coffee Beans Roasted Under Far-Infrared Radiation

Karapitiya S.L., Amaratunga K.S.P.,*, Ekanayake E.M.A.C.[1] and Wickramahewa W.H.T.D.
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Coffee is the most consumed beverage in the world besides water and the most traded agricultural commodity. Roasting is the most important step in coffee processing. Rotating in batch roasters using convective heating is popular in the industry. But the use of convective heating consumes more time and energy. The gradual heating of coffee beans under a low temperature gradient with convective heating causes excessive caramelization and deterioration of organoleptic properties in roasted coffee. Far-infrared (FIR) radiation causes rapid heating of coffee beans which eliminates the above problems. The temperature profile of coffee beans roasted under far-infrared radiation has been studied in this study to optimize the FIR coffee roasting. The temperature profile inside coffee beans and the surface temperature of the beans exposed to far-infrared radiation was simulated using COMSOL Multiphysics. Coffea arabica beans were singularly roasted in an experimental setup and the temperature-time curves were plotted to validate the model. Sets of 12 coffee beans in each batch were roasted for five time intervals (20 s, 25 s, 30s , 35 s and 45 s) to determine the roasting degrees of coffee roasted under FIR. A good agreement between the simulated data from the model and experimented data was observed (RMSE of 25.3°C at the 25% duty cycle, 35.6°C at the 17.5% duty cycle, 37.2°C at the 10% duty cycle). It can be concluded that FIR can be effectively used for coffee roasting and the roasting is much faster (internal temperature reach 300°C in 44s) than the traditional convective heating. All three roasting degrees; light roast, medium roast and dark roast can be obtained by roasting with FIR.

Keywords: Coffee roasting, Heat transfer, Modelling, Temperature profile

[1]Obihiro University of Agriculture and Veterinary Medicine, Obihiro, Hokkaido, Japan
*sanath.amaratunga@gmail.com

Statistical Process Control in Quality Assurance of Latex Crepe Production in the Dartonfield Factory, Agalawatta

Dharmasena A.H.T.S., Samita S.[*] and Wijesooriya B.W.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Statistical process control is a mechanism of examining the variability of the considered quality parameters. Out of control instances are identified by shifts from the standard mean value and high variability. Evaluation of the quality of latex crepe manufacturing process in the Dartonfield factory was done considering applied dosages of sodium bisulfite, bleaching agent and formic acid. Moving range charts (MR chart), individual value charts (I chart) and cumulative sum (CUSUM) charts were used as tools for quality assurance of latex crepe manufacturing process under this study. MR chart was used to study the stability of the process whereas I charts were used to identify out of control chemical applications. Change point analysis was done for CUSUM charts to detect trends in chemical applications. CUSUM charts can detect fluctuations in properties of quality parameters within a narrow range. Ranked CUSUM charts can be plotted if the variability of the data is high, or error structure of the data is non independent. According to the results, application of sodium bisulfite, bleaching agent and formic acid were done according to the RRI recommendations. Chemical application in crepe rubber manufacturing process was stable and under control except in 13th of May 2022. Although addition of sodium bisulfite has fluctuated during 2021-2022, it has been within standard control limits (computed using 2004 standard data set) according to both individual and moving range charts. According to moving range charts for added bleaching agent and formic acid dosages, they have been within standard limits.

Keywords: Change point analysis, Control chart, Quality assurance, Statistical quality control

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[1]Rubber Research Institute, Agalawatta, Sri Lanka
[*]ssamita@agri.pdn.ac.lk

The Clay Pot Cooler: Zero Energy and Cost-Effective Storage Method for Postharvest Storage of Leafy Vegetables

Hettiarachchi W.A.B.H., Sandarenu K.M.S.D., Gamage S.N.W., Attanayake R.M.T.D., Dasanayaka Y.M.H.M., Galahitiyawa D.D.K.[1] and Kumarihami H.M.P.C.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The zero-energy clay pot coolers are an eco-friendly system with low construction costs. This technology is based on the principles of a passive evaporative cooling mechanism. Clay pot coolers have been shown to effectively increase the shelf-life of many fresh commodities. The present study was conducted to evaluate the effectiveness of the evaporative clay pot coolers in preserving the postharvest quality of four selected leafy vegetables including, kankun (*Ipomoea aquatica*), gotukola (*Centella asiatica*), lettuce (*Lactuca sativa*) and thampala (*Amaranthus* spp.). Freshly harvested leafy vegetables were separated into bundles weighing about 200 g and stored under three different storage conditions, *i.e.,* room temperature storage, refrigerated storage, and clay pot cooler storage, for seven days. The average temperatures and relative humidity in room temperature storage, refrigerated storage, and clay pot cooler storage were 27.7 ºC and 76.1%, 7.1 ºC and 58.2%, and 25.6 ºC and 93.6%, respectively. Average cooling efficiency of clay pot coolers was 66.7%. The physiological weight losses of leafy vegetables were significantly reduced during clay pot cooler storage. At the end of the storage period, chlorophyll content, soluble solids content, color changes, and the visual quality of leafy vegetables were significantly maintained in clay pot cooler storage compared to room temperature storage. Based on the results of this study, it can be concluded that the clay pot cooler is a better alternative storage method to preserve the quality of leafy vegetables during their storage.

Keywords: Clay pot cooler, Leafy vegetables, Quality, Shelf-life

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[1]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya,
Peradeniya, Sri Lanka
[*]prathibhani@agri.pdn.ac.lk

Therapeutic Effect of an Indigenous Herbal Spray on Cutaneous Wound Healing in Swine

Jayasundara A.G.T.D., Rajapakse R.P.V.J.[1], Jinadasa H.R.N.[2] and Wijayagunawardena M.P.B.[*],
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Cutaneous mange is highly contagious, which leads to severe wounds later, thus, resulting economic losses to the farmers if not treated on time. In this study, the effectiveness of a herbal spray, which is prepared using a traditional herbal recipe for controlling mange infestation in pigs, was investigated. Herbal materials have wound-healing abilities, antibacterial, antifungal, antiseptic, and anthelmintic properties. The prepared herbal spray was applied daily on the affected area of mange-infested pigs and the prognosis was evaluated for 21 days at 07-day intervals. Efficacy was evaluated using a numerical scale based on the severity of clinical symptoms and behavioural signs at the initial treatment. A score of 0 was given to pigs with no symptoms, while a score of 100 was given to pigs showing severe clinical symptoms. Scores between 0-100 were given accordingly to pigs in between. The post-treatment evaluation was done using the same scale. The herbal spray was also tested against balb/c mice to observe the wound healing process as well. Animals with non-treated wounds served as the control. The data were statistically analyzed using Wilcoxon Signed Rank Test. The results showed that applying this herbal spray significantly ($P<0.05$) improved wound healing in pigs when compared with the control. In conclusion, this herbal spray is effective in healing cutaneous wounds resulting from mange in pigs, and the spray is highly effective for controlling general skin infections too. Therefore, this herbal spray has a potential for commercialization to control the mange and skin wounds in pigs. However, further studies have to be conducted to investigate the effectiveness of the herbal spray on other farm and pet animals.

Keywords: Cutaneous wound healing, Herbal spray, Pigs, Skin diseases

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[1]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine & Animal Science, University of Peradeniya, Sri Lanka

[2]Center for Aquatic Animal Disease Diagnosis and Research, Faculty of Veterinary Medicine & Animal Science, University of Peradeniya, Sri Lanka

[*]missaka@agri.pdn.ac.lk

Thermodynamic Analysis and Computational Fluid Dynamic Modelling of Heat Transfer in a Double Barrel Batch Pyrolysis Reactor

De Silva T.D.K., Alahakoon A.M.Y.W. and Karunarathna A.K.[*]
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Conventional mass and energy calculations are lengthy, time consuming and visualization is difficult when it comes to higher order simulations. Thus, use of CFD tools for modeling is more efficient and sophisticated. In this study, heat transfer in two cylindrical geometries of a double barrel batch pyrolysis reactor having an inner pyrolysis chamber and outer combustion chamber was mathematically built. Finite element analysis of physical geometry using COMSOL® Multiphysics software was done. Finding the appropriate temperature distribution in the combustion zone to achieve the minimum temperature of 450^0C for 30 minutes duration in the inner pyrolysis chamber was the objective of model simulation. Rice husk was used as the feedstock for pyrolysis while dried Gilicidia (*Gliricidia sepium*) biomass was used as the combustion biomass both in simulation and actual field testing. During the field experiment at Meewatura experimental station, four K-type thermocouples were placed along the vertical axis of the outer chamber to capture the temperature profile during the twenty-two hours of reactor operation process. According to COMSOL® Multiphysics simulation model, the temperature of the combustion zone should reach minimum of 600^0C temperature to ensue pyrolysis at 450^0C in pyrolysis chamber. The field testing of actual reactor showed that the combustion zone temperature reached 800^0C and retain a minimum of 90 minutes giving adequate temperature and retention time for paddy husk pyrolysis at 450^0C. In conclusion, it was found that COMSOL® Multiphysics simulation model can be effectively used to simulate the heat transfer mechanism of Double Barrel Batch Pyrolysis Reactor.

Keywords: CFD modeling, COMSOL® Multiphysics, Heat transfer, Pyrolysis

[*]anujica@agri.pdn.ac.lk

Unmodified, and Iron and Magnesium Modified Biochars Derived from Coconut Shells for Phosphate Removal from Water

De Silva D.D.T., Igalavithana A.D.[*] and Jayarathne L.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Biochar is a low-cost material that can be used as an adsorbent to remediate contaminated water. Generally, the surface of biochar is negatively charged, which restricts its affinity for phosphate anion adsorption. In this study, biochar was produced by pyrolyzing coconut shells at 400 ºC and modified with iron (Fe) and magnesium (Mg) to remove phosphate from water. To evaluate the performance of Fe- and Mg-modified biochar on phosphate removal from water, batch adsorption tests were conducted. The optimum time, dosage, and pH for phosphate adsorption were determined for both unmodified and modified biochars. The pH of the unmodified and modified biochars were 7.35 and 3.66, respectively. The Electrical conductivity of the unmodified biochar was 900 µS cm^{-1} while that of the modified biochar was 600 µS cm^{-1}. The overall effect of modified biochar materials on phosphate adsorption was significantly higher than that of unmodified biochar materials ($P<0.05$). When the modified biochar dose reached 10 g/L, the phosphate removal efficiency increased to a maximum of 97.80%. Modified biochar exhibits 72.14% adsorption after 10 minutes and then increased to a maximum of 81.89% after one hour. Hence, the optimum time period for the adsorption of modified biochar is one hour. The phosphate adsorption capacity of modified biochar was unaffected by pH. But at pH 9, unmodified biochar samples exhibited a small increase in phosphate adsorption. According to these findings, it can be concluded that Fe- and Mg-modified biochar can be used as a low-cost adsorbent to remediate eutrophic water.

Keywords: Eutrophication, Modified biochar, Phosphate removal

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[1]National Institute of Fundamental Studies, Hantana Rd., Kandy, Sri Lanka
[*]adigalavithana@agri.pdn.ac.lk

Valorization of Invasive Weed Biomass and Waste Plastic Mulch through Co-Pyrolysis into Biochar

Waththuhewage T.L., Alahakoon A.M.Y.W. and Karunarathna A.K.[*]
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The prevailing priority to stimulate the transition towards a circular economy expanded the tempo of the search for alternatives in the forms of biofuels, biomaterials, bio-based adsorbents, and other value-added components. Thereby, resource recovery techniques such as thermochemical conversions can present more sustainable solutions to waste management than conventional dumping and burning practices. Agricultural wastes are produced in massive quantities worldwide and comprise a range of feedstocks, making them potentially valuable inputs to support resource circularity. This study focused on the resource recovery through co-pyrolysis of two major waste types from the agricultural industry: weed biomass (WB) and waste plastic mulch (WPM). Six invasive WB species, Wal Suriyakantha (*Tithonia diversifolia*), Ipil-ipil (*Leucaena leucocephala*), Baloliya (*Lantana camara*), Katakalu bovitiya (*Clidemia hirta*), Podisinchomaran (*Eupatorium odoratum*), and Wedelia (*Sphagneticola trilobata*) were co-pyrolyzed with WPM at 550°C, in six different WB:WPM mass ratios of 100:0, 99.75:0.25, 97.5:2.5, 95:5, 92.5:7.5, and 90:10, respectively. The physical, chemical, and surface morphological characteristics of the produced biochar were analyzed to evaluate its suitability as soil amendments or adsorbents. The results showed that increasing the plastic ratio of the mixture decreased the biochar yield by 1-5%, with Katakalu bovitiya having the highest biochar recovery (31%) and Wal suriyakantha having the lowest recovery (28%). Increasing the PM content also increased the volatile matter content by 1–7%. The pH values of all the biochar samples were between 10 and 12, making them more suitable for soil acidity treatment. The FTIR analysis showed that there are prominent surface functional groups like carbonyl in the biochar, and alkene groups may be present due to PM. In conclusion, it can be stated that the co-pyrolysis of invasive weed biomass and waste agricultural plastic mulch is a potential agricultural waste valorization technique.

Keywords: Biochar, Co-pyrolysis, Invasive weed biomass, Waste plastic mulch

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[*]anujica@agri.pdn.ac.lk

Food Quality, Safety and Product Development

Aflatoxins in Commonly Used Feed Raw Materials:
A Quantitative Analysis

Muoneke O.E. and Ekanayake W.E.M.L.J.[*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Aflatoxins produced mainly by *Aspergillus flavus* and *Aspergillus parasiticus* are known to be carcinogenic and mutagenic. Aflatoxins concentration (AC) in feed raw materials such as maize, wheat and rice by-products can exceed the threshold levels resulting in reduced quality of feed produced. This study aimed to quantify the AC and its association with other nutrients such as moisture, crude protein, ether extract, crude fibre and ash in commonly used feed raw materials. Two-year (2021-2022) data of AC and proximate composition (PC) of commonly used feed raw materials were extracted from a database of one of the largest concentrate feed manufacturers in Sri Lanka. The data were then analyzed using R software version 4.01, and the associations between PC and AC were quantified using correlation analysis and principal component analysis (PCA). The number of PCA components was determined using both Eigen values and Monte Carlo PCA simulation. The highest crude protein was found in Meat & Bone Meal (50.3±1.8%) and the lowest in Palm Kernel Meal (17.8±1.5%) of the protein sources used in feed formulation. The Dried Distillers Grains had the highest moisture content (14.9±1.8%) and Meat & Bone Meal had the lowest moisture content (3.4±2.0 %). Overall, the AC of most of the raw materials used in feed processing exceeded the threshold of 20 µg/kg with the lowest level being observed in Boll Rice (4.9±1.2 µg/kg) and the highest (55.5±58.3 µg/kg) in Dried Distillers Grains. The correlation coefficients ranged from -0.68 to 0.57 and aflatoxin concentrations were poorly associated with feed nutrients except for moisture content (r=0.35). Therefore, these findings suggest that the aflatoxins concentration in feed raw materials increases when moisture content increases. This suggests that proper drying of raw materials should be encouraged prior to feed storage and processing to reduce the aflatoxins concentration in feed raw materials.

Keywords: Aflatoxins, Concentrate feeds, Feed raw materials, Nutritional quality

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[*] jayekn@agri.pdn.ac.lk

Antiglycation Properties of Aqueous Extracts from Selected Plant Species: An *In vitro* Study

**Senevirathne N.H.M.V.N., Mendis B.E.P., Rajapakse R.P.N.P.,
Perera H.K.I.[1*] and Weerapperuma T.M.K.B.B.**
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Glycation is a non-enzymatic reaction occurring in human body which leads to occurrence of various non-communicable diseases. In a person with chronic hyperglycemia, glycation occurs at higher rates resulting in chronic diabetic complications. With the objective of identifying potentially safe natural sources with glycation inhibition properties, lemongrass (*Cymbopogon citratus*) whole plant, turmeric (*Curcuma longa*) rhizome, Ceylon cinnamon (*Cinnamomum zeylanicum*) bark, piperine 95, a pure extract from *Piper nigrum* and ginger (*Zingiber Officinale*) rhizome were studied. The plant material for the study was collected through the Department of Export Agriculture. Dried and powdered samples were extracted three times with distilled water using ultra-sonic assisted extraction method. Aqueous extracts were first concentrated through rotary evaporation at 50 °C and then freeze-dried. Freeze dried samples were re-dissolved in distilled water to obtain the test samples in a concentration series of 200 mg/mL–0.625 mg/mL. Chicken egg lysozyme was incubated with fructose in a phosphate buffer (pH 7.4) at 37 °C for 30 days in the presence and absence (negative control) of prepared plant extracts. Aminoguanidine was used as standard glycation inhibitor in positive control and blank samples included only plant extracts incubated in lysozyme. Aliquots of samples were obtained on day 7 and 21 of incubation and analyzed along with molecular weight markers (MW) using sodium dodecyl-sulfate polyacrylamide gel electrophoresis (SDS-PAGE) to identify the inhibition effect against glycation induced cross linking of proteins. On day 7 compared to negative and the positive control, *C. zeylanicum* indicated the highest antiglycation activity resulting in a complete glycation inhibition at a concentration of 0.1 mg/mL. On day 21 both *C. citratus* and *C. zeylanicum* showed complete inhibition of cross-linking at 0.5 mg/mL concentration which was the highest inhibition activity. On both days *C. domestica* indicated the lowest antiglycation activity. In conclusion, among the studied plant extracts *C. citratus* and *C. zeylanicum* indicated the highest *In vitro* antiglycation activity.

Keywords: Diabetes complications, Glycation, Hyperglycemia

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[1]Department of Biochemistry, Faculty of Medicine, University of Peradeniya, Sri Lanka
[*]kumuduperera10@gmail.com

Applications and Usages of Different Prebiotics in the Dairy Industry: A Review

Adheela M.N.F. and Prasanna P.H.P.[*]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Prebiotics are indigestible dietary elements that may benefit the host and stimulate the growth of selective probiotics, particularly those that stimulate the growth of bifidogenic and lactic acid bacteria in the gastrointestinal tract. Prebiotics cannot be digested by small intestinal enzymes but are fermented by probiotic bacteria in the large intestine. Prebiotics can be classified in a variety of ways according to their chemical makeup, chain length or degree of polymerization, and the form of application. Prebiotics are found in several vegetables and fruits and are considered functional food components. During the selective fermentation process of colonic bacteria, it produces metabolic products such as hydrogen, methane, carbon dioxide, short-chain fatty acids, and lactate via various carbohydrate hydrolysing enzymes, which provide energy to probiotic bacteria. Some findings claim that prebiotics play a role in reducing the risk and severity of gastrointestinal infection and inflammation, inflammatory bowel disease, ulcerative colitis, bowel function disorders, and irritable bowel syndrome. Prebiotics also increase the bioavailability and uptake of minerals, and data suggest that they reduce the risk of obesity by promoting satiety and weight loss. They are used in many food applications including dairy products. Much research has been focused on using probiotics and prebiotics, generally known as synbiotics in dairy products.

Keywords: Dairy products, Health, Probiotics, Synbiotics

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[*]phpprasanna@agri.pdn.ac.lk

Assessing Cow Urine pH as an Indicator to Detect Unstable Non Acid Milk

Kumara K.P.S.A., Pathirana A.P.D.G.[1], Vidanarachchi J.K. and Prasanna P.H.P.[*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Peradeniya, Sri Lanka

The economic return and the sustainability of a dairy farm significantly depends on the quality of the milk produced by the farm. Unstable Non Acid Milk (UNAM) is a common quality defect identified in cow milk, but not been studied adequately. In Sri Lanka, ethanol stability test is commonly being used as a measure of heat stability of raw milk. Ethanol instability occurs as a result of increased ionized calcium level due to various reasons, causing rejection of milk in considerable amounts. Considering the importance of early detection of UNAM, the present study was carried out to determine the suitability of cow urine pH as an indicator to detect UNAM. In this study, milk and urine samples were collected from 35 lactating cows three times, two weeks apart from 5 dairy farms around Kandy and transported at 4°C for further analyses. All milk samples were tested in duplicates for ethanol stability (68%, 70%, 72%, and 74%), acidity, resazurine, pH, fat, lactose, solid-non-fat and protein percentages while urine samples were tested for pH using a pH meter. Binary logistic regression between pH value of urine and response to ethanol stability test under series of percentages were evaluated. Separate models were developed for each ethanol percentage. The chi-square values for goodness fit test for the model fit for each ethanol concentrations were not significantly different ($p>0.05$). Although, there was no strong correlation of statistical significance between cow urine pH and UNAM, correlation of urine pH with 70% alcohol stability was quite close to be significant. The present study did not find a strong positive correlation of any statistical significance between cow urine pH and UNAM. However, small sample size may have compromised statistics and therefore, it is suggested to carry out further studies with more samples from milking cows.

Keywords: Ethanol stability, Unstable non-acid milk, Urine pH

[1]Veterinary Research Institute, Gannoruwa, Peradeniya, Sri Lanka
[*]phpprasanna@agri.pdn.ac.lk

Assessment of the Potential Use of Microbial Protease Enzyme as a Substitute for Sodium Metabisulfite in Hard Dough Biscuit Manufacturing

Sanjana W.T., Jayawardene L.P.I.N.P.[1], Gunathilaka W.L.C.M.[1], Vidyasekara E.V.R.T.[1], Daundasekara D.M.S.S.*

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The objective of the study was to evaluate the potential of replacing sodium metabisulfite (SMS) in hard dough biscuits with a microbial protease enzyme (Veron HPP). The effect of enzyme addition on biscuit quality was investigated by comparing 6 treatments (T1:20 mg/kg, T2:40 mg/kg, T3:60 mg/kg, T4:80 mg/kg, T5:100 mg/kg, T6:120 mg/kg) with the control (SMS, 400 mg/kg). The biscuits were prepared with similar height and shape and baked at 180 °C for 9 min. The biscuit hardness was analyzed using a texture analyzer. The T4, T5, and T6 treatments had significantly lower hardness ($P<0.05$) compared to the control. Therefore, only T1, T2, and T3 were further evaluated. The proximate composition, spread ratio, color, and sensory properties of the selected treatments were compared with the control. Aerobic plate count and yeast and mould count were determined after 4 weeks of storage time. There was no significant difference ($P>0.05$) in the moisture, crude protein and ash contents, or color of the treatments compared to the control. T1 treatment had a significantly higher spread ratio compared to the control (control: 6.96 ± 0.64 vs. T1:10.309 ± 1.211, $P<0.05$). According to the sensory evaluation for texture, T2 had the highest preference while T3 had the least preference. The aerobic plate count of all treatments was significantly higher ($P<0.05$) than the control. The yeast and mould count of biscuits was less than 1 for all the treatments and the control after 4 weeks of storage. Based on the sensory results, T2 could be selected as the best formulation for hard dough biscuit with the microbial protease enzyme. Further studies are required to evaluate the shelf life and to determine a suitable packaging material for the developed biscuits.

Keywords: Hard dough biscuits, Protease enzyme, Sodium Metabisulfite (SMS)

[1]Aletek International (Pvt.) Ltd, NJV Cooray Mawatha, Rajagiriya, Sri Lanka
*saumalid@agri.pdn.ac.lk

Bioavailability of Antioxidants, Minerals, and Heavy Metals in Two Edible Seaweed Species: *Kappaphycus alvarezii* and *Caulerpa lentillifera*

Gangani W.G.R.., Jayawardana B.C.[*], Liyanage R. [1], Sewwandi S.M.[1], and Weththasinghe P.

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study investigated the bioavailability of antioxidants, minerals, and heavy metals in two selected edible seaweed species in Sri Lanka: *Kappaphycus alvarezii* and *Caulerpa lentillifera*. The collected seaweed samples were dried at 55 °C, powdered and subjected to *in vitro* digestion using synthetic gastrointestinal enzymes. A dialysis membrane of 12 kDa molecular cut-off was used to simulate intestinal absorption. Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) in seaweed powder and the bioavailable fraction of digested seaweed were measured using the Folin-Ciocalteu method and Aluminum chloride colorimetric assay, respectively. The antioxidant activity was determined using 2,2-Diphenyl-1-picryl-hyrazyl-hydrate (DPPH) radical scavenging activity, 2,2′-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) radical scavenging activity and Ferric Reducing Antioxidant Power (FRAP) assays. The mineral (Fe, K, Mg, Al, Zn) and heavy metal (Cd, Cr, Mn, Co, Ni, Mo, V) contents of seaweed powder and bioavailable fraction were measured by Inductively Coupled Plasma – Optical Emission Spectroscopy (ICP-OES). The TPC of the bioavailable fractions of *K. alvarezii* and *C. lentillifera* were 1.47±0.01 and 1.76±0.04 mg GAE/g, respectively. These values were significantly ($p < 0.05$) higher than the TPC in powdered seaweeds (0.76±04 mg GAE/g DW and 1.06±04 mg GAE/g DW respectively) showing that the simulated digestion had improved the polyphenol bioavailability in the studied seaweeds. The TFC in both seaweed powder and bioavailable fraction were not within the detectable limit. Compared to powdered seaweeds, bioavailable fractions showed a significantly ($p < 0.05$) higher antioxidant capacity for ABTS assay and a significantly ($p < 0.05$) lower antioxidant capacity for DPPH assay. For FRAP assay, *C. lentillifera* showed significantly ($p < 0.05$) higher antioxidant capacity than powdered seaweed. Both mineral and heavy metal bioavailability were significantly ($p < 0.05$) higher in *K. alvarezii* than in *C. lentillifera.* Results revealed that digestion significantly affects polyphenolic and mineral bioavailability. These seaweeds have the potential to address micronutrient malnutrition and oxidative stress-related diseases.

Keywords: Antioxidants, Bioavailability, Heavy metals, *In vitro* digestion, Seaweeds

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[1]Laboratory of Nutritional Biochemistry, National Institute of Fundamental Studies, Kandy, Sri Lanka

[*]baranaj@agri.pdn.ac.lk

Characterization of Five Selected Seaweed Species in Sri Lanka: Proximate Composition, Antimicrobial and Antioxidant Activities

Chandraprabha R.A.U., Jayawardana B.C.[*], Weththasinghe P., Liyanage R.[1] and Jayatilake J.A.M.S.[2]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Perad eniya, Sri Lanka

The present study aimed to characterize the proximate composition, antimicrobial and antioxidant activities of five seaweed species namely, *Kappaphucus alvarezii* (Dotty dotty)*, Sargassum wightii* (Gulf weed)*, Turbinaria ornata* (Crowded sea bell)*, Caulerpa peltata* (Saucer algae) and *Caulerpa lentillifera* (Sea grapes), which were collected from different areas in Jaffna district in Sri Lanka. After cleaning and washing, the samples were dried at 55 °C and ground to a powder. Proximate composition was measured in dried seaweed powder. The antioxidant activities were determined in water extracts of seaweed powder using three different assays: Total Phenolic Content (TPC), Ferric Reducing Antioxidant Power (FRAP) assay and 2, 2- diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity. Crude methanol and crude water extracts of seaweeds were examined for antimicrobial properties against four selected pathogens (*Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus* and *Candida albicans*). The proximate composition and antioxidant properties varied significantly ($P<0.05$) among seaweed species. The two green seaweeds, i.e., *C. peltata* and *C. lentillifera* had the highest ($P<0.05$) protein, fat and gross energy contents while the other three seaweeds had significantly ($P<0.05$) high ash contents. The water extracts of brown seaweed, *S. wightii* showed the highest ($P<0.05$) TPC and FRAP, whereas red seaweed, *K. alvarezii* had the highest ($P<0.05$) DPPH radical scavenging activity. Methanol extracts of the five seaweed species showed antimicrobial activity against four pathogens tested, whereas the crude water extracts of two seaweed species tested (*K. alvarezii* and *T. ornata*) showed antimicrobial activity only against *P. aeruginosa*. Present results showed that the five selected Sri Lankan seaweeds contain high nutritional value, antioxidant and antimicrobial properties and, have a potential to be used as a food or food additive that can help to reduce malnutrition and non-communicable oxidative stress-related diseases.

Keywords: Antimicrobial activity, Antioxidant activity, Extracts, Proximate composition, Seaweeds

[1]Laboratory of Nutritional Biochemistry, National Institute of Fundamental Studies, Kandy, Sri Lanka

[2]Division of Microbiology, Department of Oral Medicine and Periodontology, Faculty of Dental Sciences, University of Peradeniya, Peradeniya, Sri Lanka

[*]baranaj@agri.pdn.ac.lk

Characterization of Physicochemical Properties and Post-prandial Glycemic Response of Garlic and Bee Honey Combined Product

Dahanayake T.N., Somaratne G.M.[*], Madarasinghe S.[1], Jayawardena R.[2], Nikalansooriya N.M.A.I.,[1] and Madhumali K.D.U.[3]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Bee honey and garlic are used as valuable medicine from ancient times due to their antioxidant, anti-inflammatory, anti-diabetic and anti-cancer properties. The combination of garlic and bee honey is considered as an ayurvedic remedy to improve cardiovascular health, weight loss and for hypoglycemic effect. The reason for this is both garlic and bee honey are rich in antioxidants. The objective of this study was to identify the post-prandial glycemic response of garlic-bee honey combination. Furthermore, the physicochemical properties of the garlic and bee honey combined product was accessed. The measured parameters were viscosity, pH, acidity, sugar content, moisture content and water activity. The results of the proximate analysis revealed that the carbohydrate content of bee honey and the garlic-bee honey product was 79.9% and 73%, respectively. Additionally, the garlic-bee honey product contains 1.6% protein, 0.4% ash, 25% moisture and fat was not detected. The glycemic index (GI) test was conducted using 11 healthy subjects aged between 22-25 years, mean Body Mass Index (BMI) of 20.8 ± 1.9. The GI was measured according to ISO 26642:2010 (E). Participants were given 50 g of glucose as the reference food. Bee honey garlic product which contains 50 g of available carbohydrate was given. The results of the GI test revealed that bee honey had a mean GI of 57 ± 6.10 (medium GI) and for the garlic-bee honey product was 66 ± 8.14 (medium GI) with no significant difference ($P>0.05$). Therefore, the research concludes that, compared to the table sugar (reported GI $\approx$ 80) the garlic-bee honey product can be recommended for diabetic patients as it is a medium GI food as well as due to its reported high antioxidant capacity. It is suggested that further tests should be done to determine the long-term effect of the garlic-bee honey product on human health.

Keywords: Antioxidant, Bee honey, Garlic, Glycemic index, Post-prandial

[1]Bio extracts (Pvt) Ltd., 672/4, Mayura Mawatha, Off Maligawa Road, Ratmalana, Sri Lanka
[2]Waitaki Biosciences, 3 Desi Place, Hillsborough, Christchurch, New Zealand
[3]Department of Nursing, Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya, Sri Lanka
[*]gsomaratne@agri.pdn.ac.lk

Comparative Evaluation of Five Traditional Methods to Reduce Storage Pest Damage of Mung Bean (*Vigna radiata*)

Bandara D.M.T.S. and Jayasinghe W.H.[*]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

We evaluated five traditional methods commonly-used in Sri Lanka to minimize losses due to storage pest attacks of mung bean. These methods have become popular at present due to high cost and unavailability of chemical pesticides and potential health risks. Mung bean grains were mixed with wood ash, dried neem (*Azadirachta indica*) leaves, dried lime (*Citrus aurantiifolia*) leaves, a mixture of dried neem and lime leaves and dried lantana *(Lantana camara)* flowers. These experimental units (i.e. plastic boxes with grains mixed with the treatments and control) were kept at room temperature and allowed natural infestation. Species identification, number of adult pests, seeds with holes and seeds with eggs, living adults, pupae and larvae were counted at thirty-day intervals over a storage period of two months. *Callosobruchus chinensis* was reported as the major storage pest of mung bean. In the untreated control, a higher number of grains were damaged by *C. chinensis*. Pest population was suppressed significantly (P=0.001) in dried neem leaf treatment compared to other treatments. Number of seeds with holes and the seeds with eggs were reduced significantly in neem treated-mung bean samples (P=0.003 and P=0.000, respectively). There was no significant effect by any treatment on living larvae and pupae inside the seeds (P=0.327). The lowest yield loss was recorded in neem-treated samples (12.92%) during the storage period of two months. Therefore, mixing grains with dried neem leaves was identified as the best postharvest treatment for short duration storage (two months) of mung bean at household level.

Keywords: *Callasobruchus chinensis,* Storage pests, Traditional methods

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[*]whj@gari.pdn.ac.lk

Comparison of Effect of Different Starter Cultures on Fermentation Properties of Cow Curd

Madhuwanthi P.G.N.P., Deshapriya R.M. C.[*], Aththanayaka W.A.S.B.[1] and Disanayaka L.M.J.N. K.

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Curd is an extensively consumed traditional fermented dairy product in Sri Lanka. The repeated usage of defined starter culture in commercial curd production leads to a constant host for bacteriophage proliferation. These bacteriophages cause the low rate of lactic acid production during fermentation process which causes undesirable product quality, thereby considerable economic losses. Rotation of the starter culture has been identified as a good solution to avoid this. Therefore, this study was conducted with the objective of identifying the suitable starter cultures/culture combination for cow curd preparation that can be used for culture rotation process. The physiochemical, microbiological and organoleptic properties were evaluated to identify the most suitable starter cultures for cow curd production. Four starter cultures; Delvo FVV 211 (T1), Chr Hansen YoFlex® SLB 3.0 (T2), Sacco KD2 (T3) and a combination of Delvo FVV 211 + Sacco KD2 (T4), as a control a culture of pre-prepared buffalo curd (PPBC) was used (T5). One way ANOVA and Friedman test were used to analyze data. The curd produced with Delvo FVV 211 showed the lowest ($P<0.05$) mean pH (3.64 ± 0.00) compared to the control (3.94 ± 0.02) toward 14th day of storage in refrigerator ($4C^O$). The organoleptic properties were evaluated by twenty untrained panelists with 5-point hedonic scale. The curd produced using a combination of Delvo FVV 211 + Sacco KD2 (T4) received the highest rank for taste while other properties had no difference. The control showed a higher ($P<0.05$) mean yeast count (2.90 ± 0.08 log cfu/g) during the fifteen days of storage in refrigerator. However there was no significant mold growth in any of the sample during storage. In conclusion, a combination of Delvo FVV 211 + Sacco KD2 cultures was identified as the best option for culture rotation practices in cow curd production.

Keywords: Cow curd, Starter cultures, Organoleptic properties

[1]Milco (Pvt) Limited, Gallella, Polonnaruwa, Sri Lanka
[*]cdeshapriya@agri.pdn.ac.lk

Comparison of Pilot Scale and Mass Scale Tea Blending and Quality Evaluation

Madhuwantha M.P.L., Arampath P.C.,* and Silva R.V.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri lanka

Blending is a common practice to enhance the sensory attributes, stability, quantity and economic benefits. Tea blending is mixing of more than two varieties of single line made from seven regions of tea growing areas in Sri Lanka. Characteristics and quality of tea are typically influenced by the genetic make-up of tea variety, agroclimatic conditions, elevation, chemical makeup of green leaf, maturity of leaf and plucking method. This research was conducted to identify the deviation in-between pilot run and mass production of selected blend on liquor colour, liquor strength, infusion colour, infusion aroma and bulk density, tapped density, and compressibility index of blended tea. Samples were collected from seven batches of pilot run and mass production. Sensory evaluation was conducted by the tea tasters and semi-trained panels. "Hue" and "Chroma" values of tea brew, blended tea, and infusion were determined. There was a significant difference between the blend of pilot run and mass production on tapped density, liquor strength and aroma infusion ($p<0.05$) There was no significant difference in bulk density, compressibility index, and colour of the tea liquor of the tea blends obtained from the pilot run and mass production. Deviation of tapped density between pilot run and mass production was minimized by selecting hand blending technique with adequately splitting the batches into several portions during blending. Careful selection of pure tea lines for blending and tasting prior to formulation and blending are potential practices to reduce the deviation in-between pilot run and mass production in liquor strength and infusion aroma.

Keywords: Black Tea, Blending, Mass Production, Pilot Run, Quality Evaluation

[1]Akbar Brothers (Pvt) Limited, T.B. Jayah Mawatha, Colombo, Sri Lanka
*pcarampath@gmail.com

Comparison of Ready to Drink Artificially Flavoured Teas (*Camellia sinensis*) of Two Commercial Brands

Welgama gedara S.K., Arampath P.C.[*], Abeywickrama K.R.W.[1] and Samarasinghe M.[2]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Tea is the oldest, mostly consumed nonalcoholic plant-based beverage in the world. Ready-to-Drink (RTD) tea is one of the popular value-added products among consumers worldwide. RTD tea is processed by brewing the made tea, and dissolving tea concentrate or powder with other ingredients such as flavours, colourants, acidity regulators, sugar, or sweeteners. Due to the increasing consumer demand, RTD teas are available with different flavours and colours. Thus, evaluation of physicochemical, microbiological, and sensory attributes plays a significant role. This study was conducted to evaluate and compare the physicochemical parameters, microbiological quality, and sensory attributes of two brands (A and B) of artificially flavoured commercially available RTD tea in Sri Lanka. The pH, total soluble solids (TSS), titratable acidity, colour, total plate count (TPC), yeast and mold count and sensory attributes were determined in apple, lemon, peach, and strawberry flavoured RTD products. According to the results, the pH and TSS were significantly different ($P<0.05$) in two brands in all flavours. The pH and Brix value varied between 1.61-3.65 and 6.8-8.2 respectively. Acidity varied between 0.26-0.45 % and showed a significant difference ($P<0.05$) between the two brands for apple, lemon, and strawberry flavours. There was no significant difference ($P>0.05$) in hue values (0.50-1.37) between the two brands. The TPC was 0 cfu/mL for all the samples while yeast and mold count was 0 cfu/mL for both brands except for the lemon flavour in brand B. Considering the overall sensory evaluation, the apple flavour of both A and B brands had a better sensory profile compared to other flavours. In conclusion, all flavoured teas of both A and B brands had microbial safety and acceptable sensory attributes as a RTD tea beverage.

Keywords: Black tea, Brewing, Flavoured tea, Quality, Ready to drink

Determination and Validation of Optimum Time and Temperature Combination for a Processed Sweet Corn Product

Fernando H.D.A.P., Mendis B.E.P.[*]**, Rajapakse R.P.N.P. and Rajapakse R.P.A.D.**[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Boiled sweet corn is a favourite food in Europe. Sri Lanka recently cultivates sweet corn targeting to produce ready-to-eat entire sweet corn cobs as well as canned sweet corn in a brine solution. Because of low acidity (5.9 - 6.2), sweet corn is susceptible to the growth of spoilage and pathogenic microorganisms. In the food industry, thermal processing is the most common process which enable to manufacture microbiologically safe food and extend the useful shelf-life of foods. The research was conducted to find out the optimum time and temperature combination for the retorting process of ready-to-eat sweet corn cob pouches and to validate the process. The selection of raw materials, the effect of the blanching process, suitable time and temperature combinations for the retort process, physicochemical parameters for the final product, and sensory attributes such as colour, flavour, texture, and overall acceptability were assessed and compared among different time and temperature treatments. Sensory evaluation was done by using a hedonic ranking test and a 9-point hedonic rating test. Water that was used to clean and process steps were microbiologically safe as well as the processing environment also microbiologically safe. According to the results, 115 ℃ for 25 min and 116 ℃ for 15 min could be used effectively in the retort process. There was no significant difference (p>0.05) in physicochemical properties such as texture and salinity among the above treatments, but considering the sensory evaluation done using hedonic test, it was confirmed that most consumers preferred sweet corn processed at 116 ℃ for 15 min. Furthermore, the results of microbial validation support proving that the selected time and temperature combination would be adequate to destroy the spores of *Clostridium perfringens* and to maintain the expected shelf-life of 10 months.

Keywords: Sweet corn, Time and temperature combination, Validation

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[1]HJS Condiments (Pvt) Ltd, BOI Zone, Biyagama, Sri Lanka
[*]ereshamendis@agri.pdn.ac.lk

Determination of Optimum Time – Temperature Combination for Pasteurization and Estimation of Shelf Life of Carbonated Fruit Beverage

Wickramaarachchi S.L., Prasantha B.D.R.[*], Samarasinghe J.M.S.C.[1] and Kumara M.H.A.M.[1]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

It is important to deliver safe carbonated fruit beverages to the market. The aim of this research was to determine the optimum time-temperature combination for the pasteurization of carbonated fruit beverages and estimate the shelf-life. The optimum time-temperature combination was determined by subjecting the samples into different pasteurization conditions (63 □C/5 min, 63 □C/10 min, 71 □C/5 min, 71 □C/10 min, 75 □C/5 min, 75 □C/10 min, 80 □C/5 min and 80 □C/10 min) with or without sorbic acid as a preservative. The effectiveness of the appropriate time-temperature combination was measured using the yeast and mold count and it was considered as the critical factor for shelf-life determination. The shelf-life was determined based on the optimum heat treatment. Heat treated beverage cans were stored at accelerated temperatures of 35 □C, 45 □C for 9 weeks to evaluate the pH, acidity (%), total soluble solids (°Brix) and yeast and mold count (cfu/ml) in every week. The shelf-life of the product was determined by the accelerated shelf-life method using the Arrhenius model. The Q_{10} values were obtained from the model and literature data to calculate the estimated and predicted shelf-life, respectively. Based on the results, lowest heat treatment of 63 □C/5 min was not recommended for the pasteurization. However, heat treatment of 71 □C/10 min was recommended for the pasteurization. It was observed that, the quality attributes such as acidity, pH and °Brix of the product decreased with time. Based on the Arrhenius model, the growth of yeast and mold followed the first-order reaction. The change in yeast and mold count was used to estimate the shelf-life of carbonated fruit beverages in terms of microbial safety. According to the accelerated shelf-life model, the estimated shelf-life of carbonated fruit beverage (without preservative) was 15.44 weeks at room temperature (25 °C) and the predicted shelf-life for carbonated fruit beverage (without preservative) was 35.76 weeks at room temperature.

Keywords: Carbonated, Fruit beverage, Pasteurization, Quality, Time-temperature

Developing a Powder-based Formula of a Scrambled Egg Vegan Analogue: Suitability of Cowpea and Soybean Flours and Palsgaard® DMG 0093 Powder

Harshana H.W.L.D., Illeperuma D.C.K.[*] **and Vidanarachchi J.K.**[1]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Fast growth of sales of plant-based foods indicates their better demand over traditional meats and animal-based products. In many countries, percentage of consumers opting for vegan diets has increased, as reflected by the growth of vegan food market. As busy lifestyles of consumers restrict making healthy food choices, this study focused on developing a ready-to-cook powder-based formula of a scrambled egg vegan analogue (SEVA). Four formulae were prepared using cowpea flour (CF) and soybean flour (SF) in different ratios (100% CF, 3:1-CF:SF, 2:1-CF:SF and 1:1-CF:SF) as treatments in triplicate. Liquid soy lecithin (LSL), turmeric powder, baking powder, baking soda, carboxy methyl cellulose, citric acid powder, salt, coconut oil and coconut milk were used in equal proportions to prepare SEVAs. The best formula selected based on hardness of SEVAs. Hardness of the four SEVAs were significantly different ($P<0.05$), and the formula (1:1-CF:SF) resulted in the lowest hardness was selected for further experiments. The selected formula (1:1-CF:SF) containing LSL was used as the control and formulae containing three levels of Palsgaard® DMG 0093 (PDMG-0093) powder (1.0, 0.5 and 0.1%) were used as treatments in triplicate. Oil absorption capacity (OAC) and water holding capacity (WHC) of the control and treatments were measured. OAC of the three treatments was not significantly different ($P>0.05$) from the control. However, WHC of the formula containing 1.0% PDMG-0093 powder was not significantly different ($P>0.05$) from the control. Therefore, 1.0% PDMG-0093 was found to be suitable for producing a powder-based ready-to-cook formulation for preparing SEVA. Proximate composition and water activity of the formula containing 1.0% PDMG-0093 powder was analyzed. Moisture, crude protein, crude fat, crude fiber and total ash percentages of 8.48 ± 0.02, 34.7 ± 0.66, 17.79 ± 0.44, 1.02 ± 0.09 and 6.99 ± 0.18, respectively, and water activity of 0.707 ± 0.002 (22 ºC) were evident.

Keywords: Cowpea, Palsgaard® DMG 0093, Scrambled egg vegan analogue, Soybean, Soy lecithin

[1]Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]chamarai@agri.pdn.ac.lk

Development and Characterization of Low-Salted Fish Sauce from Spotted Oceanic Triggerfish (*Canthidermis maculata*) Using Selected Exogenous Plant Proteolytic Enzymes

Senavirathna H.M.M.M., Himali S.M.C.[*] and Prabashwari T.I.G.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Peradeniya, Sri Lanka

Fish sauce is an amber-coloured liquid condiment made from fish or fish by-products. *Canthidermis maculata* is an underutilized fish species with low dressing percentage and poor sensory attributes. This study aimed to identify the suitability of *Canthidermis maculata* for fish sauce production. Fish sauce was produced with low amount of salt and selected plant-based exogenous enzymes fermentation. Three different treatments with crude papaya fruit extract (T_1), crude pineapple fruit extract (T_2), moringa bark extract (T_3), and the control (C) with three replicates were maintained. Deskinned, eviscerated, washed and minced fish was added with 8% of salt and 15% of crude plant extracts (for the control 15% distilled water was used). The contents were air-tightly packed in sterilized glass bottles and incubated at 50 °C for 6 weeks. The produced fish sauces were evaluated for their yield, proximate composition, sensory attributes, and microbiological analysis. Results revealed that, the yield of crude papaya and crude pineapple-treated samples were significantly ($P<0.05$) higher than the other two groups. The sensory evaluation revealed that the crude pineapple extract-treated fish sauce was significantly ($P<0.05$) more preferred than other groups of sauces and the commercial product by the panelists. The microbial analysis revealed no significant ($P>0.05$) differences among the treatments and the control. The crude protein content of the pineapple extract-treated sample was 11.52 ± 0.21 which was ($P<0.05$) higher than the other three groups and it fulfilled the standards of a fish sauce. Moisture, crude protein, crude fat, ash, and NaCl contents of T_2 sample was $68.16\pm0.27\%$, $11.52\pm0.21\%$, $0.36\pm0.10\%$, $6.60\pm0.81\%$, $5.27\pm0.17\%$, respectively. Based on the findings it can be concluded that *Canthidermis maculata* can be successfully utilized with 15% pineapple crude extract for accelerated fish sauce production with high yield, sensory attributes and nutritional values as a value-added product.

Keywords: Crude plant extracts, Incubation, Proximate composition, Sensory attributes

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[1]Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka
[*]smchimali@agri.pdn.ac.lk

Development of a Fat Spread using Virgin Coconut Oil and Evaluating Its' Physicochemical and Sensory Properties

Jayasuriya J.A.G.K., Samarakoon E.R.J.[*] and Jayanthi C.K.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Virgin coconut oil (VCO) extracted from coconut kernel is a natural edible product rich in medium chain fatty acids (MCFA), vitamins, antioxidants, and minerals. This study was carried out to explore the use of fractionation method to develop a fat spread using VCO. It was possible to produce a solid fraction from VCO through slow cooling termed winterization. VCO samples were maintained at different temperatures (19- 21 °C), and resulting solid fractions were collected at different time intervals. The yield of oil fraction removed was calculated, and the physicochemical properties of the solid fractions and liquid fractions were determined. The yield of the liquid fraction decreased with time at any given temperature, indicating increasing crystal growth with time. Solid fraction of VCO at 19 °C for 30 min was identified as the most suitable fraction for the development of the fat spread. Solid fraction recovered at 19 °C for 30 min has the second lowest iodine value (1.60 ± 0.04) and the highest yield percentage ($72.02\% \pm 0.67$) compared to other fractions. Four formulations of fat spreads were developed, and physicochemical properties were determined. A seven-point hedonic test was conducted to evaluate the appearance, colour, aroma, flavour, spreadability, mouth feel and overall acceptability of developed fat spreads, and there was a significant difference ($P<0.05$) in consumer preference regarding color and the spreadability. Formulation which contained solid fraction of VCO to coconut flour weight ratio of 18:1 (w/w) was identified as the most suitable one for the further development.

Keywords: Fat spread, Medium chain fatty acids, Virgin coconut oil, Winterization

[1]Virco International PVT LTD, Seegiri Estate, Mawathagama, Sri Lanka
[*]rasanjalis@agri.pdn.ac.lk

Development of a Fish Powder Incorporated Instant Noodles

Jayalath I.H., Rajapakse R.P.N.P.[*], Mendis B.E.P. and Vidanarachchi J.K.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Instant noodles are a popular food in many parts of the world. However, most of the instant noodles commercially available are nutritionally not balanced. The aim of this study was to improve the nutritional composition of instant noodles by incorporating fish powder as a protein, vitamin and mineral source, and to evaluate its physicochemical and sensory properties. Different formulations of instant noodles were prepared with wheat flour and 0, 10, 15 and 20% of fish powder from four fish species, such as, Indian anchovy (*Stolephorus indicus*), kelee shad (*Hilsa kelee*), milk shark (*Rhizoprionodon acutus*) and sea chicken (*Balistoides viridescens*). Cooking properties (optimum cooking time, cook loss, cooking yield, swelling index and water absorption index) among fish powder incorporated noodles were not significantly (P>0.05) different. Therefore, 15% fish powder incorporated formulations were selected based on the cost factors and nutritional quality to study textural (hardness, adhesiveness, elastic recovery and firmness) and sensory properties. Among the 4-types of fish powder (15%) incorporated instant noodles, titan triggerfish and milk shark fish powder incorporated noodles had the highest consumer preference. Incorporation of fish powder did not significantly (P>0.05) affect the cooking or textural parameters of the noodles. Milk shark fish powder (15%) and sea chicken fish powder (15%) could increase protein content in noodles up to 26.10% and 27.40% respectively. According to this study, it can be concluded that milk shark and sea chicken fish powders can be successfully incorporated into instant noodles to improve its nutritional and sensory qualities.

Keywords: Fish powder, Instant noodles, Nutritional properties, Textural properties, Sensory evaluation

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[1]Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]niranjanp@agri.pdn.ac.lk

Development of a Gelatin Free Set Yoghurt Incorporating Kithul Flour

Kithulgoda H.K., Rajapakse R.P.N.P., Gunawardena T.[*1], Priyadarshana D.C.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Gelatin is a commonly used stabilizer in the processed food industry. Due to the current economic crisis in the country, importation of number of food additives have been restricted and there is a timely requirement to identify locally available alternative ingredients to replace them. Based on the properties of Kithul flour, it can be considered as a local alternative for gelatin. Therefore, this study was carried out to determine the potential of kithul flour as a substitute for gelatin in processing set yoghurt. Initially, kithul flour was modified in order to enhance its gelatinization properties. After modification, set yoghurts were prepared by incorporating modified kithul flour at varying percentages. Sensory evaluation was carried out with 21 trained panelists to compare the formulated yoghurts with 5 competitive products available in the market processed with gelatin. The sensory evaluation revealed that kithul flour incorporation had a significant ($P<0.05$) effect on the preference for aroma, appearance, color, taste, texture and overall acceptability. The appearance and the texture of kithul flour incorporated set yoghurt were not preferred. However, aroma, color and taste were highly preferred. Shelf-life of the yoghurt samples were evaluated by recording the pH for thirty days of refrigerated storage at seven-day intervals. Recorded pH revealed that it has an acceptable shelf-life. A sensory evaluation results revealed that there was no significant ($P>0.05$) difference for aroma and color of the yoghurt samples tested during the storage period.

Keywords: Set yoghurt, Kithul flour, Gelatin, Stabilizer, Alternative

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[1]Maliban Milk Products (Pvt.) Ltd., Maligawa Road, Ratmalana, Sri Lanka
[*]theja@malibanmilk.com

Development of a High-Fibre Bread using Xylanase Enzyme as a Gluten Protein Replacement

Abekoon A.M.T.H., Samarakoon E.R.J.[*], Jayawardene L.P.I.N.P.[1], Gunathilaka W.L.C.M.[1] and Vidyasekara E.V.R.T.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Xylanase enzyme is used to enhance the end product quality by giving fluffy and voluminous loaves of bread with soft and elastic properties with a small dosage. Therefore, testing the effect of xylanase is worth as a cost effective, suitable replacement for added gluten. The control sample was developed as closely to commercially available 'paralupaan'. The preliminary tests were done to prepare the control sample and identified the best bread formulation. The added gluten percentage was 3% of the dough in the control sample and it was reduced to 1.5% and 0% with added xylanase enzyme. Two series of formulations were prepared for each 1.5% and 0% gluten with 0, 30, 90, and 150mg/kg of xylanase enzyme. The physical parameters such as specific volume, density, height to width ratio of central slice, dough to bread weight ratio, hardness of the bread and the L*a*b* colour values of the crumb and crust of the bread were measured and the data were statistically analyzed. According to the physical parameters, 150 mg/kg xylanase with 1.5% gluten added sample and 150 mg/kg xylanase with 0% gluten added sample had comparable properties to the control sample and hence they were selected for the sensory analysis. Sensory analysis of these two formulations and control sample revealed that the 1.5% gluten and 150 mg/kg xylanase added bread was preferred over 0% gluten and 150 mg/kg xylanase added bread. The proximate analysis showed that carbohydrate content was decreased and crude fibre content was increased significantly ($P<0.05$) when the added gluten in the high-fibre bread was reduced by 50% and 150mg/kg xylanase was incorporated. This study showed that incorporation of xylanase enzyme has a potential to replace added gluten in high-fibre bread.

Keywords: Finger millet, Gluten replacement, High-fiber bread, Xylanase

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[1]Aletek International (Pvt.) Ltd, NJV Cooray Mawatha, Rajagiriya, 10100 Sri Lanka
[*]rasanjalis@agri.pdn.ac.lk

Development of a Vegan Jelly Dessert Powder Mix using Carrageenan and *Clitoria ternatea* Flower Powder

Imali H.L.J., Arampath P.C.[*], Rajapakse R.P.A.D.[1] and Rathnayake A.R.M.D.K.B.

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Jelly products are popular among the consumers of all ages as a dessert. Gelatin is the main ingredient in jelly products. Currently, there is a higher demand for vegan jelly products than gelatin based jelly products. This research was to develop a vegan jelly dessert as a powder mix using carrageenan and *Clitoria ternatea* (blue butterfly pea) flower powder. *C. ternatea* is grown naturally and a potential colourant in food preparations. It is a plant with great medicinal value. Carrageenan is a polysaccharide extracted from certain species of red seaweeds. The compound is widely used for the structure forming functions in foods. *C. ternatea* flower petals were cleaned, dried, ground and sieved to powder preparation. Carrageenan 3.5% to 3.75%, with and without $CaCl_2$ and citric acid 0.7% to 0.95% and flavouring agent 0.35% to 0.6% were used in 16 treatments and experimented to develop the jelly powder mix. The most acceptable treatment for jelly was selected using ranking test and Hedonic test (7-points). Texture, proximate composition, pH, titratable acidity, colour, were determined for the selected final product. Final product was possessed significantly higher ($P<0.05$) consumer preference for taste, flavour and overall acceptability. Proximate composition was 2.4% moisture, 0.48% Ash, 0.94% protein and 3.3% of fat. Final jelly product consist of 83.34% water, 0.60% gelling agent, 0.12% citric acid, 0.04% $CaCl_2$, 15.70% sugar, 0.08% flavor and 0.12% C. *ternatea* flower powder. pH and titratable acidity were 4.1 and 0.12% respectively. The best formulation of dry jelly powder mix was 3.6 % carrageenan, 0.25% $CaCl_2$, 0.7% citric acid, 94.25% sugar, 0.6% nature identical blackcurrant flavor and 0.7% C. *ternatea* flower powder.

Keywords: Blue butterfly pea, Gelatin, Jelly dessert mix, Vegan

[1]HJS Condiments Limited, Block 61, 62 & 63, Export Processing Zone, Biyagama, Sri Lanka
[*]pcarampath@gmail.com

Development of an Instant Fried Rice and Suitable Seasoning Powder Mix, Incorporated with Powdered Leaves of *Moringa oleifera*

**Chandradasa B.A.R.I.S., Mendis B.E.P., Senarathne S.M.A.C.U.[1*]
and Rajapakse R.P.N.P.**
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Rice is the staple food and the main energy source in most Asian countries, including Sri Lanka. Modern people are having hectic daily schedules and do not spend much time preparing their food. This accelerated pace of modern life has promoted new quick-cook type rice products, which can rehydrate or thaw within a few minutes. This research was conducted to develop instant fried rice which could be stored under frozen conditions (-18 °C) and a suitable seasoning powder mixture to incorporate into fried rice by using powdered leaves of *Moringa oleifera* and oyster mushrooms as the main ingredients. Moringa leaf powder incorporated (1.92%) 15 g of seasoning powder was added to 250 g of rice. The amounts of added constituents were determined based on sensory data, which was determined using a 9-point hedonic test involving 50 untrained panelists. Determination of a suitable cooking procedure for Bg 360 (*Keeri* samba) was done using an electric rice cooker, an electric multi-cooker and the steaming procedure by mainly considering cooking yield and cooking in the rice cooker was selected. The prepared fried rice was vacuum packed and stored at three different temperatures (4 °C, 12 °C and 25 °C) for the prediction of the shelf life using the accelerated shelf life test with an Arrhenius model. The moisture content varied between 62 - 67%, and there was no significant difference in color (P < 0.05). According to the acid value, the shelf life was 29 days, and according to the peroxide value, the shelf life was 36 days. After 30 days of frozen storage total plate count was measured upon thawing using, the microwave oven (74 °C), boiling water (≤100 °C) and steaming (100 °C) and the product was acceptable for consumption. The new product developed has a potential to be marketed.

Keywords: Accelerated shelf life, Instant fried rice, *Moringa oleifera*, Oyster mushroom, Seasoning powder

[1]Food Research Unit, Horticulture Crop Research and Development Institute, Department of
Agriculture, Gannoruwa, Peradeniya, Sri Lanka
*upulasen@gmail.com

Development of Instant *Kola Kenda* Mixture Utilizing Drumstick Leaves (*Moringa oleifer* L.), Curry Leaves (*Murraya koenigii*), *Gotu Kola* (*Centella asiatic*), Mung Bean Flour and Unripe Banana Flour

Somarathna E.G.P.S., Samarakoon E.R.J.[*], Lakmali K.M.[1] and Bandara E.M.S.M.

Department of Food Science and Technology
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

In the current Sri Lankan context, about 6.7 million people do not consume an adequate diet while 5.3 million people have reduced the number of meals partake during the day. Further, more than 60% of families are eating less, cheaper, and less nutritious food. The introduction of indigenous and convenient foods with better nutritional quality such as *kola kenda* will support ensuring food security among the rural population. The aim of this study was to develop an instant *kola kenda* mixture composed of curry leaves (*Murraya koenigii*), *gotu kola* (*Centella asiatica*), drumstick leaves (*Moringa oleifera* L.), mung bean flour, and unripe banana flour and characterize the physicochemical, nutritional and sensory attributes of the developed *kola kenda* mixture. The appropriate proportions of leaf powders and flours were determined by preliminary trials. Accordingly, 5 different product formulations were prepared. The best formulation was selected based on the physicochemical and sensory characteristics. Physical properties did not show any significant difference among formulations. However, higher total phenolic content [87.98±2.75 mg gallic acid equivalents (GAE) per gram of sample in dry weight (mg/g)] and significantly higher ($P<0.05$) overall preference in the sensory analysis was observed for the formulation which contains *gotu kola* 4.0%, curry leaves 1.5%, drumstick leaves 1.5%, coconut flour 28.5%, mung bean flour 21.4%, banana flour 21.4%, garlic powder 7.0%, ginger powder 5.0%, and salt 8.5%. The nutritional quality of the selected formulation was analyzed using the Association of Official Analytical Chemists (AOAC) methods and it resulted, crude protein 16.0%, crude fat 0.5%, ash 4.3%, moisture 9.4%, crude fiber 4.8%, and carbohydrates 65.0%.This study revealed that the developed instant *kola kenda* mixture has the potential to be used as a convenient food source to aid ensuring food security among Sri Lankan communities.

Keywords: Flour base, Instant mix, *Kola kenda*, Leaf powder

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[1]HJS Condiments Limited, Biyagama, Sri Lanka
[*]rasanjalis@agri.pdn.ac.lk

Development of a Cost Effective Chocolate Spread and Evaluation of its Physico-Chemical, Microbiological and Sensory Properties

Jayasooriya D.R.G.S.M., Rajapakse R.P.N.P., RajapakseR.P.A.D.[1][*] and Rathnayake A.R.M.D.K.B.[1]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Currently, Sri Lankan food industry is engaged in developing alternatives for high demanding processed food, of which many raw materials are imported. The purpose of this study was to develop a cost-effective chocolate spread with alternative ingredients and to evaluate its physicochemical, microbiological, and sensory properties. As alternative ingredients, peanuts, soybeans, and sweet potatoes were separately used as the base raw material to formulate different chocolate spreads. At the initial screening, peanut-incorporated chocolate spread was selected through a sensory testing as the most preferred formulation. Subsequently, several formulations of peanut-incorporated chocolate spreads were made with varying amounts of sugar and cocoa powder. The highest preferred formulation with 35.41% sugar and 10.62% cocoa powder was analyzed for its physicochemical properties, proximate composition, and microbial qualities. Total soluble solids, titratable acidity, and pH of the formulation were 71.73 ºBrix, 0.18, and 5.97, respectively. The develop chocolate spread had a moisture content of 31.65%, ash content of 3.91%, crude protein content of 16.55%, fat content of 13.81%, carbohydrate content of 31.37%and fiber content of 2.71%. After pasteurization, the spread had a significantly ($P<0.05$) lower levels of total plate count and yeasts and molds in the accepted range. This study describes that incorporation of peanut as an alternative base ingredient in developing chocolate spreads is a cost-effective approach due to utilization of locally available raw materials.

Keywords: Peanut, Chocolate spread,Sensory evaluation, Proximate composition

[1]HJS Condiments Limited, Biyagama Export Processing Zone, Biyagama, Sri Lanka
[*]anusha.rajapaksha@hjs.hayleys.com

Development of Fermented Fish Product (*Jaadi*) Using Masked Triggerfish (*Sufflamen fraenatum*)

Wimalarathna P.G.D.S., Madhubhashini E.T.S. and Paththuwe Arachchi M.J.[1*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Jaadi is a traditional fermented fish product which is native to Sri Lanka. This product is popular in Southern part of the country and people used to consume it as a side dish or a condiment. The liquid component of *jaadi* is known as *Lunijja* and it is a rich source of amino acids and has a strong flavor preferred by the consumers. People use their traditional knowledge to produce *jaadi* and processing practices are vary in different areas. In this study Masked Triggerfish (*Sufflamen fraenatum*) was used for *jaadi* preparation as it was one of the abundantly available fish varieties in Sri Lanka, which has less market demand as fresh fish. The treatments were planned with the objective of finding the most suitable formulation and the most suitable fermentation vat in terms of sensory, microbial and chemical properties. The treatments to find the best formulation were planned with some variations to the originally used recipe (Fish 1 Kg: Salt 500 g: Garcinia 100 g). Four different types of vats (glass, clay, wooden and plastic) were used as the treatments in order to find the most suitable vat while keeping the recipe a constant (traditional recipe). The highest scored treatment as per the results of sensory evaluation was combination of 500 g of salt with 100 g of garcinia per 1 kg of fish slices and the highest preference was obtained by the wooden vat. The Total Volatile Base Nitrogen (TVB-N) level was impacted by the different formulations ($p<0.05$) and the titratable acidity was impacted by the type of vat ($p<0.05$). In conclusion, *jaadi* with higher sensory perception can be prepared using Masked Triggerfish using the formula of 500 g of salt and 100 g of garcinia per 1 Kg of fish in wooden vats made out of *Halmilla* wood.

Keywords: Fermented fish products, *Jaadi*, *Lunijja*, Masked Triggerfish,

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[1]Aquatic Product Development Laboratory, IPHT, NARA, Mattakkuliya, Colombo 15, Sri Lanka
[*]maduni@nara.ac.lk

Development of Gelatin Free-Set Yoghurt with Seaweed Phycocolloids

Imesha T.A.D.M., Weththasinghe P.*, Jayawardana B.C., Vidanarachchi J.K., Wijesekara W.L.I.[1] and Dhamsara M.J.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study was conducted to evaluate the potential use of seaweed phycocolloids as stabilizers in gelatin-free set yoghurt. Three seaweed phycocolloids namely carrageenan, alginate, and agar-agar were extracted from *Kappaphycus alvarazii*, *Sargassum wightii* and *Gracilaria Salicornia*, respectively. Preliminary trials were conducted to select the best incorporation levels of phycocolloids in yoghurt, and the selected levels were 0.12% (w/v) carrageenan, 0.2% (w/v) alginate and 0.3% (w/v) agar-agar. These levels were selected based on the syneresis percentage. The hardness, color, proximate composition, and sensory properties of yoghurt containing selected levels of phycocolloids were assessed in comparison with a yoghurt containing gelatin (0.8% w/v). All the phycocolloids incorporated yoghurt showed lower hardness and yellowness than gelatin yoghurt. Carrageenan yoghurt had significantly ($P<0.05$) higher protein and fat contents than gelatin yoghurt. Alginate yoghurt showed similar protein content as gelatin yoghurt but had a significantly ($P<0.05$) lower fat content. Incorporation of agar-agar significantly ($P<0.05$) decreased protein content and increased fat content. The alginate incorporated yoghurt scored high for overall acceptability. The yoghurts were stored at a refrigerated temperature (4 °C) for 14 days and physicochemical parameters (pH, titratable acidity, syneresis) were analyzed on days 1, 7 and 14. There was no significant ($P>0.05$) difference in pH among treatments during storage period. Alginate yoghurt showed significantly ($P<0.05$) lower acidity on days 1, 7 and 14 than gelatin yoghurt. All phycocolloids incorporated yoghurt had significantly ($P<0.05$) higher syneresis throughout the storage period. There was no significant ($P>0.05$) difference in lactic acid bacteria count in yoghurt on day 1 while their count in phycocolloids incorporated yoghurt was significantly ($P<0.05$) higher on days 7 and 14. This study revealed that agar-agar, carrageenan, alginate from seaweeds can be used as stabilizers in set yoghurt, and incorporation of 0.2% alginate can even improve the sensory properties of yoghurt.

Keywords: Agar, Alginate, Carrageenan, Set-yoghurt, Stabilizer

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[1]Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka
*pabodhaw@agri.pdn.ac.lk

Development of Lavulu (*Pouteria campechiana*) Pulp Incorporated Drinking Yoghurt

Vithanage C.Y.P., Deshapriya R.M.C.[*], Edirisinghe M.P.[1] and Fernando P.R.M.K.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The study was conducted to investigate the effect of the physicochemical, microbiological and sensory attributes of Lavulu (*Pouteria campechiana*) pulp incorporated in drinking yoghurt. Milk was heated up to 70°C then sugar and gelatin were added. The mixture was pasteurized up to 90- 95°C/3 minutes and pulp was incorporated in three proportions as 6%, 8% and 10% w/v in last 30 seconds of the pasteurization. Mixture was cooled up to 44 °C and starter culture (Delvo FVV 211) was added. Then incubated at 44°C until pH reached 5.0 and kept overnight at 4°C. Curdle was broken by agitating the mixture. A control was prepared with all ingredients except Lavulu pulp. One-way ANOVA was used to interpret the results of analysis. There is no significant difference ($p > 0.05$) in pH value and titratable acidity between control and pulp added samples throughout the storage up to 10th day. There are significant differences ($p < 0.05$) in between pulp added and control samples in TS, Fat, Protein and DM content. The sensory evaluation indicated, pulp added drinking yogurt samples were significantly better than control samples. The sensory attributes such as color, aroma, taste, and overall acceptability in pulp added yogurt obtained higher scores compared to the control. Throughout the storage period there was no significant difference ($p > 0.05$) in yeast and mold count in between two drinking yoghurts. However, both the yeast and mold counts increased toward the tenth day of storage in refrigerator. Lavulu gives natural color and pleasant baked taste to the drinking yogurt. Overall results suggest that adding of Lavulu fruit pulp in 10% w/v is more effective and improves sensory attributes of drinking yoghurt.

Keywords: Lavulu Pulp, Drinking yoghurt

[1]Milco (Pvt) Ltd, Nawala Road, Colombo 05, Sri Lanka
[*]cdeshapriya@agri.pdn.ac.lk

Development of Nutritious and Marketable Cookie Using Coconut Flour and Unripe Banana Flour

Liyanage U.I., Samarakoon E.R.J.[*] and Sagara J.G.W.[1]
Department of Food Science and Technology
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Cookies are ready to bake snacks made by baking dough that contains flour, fat, sugar, salt, and leavening agents. Cookies have a soft and tender texture than other biscuit products due to its high fat content. Readily digestible starch and sugars available in cookies can cause sudden increase of blood sugar levels. Substitution of wheat flour with a dietary fiber source or resistant starch source will help to counter negative health effects. Therefore, this study was aimed to develop a cookie with coconut flour and unripe banana flour which is more nutritious. Coconut flour showed higher oil absorption capacity (1.22 ± 0.10 g/g) and water absorption capacity (3.36 ± 0.05 g/g) while wheat flour showed the lowest values. Two sets of cookies were prepared using unripe banana flour (UBF) and coconut flour (CF) substituting wheat flour in levels of 10, 20, and 30%. The 10% substitution was chosen after statistically analysing and comparing the results of hardness, colour, spread ratio, moisture content, and weight with the control. Substitution of UBF and CF increased the hardness and reduced the spread ratio. Composite flour mixtures were prepared by mixing UBF and CF in different percentages. Cookies with composite flour: 75% UBF and 25% CF (75B25C) was selected as the best formulation after statistically analysing and comparing the results of physical parameters of the cookies with the control. Cookies containing CF and 75B25C showed significantly higher ($P<0.05$) crude fibre content compared to the control sample. In sensory evaluation, cookies with CF showed highest scores in appearance, odour, texture, and flavour parameters while 75B25C showed lowest scores in appearance, texture, flavour, and overall acceptability. This study showed that there is a potential to develop consumer acceptable, nutritious cookies by substituting 10% of wheat flour with CF and UBF.

Keywords: Coconut flour, Cookies, Crude fibre, Unripe banana flour

[1]Vichy Cookies PVT LTD, 84/1, Bandaragama Road, Batuwandara, Madapatha, Sri Lanka
[*]rasanjalis@agri.pdn.ac.lk

Development of Omega-3 Enriched Feed Ingredient: Tailoring Fatty Acid Composition of Black Soldier Fly *(Hermetia illucens)* Larvae Using Fish Offal and Seaweeds

Wijesingha W.A.D.E.I., Weththasinghe P.[*], Jayawardana B.C. and Liyanage R.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study aimed to evaluate the potential to enrich black soldier fly larvae (*Hermetia illucens*: BSFL) with omega-3 fatty acids by feeding omega-3 rich ingredients: yellowfin tuna (*Thunnus albacares*) offal and 3 seaweeds (*Kappaphycus alvarezii, Gracilaria salicornia* and *Sargassum wightii*). Eight substrates were prepared using poultry manure as basal ingredient: a substrate containing 100% poultry manure (control), 4 substrates supplemented with 12% of one of the 4 omega-3 rich ingredients (fish offal, *K. alvarezii, G. salicornia* or *S. wightii*) and 3 substrates supplemented with 6% fish offal and 6% of one of the 3 seaweeds. A total of 5 days-old 3600 BSFL were randomly distributed into 24 plastic containers (150 larvae per container) and fed with one of the 8 substrates for 14 days (n=3). At the end of the experiment, weights of larvae were recorded. Fatty acid compositions of substrates and BSFL were measured. Omega-3 fatty acid (C20:5 EPA and C22:6 DHA) contents were significantly (P<0.05) higher in the BSFL fed 12% fish offal. *K. alvarezii* and *G. Salicornia* also showed similar results, but only when fed together with fish offal. Further, the results showed a significant (P<0.05) positive correlation between omega-3 contents in the substrate and BSFL. On the other hand, supplementation of *S. wightii* did not enrich BSFL with omega-3 fatty acids. The BSFL fed 12% fish offal had significantly (P<0.05) higher growth performance and bioconversion efficiency than the control group. The supplementation of fish offal in combination with *K. alvarezii* or *G. salicornia* did not compromise growth performance and bioconversion efficiency of BSFL. In conclusion, supplementation of poultry manure with fish offal and seaweeds (*K. alverazii* and *G. salicornia*) can enrich BSFL with omega-3 fatty acids without compromising larval performance.

Keywords: Black soldier fly larvae, Fatty acids, Fish offal, Omega-3, Seaweed

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[1]Laboratory of Nutritional Biochemistry, National Institute of Fundamental Studies, Kandy, Sri Lanka
[*]pabodhaw@agri.pdn.ac.lk

Development of Raw Jackfruit Bulb Flour and Seed Flour Based Noodles

Kalyani K.D.K., Bulathkandage M.[1*] and Prasantha B.D.R.
Department of Food science and Technology
Faculty of Agriculture, University of Peradeniya, Sri Lanka

Jackfruit is a commonly consumed fruit in Sri Lanka and has a high percentage of postharvest loss during the season. The aim of this study was to evaluate the potential of producing jackfruit bulb flour (JBF) and jackfruit seed flour (JSF) based noodles in order to reduce the high postharvest loss and develop some value-added products from jackfruit. Five samples were prepared using the composite flour mixture by mixing the refined wheat flour (WF), JBF and JSF in different ratios of 50:10:40, 50:20:30, 50:25:25, 50:30:20, 50:40:10 and the control sample by using 100% WF. Cooking characteristics of the noodle samples were analyzed with respect to cooking time, cooking loss and water absorption. Physicochemical characteristics such as bulk density, swelling index, yield ratio, color, adhesiveness, firmness, elastic recovery, hardness, moisture content and ash content were analyzed using some developed methods. There was no significant difference among all the developed jackfruit noodles samples for yield ratio ($F_{5,6}$=0.92, df=11, P>0.05), firmness ($F_{5,12}$=2.20, df=17, P>0.05) and elastic recovery ($F_{5,12}$=0.57, df=17, P>0.05). Sample prepared from flour ratio of 50:40:10 (WF: JBF: JSF) showed the lowest cooking loss (6.37 ± 0.55%) and highest swelling index (1.77 ± 0.17). Sample prepared from flour ratio of 50:25:25 showed the highest cooking time (10.05 ± 0.00 min) and the highest water absorption (134.67 ± 9.87%) values. Noodles samples prepared from flour ratio of 50:20:30 showed the highest bulk density (0.26 ± 0.01 g/cm^3) and yield ratio (1.13 ± 0.01). The control sample showed the highest firmness (89.47 ± 0.95%) and highest elastic recovery (56.95 ± 4.32%) values than the other samples. According to the sensory evaluation data, noodles sample prepared from flour ratio of 50:10:40 showed the highest preference and the noodles samples of 50:40:10 showed the least preference.

Key words: Jackfruit bulb flour, Jackfruit seed flour, Noodles

[1]Fruit Research and Development Institute, Department of Agriculture, Kananwila, Horana, Sri Lanka
[*]mbulathkandage@yahoo.com

Development of Two Types of Isotonic Beverages with Functional Attributes Using Natural and Synthetic Ingredients

Kariyawasam K.S.T.K.P., Somaratne G.M.[*], Roy D.[1], Silva D.D.[2], Weththasinghe W.A.O.W.[2] and Sandanika D.W.N.

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

A solution's impact on a cell's volume is correlated with its tonicity. Isotonic solutions are those that do not alter the volume of a cell when ingested. Since dehydration impairs athletic performance and raises the risk of injury, lost fluid during physical activity has to be replaced as quickly as possible with required levels of energy and electrolytes. For this replacement, an isotonic beverage is ideal, because it can be directly absorbed to the body within a short period of time. However isotonic sports beverages have requirements to be met in the carbohydrate and electrolyte concentrations. This research aims to develop commercially viable and economically feasible two formulations of isotonic drinks using synthetic ingredients and natural ingredients with functional attributes. Study was conducted in two phases as preliminary trial and final trial for each synthetic formula and natural formulas. Samples from preliminary test were tested for the osmolality to figure out the final treatments of sensory evaluation. Data was analyzed through SPSS software. Preferred final samples were analyzed for their mineral content and physicochemical characteristics. Final formulas were in the required ranges of osmolality (270-330 mOsm/kg) and sodium content (460 - 1150 mg/L) it to be an isotonic beverage according to the international regulations. Synthetic sample contains an osmolality of 284 ± 1 mOsmol/kg and sodium content of 688.2 ± 17.7 mg/L. Additionally, natural formula with artificial sweetener and 100% natural formula contains an osmolality and sodium content in the ranges of 307 ± 11 mOsmol/kg, 716.6 ± 5.8 mg/L, respectively. As conclusions, developed formulas adhere to the requirements of an isotonic beverage, which could enhance the performance of dehydrated athletes. There is a high potential to use coconut water and bee honey in Sri Lanka, as rich mineral and energy sources to formulate isotonic beverages.

Keywords: Dehydration, Electrolytes, Energy, Isotonic, Osmolality

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[1]Riddet Institute, Massey University, Palmerton North, New Zealand
[2]SOZO Beverages (PVT.) LTD. Royal Gardens, Kotte, Sri Lanka
[*]gsomaratne@agri.pdn.ac.lk

Digital Detection of Frying Oil Rancidity Levels and Colour Profiles Using a Mobile Application

Pussella P.D.P.C., Somaratne G.M.[*], Rathnayake P.P.A.J.[1], Samarasekara M.A.[2], Bandara C.Y.[2], Wijelath W.A.G.E.[2] and Madusanka U.G.Y.[3]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Deep-fat frying is one of the most often used methods for preparing and producing foods worldwide. In the catering industry, repeated heating of oil is done up to a certain level while achieving the customer safety and profit margins. If the level is exceeded oil quality becomes undesirable and rancidity can be developed. To ensure the safe margin of frying oil, various test kits are used in the catering industry. However, these test kits are less affordable as they are very expensive. In this study, an economically feasible test kit and a mobile application were developed based on image analysis to determine the rancidity levels of frying oil. The study was done by two methods (direct and chemical). In the direct method, total polar materials (TPM %) of the samples were determined by *Vito* oil tester and colour analysis was done by a digital colourimeter. There were strong positive correlations among the TPM (%), L* a* b* values and acid values which were above 0.90 linear regression (R^2). The chemical method was developed as an advanced version of the direct method and used a chemical solution which is sensitive to the free fatty acid percentage in frying oil. The Mobile application was developed using the *React Native* software. It was compatible with the android operating system. The mobile application was validated using randomly selected oil samples and TPM (%) values were determined by both mobile application and *Vito* oil tester. Results were analyzed using *R* statistical software. Based on the results, there was not a significant difference ($P > 0.05$) between the TPM (%) values, which were obtained by the mobile application and *Vito* oil tester. The results also indicated that the proposed method can be used as an alternative method to detect the rancidity levels of frying oil with high accuracy.

Keywords: Deep frying, Mobile application, Rancidity, Reheating, Test kit

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[1]Division of Applied and Natural Sciences, University College of Matara, University of Vocational Technology, Meddawatta, Matara, Sri Lanka

[2]Cinnamon Hotel Management Ltd, 117, Sir Chittampalam A. Gardnier Mawatha, Colombo 02, Sri Lanka

[3]SmashTaps (Pvt) Ltd, Chandra de Silva Mawatha, Nugegoda, Sri Lanka

[*]gsomaratne@agri.pdn.ac.lk

Effect of Microbial Transglutaminase Enzyme on Textural Properties and Water Holding Capacity of Jackfruit (*Artocarpus heterophyllus*) Incorporated Veggie Fingers

Jayalath A.D.W., Fernando P.R.M.K., Jayawardene N.[1], Vidanarachchi J.K., and Himali S.M.C.[*]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Jackfruit is an excellent source of carbohydrates, proteins, vitamins, and minerals. The current study was carried out to formulate a veggie finger using jackfruit and to identify the effect of microbial transglutaminase (MTG) on its quality. The preliminary studies revealed that 25% of jackfruit is the optimum level to be incorporated into veggie fingers. Three formulations (F1, F2 & F3) of veggie fingers were formulated by incorporating 25% of jackfruit. F1 contained 5% kidney bean powder, 10% isolated soy protein (ISP), and 5% texturized vegetable protein (TVP), F2 contained 5% chickpea flour and 15% ISP and F3 contained 5% chickpea flour, 5% ISP, 5% oats, and 5% wheat gluten. According to the sensory evaluation findings, F1 and F2 were selected for further improvements and, were treated with MTG at levels of 0%, 1%, and 1.5% and were subjected to sensory evaluation. Selected veggie fingers with the best level of MTG were subjected to analysis of water holding capacity (WHC), hardness, cooking loss, pH, 2-thiobarbituric acid reactive substances (2-TBARS) value, and proximate composition. The WHC of F1 (0% MTG), F1+1% MTG, F2 (0% enzyme), and F2+1% MTG were 43.47±0.52%, 46.34±0.48, 43.29±0.83%, 46.26±1.16% respectively. The hardness of veggie fingers was significantly ($P<0.05$) increased with the addition of MTG while the cooking loss was significantly ($P<0.05$) decreased. The pH and 2-TBARS values were not significantly different ($P>0.05$) among treatments. F1 with 1% of MTG was selected as the best formulation based on sensory evaluation and the overall findings. The dry matter content and the crude protein content of the Jackfruit containing veggie finger with 1% MTG were 45.61±1.13% and 19.61±0.63% respectively. It can be concluded that 1% MTG is the most suitable for Jackfruit containing veggie fingers and it can increase the WHC, and hardness while reducing the cooking loss.

Keywords: Jackfruit, MGT, Sausage analog, Veggie fingers, Vegetarian food

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[1]Allex International (Pvt.) ltd., 195/5, Ranaviru Prabath Cooray Mawatha, Rajagiriya, Sri Lanka
[*]smchimali@agri.pdn.ac.lk

Effect of Storage Time of Dietary Rice Polish on Growth Performance and Meat Quality of Broiler Chicken

Samarasinghe B.A.D.A., Jayawardana B.C.[*], Weththasinghe P., Samarakoon R.[1] and Dhamsara M.J.

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study examined the effects of dietary rice polish storage time on broiler chicken growth performance and meat quality. Ninety-six male, Cobb 500, 1-day old chicks were randomly allotted into 4 treatment groups (n=4 and 6 birds per replicate). The birds were fed with one of the four isonitrogenous and isoenergetic experimental diets: a commercial-like control diet (without inclusion of rice polish) and three diets containing rice polish stored for <24 hours, 1 week or 35 days. Feed consumption was measured daily, and body weights were measured weekly. After 35 days of feeding period, weights of the carcass & breast muscle, and the weights & lengths of the digestive tract organs were measured. The ileal contents of 16 birds (1 from each replicate) were collected. Breast muscle was stored at 4 °C until the analysis of meat quality characteristics. The birds fed diets containing rice polish stored for 1 week and 35 days showed significantly (P<0.05) lower live weight, weight gain, feed intake and feed conversion ratio than the birds fed control diet. The birds fed rice polish stored for <24 hours showed no difference in growth performance with the control birds. Feeding rice polish stored for 1 week and 35 days also significantly (P<0.05) decreased ileal fat digestibility and significantly (P<0.05) increased relative digestive tract organ weights and lengths. Furthermore, these birds showed significantly (P<0.05) higher TBARS (2-thiobarbituric acid reactive substances) values in meat than the birds fed control diet. There were no significant differences in other meat quality characteristics (cooking loss, drip loss, water holding capacity, pH and color) and ileal protein digestibility among the dietary groups. In conclusion, dietary inclusion of rice polish stored for extended time periods (over 1 week) can negatively affect the growth performance and meat TBARS values in broiler chicken.

Keywords: Broiler chicken, Digestibility, Growth performance, Meat quality, Rice polish

[1]CIC Feeds (Pvt) Limited, Ekala, Ja-Ela, Sri Lanka
[*] baranaj@agri.pdn.ac.lk

Effect of the Selected Plant Leaf Essential Oil Vapors on the Growth of *Colletotrichum gloeosporioides* Isolated from Papaya Fruits (*Carica papaya* L.)

Sewwandi D.D.P., Prasantha B.D.R.[*], Fernando H.R.P.[1] and Chandrasiri K.A.K.L.

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The essential oils were found to be a good alternative to synthetic fungicides due to their vast spectrum of antifungal compounds present. Since most of them are volatiles, *in vitro* study of its effect on selected plant pathogens is beneficial to future *in situ* applications. The aim of this study was to evaluate *in vitro* vapor phase effect of selected 3 plant leaf essential oils (PLEO) against *Colletotrichum gloeosporioides* which is the known causal fungal species for papaya anthracnose. The *C. gloeosporioides* was isolated from infected papaya fruits and after identification of fungal colonies, their spore morphologies were further identified using an optical light microscope. The pathogenicity was tested using koch's postulates method. The 3 PLEO (*Cinnamomum verum, Syzygium aromaticum,* and *Citrus aurantifolia*) were extracted using hydrodistillation method. Mycelium growth inhibition of *C. gloeosporioides* by 3 PLEO was evaluated using the modified disc volatilization method with 3 concentrations (20, 40 and 60 µL per petri plate similar to 0.5, 1 and 1.5 mL per liter). The PLEO extracted from *C. verum* and *S. aromaticum* did not show significant difference ($P>0.05$) in relation to mycelium growth inhibition percentage at all 3 concentrations. However, *C. aurantifolia* PLEO showed significantly lower ($P<0.05$) percentage of mycelium growth inhibition than other 2 PLEO at 0.5 mL/L and 1 mL/L concentrations. However, under highest concentration of 1.5 mL/L, all 3 PLEO treatments did not show significant difference ($P>0.05$) of mycelium growth inhibition percentage. Since there were more than 50% inhibitions in both *C. verum* and *S. aromaticum* PLEO at their lowest concentration, these 2 PLEO with 0.5 mL/L can be equally recommended for *in situ* applications to reduce papaya anthracnose disease severity.

Keywords: Anthracnose, *Colletotrichum gloeosporioides*, Mycelium growth inhibition Papaya, Plant leaf essential oils

[1]Food Research Unit, Department of Agriculture, Gannoruwa, Peradeniya, Sri Lanka
[*]bdrp@pdn.ac.lk

Effect of Variety, Harvesting Stage and Breaking Method on the Quality Characteristics of Tomato (*Solanum lycopersicum* L.) Paste

Udakanda U.T., Wellala C.K.D[1*] and Prasantha B.D.R.

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The objective of this research was to evaluate the effects of the pre-heat treatment (breaking) and harvesting stage on the physico-chemical quality attributes of tomato paste. Tomato breaking temperatures of 60-65 °C (cold-break) and 80-85 °C (hot-break) for 2 minutes and harvesting stages of breaker, light red and red was used to prepare tomato paste. Moreover, tomato pastes developed from "Thilina", "Bathiya" and "HTH-3" varieties were also evaluated to understand the varietal effect on physico-chemical characteristics of tomato paste. Physico-chemical characteristics of quality attributes such as color (L*, a*, and b* values), pH, titratable acidity (%), viscosity (Pa s^{-1}), lycopene content (mg kg^{-1}.), moisture content (%), and ash (%) of tomato paste were evaluated to understand the quality attributes of the different treatments. Breaking methods had a significant effect ($P<0.05$) on pH and the lycopene content ($P<0.05$) of tomato paste. The pH of the hot-brake tomato paste was higher than cold-break pastes. The lycopene content of the cold-break tomato pastes was higher than hot-break tomato paste. Tomato paste processed from harvested red-stage tomatoes showed better retention in redness and yellowness of tomato paste. The treatments between the tomato-breaking method and the harvesting stage showed a significant interaction ($P<0.05$) with the viscosity of tomato paste. The highest viscosity of 87.75±0.12 Pa s^{-1} was observed in treatments combination of the red-stage harvesting and hot-break pastes. The lowest viscosity of 57.75±0.71 Pa s^{-1} showed at the red-stage and the cold-break processed tomato paste. The results of the varietal study showed that the tomato variety also had a significant effect ($P<0.05$) on the quality attributes of tomato paste. The findings of this study showed that the cold-break method is more suitable than the hot-break method for the processing of tomato paste. Moreover, harvesting tomatoes at red stage can also be recommended for processing of quality tomato paste.

Keywords: Cold-break, Harvesting stage, Hot-break, Physicochemical properties, Tomato paste

[1]Food Research Unit (FRU), Gannoruwa, Peradeniya, Sri Lanka
*chandiwellala@gmail.com

Evaluating the Potential of Using *Lactobacillus plantarum* for Non-alcoholic Kombucha Production with Ceylon Tea

Kularathne M.A.H.D., Jayawardene L.P.I.N.P.[1], Gunathilake W.L.C.M.[1] and Daundasekara D.M.S.S.[*]

Department of Food Science and Technology
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The health benefits of tea could be improved by processing it into a functional beverage like kombucha. Traditionally kombucha is produced using a symbiotic culture of bacteria and yeast. The current study was conducted to determine the potential of using an improved method for developing a non-alcoholic kombucha product. New kombucha was developed with selected Ceylon tea using *Lactobacillus plantarum* freeze-dried culture, with a nutrient substrate, and sugar. A range of kombucha was developed using Ceylon black tea high-grown (BTHG), black tea low-grown (BTLG), green tea (GT), and herbal tea (Ginger, moringa, rampe, and lemongrass). Preliminary trials were conducted to identify the correct formulation and process conditions with the best sensory profile for the modified method of kombucha production. All samples and 2 market available Kombucha samples (controls) were analyzed for pH (an electronic pH meter), total titratable acidity (potentiometric titration), total soluble solids (TSS; refractometer), alcohol (ebulliometer), and color parameters (colorimeter). The sensory properties (color, aroma, sweetness, mouthfeel, sourness, and overall acceptability) of kombucha were evaluated using a 7-point hedonic scale with 30 semi-trained panelists. BTHG - dust, BTLG- pekoe, GT- gun powder one (GP1), and lemongrass had the highest acidity among each tea type (range 0.24 - 0.51% w/v lactic acid). The market kombucha samples had significantly lower ($P<0.005$) TSS (range 3.90 - 4.20 ºBrix) compared to all developed samples. BTHG-Flowery Broken Orange Pekoe, BTLG-dust, GT-GP1, moringa, and lemongrass teas had the highest Brix values (range 5.00-5.90 ºBrix). No alcohol was detected in the developed kombucha samples. BTHG and BTLG-Broken Orange Pekoe, GT-Sencha, and Ginger kombucha had the highest preference based on overall acceptability. Future studies should focus on the changes in the major chemical components of kombucha during the fermentation process and the functional properties of the product developed with this modified method.

Keywords: Fermented tea, Kombucha, *Lactobacillus plantarum,* Non-alcoholic beverage

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[1]Aletek International (Pvt) Ltd, Ranaviru Prabath Cooray Mawatha, Rajagiriya, Sri Lanka
[*]saumalid@agri.pdn.ac.lk

Evaluation of Antioxidant, Anti-inflammatory and Anti-diabetic Properties of Noni Fruit (*Morinda citrifolia* L.) and its Simulated Gastrointestinal Digesta Fractions

Samarasinghe H.G.A.S., Illeperuma D.C.K.,* and Gunathilake K.D.P.P.[1]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Noni (*Morinda citrifolia* L.) or '*Ahu*' has been used for years in traditional medicine. Its juice has become one of the most popular fruit juices in the global market as a wellness drink due to its health benefits. As noni fruit is not utilized by the food industry in Sri Lanka, this study focused on determining bioactives and functional properties of ripe fruit (methanolic and water) and simulated gastrointestinal digesta fractions. Methanol (80%) showed higher extractability of bioactives than water. Moreover, antioxidant and anti-inflammatory properties were higher, and anti-diabetic properties were lower in methanolic extracts than that in water extracts. The total phenolic content (TPC) of 198.6 ± 1.7 µmol gallic acid equivalent/g FW, and ascorbic acid, anthocyanin and β-carotene contents of 53.01 ± 0.59, 57.33 ± 0.96 and 0.27 ± 0.02 µg/g FW, respectively were evident in the fresh fruit. DPPH and ABTS radicals scavenging percentages of the fresh fruit were 97.09 and 98.98, respectively. The total antioxidant capacity of the fresh fruit was 33.94 mg AAE/g FW. Singlet oxygen and NO scavenging abilities of the fresh fruit were above 90%. Percentages of heat-induced hemolysis, protein denaturation inhibition and proteinase inhibitory activities of the fresh fruit were 37.14, 42.32 and 5.23, respectively at 2 µg/mL. Furthermore, alpha-amylase and alpha-glucosidase inhibitory activities of the fresh fruit were 13.7 and 17.0%, respectively at 2 µg/mL. Content of bioactives, and antioxidant, anti-diabetic, and anti-inflammatory activities of dialysable fractions were significantly lower ($P<0.05$) than their originals. Positive correlations between TPC and antioxidant activities, and anti-inflammatory and antioxidant activities were evident. As the results of this study revealed presence of bioavailable bioactive compounds possessing antioxidant, anti-diabetic and anti-inflammatory activities in the fruit, it would beneficial for the food industry and consumers, if noni fruit incorporated food products possessing appealing sensory attributes could be developed.

Keywords: Antioxidant, anti-diabetic and anti-inflammatory activities, Bio-accessibility, *In vitro* digestion, Noni fruit

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[1]Department of Food Science and Technology, Faculty of Livestock Fisheries and Nutrition, Wayamba University of Sri Lanka

*chamarai@agri.pdn.ac.lk

Evaluation of Physico-Chemical Quality Characteristics of Yoghurt and Yoghurt Drinks Available in the Sri Lankan Market

Wimansa K.G.D.H., Prasantha B.D.R.[*], Guruge K.P.G.K.T.[1] and Senevirathne D.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Peradeniya

Yoghurt is a widely consumed, most popular fermented dairy product in Sri Lanka which has numerous health benefits. The demand for yoghurt is increasing day by day acquiring a higher proportion of the overall dairy market. As a result, a number of yoghurt manufacturers emerge throughout the country. But there is a lack of data on physico-chemical quality characteristics of yoghurt and yoghurt drinks available in the market. Therefore, this study is aimed to evaluate the physico-chemical quality of yoghurt and yoghurt drinks with respect to the SLS 824:2018 standard. Eighteen yoghurt brands were purchased from retail shops and supermarkets considering an equal number of set-yoghurt and yoghurt drink brands. Physico-chemical quality characteristics such as fat (%), protein (%), milk solids non-fat (MSNF %), total sugars (%), and preservatives were analyzed and added synthetic colors were also identified. According to the results, fifteen brands were complying with the standard but three brands did not comply with the minimum requirement of the fat content. Specifications laid down in the standard for protein, MSNF, total sugars, and sorbic acid were fulfilled by the all selected yoghurt brands. But several brands did not comply with the maximum value specified in the standard for benzoic acid which is not permitted to use in yoghurt as a food preservative. Tartrazine was detected as a synthetic color only in three selected yoghurt brands. It is observed that large-scale, well-known yoghurt manufacturers mostly produce their products complying with the specifications in the standard. Many quality defects were identified in small-scale, regional yoghurt brands. Therefore, it is suggested to improve the knowledge of small-scale manufacturers in order to improve the quality of the products up to the SLS standard.

Keywords: Physico-chemical, Quality, Standard, Yoghurt, Yoghurt drink

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[1]Government Analyst's Department, Isuru Mawatha, Pelawatte, Battaramulla, Sri Lanka
[*]bdrp@pdn.ac.lk

Extraction and Characterization of Flour and Starch Derived from Buthsarana (*Canna indica*), Raja ala (*Dioscoreaalata*), Hulankiriya (*Maranta arundinacea*) and Kiri ala (*Xanthosoma sagittifolium*) Grown in Sri Lanka

Madumali P.K.J.H., Samarakoon E.R.J.* **and De Silva K.T.I.**
Department of Food Science and Technology
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Plants with edible underground organs are considered root and tuber crops. Although many varieties are grown in Sri Lanka, most are considered underutilized crops. Underutilized root and tuber flours and starches can be used in the food industry as a carbohydrate source as well as functional food ingredients. This study was conducted to characterize the flours and starches of Buthsarana (*Canna indica*), Raja ala (*Dioscorea alata*), Hulankiriya (*Maranta arundinacea*) and Kiri ala (*Xanthosoma sagittifolium*) by analyzing physicochemical and functional properties. Moisture content (dry basis), bulk density, yield and colour were determined using standard methods, and amylose content was determined using the colourimetric method. Centrifugation methods were used in determination of water holding capacity, oil holding capacity, solubility and swelling power. Flour colours were different, and *D. alata* showed a pink colour. Round or oval shaped starch granules were observed in *C. indica* and *M. arundinacea* starches and round or hemispherical shaped granules in *X. sagittifolium*. The largest granules were *C. indica* and smallest were *X. sagittifolium*. Moisture content of flours and starches varied in the range of 9.59 - 11.11% and 10.17 - 11.31%, respectively. There were no significant differences (P>0.05) between water holding capacities and oil holding capacities of flours and starches. Although solubility of flours were not significantly different (P>0.05), starch showed a significant difference (P<0.05) in terms of solubility. The highest yield and the lowest bulk density were recorded with the *X. sagittifolim* starch. Amylose content and swelling power of *C. indica* starch were significantly higher (P<0.05) than *M. arundinacea* and *X. sagittifolium* starches. Selected underutilized flours and starches have a potential to use in the food industry, as they have physicochemical and functional properties which are suitable for food applications.

Keywords: Flour, Physicochemical properties, Root and tuber crops, Starch, Underutilized crops

*rasanjalis@agri.pdn.ac.lk

Extraction, Purification and Characterization of Chitosan from Crab, Shrimp and Insect Shells

Hasara J.A.D., Weththasinghe P.[*], Abeyrathne E.D.N.S.[1], Jayawardana B.C., Jayatilake J.A.M.S.[2], Liyanage R.[3] and Rathnayake R.M.S.I.[4]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study aimed to extract, purify and characterize chitosan from crab (*Portunus pelagicus*), shrimp (*Litopenaeus vannamei*) and insect (*Hermetia illucens*) shells. The extraction and purification of crab chitosan were done using a previously developed method consisting of pre-treatment, demineralization, deproteinization, pigment removal, deacetylation and purification. The extraction and purification of chitosan from shrimp and insect shells were done with some modifications. X-Ray Diffraction (XRD) and Fourier Transform Infrared spectroscopy (FTIR) were used for the identification of purified chitosan. Two patterns and the peak positions of XRD were almost similar between standard chitosan and chitosan purified from 3 species. Vibration of functional groups of chitosan in the FTIR was comparable with the standard wavelengths of standard chitosan in literature. Crab (33%) and shrimp (33%) resulted in significantly higher ($P<0.05$) chitosan yield than insects (24%). Physico-chemical, antioxidant and antimicrobial properties of chitosan purified from 3 species were determined in comparison with standard chitosan. The degree of deacetylation was significantly higher ($P<0.05$) in crab and insect chitosan compared to standard chitosan, whereas it was ($P<0.05$) lowest in shrimp chitosan. Moisture & ash contents and water & fat binding capacities were highest ($P<0.05$) in insects among the three species. Crab and shrimp chitosan had significantly higher ($P<0.05$) whiteness index compared to standard and insect chitosan. According to the DPPH (1, 1-diphenyl-2-picrylhydrazyl) and FRAP (Ferric ion Reducing Antioxidant Power assay) assays, insect chitosan had a significantly higher ($P<0.05$) antioxidant activity than crab, shrimp and standard chitosan. Chitosan from all the species showed antimicrobial properties against *Candida*, *Staphylococcus*, *Pseudomonas* and *E. coli*, except shrimp chitosan which did not show antimicrobial activity against *Staphylococcus*. In conclusion, physico-chemical, antioxidant and antimicrobial properties of chitosan can vary with the species from which it is extracted.

Keywords: Chitin, Chitosan, Crab, Insects, Shrimp

[1]Department of Animal Science, Faculty of Animal Science and Export Agriculture, Uva Wellassa University, Badulla, Sri Lanka
[2]Division of Microbiology, Department of Oral Medicine and Periodontology, Faculty of Dental Sciences, University of Peradeniya, Peradeniya, Sri Lanka
[3]Laboratory of Nutritional Biochemistry, National Institute of Fundamental Studies, Kandy, Sri Lanka
[4]Department of Science and Technology, Faculty of Applied Sciences, Uva Wellassa University, Badulla, Sri Lanka
[*]pabodhaw@agri.pdn.ac.lk

Formulation and Development of a Dry Dog Food for the Local Market

Herath H.M.D.D., Arampath P.C.[*] and Sewwandi C.D.S.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Sri Lanka

Almost all dry dog foods available in the Sri Lankan market are imported products and are comparatively expensive. Due to present import restrictions, the price is unaffordable to dog owners and the product is unavailable in the local market. This research was conducted to formulate a palatable dry adult dog food for the local market and to compare it with the imported brands. Nutritional requirements for the formulation were determined using the daily nutrient requirement of an adult dog, literature, pet shop owners, consultation with veterinary practitioners, and an online survey of dog owners. The dry adult dog food in the form of the nugget was formulated using 14 ingredients. Crude protein, fat, carbohydrates, energy, and crude fiber were balanced in the formulation using a linear programming method. The flavour was developed separately by acid hydrolysis of chicken liver and gizzard. The hydrolysate was filtered and concentrated. Nuggets were prepared manually, coated with the developed flavour concentrate followed by drying. Proximate composition, Total Plate count, and yeast and mold count were determined in the developed product. Palatability tests were conducted using local cross-breed of 30 adult dogs. Feeding pan choice, preferred nugget colour, shape, and size, and preference over the market branded products was evaluated. The developed product contained 23.4% crude protein, 2.3% crude fiber, 49.3% carbohydrate, 9.5% crude fat, 6.0% ash, and 6.5% (dry basis) moisture. The Total Plate Count was 47.62 cfu/g and the yeast and mold count was 28.57 cfu/g Red-coloured, round-shaped large nuggets were selected as the most preferred nuggets. The preference for the developed dry dog food was not significantly different (P>0.05) compared to the imported brands.

Keywords: Flavour, Nugget, Nutritional requirements, Preference, Proximate composition analysis

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[1]Research Chemist (R&D), Raigam Marketing Services, 277, Koswatta, Kiriwattuduwa, Colombo, Sri Lanka
[*]pcarampath@gmail.com

Formulation and Quality Evaluation of a Synbiotic Concentrated Type Yogurt Incorporating Chickpea Flour and Wood Apple Pulp Powder

Fernando J.H.M., Daundasekara D.M.S.S.[*] and Vidanarachchi J.K.[1]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Yogurt is a fermented dairy product containing probiotics important for digestive health. Chickpea is a protein and fiber-rich legume with prebiotic effects. Developing a probiotic yogurt incorporating chickpeas could produce a synbiotic product and can boost gut bacteria. Therefore, the objective of this study was to formulate a synbiotic concentrated type of yogurt with chickpea flour and wood apple pulp powder. A preliminary study was conducted to determine the amount of wood apple powder to be added. Using the selected wood apple percentage (7.5%), 4 formulations were developed with 0%, 1%, 2.5%, and 5% chickpea flour. The pH, titratable acidity, viscosity, percentage of susceptibility to synersis, percentage of water holding capacity, the viability of probiotic organisms, and sensory attributes of yogurts and the moisture content, crude fiber, ash, crude protein, and crude fat of formulations were determined. The results demonstrated that chickpea flour stimulated the growth of *lactobacilli* after 14 days of storage. The numbers of viable probiotic bacteria in treatments were in the range of 6.2-7.9 log CFU/mL for *lactobacilli* in *Rogosa* agar media. During refrigerated storage, probiotics maintained a viable count above the minimum therapeutic level (10^6 CFU/g) in all yogurt formulas. There was no significant difference (P>0.05) in the pH and acidity among the treatments. However, with increasing chickpea flour percentage, the viscosity, water holding capacity, total solids, ash content, crude protein content, and crude fiber content were increased. There was no significant difference (P>0.05) in sensory properties comparing plain wood apple yogurt (0% chickpea flour) with 1%, 2.5%, and 5% chickpea flour added samples. Therefore, results suggest that a synbiotic concentrated type yogurt could be formulated by adding up to 5% chickpea flour to enhance protein and fiber content and wood apple pulp flour without adverse effects on the sensory and physicochemical properties.

Keywords: Chickpea, Concentrated type yogurt, Probiotic, Synbiotic, Wood apple

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[1]Department of Animal Science**,** Faculty of Agriculture**,** University of Peradeniya**,** Peradeniya**,** Sri Lanka

[*]saumalid@agri.pdn.ac.lk

Garcinia (*Garcinia quaesita*) as a Natural Food Preservative

Bowala B.M.R.T., Senarathne S.M.A.C.U.[1] and Daundasekara D.M.S.S.[*]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Even though chemical preservatives are commonly used in the food industry, some are proven to cause negative health effects. Therefore, food industry is seeking alternative natural preservatives. The objective of this study was to evaluate the preservative effect of garcinia (*Garcinia quaesita*). Five garcinia treatments; 3 water extracts (T1:concentrated in dialysis tubing below 60 °C, T2:concentrated in vacuum oven below 60 °C and T3:heat macerated at 100 °C), solvent extract (T4), and powdered garcinia (T5) were used in this study. Preservative action using antimicrobial activity against *Escherichia coli, Bacillus cereus, Aspergillus niger,* and *Saccharomyces cerevisiae* strains, antioxidant activity (DPPH assay) and the total phenolic content (TPC) were assessed. The highest antimicrobial activity was observed in T4 while all water extracts and garcinia powder showed moderate antimicrobial activity against the microbial strains. All garcinia treatments showed good antioxidant capacity (60 - 80%). The highest TPC was observed in T3 (22 mg gallic acid equivalents per mL). The pH of the garcinia treatments was in the range of 1.7 – 2.55 and all extracts were of shades of red color. A storage study was conducted incorporating garcinia treatments into tomato sauce and compared with a sodium benzoate added to tomato sauce as the control. No observable yeast and mold count was observed in any sample after 4 weeks of storage. Garcinia-treated tomato sauces had lower pH values compared to the control. The pH reduced over storage time while there was no significant ($p > 0.05$) change in color or total acids during the storage. A sensory analysis was conducted using garcinia powder and water extract incorporated tomato sauce and the control to assess consumer preference. The garcinia-treated tomato sauce had a similar preference compared to the control. Therefore, garcinia could be used as an effective natural preservative in food.

Keywords: Antioxidant capacity, Garcinia, Natural preservative, Solvent extraction, Water extraction

[1]Food Research Unit, Department of Agriculture, P.O.Box. 01, Peradeniya, Sri Lanka
[*]saumalid@agri.pdn.ac.lk

Grain Quality Characteristics and Related Gene Analysis (GBSSI and SSIIa) of Endemic Wild Rice Species (*Oryza rhizomatis* Vaughan) in Sri Lanka

Dharmaprema G.A.D.B.S., Hathurusinghe H.A.B.M.[1], Prasantha B.D.R. and Bandaranayake P.C.G.[1*]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Oryza rhizomatis is a perennial rice species with a rhizome, endemic to Sri Lanka, and consists of very important characteristics. Here, the grain quality characteristics at maturity, and related genes were analyzed in six accessions of *O. rhizomatis,* compared with improved varieties (Bg352 and Bg358) and wild rice species *Oryza nivara* and *Oryza rufipogon*. Physical properties of paddy and brown rice were calculated using length, width, and length-to-width ratio. Physicochemical properties such as amylose content (AC), gelatinization temperature (GT), and antioxidant activity (AOA) were also analyzed. Rice kernel endosperm and starch granule morphology were examined by scanning electron microscopy (SEM). Responsible genes of starch properties (GBSSI and SSIIa) were accessed bioinformatically using existing genomic data. Results indicated that all the wild rice species have a red pericarp layer, short or medium grain size, and medium grain shape while the improved varieties have white pericarp, short to medium size grains, and either bold or medium shapes. According to the SEM images, the morphology and distribution of the starch granules, the shape of endosperm cells, also the size and distribution of protein bodies in the kernel of wild species were similar to the improved rice varieties. However, the existence of pinholes indicated that *O. rhizomatis* might possess potential benefits for starch processing while the distinctive sub-aleurone layer indicates the possibility of high protein content. All samples belonged to the high AC category in the range of 30.27-34.17% without significant difference (P>0.05). All *O. rhizomatis* accessions were high GT category except INRC22 while others were in either low or intermediate GT category. Additionally, AOA of *O. rhizomatis* was significantly higher (P<0.05) than the improved varieties. According to the available sequencing data, there were no clear variations in the exons of two genes. However further analysis is needed for the identification of accession level differences.

Keywords: AACC, Alkali spreading value, DPPH, Iodine colorimetric procedure, Rough rice

[1]Agricultural Biotechnology Centre, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
[*]pradeepag@agri.pdn.ac.lk

Identification of Edible Macroalgae and Isolation of Endophytes in Selected Macroalgae in Hikkaduwa Coastal Area

Chathuranga P.H.T., Arampath P.C.[*] and De Silva S.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

There are three main groups of macroalgae(seaweeds); red, green and brown. Some macroalgae species are being used in food applications for centuries in certain countries. Although macroalgae are rich in nutrients, their edible uses are unexploited in Sri Lanka. The diversity of macroalgae is prominent in Hikkaduwa coastal area. Endophytes are endosymbiotic organisms with antimicrobial, anticancer and anti-insect properties, because of their secondary metabolites. These properties are important in food and pharmaceutical applications. Therefore, this study was conducted to identify the edible macroalgae species in Hikkaduwa coastal area and to isolate the endophytes present in macroalgae. Algae was collected with the prior approval of Coast Conservation and Coastal Resource Department and Department of Wildlife Conservation. Collected macroalgae was identified using fresh specimens, photographs, herbarium specimens and available literature. Endophytes study was done by culturing them in potato dextrose agar medium after surface disinfection of macroalgae. Identified green algae were *Halimeda opuntia, Caulerpa imbricata, Caulerpa racemosa, Ulva lactuca, Valoniopsis pachynema, Valonia utricularis* and *Chaetomorpha antennina*. Identified red algae were *Chondracanthus acicularis, Gracilaria canaliculata* and *Gracilaria huangii. Sargassum elegans, Sargassum muticum* and *Sargassum crassifolium* were the species identified as brown algae. Macro algae *Halimeda opuntia, Caulerpa racemosa, Gracilaria canaliculata, Ulva lactuca, Sargassum crassifolium* and *Sargassum elegans* species were identified with potential food applications. Growth of endophytes was observed in *Gracilaria* sp. In conclusion, edible macroalgae and endophytes are existing Hikkaduwa coastal area. However further research and screening are recommended.

Keywords: Edible Seaweeds, Endophytes, Macroalgae, Seaweeds

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[1]Department of Electron Microscopy, Medical Research Institute, Colombo 8, Sri Lanka
[*]pcarampath@gmail.com

Improving Postharvest Technology for Long-Distance Transportation of Banana

Rasnayaka R.M.A.M., Weerakkody W.A.P.[*] and Wasala W.M.C.B.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This research evaluates two new bulk banana packaging methods for long-distance transport in Sri Lanka. Packaging banana "hands" in plastic crates and banana bunches in two-story cabins (vertically) were the new bulk packaging methods. Two transports were done to test the new methods in a long distance transport (130 km) using a medium-size open truck, in comparison with the conventional horizontal packaging method as the control treatment. Data were collected at each step in the supply chain. Post-harvest quality was assessed based on visual quality rating (VQR), ripening index (RI), mechanical damage percentage, physiological weight loss (PWL), total soluble solids (TSS), fruit firmness and juice pH. Cost-benefit analysis and consumer preference (at retailer stage) were evaluated. Based on the VQR, which affects consumer preference, the shelf life was decided. The new bulk packaging methods showed a 2-day increment in shelf life. Packing in plastic crates and two-story cabins significantly reduced ($p < 0.05$) the mechanical damages from 19.6% to 3.2% and 8.7%, respectively. During long-distance transportation and retailer sale, bulk packaging methods were not significantly different ($p > 0.05$) with respect to PWL. The gradual changes found in fruit firmness, juice pH and TSS from the farmer to consumer level followed a similar pattern for all three packaging treatments. The plastic crates and two-story cabin increased the profit margins by 1227% and 74%, respectively, for *Embul* banana due to the reduction of postharvest losses. Consumer preference for banana transported under new packaging methods was mainly determined by their improved appearance. Hence packaging banana hands in plastic crates as well as bunches vertically in two storied cabins reduced the mechanical damage while increasing the shelf life, profit margin, and consumer preference, subjected to variety, *Embul*, long distance upto 130 km and good road conditions in a medium scale open truck.

Keywords: Banana, Bulk packaging methods, Long distance transportation, Postharvest losses, Shelf life

[1]National Institute of Post-Harvest Management, Jayanthi Mawatha, Anuradhapura, Sri Lanka
[*]wapweerakkody@agri.pdn.ac.lk

In-vitro Antihyperglycemic and Antihyperlipidemic Potential of Curry Leaves (*Murrya koenigii*), Lemongrass (*Cymbopogon citratus*) and Ceylon Cinnamon (*Cinnamomum zeylanicum*)

Arambepola W.J.M.V.R., Rajapaksha R.P.N.P., Mendis B.E.P. and Fernando W.I.T.[1*]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Glycemic stress, oxidative stress and associated inflammatory reactions are the precursors to atherosclerosis and insulin resistance that lead to cardiovascular diseases and type-2 diabetes mellitus. This study was conducted to evaluate the *in-vitro* inhibitory potential of cinnamon, curry leaves and lemongrass against pancreatic lipase and pancreatic α-amylase, and to relate their efficacy as dietary therapeutic candidates to reduce post-prandial hyperglycemia and post-prandial hyperlipidemia. The Selected plant materials were air dried and their aqueous extracts were freeze dried. Dried extracts were tested for *in-vitro* antihyperglycemic and antihyperlipidemic potential, employing pancreatic lipase and α-amylase inhibition assays. A moderate, but significant ($P < 0.05$) pancreatic lipase inhibitory activity of 38.81%, 24.52%, 22.16% and α-amylase inhibitory activity of 15.31%, 39.97%, and 46.05% was observed for lemongrass, curry leaves and cinnamon extracts respectively. Lemongrass extract had a significantly ($P < 0.05$) high lipase inhibition compared to the other extracts, and the inhibitory effects of curry leaves and cinnamon extracts was not significantly ($P > 0.05$) different. However, all three extracts had a significantly ($P < 0.05$) different α-amylase inhibition, among one another. According to the findings of this study it can be presumed cinnamon, curry leaves and lemongrass as potential dietary candidates to reduce the risk of type-2 diabetes mellitus and atherosclerosis and by reducing post-prandial blood glucose levels and post-prandial triglyceride levels. However, further studies are required to confirm the applicability and the efficacy the observed *in-vitro* activities in human subjects.

Keywords: Enzyme inhibition, Alpha-amylase, Pancreatic lipase, Post-prandial hyperglycemia, Post-prandial hyperlipidemia

[1]Department of Biochemistry, Faculty of Medicine, University of Peradeniya, Peradeniya
[*]irushikawit@yahoo.com

Manufacturing of Ice-cream Cones using Cassava, Soybean, Black-gram, Cowpea and Green-gram Flours as Major Ingredients

Janith R.M.L., Illeperuma D.C.K[*] and Vidanarachchi J.K.[1]

Department of Food Science and Technology
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Ice-cream consumption has been increasing due to changes in lifestyles and food habits. Serving ice-cream in cones is one of the most popular modes. As these products are not considered a healthy part of a regular diet, this study focused on developing an ice cream cone with added value. Nine formulations containing different proportions of flours such as cassava (38 to 51%), soybean (20 to 25%), black-gram (10 to 12.5%), cowpea (10 to 12.5%) and green-gram (5.45 to 7.99%) as major ingredients, and sugar (2.5 to 3.45%), table salt (0.05 to 0.06%) and baking powder (0.5 to 1%) as minor ingredients were the treatments. Amount of water used in 9 formulations increased from 140 to 160 ml with increase in the percentages of cassava flour from 51 to 38%. Hardness and water holding capacity (WHC) of the samples (9 formulations) and of a market sample were measured. Hardness of the market sample was 5.98 ± 0.01 N, which was not significantly different ($p > 0.05$) from the formulation containing 45.6, 5.7, 11.4, 11.4 and 22.8% of cassava, green-gram, cowpea, black-gram, and soybean flours as major ingredients, respectively, and 2.8, 0.05 and 0.75% of sugar, table salt and baking powder as minor ingredients, respectively. Lowest WHC of 19.79 ± 1.07 was evident in the same formulation, which was similar in hardness to the market sample. Therefore, the formulation resulted in hardness and WHC similar to the market sample was selected as the most suitable formulation for producing ice-cream cones. Moisture, total ash, crude protein, crude fat, and crude fiber percentages of the selected formulation were 5.42 ± 0.46, 2.58 ± 0.02, 14.39 ± 0.21, 6.07 ± 0.05 and 4.11 ± 0.09, respectively, and of the water activity was 0.45 ± 0.02.

Keywords: Black-gram, Cassava, Cowpea, Green-gram, Ice-cream cones, Soybean

[1]Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]chamarai@agri.pdn.ac.lk

Microplastics in the Gut Contents of Salt-Dried Smoothbelly Sardinella (*Amblygaster leiogaster*) from Kalpitiya and Trincomalee, Sri Lanka

Samarakoon K.M.S.M., Daundasekara D.M.S.S.[*] and Rajakaruna R.S.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Microplastics (MP) are fragments of plastics less than 5mm in size, which may pose a threat to human health through the ingestion of contaminated food. As MP could bioaccumulate in the digestive tract and other tissues of marine organisms, it is important to understand the current status of MP contamination in Sri Lankan seafood. Therefore, this study assessed the MP in the gut contents of salt-dried smoothbelly sardinella (*Amblygaster leiogaster*) produced in Sri Lanka using samples collected from secondary wholesalers in Kalpitiya and Trincomalee. Two methods of organic digestion; wet peroxide oxidation (WPO) and alkaline digestion (AD) using 10% KOH, were used to determine the best-suited method to be used for salt-dried fish. Based on the amount of MP recovered, the WPO is preferable to AD. Microscopy and ATR-FTIR spectroscopy were used for the identification and quantification of microplastics. Dried fish samples from both locations were contaminated with items that are identified as MP. However, only microfibers (fibers that are less than 5mm in length) were identified in all the samples. There was a significant difference between the levels of microplastics in samples from the two locations (P<0.05). Specifically, dried fish from Kalpitiya reported a significantly (P<0.05) higher amount of MP (12,031.55 ± 5,059 items/kg) with a higher color variation; black (50%), transparent (14%), white (10%), blue (10%), red (7%), green (5%), yellow (4%), compared to dried fish from Trincomalee (2,129.41 ± 925 items/kg) which had fewer color variations; black (46%), blue (31%), green (15%), red (8%). The current study results provide preliminary evidence for the need of quantification of microplastics assimilated in the edible content of the salt-dried smoothbelly sardinella in Sri Lanka. As the fish gut is rarely removed during dired fish production and consumption, these may contribute to the MP ingestion by Sri Lankan consumers.

Keywords: Anthropogenic activities, Dried fish, Microplastics, Organic digestion, Polymer types

[1]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]saumalid@agri.pdn.ac.lk

Morphological and Molecular Identification of Weeds in Export-Ready Coir Samples

Karunanayaka H.K.M.S., Sirimalwatta V.N.S.[*], Gunasinghe L.H.R.M.[1] and Pathirana P.B.G.

Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The coir industry is an export-oriented high-income agro-based business. Sri Lanka is the world's largest coir and brown fiber supplier. Coir products contaminated with weeds have been identified as the main challenge in coir exportation. The National Plant Quarantine Service (NPQS) of Sri Lanka is the governing agency that regulates the movement of weeds into and out of the country. Yet, the current tests used in the NPQS are not sufficient to identify certain weed species. Therefore, this project aimed to develop a strategy to identify weed contaminants in export-ready coir using DNA barcoding and morphological characters. Coir samples were subjected to grow-out tests (as recommended by the NPQS) at the NPQS planthouse from September to November 2022. Standard plastic trays were filled with coir and moisture content was maintained at 85% for 21 days. Then, seedlings (20) that emerged from coir materials were transplanted in clay pots and a seedling guide was prepared using distinctive morphological characters. Only seven morphologically distinctive seedlings were identified. Thus, it is recommended to extend the data collection up to the flowering stage to confirm the species status of each seedling. DNA was extracted from the 20 seedlings for DNA barcoding targeting 3 regions; *rbcL*, *matK* and *trnL-F*. DNA sequencing was done for *rbcL* for one species and a similarity search was conducted in NCBI BLAST. The species was identified as *Cyperus richardii* with a 99.83% identity. Since this species has not been previously recorded in Sri Lanka, further studies are suggested to confirm the results. The outcome of the study is highly useful to identify frequent weed contaminants of coir, to propose strategies to minimize the contamination and issuing phytosanitary certificates.

Keywords: Coir, DNA barcoding, Molecular identification, *rbcL,* Weeds

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[1]National Plant Quarantine Service, Katunayake, Sri Lanka
[*]nipuni.siri@agri.pdn.ac.lk

Physicochemical, Microbiological and Sensory Properties of Drinking Yoghurt Incorporated with *Kithul* (*Caryota urens*) Flour

Rasana S., Gunasekara D.C.S.1, Jayathilaka. S.N.T.1, Vidanarachchi J.K. and Prasanna P.H.P.*

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The current study was carried out to investigate physicochemical, microbiological, and sensory attributes of drinking-yoghurt prepared with varying concentrations of *Kithul* (*Caryota urens*) flour (0.1%, 0.2%, and 0.5%). The final products were stored at 4 ºC for 21 days and physicochemical and microbiological properties were evaluated weekly during the storage. The results of sensory evaluation revealed that treatment containing 0.2% (v/v) *Kithul* flour had the highest preference. pH values of all yoghurt samples reduced significantly ($p<0.05$) during the storage period. Total coliform count, yeast and mould count were negative in all sample during 21 days of storage at 4 °C. Therefore, the results of the current study suggested that *Kithul* flour could be successfully utilized to manufacture drinking-yoghurt with enhanced physicochemical and sensory properties.

Keywords: Drinking yoghurt, *Kithul* flour, Microbiological properties, Physicochemical properties

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[1]CIC Dairies (Pvt) Ltd., Ibbankatuwa, Dambulla, Sri Lanka
*phpprasanna@agri.pdn.ac.lk

Potential Gelatin Replacement in Set-Yoghurt: Use of Exopolysaccharide-Producing YoFlex® Premium 6.0 Starter Culture

Kalhari L.M.S.M., Vidanarachchi J.K.[*], Jayawardene L.P.I.N.P.[1], Gunathilaka W.L.C.M.[1], Weerasingha W.V.V.R.[2] and Priyashantha H.[3]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Microbial exopolysaccharides (EPS) are in increasing demand as a natural stabiliser in yoghurt making and could replace or reduce the use of gelatin for many reasons. The present study investigated the potential for gelatin replacement in set-yoghurt using an exopolysaccharide-producing YoFlex® Premium 6.0 starter culture (CHR HANSEN, Horsholm, Denmark). This experiment was carried out for three different fat levels (0.4%, 1.5%, and 3.0%). Each fat level contained one control sample (with 0.5% gelatin and conventional culture). Altogether eighteen treatments were prepared using YoFlex® Premium 6.0 starter culture and six different gelatin levels (0.0%, 0.1%, 0.2%, 0.3%, 0.4%, 0.5%) for three fat levels. Out of the eighteen treatments, the five best treatments (P6-A, P5-A, P4-A, P2-A, P1-A) were identified based on the texture and syneresis data for further evaluation. All those selected five treatments were included in the 0.4% fat level, and then they were subjected to sensory, texture, titratable acidity, and viscosity analyses to investigate the potential for gelatin replacement. The highest ($P<0.05$) hardness and overall acceptability were observed in the treatment with 0.5% gelatin level. However, the highest ($P<0.05$) titratable acidity and viscosity values were observed in the treatment with 0.0% gelatin level. Therefore, this study concluded that YoFlex® Premium 6.0 starter culture has good potential to replace gelatin in the set-yoghurt with 0.4% fat level and concluded that gelatin can be replaced completely in the set-yoghurt with desirable titratable acidity and viscosity attributes. However, desirable sensory and texture attributes can be obtained in set-yoghurt produced by YoFlex® Premium 6.0 starter culture with 0.5% gelatin level. It is revealed that, in the Sri Lankan context, YoFlex® Premium 6.0 starter culture may be best suited for stirred-yoghurt rather than set-yoghurt preparation.

Keywords: Exopolysaccharide, Gelatin, Syneresis, Texture, YoFlex® Premium 6.0 starter culture

[1]Aletek International (Pvt.) Ltd, NJV Cooray Mawatha, Rajagiriya 10100, Sri Lanka
[2]Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Puliyankulama, Anuradhapura, Sri Lanka
[3]Food & Pharma Technology Programme, Folkuniversitetet Uppsala, Bergsbrunnagatan 1,753 23 Uppsala, Sweden
[*]janakvid@agri.pdn.ac.lk

Priming Techniques for Seed Quality Enhancement of Selected Oil Seed Crops

Nisana R.[*], Priyantha M.G.D.L.[1], Athukorala A.R.J.[2], Samaranayake J.W.K.[3], Sivananthawerl T., De Silva S.H.N.P. and Rankoth L.M.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Seed production as planting materials is very important. However, part of those produced seeds get rejected during seed certification due to poor germination. One possible way of improving the germination is seed priming. This study was conducted to quantitatively describe the effects of different priming methods (Halo, Hydro and Osmo) on germination in accepted and rejected seed lots of groundnut (*Arachis hypogaea* L. var. *Thissa*) and sesame (*Sesamum indicum* L. var. *Uma*). This experiment was conducted at the Seed Certification and Plant Protection Center, Gannoruwa during Sept.–Dec., 2022. Seeds were primed with 2% NaCl (Halo), Distilled water (Hydro) and, 5% Poly Ethylene Glycol (Osmo) for 16 hours at 25°C. Experiment was arranged as a two-factor factorial in a completely randomized design with three replicates and the non-primed treatment was used as the control. Chlorophyll fluorescence measurements were taken in 10-day old seedlings under each treatment and were expressed as OJIP curves. Results revealed that different priming methods had significant effects on germination percentage, moisture percentage, seedling vigor, the electrical conductivity, and seed micro floral (*Aspergillus flavus*, *Aspergillus niger*, Penicillium, Rhizopus, Bacteria, and Saprophytes) counts. Halo priming increased the germination percentages, shoot length and seedling vigor, the electrical conductivity, and moisture percentage of groundnut and sesame seeds. However, none of the tested priming methods were strong enough to improve the quality of rejected groundnut seeds. Hydro and Halo priming were good for improving the seed quality in rejected sesame seeds. All three priming methods were good for increasing the seedling quality of accepted sesame seeds and they did not affect the seed germination percentage positively or negatively. Thus, seed priming is beneficial for the farmer as it increases the germination ability of seeds.

Keywords: Chlorophyll fluorescence, Oil seed crops, Seed priming techniques, Seedling vigor

[*]nisachandran19@gmail.com
[1]Seed Certification Service, Department of Agriculture, Gannoruwa, Sri Lanka
[2]Seed Health Testing Laboratory, Department of Agriculture, Gannoruwa, Sri Lanka
[3]Central Seed Testing Laboratory, Department of Agriculture, Gannoruwa, Sri Lanka

Process Optimization to Extract Oleoresin and Essential Oil from the Leaves of Allspice [Pimenta dioica (L.) Merill.] and Screening of Its Essential Oil Composition, Antioxidant Capacity and Potential to Develop New Products

Abeysinghe D.V.S., Mendis B.E.P.[*], Rajapakse R.P.N.P., Rengaraj T.[1] and De Silva U.K.S.K.[1]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Pimenta dioica (L.) Merill., the allspice plant having the combination of flavours of clove, cinnamon, cardamon and nutmeg has not been explored in Sri Lanka for its potential uses. In this study, a process optimization was carried out to extract oleoresin and essential oil from the first 8 leaf positions of shoots of allspice. Several solvent mixtures were tested for the extraction of allspice oleoresin. Total antioxidant capacity, total phenolics and total flavonoids in allspice oleoresin were determined using ferric reducing antioxidant power assay, modified Folin-Ciocalteu method and a calorimetric method, respectively. Characterization of essential oil was done using gas chromatography. Acetone: Hexane (90:10) was identified as the optimum solvent mixture to extract oleoresin and the highest yield ($8.92 \pm 0.03\%$) was obtained from the 7th leaf position. There was no significant ($p > 0.05$) difference in the yield of oleoresin from the 6th leaf position upwards, the highest yield ($4.45 \pm 0.10\%$) of leaf essential oil was observed in the 3rd leaf position. The highest amount of total antioxidant capacity ($1,555.69 \pm 7.04$ mg TE/g of oleoresin) and total phenolic content (143.19 ± 2.24 mg GAE/g of oleoresin) were observed in oleoresin extracted from 2nd leaf position whereas highest total flavonoids (718.78 ± 25.24 mg RE/g of oleoresin) were recorded in the 5th leaf position. Eugenol was the most abundant ($89.43 \pm 0.03\%$ in 7th leaf) chemical in the leaf essential oil followed by β-caryophyllene ($10.92 \pm 0.07\%$ in 1st leaf) and Myrcene ($2.21 \pm 0.02\%$ in 1st leaf) respectively. The residual solvent level was maintained below 25 mg/kg levels in the final allspice oleoresin product. Two products, allspice herbal black tea and green tea, from allspice leaves, were developed. The findings of this study encourage the commercial-scale cultivation of allspice in Sri Lanka.

Keywords: Antioxidant capacity, Essential oil, Oleoresins, Phenolics, *Pimenta dioica*

[*]STAY Naturals Private Limited., No. 45, Ambangangawatte Road, Kawatayamuna, Kawdupelelle, Matale, Sri Lanka. 21072
[1]ereshamendis@agri.pdn.ac.lk

Production of Cowpea (*Vigna unguiculata L.*) Seed Powder by Spray Drying and Ingini (*Strychnos potatorum*) Seed Powder by Roasting

Jayasekara G.H.M.R., Illeperuma D.C.K.,[*] and Jayathunge K.G.L.R.[1]
Department of Food Science and Technology
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Growth of vegan food market indicates the desire of consumers for vegan diets. As modern consumers are health conscious regardless of their busy lifestyles, this study focused on developing cowpea milk powder and *ingini* seed powder for possible incorporation in formulating vegan products. Cowpea seeds were sundried, dehulled and soaked in 1% $NaHCO_3$ (24 h). Swollen seeds were rinsed, hand-peeled, blanched (95 °C for 1 minute), cooled and ground with water in 1:3 (w/v). The resultant slurry was filtered through a muslin cloth, and consistency of the filtrate was adjusted by adding 1 fold of distilled water, followed by mixing with maltodextrin (3% - w/v). Cowpea milk containing maltodextrin (CM-MD) was spray dried at an inlet and outlet temperatures of 185 °C and 90 °C respectively, and 35-40 rpm of feed pump rate at 0.6 MPa constant compressed air pressure. Moisture content (MC) of $3.62 \pm 1.09\%$, bulk density of 0.55 ± 0.00 g/mL and particle density of 1.61 ± 0.17 g/mL were evident in spray dried CM-MD. Ingini seeds were roasted at 200, 220 and 240 °C for 20, 15 and 10 min, respectively, as treatments in triplicate, ground and sieved (200 μm). Physical properties of roasted ingini seed powder (RISP) revealed no significant effect ($P>0.05$) of roasting on MC, colour and swelling index, and significant effect ($P<0.05$) on yield and solubility. Among the three roasting conditions, roasting at 220 °C for 15 min was found to be the most suitable for obtaining RISP, in which moisture content of $6.66 \pm 0.07\%$, yield of $56.01 \pm 6.93\%$, colour of 89.7 ± 5.4 (lightness), swelling power of $47.94 \pm 2.53\%$ and solubility of $71.7 \pm 0.7\%$ were evident. Further research is necessary to find out the suitability of CM-MD and RISP for formulating plant-based milk alternatives, particularly for vegans.

Keywords: Cowpea milk powder, Ingini seed powder, Roasting, Spray drying

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[1]Department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka
[*]chamarai@agri.pdn.ac.lk

Quality Comparison of Instant Tea Made from Refused Tea (BMF), Taken from Organically and Conventionally Managed Tea Fields of Three Elevation Categories in Sri Lanka

Premakumara S.D.D., Dalpathadu K.A.P.[1], Amaratunga K.S.P.[2] and Nissanka S.P.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The quality of instant tea is based on the raw materials, which depend on the tea cultivar, management practices, climatic conditions, etc. This study aimed to compare the quality parameters of instant teas produced from BMF obtained after the orthodox manufacturing process of clone TRI-2025, taken from organically and conventionally managed two selected tea estates from each elevation category of up-country (UC), mid-country (MC), and low-country (LC) of Sri Lanka. Total polyphenol content (TPC) using folin-ciocalteu method (ISO 14502-1), caffeine content using chloroform extraction method, maximum residue levels (MRL) using AOAC 2015.01 with ICP-MS method, phosphorous and potassium content, colour, and haze of instant tea were analyzed. A significant difference was observed for TPC in three elevations where UC showed the highest (25.74%) and LC showed the lowest (19.27%). The caffeine content in MC (8.2 mg/ L) and LC (8.1 mg/ L) was greater than in UC (6.2 mg/ L). The L value for color, UC recorded 53.51 (lightness) while it was 44.5 (darkness) MC. Higher L gives more clarity whereas a lower L gives less clarity, therefore, to prepare ice tea like beverages UC tea extract would be the best. The highest haze value of (232.17 NTU) was detected in UC and the lowest of (78.10 NTU) in LC, which gives more 'teaness' in UC and is good for 3-in-1 sachet pre-mixtures. No heavy metals (Pb, Cd, As, and Hg) were detected in any of the instant tea types which confirmed that still Ceylon tea can be demanded at a premium price for its superior quality. These findings could be used in the food and pharmaceutical industries to produce value-added products in line with the customer's preferences and to explore even better marketing avenues for Ceylon Tea to enhance revenue generation in the country.

Keywords: Broken mixed fanning, Conventional, Instant tea, Organic, Quality comparison

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[1]Martin Bauer Hayleys (Pvt) Ltd, Blink Bonnie Estate, Dickoya, Hatton, Sri Lanka
[2]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]spn@agri.pdn.ac.lk

Study on the Effect of Raw Milk Properties on the Sensory Attributes of Flavoured Pasteurized Milk from a Dairy Manufacturing Plant in Sri Lanka

Haputhanthri R.Y., Daundasekara D.M.S.S.,* and Liyanagamage N.[1]

Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The consumer acceptability and the sensory attributes of flavoured pasteurized milk products are influenced by the raw milk quality (i.e., fat, and solid not-fat (SNF) percentages). The current study was designed to evaluate the quality of raw milk received at the dairy processing plant and to determine whether there is an impact of added skimmed milk powder (SMP) on the sensory attributes of the finished product. The plant used milk from 8 collecting centers to produce pasteurized milk products. The fat% (Gerber method), SNF%, and keeping quality (Resazurin test method) of raw milk received from each center were analyzed to identify significant variation within a center with time and between centers. Sensory analysis was conducted to identify consumer preference for the milk samples (3 flavours: vanilla, strawberry, and chocolate) based on the amount of SMP added. The results indicated that within each center there was a slight variation in the initial fat%, SNF% and keeping quality. However, this was not statistically significant ($P>0.05$). The pairwise comparison between centers indicated that there were significant differences in the fat% SNF% and keeping quality ($P<0.05$) between some of the milk collecting centers. Bopaththalawa center provided the milk with the highest quality considering all 3 factors (mean fat%: 4.08, SNF%: 8.51, and keeping quality: 6 days). Samples produced with the highest initial fat% and lower SMP had the highest consumer preference. The study results indicated that the consumer preference for the final product relies on both SMP% and raw milk fat%. Therefore, to produce a final product with a consistent flavour profile, the manufacturer should consider using fat-free raw milk and adding cream at the standardization to get the required fat percentage.

Keywords: Flavoured Pasteurized Milk, Raw Milk, Sensory Properties, Skimmed Milk Powder, Solid Non-Fat

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[1]Research & Development, Richlife Dairies Limited, Wadduwa, Sri Lanka
*saumalid@agri.pdn.ac.lk

Study on Extending the Shelf Life of Butter Flavoured Cookies

Bandara U.R.S.P., Madhujith W.M.T.[*] and Priyantha K.P.S.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Cookies are baked or cooked snacks or desserts, which are small, flat and sweet in nature. They can also be bland-flavoured and can be moulded into different shapes. The basic ingredients used for butter flavoured cookies which are manufactured by the Perera & Sons Bakers (Pvt) Ltd. are wheat flour, corn starch, sugar, butter, margarine, fresh milk, salt and leavening agents. The prepared butter flavoured cookies are packed in three different packaging materials such as metal cans, polypropylene pouch with a tray made using PVC and paperboard carton with LDPE inner package and a tray made using high impact polystyrene. The shelf life of butter flavoured cookies packed in all three packaging materials is four months. This study was conducted to extend the shelf life of butter flavoured cookies. Two experiments were conducted separately to determine the most effective concentration of potassium sorbate and to determine the most effective concentration of ascorbyl palmitate. Potassium sorbate was incorporated into four different concentrations separately such as 0 mg/kg, 100 mg/kg, 200 mg/kg and 300 mg/kg and were packed in all packaging materials. Prepared cookies were stored at 45° C for four weeks and moisture content, hardness, total plate count and yeast and mould count were determined and sensory evaluations were carried out. Ascorbyl palmitate was incorporated into four different concentrations such as 0 mg/kg, 200 mg/kg, 300 mg/kg and 500 mg/kg and were packed in all packaging materials. Prepared cookies were stored at 45° C for three weeks and thiobarbituric acid reactive substances content was measured and sensory evaluations were carried out. The most effective concentration of potassium sorbate was 200 mg/kg ($P < 0.05$) and the most effective concentration of ascorbyl palmitate was 500 mg/kg ($P < 0.05$). The most suitable packaging material was the metal can ($P < 0.05$).

Keywords: Ascorbyl palmitate, Butter flavoured cookies, Packaging materials, Potassium sorbate, Shelf life

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[1]Perera & Sons Bakers (Pvt) Ltd., No. 122-124, M.D.H. Jayawardena Mawatha, Madinnagoda, Rajagiriya, Sri Lanka
[*]tmadhujith@agri.pdn.ac.lk

Suitability of Pre-ozonated Water and H_2O_2 as Disinfection Treatments for Producing Minimally Processed and Refrigerated Coconut Haustoria

Wijerathna K.K.A.L.M., Illeperuma D.C.K.,[*] and Lankachandra S.S.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Coconut haustoria are underutilized, thus their disposal is a challenge faced by coconut processing industries. As coconut haustorium contains health beneficial compounds, this study focused on finding out a disinfection treatment for producing minimally processed and refrigerated (MPR) coconut haustoria. The washed and wiped samples were cut into wedge-shaped slices (8 mm), and dipped for two min in water as the control (TW) and in solutions containing 5% H_2O_2 (HPS), and citric acid (1 $g.L^{-1}$) and 5% H_2O_2 (CA&HPS) as treatments in triplicate. The samples packaged in polypropylene trays and covered with polyvinylidene chloride films were refrigerated (4 ± 1 °C and 48 ± 17% RH) for two weeks. Total soluble solids (TSS), pH, and inner and outer firmness values of the control samples were not significantly different (P>0.05) from the treatments. TPC (total plate counts) of the control samples was significantly higher (P<0.05) than that of HPS and CAS&HPS, resulting in reduction of microbial load by 36%. The slices prepared as before were dipped for 2 min in a 5% HPS as the control, and for ten min in pre-ozonated water containing 100 and 200 $mg.L^{-1}$ of ozone as treatments in triplicate. Afterwards, the slices stored for two weeks under similar conditions as above. TSS, pH and inner firmness of the control samples after two weeks in storage were not significantly different (P>0.05) from the treatments. However, outer firmness of the treatments was significantly higher (P<0.05) than the control. TPC was significantly higher (P<0.05) in the control samples than those treated with water containing 100 and 200 $mg.L^{-1}$ of ozone, resulting in a reduction of microbial load by 2 and 14%, respectively. Therefore, treating with pre-ozonated water containing 200 $mg.L^{-1}$ of ozone can be recommended as a disinfection treatment, instead of dipping in H_2O_2, for producing MPR coconut haustoria.

Keywords: Coconut haustoria, Hydrogen peroxide treatment, Ozonation

[1]No: 53/6, Kandalama, Mirigama, Sri Lanka
[*]chamarai@agri.pdn.ac.lk

Ultrasonication of Milk from Thamankaduwa White and Holstein Friesian Cattle Breeds and Its Effects on Lactic Acid Coagulation

Johnson L.B., Vidanarachchi J.K.[*], Prasanna P.H.P., Abesinghe A.M.N.L.[1] and Priyashantha H.[2]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The application of ultrasound technology in dairy processing is relatively a new field of study. Ultrasonication alters the properties of milk, allowing for the production of novel-textured, high-moisture dairy products. This study was conducted to assess the effect of ultrasonication on lactic acid-induced coagulation of milk from indigenous cattle, Thamankaduwa White (TW) and exotic cattle, Holstein Friesian (HF). Milk samples from pure TW and HF were subjected to ultrasonication at 3 different power levels: US 42, US 51, and US 60 with the energy densities 504 JmL^{-1}, 612 JmL^{-1}, and 720 JmL^{-1}, respectively, for 10 minute duration with temperature control (<40º C). Treated and untreated milk samples were acidified by adding lactic acid bacteria (*Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus*). Coagulation properties such as water holding capacity (WHC), syneresis and texture profile analysis (TPA) and microstructure were determined. Statistical analysis was carried out using a 2-factor factorial CRD followed by Fisher's LSD test. The main findings suggest that ultrasonication increased ($p<0.05$) the WHC of coagulums from HF milk and decreased ($p<0.05$) the WHC of coagulums from TW milk. Ultrasonication increased ($p<0.05$) the firmness of coagulums from both TW and HF milk. An interaction effect ($p<0.05$) of milk type (breed) and ultrasound energy density on WHC and firmness was observed. Ultrasonication of raw milk from HF had little effect on the final structure of the coagulum compared to that of TW. However, at a high level of treatment *(i.e.,* 720 JmL^{-1}) more porous structures of acid gels from both breeds were observed. Results of the current study indicate that ultrasound treatment improves the lactic acid coagulation properties of milk from both breeds. However, the same ultrasound energy density affects the coagulation properties of milk from both breeds differently.

Keywords: Holstein Friesian, Lactic acid coagulation, Thamankaduwa white, Ultrasonication

[1]Department of Animal Science, Faculty of Animal Science and Export Agriculture, Uva Wellassa University, Passara Road, Badulla, Sri Lanka
[2]Food & Pharma Technology Programme, Folkuniversitetet Uppsala, Uppsala, Sweden
[*]janakvid@agri.pdn.ac.lk

Ultrasound Treatment as an Alternative Method for Ripening of *Seeni* Banana and *Embul* Banana (*Musa spp.).*

Samaranayake.U.C., Prasantha B.D.R.* and Chandrasiri K.A.K.L.
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The aim of this study was to investigate the effect of ultrasound as pre-treatments on the physiochemical characteristics of the *Seeni* and *Embul* banana varieties in Sri Lanka. Ultrasound treatment of 25 kHz frequency was applied to physiologically matured, freshly harvested *Seeni* and *Embul* banana fruits for different time periods (0, 10, 20, and 30 min). The ultrasound-treated samples were stored for 4 days at room temperature (28 °C). The changes in firmness (N), °Brix, pH, titratable acidity (TA%), peel color, weight reduction (%), carbon dioxide (CO_2) production rate (ml kg^{-1} h^{-1}), antioxidant activity (DPPH radical scavenging activity %) and the light microscopy study of tissue damage of both banana samples were investigated. The pulp firmness of the banana samples significantly decreased ($P<0.05$) with the time of ultrasound treatment of both banana varieties. The CO_2 production rate, °Brix, and weight reduction percentage of both varieties were significantly increased ($P<0.05$) with the period of ultrasound treatment. At 30 min of ultrasound treatment time, the antioxidant activity of the *Seeni* and *Embul* bananas increased from $12.05 \pm 1.94\%$ to $57.72 \pm 3.88\%$, and $78.52 \pm 3.22\%$ to $95.36 \pm 0.96\%$ respectively. The peel lightness (L), redness (a), and yellowness (b) values and the pH reduction of the *Embul* banana sample did not significantly vary ($P>0.05$) with the ultrasound time. However, the "b" value of the *Seeni* banana samples significantly increased ($P<0.05$) with the ultrasound treatments. Microscopic study showed that the ultrasound treatment time directly affected the microchannel formation and cell damage of both varieties. Moreover, ultrasound treatment effect on the peel discoloration of the *Embul* banana variety was identified as undesirable postharvest quality characteristics. The results of this study suggested that the ultrasound treatment may provide an alternative method to enhance the ripening rate and maintain the proper postharvest quality of and *Seeni* banana varieties.

Keywords: Antioxidant, Banana, Physiochemical properties, Respiration, Ultrasound

*bdrp@pdn.ac.lk

Antiglycation Properties of Aqueous Extracts from Selected Plant Species: An *In vitro* Study

**Senevirathne N.H.M.V.N., Mendis B.E.P., Rajapakse R.P.N.P.,
Perera H.K.I.[1*] and Weerapperuma T.M.K.B.B.**
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Glycation is a non-enzymatic reaction occurring in human body which leads to occurrence of various non-communicable diseases. In a person with chronic hyperglycemia, glycation occurs at higher rates resulting in chronic diabetic complications. With the objective of identifying potentially safe natural sources with glycation inhibition properties, lemongrass (*Cymbopogon citratus*) whole plant, turmeric (*Curcuma longa*) rhizome, Ceylon cinnamon (*Cinnamomum zeylanicum*) bark, piperine 95, a pure extract from *Piper nigrum* and ginger (*Zingiber Officinale*) rhizome were studied. The plant material for the study was collected through the Department of Export Agriculture. Dried and powdered samples were extracted three times with distilled water using ultra-sonic assisted extraction method. Aqueous extracts were first concentrated through rotary evaporation at 50 °C and then freeze-dried. Freeze dried samples were re-dissolved in distilled water to obtain the test samples in a concentration series of 200 mg/mL–0.625 mg/mL. Chicken egg lysozyme was incubated with fructose in a phosphate buffer (pH 7.4) at 37 °C for 30 days in the presence and absence (negative control) of prepared plant extracts. Aminoguanidine was used as standard glycation inhibitor in positive control and blank samples included only plant extracts incubated in lysozyme. Aliquots of samples were obtained on day 7 and 21 of incubation and analyzed along with molecular weight markers (MW) using sodium dodecyl-sulfate polyacrylamide gel electrophoresis (SDS-PAGE) to identify the inhibition effect against glycation induced cross linking of proteins. On day 7 compared to negative and the positive control, *C. zeylanicum* indicated the highest antiglycation activity resulting in a complete glycation inhibition at a concentration of 0.1 mg/mL. On day 21 both *C. citratus* and *C. zeylanicum* showed complete inhibition of cross-linking at 0.5 mg/mL concentration which was the highest inhibition activity. On both days *C. domestica* indicated the lowest antiglycation activity. In conclusion, among the studied plant extracts *C. citratus* and *C. zeylanicum* indicated the highest *In vitro* antiglycation activity.

Keywords: Diabetes complications, Glycation, Hyperglycemia

[1]Department of Biochemistry, Faculty of Medicine, University of Peradeniya, Sri Lanka.
*kumuduperera10@gmail.com

Effects of Storage Time Period on Grain Quality Characteristics of Selected Improved and Traditional Rice (*Oryza sativa* L.) Varieties in Sri Lanka

Herath H.M.L.P., Rajapakse R.P.N.P., Senanayake D.M.J.B.[1]* and Senarathna B.M.K.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Several physical and milling properties of rice grains of 12 selected improved and traditional rice (*Oryza sativa* L.) varieties harvested in three seasons (2021 *Yala*, 2021/22 *Maha*, and 2022 *Yala*) were evaluated. All the tested parameters had significant ($P<0.05$) variations among rice varieties in relevant seasons and among seasons. The brown rice and hull percentages varied from 75-79% and 20-24%, respectively while the head rice yield varied between 56-71% for raw rice in 2021 *Yala* season. In the 2021/22 *Maha* season, the brown rice and hull percentage varied from 74–80% and 20–25% for selected varieties, except for the variety suduheenati, At 311 and At 362. The brown rice and hull percentages varied from 75-79% and 21-25%, respectively while the head rice yield varied between 55-74% for raw rice, except for the variety At 311 and Bg 374 in 2022 *Yala* season. Majority of rice varieties harvested in all three seasons, except for suduheenati in 2021 *Yala* and 2021/22 *Maha* showed an intermediate gelatinization temperature (70–74 ºC). At 362 rice variety in all three seasons showed low gelatinization temperature of 55-69ºC. High amylose content was observed in the majority of varieties except for At 311 in the 2021/22 *Maha* and 2022 *Yala* seasons. Bulk density, grain elongation, and thousand-grain weight varied significantly ($P<0.05$) in 2021/22 *Maha* season, and there was no significant ($P>0.05$) difference between 2021 *Yala* and 2022 *Yala* seasons.

Keywords: Cooking qualities, Improved rice varieties, Milling properties, Physical properties, Traditional rice varieties

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[1]Rice Research and Development Institute, Bathalagoda, Sri Lanka.
*jsenanayake@gmail.com

Development of an Avocado Pulp Based Spread

Rajapaksha R.M.M.P., Mendis B.E.P.[*], Rajapakse R.P.N.P. and Rajapakse R.P.A.D.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Avocado (*Persea americana*) is a nutritious fruit. The development of products using avocado pulp is a better solution for reducing the post-harvest losses of avocado fruits. This research was conducted targeting to incorporate avocado pulp to formulate a spread with suitable physiochemical characteristics that can be stored at refrigerated conditions. Pretreatment for avocado pulp to reduce enzymatic browning was done by blanching under a hot water bath for 10 s and 20 s at each temperature 80 ℃, 90 ℃ and 100 ℃ and the best time and temperature combination selected was 100 ℃ for 10 s. Ascorbic acid and Sodium metabisulfite were added to the pulp as anti-browning agents and the best combination selected was 2000 mg/kg and 300 mg/kg respectively. Butter was selected as a suitable fat source among margarine and virgin coconut oil by considering the results of sensory evaluation and microbiological evaluation. Curd was added as a texture enhancer by the 1:1 ratio with the butter. As the principle of preservation, pasteurization was done at 90 – 95 ℃ for 45 min to have the least resulting bitterness in the avocado pulp upon heating. Sugar and vanilla were added in different percentages of final weight to mask the bitter taste (sugar - 32%, 34%, 36%, 38% and vanilla - 0.7%, 1.4%, 2.1%, and 2.8%). According to the results of sensory evaluation, 36% sugar level and 0.7% vanilla amount were selected for the final formulation. In the sensory evaluation colour, texture, flavour, aroma, and overall acceptability were evaluated by using hedonic ranking tests and 9-point hedonic rating tests. In the final product pH was 3.91 ± 0.01 and the Brix° value was 49.26 ± 1.861. It consisted of 1325 kJ, 14.4 g and 45.8 g of energy, total fat, and available carbohydrate per 100 g, respectively.

Keywords: Anti-browning, Avocado pulp, Blanching, Masking of bitterness

[1]HJS Condiments (Pvt) Ltd, BOI Zone, Biyagama, Sri Lanka
[*]ereshamendis@agri.pdn.ac.lk

Extraction of Rambutan (*Nephelium lappaceum* L.) Peel and Possibility of using the Microencapsulated Extract in Product Development

Samarakoon S.M.V.G.A.P., Illeperuma D.C.K.[*] and Senarathne S.M.A.C.U.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Malwane variety of *rambutan* is popular due to its attractive reddish colour peel and easily separable thick flesh. Increase in its consumption has led to accumulation of considerable amount of the peel, which contains anthocyanins and other bioactive compounds. Therefore, the objectives of this study was to extract rambutan peel, and to explore the possibility of using microencapsulated extract in product development. The frozen peels (-18 °C) were extracted with water at 50 °C. The extract was microencapsulated using maltodextrin, and spray dried to a powder (MESP). Total phenolic content (TPC) of the water extract of the frozen peel (WEFP), and anthocyanin content (AC), TPC, and antioxidant activity (AA), moisture content (MC) and water activity of the MESP were determined. The MESP was incorporated as an ingredient in formulating pasta and jelly to find out the effectiveness of its incorporation. TPC of the WEFP was 24.52 ± 0.47 mg/mL, amounting to 12.3% (g/g) of the frozen peel. AC of 24.76 ± 0.04 µg/g, TPC of 373 ± 7 mg/g, AA of 81%, MC of 7.8 ± 0.0% and water activity of 0.413 ± 0.004 were observed for the MESP. Incorporation of the MESP in pasta imparted a reddish colour, which did not change during boiling of the finished product. This indicates the ability of MESP to impart colour in starch-based products processed at high temperature and re-constituted in boiling water. However, coagulation and darkening of colour were evident when MSSP was incorporated in the formulation of jelly. Further research is necessary to find out possible applications of the MESP. The results of this study revealed the potential of utilizing throwaway rambutan peels.

Keywords: Bioactive compounds, Microencapsulation, Rambutan peel extract

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[1]Food Research Unit, Department of Agriculture, Gannoruwa, Sri Lanka
[*]chamarai@agri.pdn.ac.lk

Formulation and Production of Vegan Mayonnaise

Sandamenu H.A.T., Arampath P.C.[*], Rajapakse A.[1] and Rathnayake A.R.M.D.K.B.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Mayonnaise is a popular semisolid condiment that enhances mouth feel and flavour of food. There is a huge demand for vegan mayonnaise from worldwide by the vegetarian. Aquafaba, a viscous liquid produced during cooking of chickpeas, is a popular egg replacement. It has the ability of performing functionality of eggs. Aquafaba is prepared by soaking different types of legumes. Because of various functional properties, it is utilized in production of several plant-based foods. This research was to produce a vegan mayonnaise using aquafaba and to evaluate the most suitable formulation. Physicochemical properties and consumer acceptability were determined. The chickpea aquafaba was prepared by soaking chickpeas for 24 h with 7.5% (w/v) brine solution and later boiled for 15 min at 100 °C with different volumes of water (650 mL, 750 mL and 850 mL). The results were significantly ($P < 0.05$) higher in total soluble solids (4.53 ± 0.05), viscosity (81.16 ± 0.28), and pH (3.33 ± 0.01) in chickpea aquafaba boiled with 750 mL of water. The mayonnaise prepared with 750 mL of water, chickpea aquafaba performed desirable hardness (0.10 ± 0.00). The total plate count (138 CFU/g) and yeast and mold count (39 CFU/g) were determined. The consumer acceptability evaluation was significantly different ($P < 0.05$) among three treatments. Vegan mayonnaise produced with 750 mL water aquafaba showed the highest mean score for colour, appearance, mouth feel, flavor, and overall acceptability. The 750 mL water treatment showed 2.7 g/100 g protein, 57.9 g/100 g fat, 6.6 g/100 g carbohydrate, 0.2 g/100 g ash, 558.3 g/100 g energy value and 32.6 g/100 g moisture. Aquafaba produced from chickpeas soaked for 24 h, boiled with 750 mL of water for 15 min at 100 °C possessed a high potential for applications in plant-based mayonnaise with microbial safety and consumer acceptability.

Keywords: Aquafaba, Egg replacement, Emulsion, Reformulation, Vegan mayonnaise

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[1]HJS Condiments Ltd., Block 61,62 &63, Biyagama Export Processing Zone, Sri Lanka
[*]pcarampath@gmail.com

Development of Nutritious Biscuits using Composite Flour of Pumpkin (*Cucurbita maxima*), Corn (*Zea mays)* and Soybean (*Glycine max*) for Young Children and Quality Evaluation

Wanigasooriya W.M.D.S.N., Arampath P.C.[*] and Wellala C.K.D.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Nutrients are vital for growth and development of body. The growth and mental development of malnourished young children are affected due to intake of inadequate nutrients. The objective of this study was to formulate and develop a nutritious biscuit using composite flour of pumpkin, soybean, and corn for children under 5 years old. Composite flour was prepared by blending wheat flour with pumpkin flour, soybean flour and corn flour; 100:0:0:0 (T1), 85:5:5:5 (T2), 70:10:10:10 (T3) and 55:15:15:15 (T4) respectively. The functional properties of the prepared composite flour were evaluated for suitability on production of biscuits. Functional properties, microbial quality, sensory parameters, proximate and nutritional composition were tested. Functional properties, water absorption capacity, oil absorption capacity and foam capacity were significantly higher ($P<0.05$) in composite flour. However, foam stability, and bulk density were significantly lower ($P<0.05$) compared with wheat flour. There is no significant different in swelling capacity among four treatments ($P>0.05$). Sensory evaluation indicated that baby biscuit with composite flour (wheat: soyabean: pumpkin: corn) incorporated at the level of treatment three (T3: 70:10:10:10) was significantly higher ($P<0.05$) in biscuit for colour, flavour, texture and overall acceptability except for aroma as revealed by preference tests. The biscuits made from T3 contained was 3.96% moisture (wb), 2.66% ash, 14.18% fat, 2.23% fiber, 3.43% protein, 74.75% carbohydrate, 46.00 mg/g calcium, 3.18 mg/g iron and 427.90 mg/g potassium. Total plate count (540CFU) and yeast and mold counts (360CFU) were less than the microbial limits of the standard for biscuits. In conclusion, developed biscuits using the composite flour is an alternative to provide nutrient for young children.

Key words: Baby biscuit, Complimentary feeding, Nutrition composition, Microbial quality, Sensory evaluation

[1]Food Research Unit, Gannoruwa, Sri Lanka
[*]pcarampath@gmail.com

Development of a Spice Oleoresin Mixture as a Substitute for Commercial Raw Spice Mixture, in the Processed Meat Industry

Waraketiya W.M.A.S., Mendis B.E.P.[*], Rajapakse R.P.N.P., Rengaraj T.[1] and De Silva U.K.S.K.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

In the processed meat industry, a wide range of raw spice blends is added to products to impart unique sensory attributes. It is a challenge for manufacturers to maintain quality consistency in their products, as the sensory, and other physicochemical properties of raw spices vary due to many factors. This research was conducted to identify the potential of using oleoresin mixtures as substitutes for raw spice mixtures. Eight Oleoresin mixtures (F1- F8) were prepared using pepper, coriander, nutmeg and cardamon oleoresins and the mixture of modified starch and maltodextrin was used as the carrier of oleoresin mixtures. These mixtures were incorporated into sausages to match the flavour of the target raw spice mixture. Based on sensory data obtained using preliminary trials, oleoresin mixtures (F1, F4 and F5) were selected and incorporated into the sausages. Sausages were subjected to sensory evaluation using difference from control test to identify the perceived differences in flavour between raw spice mixture and oleoresin-incorporated sausage samples. Difference from control mean score of sample F5 showed no significant difference from that of the blind control ($P>0.05$) exhibiting its potential to incorporate into sausages to obtain the same flavour properties of the raw spice mixture. Physiochemical properties (pH, hygroscopicity, moisture content, color value, bulk density, tapped density and, residual solvent) and microbiological properties of the selected oleoresin mixture (F5) were also examined. The oleoresin mixture was evaluated for its stability to impart flavour for 5 weeks and a regression analysis was used to determine its stability in terms of $t_{1/2}$, the time required for an analyte to reduce to 50% of its initial value. Major flavor components of the oleoresins used in the mixture; piperine, sabinene, myristicin and β-caryophyllene showed $t_{(1/2)}$ of 42.25, 12.16, 12.83 and, 53.30 weeks respectively.

Keywords: Maltodextrin, Modified starch, Oleoresin

[1]STAY Naturals Private Limited., No. 45, Ambangangawatte Road, Kawatayamuna, Kawdupelelle, Matale, Sri Lanka.
[*]ereshamendis@agri.pdn.ac.lk

Nutritional Composition and Anti-hyperglycemic Potential of *Terminalia catappa* L. Fruits' Seed Kernel

**Wijesekara M.M.T., Mendis B.E.P., Marikkar J.M.N.[1*],
Jayasinghe U.L.B.[1] and Ulpathakumbura B.S.K.[1]**
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Terminalia catappa L. is an underutilized plant species and studying the nutritional and functional properties of the seed kernels would be supportive in order to identify its potential uses. This research aimed to assess the nutritional composition, antioxidative and *in vitro* antihyperglycemic properties of seed kernels obtained from two cultivars grown in Sri Lanka, namely, the purple cultivar and the yellow cultivar. The varietal differences in proximate composition, fatty acid profile and mineral composition were determined. Seed kernel samples of individual cultivars were sequentially extracted with hexane, ethyl acetate and methanol The extracts were evaluated for total phenolic content, anti-oxidative and *in vitro* antihyperglycemic activities using relevant assays. The main constituents of these seed kernels, regardless of cultivar, were fat (60.36-66.25%) followed by protein (25.22-25.95%). Linoleic, palmitic, and oleic were found as the major fatty acids, whereas unsaturated fatty acids were predominantly found in the oil fraction of this seed. Among solvent extracts, the methanol extract of the purple cultivar had the highest total phenolic content (17.77 ± 0.15 mg of GAE/g) and FRAP value (116.12 ± 11.80 µmole of $FeSO_4$ /g). The hexane extract of the yellow cultivar exhibited the highest DPPH radical scavenging activity (IC_{50}-280.79 ± 10.11 mg/dm^3), while the methanol extract of the Purple cultivar showed the highest $ABTS^+$ radical scavenging activity (IC_{50} -1723.44 ± 53.73 mg/dm^3). Ethyl acetate extract of Purple cultivar displayed the strongest inhibitory activity against alpha-glucosidase (IC_{50} -104.13 ± 1.22 mg/dm^3). Interestingly, Ethyl acetate extracts of both cultivars showed significantly ($p<0.05$) higher inhibition against alpha-glucosidase when compared to the acarbose drug. Meanwhile, the methanol extract of yellow cultivar showed the strongest alpha-amylase inhibitory activity (IC_{50} -2137.95 ± 118.54 mg/dm^3). This study concludes that *Terminalia catappa* L. is a potent source that can be used to develop safer alternative remedy for controlling diabetes.

Keywords: Antihyperglycemic activity, Antioxidant activity, Bioactivities, Fatty acid profile, *Terminalia catappa* L. seed kernel

[1]National Institute of Fundamental Studies, Hanthana Road, Kandy, Sri Lanka
*nazrim.ma@nifs.ac.lk

Community, Environment and Management

A Case Study on the Relationships between the Dietary Patterns and the Nutritional Status of School Children of the Farming Community in "*Galkadapathana*" Village in Sri Lanka

Siriwardhane J.M.C.K.B., Samarakoon E.R.J.,[*] and Anuradha J.M.P.N.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Nutritional status is an important indicator for measuring the quality of life of children. *Galkadapthana* is a rural agricultural village in the Nuwara Eliya district. Villagers confront difficulties related to their nutritional status due to low-income levels, education levels, and infrastructure facilities. This study was undertaken to identify the relationships between the nutritional status of school children of *Galakadapathana* village and their dietary patterns. A community-based cross-sectional study was carried out using a deductive approach. A total of 85 households with 137 school children in the age group of 6-18 years were randomly selected. Data was collected using structured surveys and conducting face-to-face interviews. The nutritional status of children was assessed through anthropometric measurements. Among 137 school children, there were 71 boys and 66 girls. Stunting was seen in 16.9% of boys and 4.2% were severely stunted based on height- for- age, according to the WHO standard. Furthermore, 12.1% are stunted, while 7.6% were severely stunted in girls. Based on the WHO standard for BMI-for-age, 7.6% of girls and 7.0% of boys were severely underweight. The prevalence of overweight was 3.6% and obesity was 2.2% of the population. Obesity was predominantly seen among girls (4.5%), and not observed among boys. The amount of starchy food intake showed a significant impact on the prevalence of wasting ($P<0.05$), but not the dietary diversity.

Keywords: Dietary diversity, Malnutrition, Nutritional status, Stunting, Underweight

[1]Department of Agricultural Extension, Faculty of Agriculture, University of Peradeniya,
 Peradeniya
[*]rasanjalis@agri.pdn.ac.lk

A Comparative Study of Species Diversity and Composition of Homegardens in Matara District: A Case Study from Hakmana and Akuressa

Madushani K.G.D. and Sivananthawerl T.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Tropical homegardens are characterized by a diverse mixture of perennial and annual plant species arranged in a complex vertical and horizontal structure in which trees play a dominant role. They have multiple functions, especially in rural areas in Sri Lanka. Homegarden systems can be considered as one of the best ways to fulfill food and nutrition requirements of the increasing population. With increasing pressure with land fragmentation, and food and nutrition requirements of family, it is necessary to identify potential measures for improvement of home gardens to reach increasing demands. The objectives of this study were to assess the home garden systems in Akuressa and Hakmana Divisional Secretariat (DS) of Matara district which belong to wet and intermediate zones respectively, for their species composition and diversity. For the study, 60 homegardens were selected randomly as 30 homegardens per each DS division. Eighty-one different crop species were identified in the homegardens. Tea was the most dominant crop species found in Akuressa. Coconut, Arecanut, Mango, Jack and Bread fruit were the other most abundant crop species found in both DS divisions. Higher number of timber trees was found in Hakmana (13 trees/home garden). Higher number of fruit trees (20 trees/home garden), export agricultural crops (23 trees/home garden) and other cash crops were found in Akuressa. Shannon Wiener index was used to compare the diversity, which showed no differences between Hakmana and Akuressa for Timber trees (P=0.71), Fruit trees (P=0.65) and Export agricultural crops (P=0.56). However, it showed a significant difference for other cash crops (P<0.0001). This was mainly due to the mono crop of tea found abundantly in Akuressa which reduced the Shannon Wiener index values.

Key words: Akuressa, Comparison, Hakmana, Home Garden, Species diversity

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[*]sivawerl@agri.pdn.ac.lk

A Need Assessment of Poultry Farmers for Developing a Digital Application to Improve Feed Efficiency

Rajapaksha R.W.M.M.P., Perera W.N.U.[*], Vidanarachchi J.K. and Adikari N.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Feed cost occupies around 70% of the cost of production in poultry operations and justifies efficient feed utilization. The potential for developing a digital application to support record-keeping and efficient feed utilization was evaluated by assessing farmers' needs as the initial step. This study investigated the responses of poultry farmers to a structured questionnaire based on their awareness of feed efficiency, current record-keeping practices, and digital literacy. Data were collected from 72 poultry farmers in Dummalasuriya veterinary region through a primary survey. Data were analysed using descriptive analytics and the Chi-square test by SPSS version 22 software. The sample comprised mainly layer (80.5%) and broiler (19.5%) farmers. Most farmers (72%) have multiple batch systems of rearing birds that generate more data to be recorded, justifying the need for a proper record-keeping system. Most farmers (97%) were aware that the feed cost is the highest contribution to the total cost of production. Farmers' awareness of feed efficiency was associated ($P<0.05$) with their education level. Despite the higher awareness of feed conversion ratio (FCR) in more educated farmers, the practice of calculating FCR was influenced by the type of bird ($P<0.05$), showing their perspective that FCR is only for broiler chicken. Irrespective of the scale of operation and level of commitment, around 80% of farmers kept records. Only one farmer uses an app currently. Nevertheless, most farmers were willing to use an app (65%), with 94% preference for using it on a mobile device. Around 83% of the farmers who were willing to use an app had no access to a desktop computer. These findings justify and facilitate the development of a mobile application for improving feed efficiency, and recommend providing skills, literacy and logistics for digital involvement in poultry operations for an efficient use of valuable feed resources.

Keywords: Broiler, Digital app, Feed conversion ratio, Layer, Record-keeping

[1]Department of Computer Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka
[*]nipunap@agri.pdn.ac.lk

A Review of Fundamentals and Applications Involved in Stereotypic Behaviors in Zoo Animals

Wijethilake M.M.D. and Samarakone T.S.[*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Animal and human activities that are repetitive, unvarying and purposeless are described as stereotypic behaviours. Frustration to perform normal behavioural patterns, brain malfunction or repeated attempts to fix some problems are identified among many causes of these behaviours. Stereotypic behaviours are observed in many categories of animals including farm and pet animals. However, in wild animals, especially mammals in captivity frequently perform stereotypic behaviours that indicates stress from inadequate adaptation to captivity which is a serious welfare concern. Some common forms of stereotypies observed in captive conditions include repeated swaying of the whole body from one side to the other, weaving with the head, swinging the trunk, lifting the feet and bobbing up and down with the head in captive elephants. Pacing, head-bobbing, rocking, walking in circles, compulsive licking, bar biting, and self-mutilation are commonly observed stereotypies in carnivores such as captive tigers, leopards and lions. In non-human primates, self-clasping, rocking, eye poking, pacing, coprophagy, head shake and hair picking have been commonly observed. In this review, fundamental causes of stereotypic behaviours, welfare implications and some strategies that have been adopted to mitigate stereotypic behaviours (i.e., social, feeding and environmental enrichments) are discussed mainly focusing captive elephants, carnivores and non-human primates.

Keywords: Behaviour, Stereotypes, Welfare

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[*]thusiths@agri.pdn.ac.lk

A Situational Analysis of Wild Animal Damage in *Kandyan* Homegarden System

Kumara N.V.K.P., Wijerathna R.M.S.[1], De Silva S.H.N.P., Sivananthawerl T. and Ranil R.H.G.*

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Wild animal damage is a big challenge for the cultivation and management of home garden crops across the country making significant yield losses, physical damages, and provoking financial losses. The *Kandyan* home garden system (KHGS) is considered one of the most sustainable agricultural ecosystems and wild animal attack in the KHGS has increased at an alarming rate over the last two decades. The present study aimed to understand and analyze the current situation of crop damage by wild animals within the KHGS. A questionnaire survey was conducted in 60 home gardens in the *Kandy* district. The quadrat method was used to assess the crop damage of the wild animal attack in six selected home gardens over two months. The risk index and severity index were calculated to access the risk and the severity of the wild animal damage. Currently practiced control methods were also assessed for their effectiveness and the ethnobiological knowledge related to wild animal damage was also extracted. Data were analyzed using the chi-square test and descriptive statistics methods. This study confirmed that wild animal attack is a main problem in the KHGS which requires immediate attention. Monkey is the most distractive and severe animal, and they have adapted to most of the widely practiced control measures. The highest risk index was observed for wild boars (0.870), followed by monkeys (0.833), porcupines (0.790), and giant squirrels (0.550). The peacock attack is not significant in KHGS yet. Annona, avocado, rambutan, guava, and durian was found to have more than 70% of yield losses due to wild animal damage. The currently practiced methods would not be effective to control wild animal attacks in KHGS. It implies that a well-focused strategic plan is required to handle this issue without further delay.

Keywords: *Kandyan* home garden, Risk index, Severity index, Wild animal damage

[1]Department of Extension, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
*rrajapaksha@agri.pdn.ac.lk

Above Ground Biomass Estimation of *Gliricidia sepium*

Piyarathna L.A.R.[*i] and Sivananthawerl T.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Gliricidia sepium is the most widely known cultivated species which belongs to genus *Gliricidia* is a tree species with several remarkable attributes. As a result it is popular among the farming communities of the Asian and Pacific region. Even though, weighing of the actual tree biomass in the field is the most accurate method to determine tree biomass, it is an extremely time consuming and destructive method. Use of allometric relationships yields a non-destructives and indirect measurement of biomass components and is often the preferred approach since it is less time consuming and less expensive than direct measurements. Development of relationship between biomass and diameter is very useful for the timber merchants and to the officers who are involved in the legal procedures of felling. This study was carried out to identify the relationship among tree biomass and diameter at the breast height, basal diameters and tree height. For this purpose different fitted models were tested to select a most appropriate model. To develop the relationship between biomass/carbon stock and the tree parameters (Tree height, Diameter, Weight) 22 trees were felled and measured. Standing trees 732, were measured for their diameter and height and predicted the weight and carbon stock based on felled trees. A number of non-linear models were used to identify the best fitted model for biomass estimation using SPSS software. Coefficient of determination (R^2) and RMSE was used to identify the appropriate model. Polynomial quadratic model was found as the best model for estimating the above ground fresh biomass and carbon stock of *Gliricidia sepium.* No relationship between biomass with tree height was observed due to maturity of the trees. Most appropriate fitted model for total biomass was: Total weight :$w = -5.949 *D20 + 1.142* D20^2$. Most appropriate fitted model for total carbon stock was ,Total carbon stock :$C = -2.974 *D20 + 0.571 * D20^2$ (D20;Diameter at the 20cm above root collar)

Keywords: Biomass, Diameter, height, Gliricidia, Models

[*]ag16126@agri.pdn.ac.lk

An Analysis of Economic Transactions of Households in a Rural Community: A Case Study in "*Diddenipotha*" Village in Sri Lanka

Madhurangi B.L.N.K. and Weligamage P.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Information about the nature of transactions by economic agents and the importance of such in the income distribution within economies provide designing social safety nets. However, this information is rarely available for rural communities. This research aimed to identify economic transactions that are taking place within rural households in a selected rural community, quantify the values of transactions, identify the shares of different parties involved in the transactions, and identify the shares of households within and outside of the area. Ellis's (2000) "Sustainable Livelihoods Framework Model" is used as the theoretical framework. Data were collected from 100 randomly selected 100 households from *Diddenipotha* village in the Matara district of Sri Lanka. A structured survey schedule was used. Economic transactions that are currently taking place within households were identified and listed. Binary logistic regression was used to model the relationship between the current employment status and current financial status. Whitney U test was used to check the difference between the quantity of labor within the village and outside of the village. Findings show that there is a significant difference between the quantity of labour used within the village and outside of the village Sixty-five percent of households engage in farming and the sale of farm produce. Thirty-one percent of household heads are tea estate labourers. Some households can be included in neither as labor-hiring nor labor-supplying since they are engaging in self-employment or using family members to work in their fields.

Keywords: Binary logistic regression, Factor shares, Labour use, Rural Sri Lanka, Sustainable livelihoods

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[*]parakw@agri.pdn.ac.lk

An Assessment of Podcasts as a Potential Approach for Agricultural Information Dissemination to Coconut Smallholders in Kurunegala District

Ranaweera K.K.D.M., Dissanayeke U.I.[*] and Herath C.S.[1]
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study was conducted to design, develop and evaluate a podcast series to assess the potential of the podcast for agricultural information dissemination to coconut smallholders in the Kurunegala district. The study was mainly focused on the Wallawa Coconut Development Officer's area in the Kurunegala Coconut Cultivation Board region. ADDIE (Analysis, Designing, Development, Implementation, and Evaluation) instructional design model was followed for the production process. Study community characteristics and coconut cultivation-related information gaps were identified using a baseline survey (n=40), key informant interviews, and focus group discussion. Content for the podcasts was developed, organized, and recorded with the collaboration of the Technology Transfer Division, Coconut Research Institute. Podcasts were presented to the subject expert panel for content validation and to get expert suggestions to improve the podcast. Feedback from the experts was obtained through an online survey and telephone interviews. 35 coconut smallholders in the Wallawa area were recruited and a WhatsApp group was created for the implementation of the finalized Podcast. A short-term WhatsApp Extension campaign was launched to implement the podcast series. The effectiveness of the podcast series was evaluated through an online survey (n=35) and telephone interviews (n=11). According to the finding's majority of the listeners, perceived information disseminated in the programs was very useful (60%), it is easier to get agricultural information through podcasts (96%) and the use of podcasts to disseminate agricultural information is successful (64%). The study concludes that podcasts can be used to disseminate agricultural information related to coconut cultivation in the selected community and communities with similar conditions. The developed podcast series can be integrated into the digital information communication platforms of the Coconut Cultivation Board and Coconut Research Institutes.

Keywords: ADDIE model, Coconut smallholders, ICT, Information dissemination, Podcast

[1]Coconut Research Institute, Bandirippuwa Estate, Lunuwila, Sri Lanka
[*]uvasara@agri.pdn.ac.lk

Analysis of Estate Sector Household Food Security during Economic Crisis 2022 in Sri Lanka

Nanthagopan J. and Prasada D.V.P.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The economic crisis in Sri Lanka creates severe impacts on estate sector food security. This study attempts to estimate the food consumption changes, identify the determinants of food insecurity dimensions, especially the shock factors related to consumption and status of the household food security. The study was carried out with 100 households, selected using stratified random sampling, at the *Kataboola* estate in *Nawalapitya*. Data collection involved interviews using a structured questionnaire. According to the results, households reduced the quantity of wheat (58.7 percent), chicken (70.8 percent), egg (54.8 percent), fish (57.9 percent) and milk powder (73.3 percent) during the crisis episode. Further analysis by multiple linear regression identified the relationship between food insecurity dimensions with the socio- economic factors and shock factors. Food unavailability was negatively impacted by total household income and protein availability shock. Lack of access was also associated with income negatively but positively related with number of household members, number of *Samurdhi* beneficiaries and transport expenditure. Food underutilization was positively impacted by medical expenditure but negatively related to total household income and the number of sick members. The food instability is positively impacted by total number of members and negatively impacted by total household income. The results also displayed that about 56 percent of the households are at the moderate food secure level and 42 percent of the households are in an 'urgent-action-required' situation. Households increased their food expenditure, but this was not sufficient to compensate for the effects of price inflation. This study provides insights which will have important policy implications on the development interventions in the estate sector.

Keywords: Economic crisis, Estate sector, Food security, Regression analysis

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[*]prasada@agri.pdn.ac.lk

Antimicrobial Resistance and Integron Diversity of *Pseudomonas* spp. Isolated from Freshwater Aquarium Fish and Their Environment

Bandara R.M.P.A., Jayawardana N.U. and Jagoda S.S.S. de S.[1*]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Pseudomonas spp. are Gram-negative bacteria widespread in aquatic environments. They are well-known pathogens of fish, terrestrial animals and humans. The objectives of this study were to characterize *Pseudomonas* spp. from freshwater ornamental fish and their farming environment and to determine the antimicrobial susceptibility and presence of integrons. Ten freshwater ornamental fish farms located in the Kurunegala and Puttalam districts (5 each) were visited during the period of August-September 2022. Samples were collected from the skin mucus of apparently-healthy ornamental fish and their farming environment (i.e. tank water, tank sediment and biofilms) and cultured on trypticase soy agar and glutamate starch phenol red agar. *Pseudomonas* spp. were identified using morphological characteristics and conventional biochemical tests. Genetic confirmation at the genus level was done by PCR using *Pseudomonas* genus-specific primers targeting the *16S rRNA* gene. Susceptibility against 5 antimicrobials was determined by the Kirby-Bauer disc diffusion method. The presence of integrons, their class and resistant gene cassettes was determined by PCR. A total of 41 *Pseudomonas* spp. were isolated and characterized. The antimicrobial resistance frequencies of the isolated *Pseudomonas* spp. were; erythromycin (82.93%), amoxicillin (78%), chloramphenicol (56.10%), enrofloxacin (14.63%) and tetracycline (9.76%). Among them, 53.66% isolates were multidrug-resistant (MDR) and 73.17% had multiple antibiotic resistance (MAR) indices of > 0.2, suggesting they originate from high-risk sources of contamination where antibiotics are used frequently. However, only 2 isolates (4.87%) carried integrons of class 1 and one of them had a class 1 gene cassette. Our findings revealed that freshwater aquarium fish and their farming environment act as reservoirs of MDR *Pseudomonas* spp. They may disseminate directly or indirectly *via* ornamental fish and cause difficult-to-treat infections in humans. Our findings highlight the importance of the judicious use of antimicrobials in aquaculture and responsible fish ownership.

Keywords: Antimicrobial resistance, Integron, Ornamental fish, *Pseudomonas*

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[1]Centre for Aquatic Animal Disease Diagnosis and Research (CAADDR), Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]samanthika@vet.pdn.ac.lk

Are Non-Tariff Measures (NTMs) Promoting or Deterring Trade? A Case Study on Mango Exports from Sri Lanka

Wickrama D.G.S.P., Weerahewa J.* and Wickramarachchi W.N.R.[1]
Department of Agriculture Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Tropical fruits have a higher demand from international market and many countries in the tropics can capitalize on this opportunity to earn foreign exchange. Accessing the international fresh fruit market is constrained by the non-tariff measures (NTMs). Better understanding of the nature of NTMs and their effects is a pre-requirement to enter the international fresh fruit market. This study focuses on mango exports from Sri Lanka, NTM related rejections, main NTMs facing mango exports from Sri Lanka, and analyses the effects of NTMs on mango exports. To extract the mango internal and external rejections National Plant Quarantine Service (NPQS) database were used. To identify and classify the main NTMs affecting mangos, the frequency and coverage ratios were calculated using the UNCTAD TRAINS database. To determine the effect of NTMs on mango exports from Sri Lanka, two gravity models were estimated using a panel data set. Bilateral exports of mango at HS 6-digit level were regressed against NTMs for 16 countries for the period 2000 to 2021. The total number of NTMs and specific NTMs related to Sanitary and Phytosanitary (SPS) conditions (A8) were included in the models. The results shows main reasons for internal and external rejections were the presence of pests namely seed weevil and fruit fly and absence of phyto-certification. The incidences of NTM revealed that mango exports in Sri Lanka are critically regulated by SPS, Technical barriers to Trade (TBT), and pre shipment inspection formalities (PSI). The results of the gravity model indicate that TBT, and PSI have positive effects, and total NTMs, SPS, and conformity assessment of SPS have negative effects on mango exports. The results imply NTM and NTM related measures have a considerable impact on mango exports in Sri Lanka illustrating the need to keep higher attention on NTMs to enhance fresh fruits exports.

Keywords: Coverage ratio, Frequency ratio, Gravity model, Incidence approach, Non-tariff measures

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[1]IPPC official contact point, National Plant Quarantine Service (NPQS), Department of Agriculture, Canada Friendship Road, Katunayake, Sri Lanka
*jeevikaw@pdn.ac.lk

Assessment of Consumer Perceptions on Polythene Grocery Bags and Their Alternatives; A Study with Supermarket Consumers in Kurunegala

Withanage W.I.M. and Gunaratne L.H.P.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Plastic grocery bags can cause a variety of environmental problems. Even though a ban on using polythene with a thickness below 20 microns was imposed in 2017, the intended outcome could not be achieved due to the ignorance of consumer preferences of the authorities and the unavailability of suitable alternatives at a reasonable price. In this context this study was carried out to evaluate how people value environmentally friendly approaches against polythene grocery bags, to estimate the different trade-offs among the consumer preferences on packaging material, and to evaluate the relative importance of each attributes of packaging materials. Research design is developed based on random utility models as a discrete choice experiment. Four attributes, namely reusability, environmental friendliness, convenience & availability and price per unit use with three levels each generated 81 treatment combinations and this was reduced to 9 choice sets using Fractional factorial design. The study population was supermarket consumers in Kurunegala district. The study generated 440 observations which were analyzed through a conditional logistic regression model in STATA 14.0. Part-Worth Utilities were calculated according to coefficients of variables. Consumers are willing to pay an additional amount of money over current price for attributes and their levels of shopping bags. Consumers' Marginal willingness to pay is highest, when shopping bags are more times reusability. Consumers' Marginal willingness to pay is lowest, when shopping bags have moderate biodegradability. Consumers are willing to pay [i]around Rs.9.13 for one-time use with desirable environmental characteristics including reusability, bio-degradability, and convenience. Due to consumers' Marginal willingness to pay is highest, when polythene bags are more times reusability, reusable bags can be promoted and improved by banning single-use polythene bags, using technology, promoting the use of polyester reusable bags, increasing the availability and affordability of reusable bags, promoting the use of polyester reusable bag.

Keywords: Choice experiment, Conditional logistic model, Fractional factorial design, Part-worth utility, Supermarket consumers

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[*]lhpgunaratne@agri.pdn.ac.lk

Assessment of Floristic Diversity and Species Composition of Badagamuwa Conservation Forest

Pitiyage I.L. and Sivananthawerl T.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Badagamuwa conservation forest is a semi natural forest located on the wayside of Kurunegala-Dambulla road (A6 road). The forest is resulted from forest regeneration followed by the abandonment of the plantation for several decades. The forest has been subjected to some studies especially identifications of species. However, interpretation of data is mainly limited to a list of species found in the forest. Quantification and calculation of indices of flora have been not developed in the past. As the forest cover has led to destruction by economic activities and development projects in the area, it is important to assess the biodiversity in the forest for the implementation of appropriate conservation management practices. Accordingly the objective of this study was to assess the floristic diversity and species composition of Badagamuwa conservation forest. The experiment was carried out in the forest by randomly allocated 20 sample plots of 20 m × 20 m. The number of seedlings, saplings and trees were identified and recorded to species level. Diameter at breast height of all plant species above 10 cm and height of all plant species above 1.3 m were measured along with their numbers. Shannon - Weiner index, Simpson diversity index and Important Value Index were calculated. The study plots were documented with 75 species belonging to 28 families. The most dominant tree species identified were *Swietenia macrophylla* (introduced)*, Artocarpus hirsutus* (introduced)*, Artocarpus heterophyllus* and *Tectona grandis* (introduced)*. According to the relative abundance, the most abundant plants species detected were *Polyalthia korinti* (12.1%), *Stachytarpheta urticifolia* (12.0%) and *Glycosmis angustifolia* (10.5 %) which all were native shrub layer species. Introduced species such as *Swietenia macrophylla, Tectona grandis, Artocarpus hirsutus* and *Berrya cordifolia* were dominant in saplings and trees compared to native/endemic species. Shannon-Weiner index and Simpson diversity index were 2.6±0.22 and 0.875±0.08 respectively.

Keywords: Badagamuwa, Diversity, Shannon-Weiner index, Simpson's index

[*]sivawerl@agri.pdn.ac.lk

Assessment of Food Safety Knowledge, Attitudes and Practices on Seafood Handling Among Onsite Fish Retailers in Western Province of Sri Lanka

Fernando W.A.M.C., Fernando P.R.M.K., Salwathura A.[1] Himali S.M.C.[*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Food safety plays a significant role in reducing the occurrences of food borne illnesses. When considering seafood safety, the fish retailers knowledge, attitudes and practices (KAP) play a vital role. This survey aimed to assess the KAP of the onsite fish retailers of the Western Province in Sri Lanka. Further the study aimed to find out the association between KAP and socio demographic variables of respondents. A pre tested questionnaire consisted of four main sections; socio demographic variables, knowledge, attitude and practices was used for the survey. Randomly selected 150 fish retailers were chosen to evaluate the KAP. Direct observation and in-depth interviews were conducted to collect the qualitative data. The data were analyzed using SPSS (Statistical Package for the Social Science) version 26. Kruskal Wallis H test was ($P<0.1$) used to examine the socio demographic variables with KAP. Pearsons' correlation analysis was ($P<0.05$) conducted to measure the relationship between KAP. Linear regression model was used to assess the strength of the correlation ($P<0.05$) between knowledge and attitudes. Eighty-eight percentage of the participants were males and the highest number of responses were from the age group of 40 to 60 years. The overall score of the knowledge, attitudes and practices of the fish retailers were 38% (good), 95.33% (positive) and 0.6% (poor), respectively. There were significant relationships between practices with gender, knowledge with age and the attitudes with monthly income. The findings revealed a weak but positive correlation ($r^s= 0.178$) between knowledge and attitude towards the food safety. There was a significant correlation between knowledge and attitude of fish retailers while food safety practices were independent. The knowledge and attitudes of fish retailers on seafood safety are good and positive respectively while their food safety practices on seafood safety is poor.

Keywords: Correlation, KAP, Pre-tested questionnaire, SPSS, Survey

[1]Sri Lanka Standard Institution, 17, Victoria place, Elvitigala Mw., Colombo 08, Sri Lanka
[*]smchimali@agri.pdn.ac.lk

Assessment of Fruit and Vegetable Intake and Nutritional Status of Undergraduate Students at the Faculty of Agriculture, University of Peradeniya

Rankoth L.M., Daundasekara D.M.S.S.,[*] and Rathnaweera W.[1]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The dietary patterns and nutritional status of young adults are important determinants of their health and performance. Therefore, the cross-sectional case study was conducted to explore the dietary practices and nutritional status of undergraduate students of the Faculty of Agriculture, University of Peradeniya. Further, the study aimed to determine the factors associated with fruit and vegetable intake and anthropometric indices of nutritional status. The study sample consisted of 186 students representing all academic years of the Faculty. The weight (kg), height (m), waist circumference (WC) and hip circumference (HC) were measured to calulate the Body Mass Index (BMI), and the Waist to Hip Ratio (WHR). The socio-demographic, lifestyle and dietary data were collected using an online survey. Data were analyzed using SPSS (version 26.0). The majority of the sample was Sinhala (96.7%), female (73.7%) students residing in the university hostels (65.6%). The mean age of the sample was 24.5 years. The commonly consumed fruits among the students were banana, avocado, wood apple, and papaya and the vegetables were carrot, beans, pumpkin, and beetroot. The mean fruit and vegetable intake of students per day was 1.37 (±1.34) and 2.42 (±1.66), respectively. Only 21.5% of the students achieved the recommended fruit intake, while 25.8% achieved the recommended vegetable intake. Based on the Asia-Pasific classification, 47.9% of students were normal weight while 23.1% were underweight, 19.4% were overweight and 9.7% were obese. The place of residence, province, age category and family income were significantly related to the fruit and vegetable intake ($P<0.05$). There was no significant difference ($P>0.05$) in the fruit and vegetable intake by the BMI categories. The factors associated with the BMI and WC were gender, time of stop eating food and water intake. Only gender and age categories were significantly related to the WHR ($P<0.05$).

Keywords: Cross-sectional case study, Dietary patterns, Nutritional status, Recommended dietary intake, Young adults

Assessment of Kandyan Homegardens Towards Enhancing Domestic Food Security, Biodiversity, and Ecosystem Services

Lakshitha K.G.S. and Pushpakumara D.K.N.G.[*]

Department of crop science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

In this study, assessment of the existing level of food security, biodiversity, and ecosystem services was done using 20 Kandyan homegardens located in Peradeniya, Pilimathalawa, and Doluwa areas in the Kandy district. All homegardens were grouped into 3 as small (<0.04 ha), medium (0.04-0.09 ha), and large (>0.09 ha) considering the size of the homegarden. The biodiversity of homegardens was quantified using Shannon Wiener index, and it ranged between 2.02 and 2.74. Species richness was 52 species and ranged from 8 to 21 species among homegardens. There was no significant difference in species richness with the size of the homegarden ($P>0.05$). The abundance of the homegardens was significantly high ($P<0.05$) in medium and large homegardens compared to small homegardens. The evenness ranged between 0.76 and 0.97 irrespective of the size of the homegarden ($P>0.05$). The species density per hectare (range 24 - 813), and tree density per hectare (range 61 - 1500) were found to be significantly different with respect to the size of the homegarden ($P<0.0001$). There were 23 vegetables, 14 leafy vegetables, 25 fruits, 7 spices, and 13 herb species identified within the sampled homegardens. Some homegardens are rearing poultry and livestock. The above-ground (AGB) carbon stocks in sampled homegardens ranged from 4.4 to 100.7 Mg C ha^{-1} with a mean value of 36.5 Mg C ha^{-1}. The proportion of AGB carbon stocks compared to the total carbon stock was high in Jackfruit (*Artocarpus heterophyllus*). Different ecosystem services were also identified. Well-managed Kandyan homegardens ensure food security and ecosystem services, which can be adapted by poorly managed categories with identified species to achieve food security through an increasing number of species, introduction, and management of tree species.

Keywords: Biodiversity, Ecosystem services, Food security, Kandyan Homegardens

[*]ngpkumara@agri.pdn.ac.lk

Assessment of Microplastic Contamination in Upland Vegetable Cultivation System of Sri Lanka

Hansani T.W.P.A., Alahakoon A.M.Y.W. and Karunarathna A.K.[*]
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Microplastics are an emerging contaminant in the environment as it threatens the living creatures in aquatic as well as terrestrial environments. There are increasing number of evidence of accumulating microplastic contaminants in the world, especially in agricultural lands. However, evidence of microplastic pollution in agricultural soils of Sri Lanka are rare; therefore, this study was conducted to assess the microplastic contamination in five fields of upland vegetable cultivation systems of Sri Lanka. Soil samples were collected from five fields; two locations at Meewatura Experimental Station of University of Peradeniya, Gannoruwa Field Experimental Station, a farmland in Doragala, and a farmland in Nuwara Eliya, where there is a history of plastic mulch usage. The soil samples were taken from 0-5 cm and 5-10 cm depth layers and all general chemical and physical parameters were tested. Microplastic analysis was done by digesting the soil using H_2O_2 solution, and density separation with NaCl solution. The extracted microplastics were counted under a light microscope, pictures were taken to record shape factors, and weighted using analytical balance. The results revealed that the number of microplastic particles in fields were ranging from 2,550±70.8 to 5,800±424 particles kg^{-1} of soil and Nuwara Eliya strawberry cultivation field had significantly higher number though there was no significant difference between depth layers. The microscopic analysis showed that fragment particles were dominant in Meewatura field (50-70%) while filament particles were greater in other fields. Black, transparent and blue color microplastics were dominant over other colors such as red, yellow, purple, and white. The estimated plastic contamination levels were comparable to reported values in agricultural fields of other countries. In conclusion, the preliminary research revealed that the assessed fields of upland agricultural cultivation system of Sri Lanka are contaminated by microplastics that could have been originated from plastics utilities, agro-inputs and runoff flow into agricultural fields.

Keywords: Microplastic, Soil contamination, Upland vegetable system

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[*]anujica@agri.pdn.ac.lk

Assessment of Riparian Vegetation of *Weoya* and *Halgolla* Estates in *Weoya* Catchment for its Conservation

Bandara U.D.H.P., Gamage A.T.[1], Thilakarathne A.[1] and Pushpakumara D.K.N.G.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Riparian ecosystems which are lying on the riverbanks are highly diverse in nature and also referred eco-tones since they are located in between terrestrial and aquatic ecosystems. Sri Lanka, an island of Indian Ocean comprises 103 natural rivers; therefore studying about riparian ecosystems of the country is significant in ecological purposes. This study was conducted to assess the riparian vegetation of the *Weoya*, a left bank tributary of *Kelani* River, Sri Lanka, under four land use categories, namely Rubber Buffer Zone (RBZ), Encroached Riverbank Reservation (ERR), Homegarden based Riparian (HGR) and Natural Riparian (NRF). Plots of 5 m ×20 m established perpendicular to the riverbanks from shallow water depth were again divided into two-transverse adjoined plots. Vegetation diversity of each land use was calculated for three strata; canopy, understory and ground cover, using Shannon-Weiner Diversity Index (SWI). From experimental plots, 182 floral species were recorded and categorized under trees, vines, shrubs, herbs, grasses and ferns. Nested factor factorial model and ANOVA procedure were used to analyze data at $P<0.05$ significance. Results show that canopy SWI is significantly higher in RBZ and NRF than ERR and HGR showing human influences to reduce tree diversity. Understory SWI is significantly low in upper plots than lower plots while ground cover shows no significant difference in SWI. Due to presence in all land use categories and also due to the suitability, *Areca catechu, Caryota urens, Artocarpus heterophyllus, Madhuca neriifolia, Hydnocarpus venenatus, Horsfieldia iryaghedhi, Bambusa vulgaris* and *Barringtonia racemosa* were identified as suitable tree species to plant on the riverbanks of *Weoya* catchment.

Keywords: *Kelani* River Basin, Riparian vegetation, Sri Lanka, Vegetation assessment, *Weoya*

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[1]Kelani Valley Plantations PLC, 400, Dean's road, Colombo 10, Sri Lanka
[*]ngpkumara@agri.pdn.ac.lk

Can Tea-Coffee Agroforestry Model Restore Tea, Coffee Production, Above Ground Biomass, Bio Diversity and Soil Health?

Kumara N.G.K.L.C., Gamage A.T.[1i], Wanniarachchi U.[1] and Pushpakumara D.K.N.G.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Global agriculture is now facing challenges, and important challenges for agriculture at the global level may be identified. Climate change, limited arable land area, and limited agricultural inputs are all common among the primary challenges stated, and they all require common solutions. Experts recommend going with green agriculture as a solution, as well as developing and testing ways to restore damaged areas to arable status. The purpose of this study is to assess the appropriateness of a naturally generated tea-coffee agroforestry integrated ecosystem model for restoring degraded lands to arable status. In the study, the tea-coffee agroforestry model was compared to the natural forest ecosystem and tea cultivated land. As major sections of study, the aboveground biomass, soil health, bio diversity, and economic production were all tested in three ecosystems. For that, each ecosystem was examined for, soil parameters (total nitrogen, available potassium, available phosphorus, pH, EC, OM%, OC%, soil macro faunal density, physical parameters: sand%, silt%, clay%, bulk density), Biological parameters (floral variety, floral density, soil surface insect density, aboveground biomass), and economic outcome from each ecosystem. The one factor factorial experimental method was used to analyze data, and mean comparisons revealed that soil organic matter%, soil organic carbon%, soil EC, average Shannon Weiner index, average floral species evenness, average floral density (<5cm diameter), average floral diversity (<5cm diameter), and total average ground insect count had comparatively higher and significant different values. Different levels of soil total nitrogen, available potassium, soil average pH, and floral species density were shown to be comparably lower and significant in the findings (all plant species from ground cover). As a consequence of the findings, the tea-coffee agroforestry model is in the midst of the secondary successional phase and may be successfully applied to create arable land from degraded land.

Keywords: Agroforestry, Coffee, Degraded land, Secondary succession, Tea

[1]Kelani Valley Plantations PLC, 400, Dean's road, Colombo 10, Sri Lanka
[*]ngpkumara@agri.pdn.ac.lk

Cognitive Factors Affecting Soil Conservation Efforts of Farmers in the Hill Country of Sri Lanka: An Insight from Galkadapathana Village in the Walapane Divisional Secretariat

Jayasinghe R.G.N.D. and Jayaweera A.[*]

Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Soil erosion and loss of soil fertility are burgeoning environmental issues with adverse repercussions on farm livelihoods in the Hill Country of Sri Lanka. Expansion and intensification of commercial vegetable farming, in the absence of adequate efforts to curb soil erosion and nutrient loss at the farm level, have led to soil degradation at an alarming rate in the Central Hills. Although farmers have been constantly made aware of the risks of soil degradation on their livelihoods by the extension and other state agencies, adoption of soil conservation measures in the Hill region still remains at an unsatisfactory level. Soil conservation, in an agrarian context, is the sustainable utilization of available land resources, application of erosion control measures, and adoption of suitable cropping patterns with the goal of maintaining soil productivity and soil health. This study, with reference to a sample of farmers (n = 60) drawn from the Galkadapathana GN division of the Walapane Divisional Secretariat, was conducted to reveal the cognitive factors (i.e., values, perceived risk, perceived behavioural control and perceived benefits of soil conservation) that would predict the adoption of soil conservation practices by the Hill farmers. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to validate the measurement model and to test the hypotheses. The SmartPLS-4 was used to assess both the measurement model and the structural model. The results confirmed the validity of the model. The findings of the research depicted the pervasive role of farmers' perceived behavioural control in predicting their tendency to adopt soil conservation measures. The finding of this study can contribute to develop programs to motivate farmers to adopt soil conservation practices.

Keywords: Perceived behavioral control, Perceived benefits, Perceived risk, Soil conservation, Values

[*]anuradhaj@agri.pdn.ac.lk

Consumer Awareness and Acceptance of Insect-Based Food and Feed in Sri Lanka

Bhagya V.P.I., Weththasinghe P.*, Weerasooriya S.A.[1] and Jayawardana B.C.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study aimed to evaluate the consumer awarene ss and acceptance of insect-based food and feed in Sri Lanka, and to determine whether the acceptance can be increased by provision of information. A web-based survey was conducted with 1059 participants to determine consumer awareness and acceptance. Among the participants, 93%, 43% and 33% were aware of insect-based food, feed and pet food, respectively. The probability of being aware of insect-based food was significantly ($P<0.05$) lower among males than among females. The probability of being insects aware of insect-based feed was significantly ($P<0.05$) higher among people aged 18-30 years than among people aged below 18 years. A majority (75%) of participants in the survey were willing to eat insect-based food or food produced from animals fed with, where a majority of them was willing to eat insects-fed chicken eggs. Acceptance of insect-based food and feed among males was significantly ($P<0.05$) high compared to that among females, and low among Hindus compared to Buddhists. A paper-based survey was conducted (using 210 third-year undergraduate students) to evaluate whether the provision of information could change the level of acceptance. The participants were randomly assigned to 3 groups (n=70): the control group (no information), group provided with information via a leaflet, and group provided with information via a video. The acceptance of insects-based food was significantly ($P<0.1$) high in the video group compared to the control group, whereas there was no difference between leaflet and control groups. The acceptance of insects-based feed and pet food was not affected by the information provided. In conclusion, there is a potential to use insects as a food and feed source in Sri Lanka, and consumer acceptance of insect-based food can be increased by provision of information via video.

Keywords: Consumer acceptance, Consumer awareness, Insect-based feed, Insect-based food, Pet food

[1]Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
*pabodhaw@agri.pdn.ac.lk

Consumer Awareness, Perceptions, and Health-Related Marketing of Ceylon Black Tea

Weerasinghe W.M.A.M., Weerasooriya S.A.[*] and Shyamalie H.W.[1]
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Local tea consumption in Sri Lanka is at a lower level. In addition, the threat of Sri Lanka losing its comparative advantage in the global tea market is ever looming. A dearth of literature provides evidence of the health benefits of black tea in a Sri Lankan context. Within this milieu, this study aims to assess the impact of socio-demographic factors on the awareness of the health benefits, and differences in perceptions among different consumer segments towards black tea consumption and to investigate the possibility of health-related marketing in black tea. A case study was carried out using a cross-sectional questionnaire by recruiting 150 local and foreign individuals over 18 years old, in the Nuwara-Eliya DS division by adopting cluster and convenient sampling respectively. The questionnaire focused on socio-demographic and awareness-related information, consumer perceptions based on the health belief model, and health-related marketing aspects based on a discrete choice model. Awareness of cardiovascular disease prevention got the highest mean score whereas bone health got the lowest. Education level and marital status positively, and age negatively affected the level of awareness ($p<0.05$). MANOVA results depict there are significant differences in consumer perceptions among immigration statuses, education and awareness levels ($p<0.05$). Multinomial logit regression results depict the probabilities of secondary and tertiary educated respondents choosing choices 4 (light color, sweet taste, high price with health benefits) and 2 (dark color, bitter taste, low price without health benefits) got positive and negative coefficients respectively. Choice 3 (dark color, bitter taste, low price with health benefits) was the base outcome. It could be concluded, (1) Consumer awareness is at a medium level (2) Age, education level, and marital status affect the level of awareness (3) Differences in perceptions among immigration statuses, education, and awareness levels (4) A possibility of health-related marketing in black tea.

Keywords: Consumer perceptions and awareness, Discrete choice model, Health belief model, Health benefits of black tea, Multinomial logit regression

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[1]Tea Research Institute of Sri Lanka, Sri Lanka
[*]senalw@agri.pdn.ac.lk

Current Status and Future Potentials for Alternative Feed Ingredients Usage in Self-Mixed Poultry Feed Production in Dummalasuriya Veterinary Region, North-Western Province, Sri Lanka

Rubasinghe T.P., Perera W.N.U.,* and Vidanarachchi J.K.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Even the most optimistic forecasts do not guarantee that the animal feed industry can meet the future global requirements for traditional feed ingredients. Therefore, an increasing interest in locally available, low-cost alternative feed ingredients (AFI) is evident. The primary aim of this study was to identify the current practices and future potentials of using AFI in self-mixed feed production based on self-mixers' experiences, production scale, and education level. A pre-tested questionnaire was used in face-to-face interviews with poultry feed self-mixers in Dummalasuriya veterinary region, North-Western Province, Sri Lanka. The responses collected from 61 self-mixers were statistically analyzed using the Chi-square and Ordinal Logistic Regression tests in SPSS version 22.0. According to results, around 84% of poultry feed self-mixers were commercial layer farmers. Only 13% of self-mixers were using AFI in their self-mixed feed production. Self-mixers' willingness to use AFI was impacted by the production scale ($P<0.05$), as the willingness to use AFI was lowered with higher production scales. Constraints for adaptation to AFI were associated with the production scale and education level of the self-mixers ($P<0.05$). The impact of lack of awareness on AFI was higher for small- and medium-scale self-mixers than for large-scale self-mixers (OR>1). The self-mixers who had higher education beyond secondary education were more aware of AFI (OR>1). The impact of insufficient supply of AFI was more detrimental for large-scale self-mixers compared to small- and medium-scale self-mixers (OR<1). Educating the self-mixers about the available AFI and its technical applications would improve the use of AFI by small-and medium-scale self-mixers. On the other hand, encouraging investments in large-scale AFI production to ensure a continuous supply is recommended to popularize AFI usage by large-scale self-mixers.

Keywords: Alternative feed ingredients, Poultry feed, Self-mixers, Production scale

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*nipunap@agri.pdn.ac.lk

Decomposition of the Determinants of Food Price Inflation in Sri Lanka during the Period 2016-2022

Malaviarachchi M.A.C.D. and Korale-Gedara P.M.[*]
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The food inflation in Sri Lanka is rising starting from November 2021, at one of the fastest rates and has reached a peak of 94.9% (Y-o-Y) in September 2022, threatening the food and nutrition security of the population. This study attempts to identify the drivers of food inflation in Sri Lanka during the period 2016 to 2022 using Cointegration and Error-correction models to analyze monthly data. Our findings suggest that the recent price surge is a result of changes in the exchange rate, crude oil, and agricultural wages. The Impulse Response Function revealed that food inflation responds positively to the shocks in world food prices, crude oil prices agricultural wages and exchange rate. The response to exchange rate shocks was immediate. The variance decomposition analysis further revealed that food price inflation accounts for a significant portion of volatility on its own shocks. Exchange rate was found to be a major driver of food inflation in the short run, however, the effect of exchange rate diminishes with the time. Contradicting to this, the effect of changes in agriculture wages, oil prices and global food prices is higher in the long-run than in the short-run. The findings stress the importance of having appropriate policies to stabilize the exchange rate and input prices to avoid excessive food inflation in the country.

Keywords: Agricultural wages, Cointegration, Crude oil price, Error variance decomposition, Exchange rate, Vector error correction

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[*]pradeepakg@agri.pdn.ac.lk

Demand Estimation of Household Food Waste in Kurunegala District

Thilakarathna G.D.S. and Weerasooriya S.A.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Household food waste is driven by consumer habits and behavior. It differs with various demographic, social, and economic factors. This study aims to determine whether household food waste is a luxury good or not and identify how demographic and socioeconomic factors affect household food waste. For this, a Quadratic Almost,Ideal Demand System (QUAIDS) model was used, which is augmented with demographic, socio-economical, and expenditure controls. From 195 respondents, using an online survey, we obtained data on food habits and food waste in the Kurunegala district for October 2022. In this case, food categories were selected basedon the consumption of most households in Sri Lanka, namely, rice, other kinds of cereals, pulses, fruits, vegetables, meat, fish, dairy products, eggs, and miscellaneous foods. Expenditure on the waste of each food category was calculated by multiplying expenditure on each food category with the percentage of waste, and then expenditureshare on each household food waste was obtained. The demand system estimation showed that all food waste categories are normal goods i.e., expenditure elasticities were all positive. Based on the expenditure elasticities, food waste categories were demarcated as luxury goods or necessity goods. Waste of rice, other cereals, pulses, fruits, vegetables, and miscellaneous food at the household level were necessity goods,while the waste of meat products, fish, dairy products, and eggs food categories were luxury goods. Expenditure share on household food waste differs with residence area.High-income group of households shows higher expenditure shares on food waste, lowest in the low-income group, and in between among middle-income households. Expenditure shares and expenditure elasticities vary with demographic, social, and economic factors. According to the study, most households practiced different management practices and they had positive attitudes toward minimizing household food waste.

Keywords: Expenditure elasticity, Household food waste, QUAIDS

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[*]senalw@agri.pdn.ac.lk

Developing and Designing an Agricultural Television Program to Motivate Urban Community to Home Gardening

Gunawardana M.P. and Dissanayeke U. I.[*]
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Home gardening is considered as a key strategy when it comes to ensure the food security in a given community. Urban communities are vulnerable for food insecurity. Television programs are preferred by urban communities to receive information. This study was conducted to the design and develop a video program to motivate urban dwellers to practice home gardening. A preliminary need identification was conducted with 20 urban home gardeners, in Kandy district. Majority (90%) of them watched television and preferred short duration video clips (73%). Thus a video program structure having three independent segments namely i) entrepreneurship ideas for home gardens, ii) success story and iii) do it yourself task were produced. Locations for video recordings were selected based on key informant discussions. The video contents were evaluated using a questionnaire, with 25 urban dwellers, selected conveniently. The respondents reaction was positive that many of them stated the content is attractive (83.3%), motivating (69.6%), and of suitable duration (40.9%). Study concludes that the educational video contents have the potential to motivate agricultural communities for home gardening. Further research is required to test the knowledge obtained and any behavioral change of participants.

Keywords: Home gardening, Motivation, Television program, Urban community

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[*]uvasarad@agri.pdn.ac.lk

Development and Evaluation of a Methodology for Plant Selection for Floating Treatment Wetlands

Sanjeewani S.N., Chandrasekara S.S.K. and Mowjood M.I.M.*
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Constructed floating treatment wetlands (CFTW) are a new intervention to purify urban lakes that are polluted. The selection of appropriate plants for the CFTW is crucial and requires scientific methodology. The objective of this study was to develop an appropriate methodology for plant selection for FTWs for wastewater treatment. The study consisted of three phases: Criteria selection, screening system, and field study for verification. A literature review followed by preliminary screening using 5 criteria: plants available or not available in Sri Lanka, invasive/non-invasive, aquatic/terrestrial, perennial/annual, and adapted/not adapted to submerged conditions. Weighted scoring was adopted to select 3 plant types i.e., most, moderately, and least suitable for the field implementation. The selected 3 types of plants were used to establish the CFTW in Kandy Lake, Kandy. The plants were harvested after 40 days of planting for the assessment of total nitrogen (N), total available Phosphorous (P), and biomass. The data obtained were statistically analyzed using the pooled t-test in SAS software. Finally, the validation of the developed methodology was carried out. The literature review identified 50 plants used for the CFTW and 9 plants were screened which are suitable for Sri Lankan conditions. *Canna indica*, *Dracaena sanderiana*, and *Vetiveria zizanioides* (L.) were identified after weighted scoring as the most, moderately, and least suitable plants., respectively. The average biomass increases of *Canna indica*, *Dracaena sanderiana, and Vetiveria zizanioides (L.)* were 57.50%, 8.18%, and 30.18%, respectively, and their average nutrient removal rates were 88.82%, 2.89%, and 24.98% for N and 66.80%, -39.36%, and -50.20% for P, respectively. It is concluded that *Canna indica* is the best plant for FTWs under Sri Lankan conditions. Since this study considered nutrient removal efficiency as a parameter for the methodology, further studies are suggested on assessing the other relevant parameters for selecting plants for CFTW.

Keywords: *Canna indica,* Floating treatment wetland, Nutrient uptake, Plant selection, Sri Lanka

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*mowjood2010@gmail.com

Development of Healthy Supermarket Initiatives and Strategies to Encourage Healthy Food Choices in the Retail Store Environment in Sri Lanka

Manawadu T.N.D., Somaratne G.M.[*], Weerasinghe L.[1], Muthurathnandan N.[1], Hettiarachchi N.[1], Demetrius T.[2], Chandrasekara A.[3] and Singh J.[4]
Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

A healthy diet plays an important role in the maintenance of a healthy human body. Daily food consumption is influenced by food choices. Therefore, awareness about healthy and nutritious food consumption is important to improve the health status of a population. Food retail environments are settings that make food available and accessible to consumers. Modern food retail environments such as supermarkets have been identified as major contributors to consumers' choice of unhealthy foods in Sri Lanka leading to an alarming increase in non-communicable diseases. The foods available in the supermarkets may be classified as healthy to moderately healthy and unhealthy depending on the composition of the food and the health status of consumers. Therefore, consumers need more awareness to make healthy food choices. Healthy supermarket interventions are designed as a public health approach to promote and encourage healthy food purchasing. This research aimed to develop healthy supermarket initiatives for a supermarket chain in Sri Lanka by compiling a guidebook that includes retail foods identified as "healthy" and "unhealthy" food choices based on food composition and the health status of the Sri Lankan population. The research resulted in a guidebook (ISBN 978-624-97482-1-7) which comprises healthy food choices concerning specific health conditions, ages, and nutrient requirements for specific population groups. Information in the guidebook has been given based on the most recent literature reviews, food-based dietary guidelines, and the recommendations of nutrition experts. The guidebook will be used as a manual by the supermarket management team and is expected to provide guidance for the implementation of healthy supermarket interventions. The research concludes with recommendations for the retail sector that can be used to communicate the content of the guidebook to supermarket consumers through educational interventions, economic interventions, and by making store environment changes in the supermarket.

Keywords: Food based dietary guidelines, Food retail environment, Healthy food choices, Supermarket interventions

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[1] Jaykay Marketing Services (Pvt) Ltd., 148, Vauxhall Street, Colombo 02, Sri Lanka
[2] Diabetes Association of Sri Lanka, 50, Sarana Mawatha, Rajagiriya, Sri Lanka
[3] Department of Applied Nutrition, Faculty of Livestock and Fisheries, Wayamba University, Sri Lanka
[4] School of Food and Advanced Technology, Massey University, New Zealand
[*] gsomaratne@agri.pdn.ac.lk

Economic Crisis Impact on Health and Wellbeing of Household in Estate Sector in Sri Lanka

Jathurshan S. and Prasada D.V.P.[*]

Department of Agricultural Economic and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The Sri Lankan financial crisis is an ongoing crisis that started in 2019. It causes near-depletion of exchange reserves, shortage of medicine, shortage of food, shortage of food supply, and an increase in prices of food and non-food commodities. This study focuses on the relationship between health and wellbeing of estate households, the current economic shocks due to crisis. The main research objective is to identify the most important factors affecting household wellbeing during the economic crisis. Data on 100 households were collected from the *Kataboola* estate in *Nawalapitiya* by using pre-tested structured questionnaires. The questionnaire contains both quantitative and qualitative questions. Stratified random sampling was used to select respondents for study. Results show that the more than half of the sampled households increased food expenditure by more than 50%. The key concerns reported were about fuel availability, household financial status and cleanness of drinking water. Further, regression analysis showed total income, age of household head, protein availability shock, grain availability shock, Vegetables availability shock, Medical expenditure and transport expenditure are related to subjective and objective wellbeing of households. The finding of this study highlight that encouraging and awareness programmes should be conducted for affected households in estate sector.

Keywords: Economic crisis, Estate sector, Health, Households, Wellbeing

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[*]prasada@agri.pdn.ac.lk

Effect of Job Characteristics on Employee Performance in a Sri Lankan Apparel Sector Organization

Perera K.K.N. and Jayawardena L.N.A.C.[1]
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Employee performance drives organizations. Literature suggests the effect of job characteristics to enhance employee performance in organizations. The objective of this study was to examine the impact of job characteristics on employee performance in apparel sector organizations in Sri Lanka. Since there is lack of empirical findings in that context this study could contribute to human resources management field. A self-administered questionnaire was used to measure the variables of the study. Skill variety, task identity, task significance, autonomy, feedback, social support, and psychological job demand were considered as job characteristics in this study. A sample of 120 managerial category employees were selected from an established apparel sector organization in Sri Lanka. Study was conducted as a case study. Results of the study were analyzed using the Multinomial logistic regression, Man-Whitney U test and Kruskal Wallis test. Results indicated significant positive relationships (at $p<0.05$) between skill variety and employee performance, task identity and employee performance, task significance and employee performance, autonomy and employee performance, psychological job demand and employee performance, social support by coworkers and employee performance. There were no significant relationships (at $P>0.05$) between feedback and employee performance, social support by supervisor and employee performance, age and employee performance, experience in the current organization and employee performance. The R^2 indicated that 62% of employee performance was explained by independents variables. Study suggests that improved job characteristics factors contribute to improved employees' performance in the organization.

Keywords: Apparel industry, Employee performance, Job characteristics, Managerial level employees

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[1]chandanacj@agri.pdn.ac.lk

Effect of Stocking Density on Growth, Feed Conversion and Survival of a Critically Endangered Freshwater Fish *Labeo lankae* (Sri Lankan Orange-fin Labeo) Under Captivity

Ekanayaka E.M.D.D., Athauda A.R.S.B.[*], Walpita C.N.[1] and Mudalige A.R.[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Labeo lankae is a critically endangered freshwater fish, captively bred very recently for conservation purposes and its larval rearing protocols are being optimized for maximum survival. This study examined the impact of stocking density on growth indices, feed conversion ratios, and survival of *Labeo lankae* fry during 42 days in captivity. A total of 1593 fry (0.1 ± 0.001g) were collected, weighed, and stocked in 15 tanks. Each experimental tank (cement tanks) having dimension of tank $90cm\times70\ cm\times45cm$ was filled 150L of water and fry were stocked at 5 stocking densities as 0.5 fry/L (T1), 0.57 fry/L (T2), 0.66 fry/L (T3), 0.8 fry/L (T4) and 1 fry/L (T5) in triplicates. Fry were fed with formulated feed (40% crude protein) 4 times a day. The water quality parameters were monitored and found to be within a range suitable for freshwater aquaculture. Significant differences ($P<0.05$) between the various treated groups were seen at the end of the experimental period, with T1 exhibiting the best performance through all parameters studied, including final body weights, final body length, daily weight gain (DWG), specific growth rate (SGR) and feed conversion ratio (FCR). Survival rates were not significantly ($P>0.05$) affected by stocking densities and were ranged from 94-97% among all treatments. The feed conversion ratios were reported as 1.42 ± 0.021, 1.62 ± 0.019, 1.82 ± 0.007, 1.88 ± 0.106 and 1.9 ± 0.06, respectively. The results of this study revealed that the fry held at the lowest density of 0.5fry/L obtained the highest growth rate, highest survival rates, and the lowest feed conversion ratio. Hence, 0.5fry/L can be used as the best stocking density for the rearing fry of *Labeo lankae* in captivity.

Keywords: Daily weight gain, Feed conversion ratio, *Labeo lankae*, Stocking density, Survival rate

[1]Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, PO Box 02, Belihuloya, Sri Lanka
[2]National Aquaculture Development Authority of Sri Lanka, Aquaculture Development Center, Dambulla, Sri Lanka
[*]sbathauda@agri.pdn.ac.lk

A Study of Entrepreneurial Adaptation Strategies of Small Scale Business Operators during Challenging Situations

Priyadarshani G.P.K., Kodithuwakku K.A.S.S.,* and Hemachandra S.D.S.
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Small-scale business prosperity, especially in challenging situations, results from many factors. Among them, entrepreneurial strategies can be considered a primary factor. This research explores the entrepreneurial adaptation strategies of small-scale business operators during the COVID pandemic and the ongoing economic crisis. This study aims to investigate small business operators' adaptation strategies and howentrepreneurial such adaptation strategies are in the theoretical contexts of Effectuation, Causation, and bricolage entrepreneurial decision-making behaviors. A qualitative multiple-case study design was adopted to pursue research objectives. An individual business operator and his/her business were treated as a case and the unit ofanalysis. The study sample was selected from Kurunegala and Narammala areas usinga snowballing sampling technique. In-depth interviews were conducted using a topic guide with 21 small-scale business operators who have successfully navigated challenging situations. Furthermore, within-case and cross-case analyses were employed to identify the patterns of entrepreneurial processes. The findings revealed that small business operators who have successfully navigated challenging situations have identified and capitalized on multiple opportunities without regard to resource ownership while running multiple businesses (i.e. being proactive). They have practiced all five principles of effectuation in their entrepreneurial decision-making process, as opposed to the causation logic. Most of the business operators have used the bird-in-hand principle in identifying opportunities while few have used the patchwork quilt principle. And also, they have used bricolage selectively, in the form of the internal, external network, and external asset bricolage in their decision-making process. Many have used external bricolage, and no one has used parallel bricolage inthe decision-making process. Almost all the respondents have used more than one decision-making approach to thrive during crises. The findings reveal that entrepreneurial strategies were necessary for business operators to navigate challenging situations successfully.

Keywords: Bricolage, Challenging situations, Effectuation, Entrepreneurship, Pluriactivity

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*sarathsk@agri.pdn.ac.lk

Estimating the Technical Efficiency of Small-scale Inland Fisheries: A Case from Vavunikulam Tank

Nilusha S. and Weerasooriya S.A.*

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The Fisheries sector is categorized into three subsectors i.e. coastal, offshore, and inlandfisheries. Inland fisheries are defined as exploiting fishery resources from the inland water environment. Vavunikulam is one of the largest tanks in the Mullaitivu district, Northern Province, Sri Lanka. It has huge potential for inland fishing. This study aims todetermine the level of technical efficiency and identify factors affecting the technical efficiency of small-scale fishing households. This study also focuses on the role of the National Aquaculture Development Authority of Sri Lanka (NAQDA) and the role of thefishing society in this study area. Data on 50 fishermen were collected from Ampalpuramvillage by using well-structured questionnaires. A Cobb-Douglas stochastic frontier approach with an inefficiency model was used to estimate the technical efficiency and identify the determinants of the efficiency of fishermen. The maximum likelihood parameter estimates showed that fishing output was positively and significantly influenced by the number of fishing gear and duration of fishing. It implies that there is a possibility to increase fish output level if fishermen can efficiently use inputs. The results revealed that 69.80% of the deviation from fishing output was due to technical inefficiency. The estimated mean of technical efficiency of the sample fishermen was about to 86%, which means there is a possibility to increase the level of technical efficiency by 14% through efficiently utilizing the existing resources. Further results showed that education level, experience, and income from other sources were found to have a negative and significant effect on technical inefficiency, and age was found to have a positive and significant effect on technical inefficiency of fishing output. Therefore, government and policymakers should take necessary actions and foster policies to improve the technical efficiency of fishermen through providing formal as well as informal education, training programs, and credit facilities.

Keywords: Catch-rate, Inefficiency model, Inland fisheries, Stochastic frontier analysis,Technical efficiency

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*senalw@agri.pdn.ac.lk

Estimation of Socio-Economic Costs and Benefits of Forest Reforestation in "*Hanthana*" Mountain Range, Sri Lanka

Idirisinghe I.M.G.C.K. and Prasada D.V.P.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Forests are a significant aspect of nature that deliver ecosystem services for the betterment of living beings. Most ecosystem services of forest are unquantified in monetary terms due to the unavailability of direct market values. The study is conducted based on the economics of ecosystem and biodiversity framework to recognize, demonstrate and capture the values of forests with reference to *Hanthana* forest range. The two main objectives of the study are to determine the relationships among ecosystem services, demographic data and reforestation choice and to determine the costs and benefits of reforestation scenarios. The study population consists of three main segments; Villagers (*Uda-peradeniya*, *Mawelawaththa*), undergraduates (University of Peradeniya) and related stakeholders (around the *Hanthana* forest). The study sample consists of 85 respondents identified through convenience sampling. Face to face interviews guided by a structured questionnaire were used to obtain the primary data. The survey data were analyzed using descriptive analysis, multiple regression modelling and probit regression modelling. Benefit-cost analysis was conducted to obtain the economics of reforestation for three scenarios: ecotourism site, primary forest and participatory forest. Study revealed that the educational level of the respondents and the type of the respondent have significant ($p < 0.05$) relationships with the expected ecosystem services. Gender and status of employment have significant ($p < 0.05$) relationships with reforestation choice. The study revealed the average benefit-cost ratios for ecotourism site, primary forest and participatory forest are 0.865($\pm$0.462), 2.233($\pm$0.101) and 6.20($\pm$2.509) respectively. The study serves as a feasibility study of comparative merits between reforestation project and community participation.

Keywords: Biodiversity, Community, Ecosystem services, Ecotourism, Reforestation

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[*]prasada@agri.pdn.ac.lk

Estimation of the Above- ground, Below-ground, and Total Biomass and Carbon Stocks of tea plants in Organic and Conventional Tea Cultivation Systems in the Uva Region of Sri Lanka

Madhuranga, H.P.N., Rathnayaka, R.A.A.S.[1], Mohotti K.M.[2], Sivananthawerl, T.[1] and Mohotti A.J.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study was designed to develop an allometric equation to estimate the above-ground (AGB), below-ground (BGB), and total biomass (TB) of tea, and the carbon stocks of tea grown in organic and conventional systems in the Uva region of Sri Lanka. Measurements are collar circumference and diameter (CDSL) at soil level, collar circumference and diameter at 6 cm height from soil level (CDSH) to beginning of primary branch, number of primary branches, circumference and diameter of the beginning of primary branches, circumference and diameter of the end of the primary branches and length of primary branches. Allometric equations were developed with the AGB, BGB and TB and these parameters, and the best-fitted equation was selected by Pearson correlation coefficient and simple linear regression. Using this equation, the AGB, BGB and TB in each selected tea land was estimated. Carbon stock was considered to be 50% of the biomass. The significance of differences between the two systems were analyzed using two sample t test. CDSH had the best ($P < 0.05$) correlation coefficient in both fresh weight and dry weight basis with AGB BGB and TB in fresh weight basis. The determined allometric equations in fresh weight basis were; AGB = 741.222 × CDSH(R^2=0.972), BGB = 351.600 × CDSH(R^2=0.946) and TBM = 822.822 × CDSH(R^2=0.980). Determined allometric equations in dry weight basis were AGB = 226.716 × CDSH (R^2 = 0.955), BGB = 153.675 × CDSL (R^2 = 0.950) and TB = 377.390 × CDSH (R^2 = 0.950). There was no significant difference ($P>0.05$) in the AGB, BGB and TB, and the carbon stocks of tea plants between the organic and conventional systems. The results indicate that tea plants cultivated in both systems are equally capable of sequestering the atmospheric carbon.

Key words: Allometric equation, Biomass, Collar diameter, Conventional, Organic, Tea

[1]Department of Agricultural Engineering and Soil Science, Faculty of Agriculture, Rajarata University of Sri Lanka.
[2]Tea Research Institute of Sri Lanka
[*]mohottij@agri.pdn.ac.lk

Estimation of Tree Diversity and Carbon Stocks in Organic & Conventional Tea Systems

Jayasekara R.H.D.A., Rathnayaka R.A.A.S.[1], Mohotti K.M.[2], Sivananthawerl T. and Mohotti A.J. [*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

In Sri Lanka, tea is commonly grown as an intensive cultivation, organically & conventionally. In the present study, shade tree diversity and the biomass of shade trees were estimated, and compared between organic and conventional tea systems in Uva region of Sri Lanka. Fifteen organic and fourteen conventional tea fields were selected for the study, which were either smallholders (SH) or medium/ large estates (> 10Acres). In each field, an area of approximately 0.1 ha land was demarcated and a tree survey was conducted, beginning with species identification. For all the lands, Shannon-Wiener and Simpson Diversity Indices were calculated. The total, above (AGB) - and below-ground (BGB) biomass of each shade tree was calculated as follows: For high-shade trees, allometric equations (species specific equations wherever available, otherwise common equations) were used, and for medium shade trees, manual method and species-specific allometric equations were used. For the data analysis Nested experimental design was used. The Shanon Weiner Index of organic tea lands exhibited a significantly higher (p <0.05) diversity in the organic (ORG) lands compared to the conventional (CONV) systems. There was no significant difference between smallholder and medium/ large scale farmers nested within each tea cultivation system. However, the Simpson Diversity Index showed no significant difference between organic and conventional tea system at (p<0.05) level of significance. Further, there were no differences in AGB/ BGB/ total biomass and carbon stocks between organic and conventional systems. Within the ORG farms, the AGB/ BGB/ total biomass and carbon stocks were significantly (p < 0.05) higher in ML compared to SH, which was not evident in the CONV, and the difference was identified occurring due to old shade trees in one estate. In conclusion, ORG and CONV lands exhibit differences in biodiversity, total biomass, AGB and BGB, which could be attributed to differences in the management of each plantation.

Key words: Biomass, Carbon stocks, Conventional tea cultivation, Organic, Tree diversity

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[1]Department of Agricultural Engineering and Soil Science, Faculty of Agriculture, Rajarata University of Sri Lanka
[2]Tea Research Institute of Sri Lanka
[*]mohottij@yahoo.com

Evaluation of Restoration Methods of Pine Plantation Adjacent to Natural Forest in Buffer Zone of Sinharaja World Heritage

Kumara K.H.S.P. and Pushpakumara D.K.N.G.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The Forest Department of Sri Lanka experimented six methods in 2015 to establish a feasible and sustainable aproach in converting Pinus (*Pinus caribaea*) plantations to natural vegetation at Kahagala Research Block in Kamburupitiya forest range of Sinharaja World Heritage. Evaluated treatments were undisturbed Pinus plantation with regeneration (T1), ring-barked of Pinus trees with old regeneration (T2), newly planted stand with *Dipterocarpus* spp. and mixture of indigenous species after clear felling of Pinus and other vegetation (T3), natural succession without any disturbances over 7 years (T4), natural succession and patches has cleared around regenerating plants annually over 7 years (T5), natural succession and patches has cleared around regenerating plants and low slashing annually (T6). Six treatments were assessed after seven years from establishment by stand density, basal area, diameter classes and height class distribution, species diversity, and cost estimation to implement the treatments. Means and standard errors of variables were estimated as descriptive statistics. Treatments with old regeneration and Pinus stands were always better than younger stands in terms of diversity, stand structure. In T3, the stands were replanted with *Dipterocarpus* species and indigenous species, which was a less-successful restoration method. The diversity and stand density was low in T2 which could be due to damages to other trees caused during the felling period of dead Pinus trees. In T1 and T4, competition was high because Pinus trees are available in T1 and there are no management practices in T4; hence competition is high in T4. Management in T6 and T5 methods, tree stand density, stand structure, biodiversity, and cost of treatments are better than the others. As of the data, it is recommended to accelerate natural regeneration by felling of Pinus trees without clear felling of entire area, or take pines timber with least damage to natural vegetation or leave Pinus for natural death.

Keywords: Pinus plantation, Regeneration, Restoration

[*]ngpkumara@agri.pdn.ac.lk

Evaluation of Species Composition of Homegardens in *Galgamuwa* and *Kandy*

Kumara K.I.U.E. and Hitinayake H.M.G.S.B.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Homegarden is defined as a complex sustainable land use system that combines multiple farming components, such as annual and perennial crops, livestock and occasional fishing. The objective of this study was to evaluate the differences in species composition between wet zone and dry zone homegardens. Thirty homegardens from each site selected for the study. Sites were selected from *Galgamuwa* in the *Kurunegala* district and mid country wet zone areas in the Kandy district. A vegetation survey was conducted in two Grama Niladari divisions in *Galgamuwa* divisional secretariat division and *Gannoruva, Kulugammana, Galagedara* GN divisions in the *Kandy* district. In addition to vegetation survey, a questionnaire survey was conducted to collect household information. Homegrdens in Kandy recorded 46 species whereas it was 27 in the dry zone homegardens. Result shows that coconut is the most dominant tree species in both dry zone (RIV=0.326) and wet zone (RIV=0.236) homegardens evaluated under present study. Jack and Mango was also among 10 most dominant species recorded at both sites. Homgardens in *Kandy* recorded two spice species, Nutmeg and clove among 10 most dominant species.

Keywords: Dry zone, Homegardens, Relative importance value, Species composition, Wet zone.

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[*]gaminih@agri.pdn.ac.lk

Exploring Cost-effective and Non-hazardous Options for Dormancy Breaking and Germination Induction of Selected Weed Seed Species Present in Coir Pith Blocks, Manufactured by the Exporters in the Coconut Triangle, Sri Lanka, for Phytosanitory Certification Purposes at NPQS

Amarasena N.G., Gunasinghe R. and Weerarathne L.V.Y.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Weed seed contaminations are unavoidable in coir pith-based products (CP) manufactured by the exporters in the coconut triangle of Sri Lanka. Inefficiency and low success rate of the regular 'Grow Out' test used for detecting the viable weed seeds present in export-ready CP is the key challenge in timely-issuance of phytosanitory certificate by the National Plant Quarantine Service (NPQS) of Sri Lanka. This study was conducted to test cost-effective, non-hazardous, and efficient alternatives to the H_2SO_4 pre-treatment (the most successful for the target species so far) for breaking dormancy and inducing germination of few troublesome weed seed species present in CP, namely *Urena lobata* (UL), *Cenchrus echinatus* (CE); *Cassia occidentalis* (CO), and to re-test the most effective alternative on *Chrysopogon aciculatus* (CA) and *Stachytarpheta indica* (SI). Scarified and non-scarified seeds (n=30*2) of each species were treated with H_2SO_4 (control), acetic acid, KNO_3, vinegar, coconut water, and distilled water (blank control) for 10, 30, 45, and 60 minutes, followed by 24-hour soaking in water. Treated seeds were germinated on wet filter papers and/or coir substrate in Petri dishes at laboratory conditions for 14 days. Germinated and non-germinated seed count was recorded, followed by a Tetrazolium test to check the viability of non-germinated seeds. Final germination percentage (GP), mean germination time (MGT), germination index (GI), and non-germinated viable seeds percentage (via) were calculated. Results showed that the most effective treatment combination for viable CE and CO seeds was using "vinegar for 30 min pre-treatment + 24-hour water-soaking + scarification" (GP and GI >60%, MGT = 1-3 days; p< 0.05). This treatment combination also resulted in GP and GI of >45% for weeds CA and SI with the lowest MGT in coir substrate ({<0.05). However, vinegar pre-treatment was not effective for test parameters of UL (P>0.05) and warrants further research.

Keywords: Coconut triangle, Cost-effective, Dormancy breaking, Germination, Weeds

[*]vishnaweerarathna@gmail.com

Factors Affecting the Business Growth of Micro, Small, and Medium-Sized Enterprises: Evidence from Trincomalee District

Aiyas A.A.M. and Korale-Gedara P.M.[*]

Department of Agriculture Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Micro, small, and medium-sized enterprises (MSMEs) are experiencing widespread impact from Covid-19, the Easter bomb attack, and the recent economic crisis. To reduce the negative effect of multiple crises on the performance of the sector, the identification of factors that contribute to the growth of MSMEs is paramount importance. The objective of this study is to examine the effect of socio-demographic characteristics of the owner, firm characteristics, and environmental factors namely access to information, social support, and government support in determining the growth of the business. Survey and informal interviews were conducted using a self- structured questionnaire to collect the primary data from the owners of 80 MSMEs in the retail sector operations in the Trincomalee district. The study revealed that 76% of sampled MSMEs have recorded growth in their business during the last 5 years. As the result of binary logistic regression analysis suggested, firm age, access to information, and government support drive the business growth of MSMEs ($P<0.05$). This research recommends that the government can introduce new loan schemes and new incentives to help the MSMEs sector and also the government can introduce new technologies to strengthen information transfer between MSMEs and government sources and research institutions that support business growth. This finding could be useful for governments, NGOs, and policymakers to design targeted policies and programs to develop the MSMEs sector.

Keywords: Business growth, Micro small and medium-sized enterprises, Retail sector, Sri Lanka, Trincomalee

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[*]pradeepakg@agri.pdn.ac.lk

Factors Affecting the Decision-Making Styles of Branch Managers in Private Sector Banks

Hathurusinghe H.D.H.S. and Jayawardena L.N.A.C.[*]

Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Banks are facing the challenge of a global recession. The objective of the study was to identify the decision-making styles of branch managers in private sector banks and to determine the effect of perceived stress, self-efficacy, and heuristics on the decision-making styles. Branch managers of private sector banks in the central province were selected as the study population. Banks were stratified into categories based on the financial assets owned by respective banks. Five banks were selected using stratified purposive sampling and 72 branch managers were selected accordingly. A self-administered survey was conducted together with key informant interviews. Results of the study were analyzed using the Multinomial logistic regression, spearmen correlation, and Kruskal Wallis test. Majority of the respondents (51.39%) practice rational decision-making style as the dominant decision-making style. Self-efficacy of branch managers has a significant correlation ($p < 0.01$) with dependent and intuitive decision-making styles. Perceived stress of branch managers significantly correlated with the avoidant and spontaneous decision-making styles ($p < 0.01$). Self-efficacy of branch managers has a significant effect on all of decision making styles ($p < 0.05$). However, perceived stress did not indicate a significant effect on intuitive decision-making style. It has effected all of other decision-making styles ($p < 0.05$). Availability heuristic indicated a significant effect on rational and intuitive decision-making styles ($p < 0.05$). Identifying the decision-making styles and individual differences assist the management to develop effective training programmes for employees. It serves to avoid biases in making routine and strategic decisions in organizations.

Keywords: Banking sector, Decision making style, Heuristics, Perceived stress, Self-efficacy

[*]chandanacj@agri.pdn.ac.lk

Factors Affecting the Diet Quality of People in Kandy District during the Economic Crisis

Manjula E.M.N. and Hemachandra S.D.S.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This research aims to identify the diet quality, the factors affecting diet quality and the coping strategies adopted during the economic crisis and food inflation in Sri Lanka. The study was conducted in Kandy district targeting rural, urban, and estate areas. A questionnaire survey was carried out with a sample size of 100. Multiple linear regressions, descriptive statistics and graphical analysis were carried out. Diet quality was calculated as a percentage of daily carbohydrate, protein, fat, vitamin and mineral intake from the recommended level. As factors affecting diet quality gender, income, living area, household size, source of food, food budget share, health condition, and food preference were considered in the regression analysis. The results found that income has a significant positive relationship with diet quality ($P < 0.05$). Rural people show a higher level of consumption in carbohydrates, proteins, vitamins and minerals compared to urban and estate people. Estate people show the lowest nutrient intake. All the three areas show higher carbohydrate consumption beyond the recommended level. However, all other nutrients are consumed in lower levels than the recommended level. As coping strategies most of the people have stopped consuming expensive food items and shifted to cheaper alternatives and also have reduced the nonfood expenditures to fulfill the food requirement. The diet quality of estate people is the most affected during the economic crisis. Diet qualities of all people have been affected during the economic crisis and hence they are unable to fulfill their daily nutrient requirement. Consuming excessive carbohydrate and an imbalanced diet could result in serious health problems in the future. Therefore, programs should be implemented to introduce balanced diets to cope up during the economic crisis.

Keywords: Diet quality, Food inflation, Household income

[*]dilinihema@agri.pdn.ac.lk

Factors Affecting the Employee Engagement of Extension Officers in the Department of Agriculture: A Study in the Central Province

Dassanayake D.M.N.H.B. and Jayawardena L.N.A.C.[*]

Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Agriculture Extension service plays a vital role to provide farmers knowledge, skills and attitude. It bridges the information gap between farmers and Agriculture research institutes. The job engagement of extension officers plays an effective role to have a productive outcome. The study was aimed to examine the factors contributing to the employee engagement of agricultural extension officers. It further examined the effect of factors on different elements of employee engagement. A thorough literature review indicated job autonomy, social support by supervisor, employee training, work life balance, and non-monitory rewards as factors associated with the employee engagement of agricultural instructors. A self-administered questionnaire was used to collect primary data of 100 agriculture instructors in Provincial department of Agriculture, Central Province (Kandy, Matale and Nuwara-Eliya district). Results of the study were analyzed using descriptive and inferential analyses, namely; Multinomial logistic regression, Man-Whitney u test, and Kruskal Wallis test. Results of the study revealed non-monetary reward, and supervisory support (at $P<; 0.1$) contributes to employee engagement of agriculture instructors. Employee training, work life balance, and non-monetary rewards did not indicate significant relationships with job engagement of employees. There was no relationship between employee engagement and demographic factors such as gender, age, education status, and work experience. About 45% of employee engagement was explained by above independents variables. The focus group discussions with agriculture instructors suggested that lack of clarity of job roles has a negative impact on their level of job engagement. Addressing above factors contribute to upgrade the employees' engagement of Agriculture Instructors.

Keywords: Agriculture instructors, Employee engagement, Non-monitory rewards, Supervisory support

[*]chandanacj@agri.pdn.ac.lk

Factors Affecting the Success of Good Agricultural Practices (GAP)

Perera M.S.D. and Gunaratne L.H.P.[*]
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The GAP (Good Agricultural Practices) program has been initiated by the Department of Agriculture (DOA) as a solution for the overuse of fertilizer and agrochemicals while increasing the production and marketing standards of agricultural commodities. Although the GAP has been given wide publicity, the issues faced by GAP producers have not been evaluated. Therefore, this study investigates the perception of GAP producers, factors affecting the level of adoption of GAP practices, achievement of intended outcomes by GAP producers, and technical efficiency (TE) of GAP producers. The necessary data was collected by surveying a random sample of 33 GAP farmers who cultivate snake guard, long bean, salad cucumber, and capsicum. The GAP farmers' perception was analyzed using descriptive analysis. GAP farmers have a positive perception of the overall benefits of the GAP program, income, farmgate price, and attraction of new markets, and a negative perception of financial support. The factors affecting to adoption level were analyzed by multiple linear regression. The information received and training received from DOA had a significant relationship with the adoption level of GAP. Of the surveyed GAP producers, 80% of snake guard, 71% of long bean 100% of salad cucumber and capsicum had lower costs of production compared to the DOA estimates. The TE is analyzed by stochastic frontier analysis. The technical efficiency ranged between 0.31 to 0.99 and the mean TE was 0.79 implying that there is a 21% scope of increasing the production without any additional inputs. The technical efficiency has been affected by the level of adoption and number of meetings per year with officers of DOA. The findings are useful for the further development of the SL-GAP program.

Keywords: Adoption, Good agricultural practices, Stochastic frontier analysis, Technical efficiency

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[*]lhpgunaratne@agri.pdn.ac.lk

Factors Influencing the Stakeholders' Intention to Adopt Mobile Application with Special Reference to Traditional Vegetable Supply Chains of Sri Lanka

Vidusari W.L.K.N., Kodithuwakku K.A.S.S.,* and Hemachandra S.D.S.
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Vegetable cultivation is an important subsector in the agriculture sector in Sri Lanka. However, traditional vegetable supply chains are affected by many inefficiencies due to long food miles which lead to high postharvest losses. This research explores the option of using a mobile application to develop linkages among various stakeholders in the vegetable supply chain and to create new market opportunities to address the existing inefficiencies. Due to the complexity of the supply chain and the involvement of several stakeholders it is of utmost importance to look at the stakeholder's intention to adopt such a technology before its introduction to the market. Therefore, the objective of this study is to identify factors that affect stakeholder's intention to adopt, identify how age affects intention to adopt and the stakeholder intention to adapt to the proposed mobile application. The research identified producers, consumers, delivery riders, wholesalers, retailers, and commission agents as the stakeholders in the vegetable supply chain. The Extended Technology Adoption Model was used to conceptualize the research. Perceived usefulness, perceived ease of use, perceived trust, perceived cost, subjective norms, and perceived risk are the independent factors and intention to adopt was the dependent variable. Primary data were gathered through a questionnaire across five stakeholder categories at the Dambulla Dedicated Economic Centre and the data of consumer category were collected through e-questionnaire. Sampling method is convenience sampling. All the results were calculated and analyzed through the smart pls, Amos and SPSS respectively. The findings show a significant positive relationship between perceived usefulness, subjective norms, and perceived ease of use in terms of stakeholders' intention to adopt mobile applications, while an insignificant relationship was identified with perceived ease of use, trust, age, and cost.

Keywords: Mobile application, Stakeholders, Supply chain, TAM model, Vegetables

*sarathsk@agri.pdn.ac.lk

Farmer Perception on Changing Extensive Cattle Production System to Climate- Smart Dairy System in a Selected Cascade-Based Farming Area

Rathnayaka S.D., Silva G.L.L.P.,* and Samarathunga D.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya

The dairy sector is prominent among all the livestock sub-sectors primarily due to its influence on the rural economy. This study focuses on evaluating the extensive production system of cattle in Thuppitiyawa and Siyabalagaswewa villages in Anuradhapura district, and assess the perception of farmers on changing to a semi-intensive farming system as an adaptive option to changing climate. The study also included the evaluation of the climate smartness of such a change by employing a score card system, collectively developed by the Market Oriented Dairy project, Department of Animal Production and Health and International Union for Conservation of Nature. The score card quantified farm level climate smartness related to farm management, animal welfare and comfort, land and water management and emission management. A total of 31 dairy farmer selected by purposive sampling were surveyed for the willingness to change into semi-intensive system using a structured questionnaire, and the data were descriptively analysed. According to the study, irrespective to the age and educational level, 75% of farmers were willing to shift to the semi-intensive system, and 32% of farmers are willing to invest on developing shelters according to the climate-smart specifications proposed by the study. Moreover, the study revealed that, lack of awareness on improved fodder verities and key management steps such as keeping correct herd composition, night shelter and providing ad-lib drinking water are significantly influencing the milk production in those herds. The assessment of climate smartness using the score card revealed that 68% of farms could achieve at least 30% of climate smart criteria tested. The study concluded that with appropriate and timely technical assistance, the farmers in the area have a potential and capacity to shift towards climate-smart dairy systems for low-carbon milk production.

Keywords: Climate-smart dairy, Extensive system, Semi-intensive system

[1]IUCN (International Union for Conservation of Nature), Battaramulla, Sri Lanka
*pradeepas@agri.pdn.ac.lk

Farmer's Intention to Engage in Groundwater Recharging and Management Practices: A Case Study from the *Mottapeththewa* Cascade System

Wanasekara K.H., Weerasooriya S.A.,* and Kumara G.K.T.P.[1]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The *Mottapeththewa* cascade system is located in the *Galgamuwa* area of the *Kurunegala* District. The depletion of vegetation cover, soil erosion, and the recession of the water table are some issues emblematic in many catchments including the *Mottapeththewa* cascade system. The objectives of this study are, to estimate the factors affecting the intention of farmers to engage in groundwater recharging and management practices, and to estimate the factors affecting farmers' engagement in groundwater recharging and management practices. A field survey was conducted using a questionnaire. The descriptive statistics indicate that more than half of the sample had training on groundwater recharging. The conceptual framework based on the Technology Acceptance Model consists of 7 constructs such as (i) result demonstrability, (ii) self-efficacy, (iii) perceived usefulness, (iv) perceived ease of use, (v) attitude, (vi) intention, and (vii) demographic factors. According to the results of the Structural Equation Model, result demonstrability and perceived usefulness have an indirect effect on intention ($P<0.05$) while attitude and perceived usefulness have a direct effect on intention ($P<0.05$). A multivariate probit model was conducted to find the factors affecting farmers' engagement in groundwater recharging practices. The results revealed that the practice of percolation pits is affected by education, farming experience, land area, training on groundwater recharging, annual and perennial crop types, and home gardening ($P<0.05$). Constructing percolation wells is affected by the farming experience, land area, training, vegetables, and field crops ($P<0.1$). The practice of lock and spill drain is affected by home gardening, perennials, and manual irrigation ($P<0.1$). Home gardening, field crops, and manual irrigation affect practicing runoff water harvesting trenches ($P<0.1$). The practice of organic mulching is affected by education, annuals, and vegetable crop type ($P<0.1$). The findings of the study imply that farmers' engagement in groundwater recharging practices is affected by different farm and demographic factors.

Keywords: Ground water management practices, Ground water recharging, Structural equation model, Technology acceptance model

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[1]Groundwater Recharging for Disaster Preparedness Project, Sri Lanka Red Cross Society, Sri Lanka
*senalw@agri.pdn.ac.lk

Financial Feasibility of Integrating *Jamnapari* Goats into Underutilized Pastures under Coconut Cultivation in Coconut Research Institute, Sri Lanka

Rajapaksha R.P.U.N., Ekanayake W.E.M.L.J.,[*] Weerasooriya S.A.[1] and Atapattu A.A.A.J.[2]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study was conducted to evaluate the nutritional and botanical composition of underutilized pastures under coconut lands in Coconut Research Institute (CRI), Sri Lanka and to assess the financial feasibility of *Jamnapari* goat integration into these pastures. Naturally grown (uncultivated) and improved (cultivated) pasture samples were collected from coconut lands in Bandirippuwa and Makandura estates, respectively. Improved pasture varieties were *Brachiaria brizantha, Brachiaria ruziziensis* and *Brachiaria milliformis*. Quadrat cut samples were taken randomly and analysed for the dry matter availability (kg/ha), Crude Protein (CP %) and Crude Fibre (CF %). Feasibility analysis was carried out based on of average dry matter yields and respective carrying capacities of pastures and related production and market data. In natural and improved pastures, mean dry matter yields varied from 2141 ± 193 kg/ha to 3314 ± 212 kg/ha and from 4231 ± 407 kg/ha to 9152 ± 531 kg/ha, respectively. The CP % and CF % varied from $6.31\pm0.29\%$ to $18.51\pm0.22\%$ and from $30.07\pm0.48\%$ to $33\pm0.39\%$, respectively. Grass and legume percentages of natural and improved pastures varied from 1.97% to 66.38% and 7.03% to 83.91%, respectively. Estimated *Jamnapari* goat carrying capacities for natural and improved pastures were 8-11 heads/ha and 24-27 heads/ha, respectively including does, kids, and a buck. The Net Present Value for the coconut monoculture system was around LKR 0.441 million whereas, for integrated systems with natural and improved pastures, it was LKR 1.432 and LKR 4.689 million, respectively at a 15% discount rate for 10 years. Feasibility and profitability estimates increased in the order of Coconut monoculture, Coconut-Natural pasture-Goat integration and Coconut-Improved pasture-Goat integration.

Keywords: Coconut, Financial Feasibility, Goats, Integration, Pasture

[1]Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[2]Agronomy Division, Coconut Research Institute, Bandirippuwa Estate, Lunuwila, Sri Lanka
[*]jayekn@agri.pdn.ac.lk

Food Coping Strategies, Determinants of Food Insecurity and Dietary Diversity of the Rubber and Coconut Estate Workers during Economic Crisis

Pathirana I.P.D.N. and Korale-Gedara P.M.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The current economic crisis in Sri Lanka has challenged the food and nutritional security of people, especially people who live in the estate sector. Though a few researches have assessed the vulnerability of certain communities, vulnerability of the estate sector, specially rubber and coconut dwellers has not been assessed so far. Against this background, the objective of this study is to assess the vulnerability of estate people to food and nutrition security using Coping Strategy Index (CSI) developed by Care International and World Food Program. The study collected data using a semi-structured questionnaire and a focus group discussion from a sample of estate workers in Lavant estate drawn using proportionate stratified random sample method. Subsequently determinants of coping strategy index examined using a linear regression analysis. To explore an association between Household Dietary Diversity Score and CSI correlation technique was used. The results revealed that eating less preferred food and cutting portion size were the mostly adapted strategies by households in both coconut and rubber sectors. Coping strategy index had a significantly negative relationship with sector and the income while significantly positive relationship with dependency ratio ($p<0.05$). Drastic reduction of the consumption of imported food items such as milk and wheat was noted. These findingsstress the importance of strengthening the social safety net to reduce food and nutritionimplication of the economic crisis.

Key words: Coping strategy index, Economic crisis, Household dietary diversity score

[*] pradeepakg@agri.pdn.ac.lk

Institutional Robustness and Its Association with Social Capital: Evidence from Community Based Inland Fisheries Organizations

Aakil R.S. and Korale-Gedara P.M.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Fishing in inland reservoirs is carried out by community-based organizations. The success of community-based management is conditional upon the institutional robustness of the organization that governs fisheries management. The strength of fisheries community organizations depends heavily on the mutually respect, connectedness and trustworthiness among the fishers. Social capital is a measure of this. The objective of this research is to assess the institutional robustness of five selected medium perennial reservoirs. Institutional robustness was assessed by examining the degree of compliance with Ostrom's design principles. Furthermore, the study assessed the association between institutional robustness and social capital. The social capital was measured by considering social network and groups, social cohesion, trust and solidarity, collective action, information and communication, empowerment and political action. The result suggests that there was a diversity among the selected reservoirs on institutional robustness though fisheries organizations in all medium perennial reservoirs compiled with all the 11 modified design principles except "clearly defined user boundaries". Institutional robustness is high in the community-based organization of *Irakkamam* reservoir, it complied well with Ostrom's design principles and had an average value of 77.3 for social capital. There is a significant ($p<0.05$) association between institutional robustness and social capital in the community. To improve institutional robustness, it is important to enhance the social capital of the community. Weak institutions should rebuild their organization with new effective administrative committee and should need to follow the aspects practicing in robust institutions.

Keywords: Community-based organizations, Inland fishery, Institutional robustness, Ostrom's principles, Social capital

[*]pradeepakg@agri.pdn.ac.lk

Isolation and Characterization of Antibiotic Producing Bacteria from Soil

Mohideen F.M.S. and Dandeniya W.S.*
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Antibiotics are one of the most significant groups of secondary metabolites that have been used to treat diseases. Soil dwelling microorganisms have been studied extensively to identify those who could produce antibiotics. This study was carried out to isolate antibiotic producing bacteria from soil and compost samples and to characterize those isolates. Potential antibiotic producing bacteria were isolated from soil and compost samples using crowded plate technique and the isolates were tested against three different group of sensitive microorganisms, namely; (1) unidentified sensitive bacteria that were isolated from the same soil and compost sample (2) two pathogenic test bacteria with known antibiotic sensitivity profiles [*Escherichia coli* (ATCC 25922) and *Staphylococcus aureus* (ATCC 25923)], and (3) phosphorus solubilizing bacteria isolated from soil (*Pseudomonas marginalis, Acinetobacter baumannii, Bacillus pacificus, Lysinibacillus spaericus, Staphylococcus warneri, Stenotrophomonas sp., Bacillus sp., Bacillus cereus,* and *Bacillus subtilis).* Antimicrobial screening was carried out by using streak agar plate method and inhibition zone method. Out of 13 isolates, 8 isolates caused inhibition of the growth of one or more sensitive bacteria. Two bacterial isolates (A2 and A5) caused a wide spectrum of inhibition against test bacteria. Isolate A2 inhibited the growth of some microorganisms (A2R, A4R and A5R), *Bacillus pacificus and Lysinibacillus spaericus* in streak agar method. The results obtained from streak agar plate method and inhibition zone methods were not consistent. Isolate A5 caused inhibition against some sensitive soil bacteria (A2R and B1R) and *Acinetobacter baumannii,* Stenotrophomonas *sp, Bacillus sp.,* in streak agar method. The result of present study revealed that identified antibiotic producing bacteria did not inhibit the activity of pathogenic test bacteria (*E.coli* and *S. aureus*), but inhibited the growth of some unidentified bacteria used in this study.

Keywords: Antimicrobial screening, Inhibition zone, Potential antibiotic producers, Streak agar method, Turbidity method

*warshisd@agri.pdn.ac.lk

Mapping of Eco-geographic Distribution of Native Medicinal Plants of Sri Lanka: The Basis of Study, Conservation and Utilization

Kithsiri U.A.M.T., Kumarasinghe P.G.S.A.[1], Janaranjana U.G.T.N.[1], Gunawardhena G.M.W.L.[2], De Silva S.H.N.P. and Ranil R.H.G.[*]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Among the native flora of Sri Lanka, more than 1,400 plants are used in indigenous medicine for treating illnesses for over a thousand years. However, due to degradation of natural vegetation and unsustainable human activities, most of the native medicinal plants have lost their natural habitats. The commercial cultivation of native medicinal plants is also restricted to a few species. Though taxonomic information is available, the distributional ecology of native medicinal plants has not been studied adequately. The mapping of geographical distribution will provide the basis for study, conservation, and utilization as well as understanding the cultivation requirements. The based document was developed referring to 16 volumes of the flora of Ceylon and available checklists for Sri Lankan plants. It includes 12,450 localities of 983 species of medicinal plants. Based on that, the distribution pattern of native medicinal plants was mapped using QGIS software and Arc GIS software. Ten native species were selected based on records of the Export Development Board. A checklist of native medicinal plants was prepared. The list consists of 1059 species including 172 endemic species. Distributional maps were developed for 983 species and endemic species, separately. According to the Average Nearest Neighbor Analysis, species show clustered distribution patterns, and leading into hotspots for both native and endemic groups. Giving the Z-Scores; -124.89 and -50.54, there is a less than 1% likelihood that these clustered patterns of all species and endemic species could be the result of random chance, respectively. Nearly 58% of species have been distributed in the *Kandy* district followed by *Ratnapura* (36%) and *Matale* (34%). The distribution, climatic and soil maps were prepared for ten selected species aiming for commercial cultivation. The study provides required information for the study, conservation, and sustainable utilization of native medicinal plant species in Sri Lanka.

Keywords: Eco-geographical distribution, Mapping, Medicinal plants, Native, Sri Lanka

[1]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

[2]Department of Town and Country Planning, Faculty of Architecture, University of Moratuwa, Sri Lanka

[*]rhgranil@gmail.com

Occupation of Nutmeg in Kandyan Homegardens: Is it a Blessing or Threat to its' Biodiversity and Performing Ecosystem Services

Mihiranga K.K. and Hitinayake H.M.G.S.B.*
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Sri Lanka

Kandyan homegardens is a well-established and culturally important land use system found in the mid country wet zone especially in and around the Kandy district. This study aims to investigate the occupation of Nutmeg in Kandyan homegardens and their impact on the biodiversity by comparing the species diversity of homegardens that are having and not having Nutmeg trees. The study evaluated a total of 48 homegardens in Kandy district which are having and not having Nutmeg by estimating relative height, relative DBH, relative density and relative frequency for calculating Relative Importance Value (RIV) for plant species. The results showed that RIV value for nutmeg is 14.54 in the homegardens that have selected for study as nutmeg is present in them. RIV values of coconut, hawarinuga, clove, aricanut, mahogany, mango, avocado and rambutan are higher in homegardens that do not have nutmeg trees. When Nutmeg shows some dominance, RIV of the other species have decreased substantially. It is observed that Nutmeg suppresses and eliminates other tree species from the homegarden as it grows bigger. People place a lot of care on Nutmeg as they have emerged as one of the main species providing cash to the farmers and hence they don't thin or prune them.

Keywords: Kandyan homegardens, Nutmeg, Relative importance value, Species diversity

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*gaminih@agri.pdn.ac.lk

Perception of a Balanced Diet and Food Consumption Patterns of University Undergraduates: The Case of the University of Peradeniya

Bhattarai A. and Kumar S.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

With the prevailing economic crisis, high food inflation was at an estimated 86.4% year-on-year in October 2022. During the crisis, university students are highly vulnerable as they live away from home and have limited funds to fulfil their dietary needs. However, just as the economic crisis can affect their food intake, so can undergraduates' general tendency to be unconcern over diet. Therefore, the extent to which their diet results from the economic crisis is unclear. This research studies university students' perceptions of a balanced diet and food consumption patterns. The Theory of Planned Behaviour was used as the theoretical foundation to conduct a survey of students attached to the University of Peradeniya, Sri Lanka. A sample of 450 students participated in the study. Results revealed that students with a better financial status were mainly from urban areas and had a higher intention to eat a balanced diet. They also had higher consumption of protein-rich foods, and fruits, which are usually more expensive. Students with low financial capacity had less intention to take a balanced diet and lower consumption of protein-rich foods and fruits. Students staying at boarding places had the highest monthly expenses and monthly food expenses. The fact that food is cheaper at university canteens than outside explains the trend. Students from home had the highest consumption of legumes, meat, milk, and fruits. They had the lowest monthly expenses for food. However, the intention to take a balanced diet did not vary with accommodations. Attitudes and perceived behavioural control were major factors affecting the intention to take a balanced diet ($P<0.05$), while subjective norms did not significantly affect intention ($P>0.05$). Furthermore, the research found that the sociodemographic factors of ethnicity, area of residence and gender influenced students' attitudes, subjective norms, and perceived behavioural control ($P<0.05$).

Keywords: Economic crisis, Intentions, Protein-rich foods, Theory of planned behaviour, Undergraduates

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[*] skumar@agri.pdn.ac.lk

Perception of University Students on Key Dairy Calf and Cow Management Practices and Welfare: A Case Study

Aththanayaka A.M.T., Samarakone T.S.* and Wijerathna R.M.S.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The overall objective of this study was to assess the perception of undergraduates of the Faculty of Agriculture, University of Peradeniya on selected dairy calf and cow management practices and welfare, and to assess the knowledge and awareness of undergraduates on dairy calf and cow welfare. The specific objective was, to investigate the factors affecting the perception. The survey was conducted using 357 undergraduate students representing three-degree programs who were in their first to final year. The survey was categorized into 6 main groups; demographic factors, eating habits of undergraduates, relationship with animals, and knowledge, perception, and attitudes on selected management practices. Data were collected through a google form questionnaire. The data were analyzed using the Statistical Package for the Social Sciences (SPSS). The one-way Analysis of Variance (ANOVA), Kruskal-Wallis and Pearson correlation tests were used to study the relationship between perception and independent variables. According to the results, the majority of undergraduates participated in the survey were females (52%) and the rest were males (48%). Undergraduates' perception on calf and cow management practices and welfare were significantly affected by degree programs ($P<0.05$), gender ($P<0.05$), and experience with rearing dairy cattle ($P<0.05$). Undergraduates' academic year, religion, area of origin, and eating habits did not significantly affect their perception. According to the results of correlation matrix, knowledge, perception, and attitudes were correlated ($P<0.01$). The majority of undergraduates participated in the survey (61%) were aware of key dairy calf and cow management practices and welfare. However, most of the responses with respect to perception on management practices and welfare were 'neither agree or disagree'. It is suggested that perception related to key dairy calf and cow management practices and welfare should be improved, possibly through better learning opportunities.

Keywords: Attitudes, Knowledge, Management practices, Perception, Welfare

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[1]Department of Agricultural Extension, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
*thusiths@agri.pdn.ac.lk

Potential of Composting Kitchen Waste with Black Soldier Fly (*Hermitia illusence*)

Welkotuwa W.G.N. and Hemachandra K.S.[*]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Compost is a cheap source of plant nutrients and a soil amendment. Management of kitchen waste (KW) is a challenging task due to reasons such as development of unacceptable odor and house flies. Black soldier fly (BSF)-aided composting of KW can minimize the challenges mentioned previously; hence, this study was conducted with the objective of determining the potential of BSF larvae for rapid composting of KW. Combination of vegetable waste (VW) and fish wastes (FW) was taken as treatments, simulating KW, with and without BSF larvae. After 15 days, amount of compost in treatments was measured, and compost percentage was calculated on a dry weight basis. In addition, survival of BSF larvae in treatments and effect of temperature on survival of pupae were examined. Composting percentage was significantly different ($F_{(5, 18)} = 27.8$ $P<0.05$) among the treatments (5-79%). The highest composting percentage (79%) was found in the treatment; vegetable and fish waste (1:1) (VFW) with BSF larvae. The least composting percentage was found in VW (5%) without BSF larvae. Adding of BSF larvae has a significant ($P<0.05$) effect on composting. The interaction between media and presence/absence of larvae was not significant ($P>0.05$). There was a significant difference among ($F_{(2, 27)} = 186$ $P<0.05$) the three media in relation to BSF larvae survival; the highest survival (43.9 ± 0.6) was in VFW followed by VW (33.8 ± 0.9) and FW (24.2 ± 0.5). Temperatures (26-34 °C) significantly ($P<0.05$) affected the survival of BSF larvae. The highest survival rate was found at 30 °C. Based on the results, it can be concluded that vegetable and fish waste can be rapidly decomposed by using BSF larvae and it is beneficial to use BSF larvae in composting.

Keywords: Black soldier fly, Composting, Kitchen waste, Temperature, Waste combinations

[*]ks_hemachandra@agri.pdn.ac.lk

Profitability and Sustainability of GAP Adoption: A Study of Capsicum and Tomato Farmers in Kandy District of Sri Lanka

Abepala Y.G.S.B. and Prasada D.V.P.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Sri Lanka Good Agricultural Practices (SL-GAP) was introduced with the aim of ensuring consumer safety and providing market benefits to local vegetable, fruit farmers. This study is an attempt to determine the profitability of SL-GAP adopted capsicum and tomato farmers and sustainability of adopting SL-GAP as a farming practice in Kandy district of Sri Lanka. Primary data was collected from 120 farmers including 60 farmers each from GAP-adopted and others. Stratified sampling technique was used. Mean comparison done using paired t-test showed that there is a significant difference of net profits of GAP and non-GAP capsicum farmers and GAP and non-GAP tomato farmers. Multiple linear regression was estimated to identify the factors which determine the net profit variation. Transport cost, GAP adoption and capsicum showed positive significant ($p<0.05$) relationship with the net profit. Inorganic fertilizer cost, labor cost, farm maintenance cost, cost for worker's security and welfare had a negative significant ($p<0.05$) relationship with the net profit. A Logistic model was estimated to analyze the factors which determine the GAP adoption. Extension service has a positive significant ($p<0.05$) relationship to the GAP adoption. Qualitative analysis revealed that ensuring safety of farm produce, receiving new techniques and knowledge, increasing the quality of products determine the future adoption, continuation of SL-GAP program. High initial investment, input costs, absence of a guaranteed market for SL-GAP products are the major challenges for farmers in the Kandy district who cultivate capsicum and tomato.

Keywords: Adoption, Constraint, GAP, Profitability, Sustainability

[*]prasada@agri.pdn.ac.lk

Recruitment and Management of a Healthy Human Panel for Clinical Trials to Analyze the Post-prandial Glycemic Response of Food

Nikalansooriya N.M.A.I., Somaratne G.M.[*], Maithreepala S.D.[1], Gunasekara D.C.S.[2], Abeysiriwardena D. S. D. Z.[3], Chandrasekara A.[4], Dahanayake T.N., Karunarathna H.K.A.T.[1] and Madhumali K.D.U.[1]

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The glycemic index (GI) and glycemic load (GL) are valuable indicators of carbohydrate-rich diets that are used to assist people to manage their blood glucose levels and improve overall health. There is a growing demand for employing healthy participants for clinical trials in GI studies. However, there is no any commercially established, accredited GI testing laboratory in Sri Lanka. This study was conducted to recruit and manage a healthy human panel for clinical trials to analyze the post-prandial glycemic response of food. Initially, 301 university undergraduate students were recruited in the age group 21-25 years, and collected anthropometric and demographic parameters. The recruited participants were screened based on anthropometric and demographic parameters. Then 97 participants were screened and trained for clinical trials in GI studies. Finally, 50 interested and available participants were chosen as the "healthy human panel for GI studies". Inter-laboratory validation of GI values was conducted using the GI data obtained by CIC Food and Nutrition Research Laboratory and Glycemic Index Research Unit, Singapore. The healthy human panel consisted of participants aged between 22-25 years, mean body mass index (BMI) of 20.9 ± 1.7 kg/m^2 and a mean waist-to-hip ratio (WHR) of 0.8 ± 0.1. The performance of the developed healthy clinical panel was evaluated according to ISO 26642:2010 (E). The results for the GI of super kernal, rathu suduru, red fragrant, and purple queen rice varieties were $40 \pm 5.5\%$ (low GI), $61 \pm 5.5\%$ (medium GI), $54 \pm 3.8\%$ (low GI), and $47 \pm 4.9\%$ (low GI) respectively. Results of inter-laboratory validation revealed no significant difference ($P>0.05$) in GI values of the selected rice varieties. Therefore, the proposed healthy human clinical panel for GI studies can be used in future GI studies of the food industry to facilitate GI labeling of food products.

Keywords: GI labeling, Glycemic index, Glycemic load, Inter-laboratory, Post-prandial

[1]Department of Nursing, Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka

[2]CIC Food and Nutrition Research Laboratory, CIC Agri businesses (Pvt) Ltd, Sri Lanka

[3]CIC Agri businesses (Pvt) Ltd, Pelwehera Dambulla, Sri Lanka

[4]Department of Applied Nutrition, Wayamba University of Sri Lanka

[*]gsomaratne@agri.pdn.ac.lk

Remediation of Copper Contaminated Soil by Char Derived from Used Disposable Baby Diapers

Kavinthini A. and Igalavithana A.D.[*]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Plastic is an emerging soil pollutant. The increased use of single-use plastic products is the main reason for plastic wastes. Disposable baby diapers (UDD) are one of those. Fifty percent of its content is plastic. The degradation time of UDD can be > 100 yr. Pyrolysis is a possible way to recycle plastic wastes. The aim of this study was to produce plastic char from used UDD and to assess its effectiveness in using it as a soil amendment to immobilize copper (Cu) in soil. Uncontaminated soil was spiked with copper (II) sulfate. Based on the thermo gravimetric analysis of UDD, 550°C was selected as the pyrolysis temperature. Produced plastic char was characterized before applying them to soil. The contaminated soil was incubated after applying plastic char at (the rates of 0%-control, 1 and 2.5%). Immobilization of Cu was measured after one month of incubation period by using single extraction using 1M ammonium acetate and consecutive extraction using 0.01M $CaCl_2$ methods. The soil pH, Electrical conductivity (EC), available Na, available Mg, available K, available P, available Ca and available N were analyzed. Based on the consecutive extraction analysis, plastic char added treatments showed significant ($p<0.05$) reduction of extractable Cu concentration. The reduction was similar in soil with the two application rates of plastic char. Properties of plastic char i.e., high pH (11.27), high ash content (36.38%) and high EC (0.03 dS/m) could increase the soil pH thereby facilitate Cu immobilization. The C-H, C=O, C-C and phenols-like functional groups on the surface and high fixed C content (48.14%) of plastic char also might have supported the immobilization of Cu. These findings indicate that derived plastic char from UDD could be applied to immobilize Cu in contaminated soil. Pyrolyzed UDD could be an efficient waste management practice which minimize the environmental pollution.
Keywords: Copper contaminated soil, Disposable diapers, Immobilization, Plastic char

[*]adigalavithana@agri.pdn.ac.lk

Risk Management Strategies Adopted by Small and Medium Scale Layer Chicken Farmers in Kurunegala District during Economic Crisis in Sri Lanka

Senadhilankara K.D.P.V., Korale-Gedara P.M.* and Perera W.N.U.[1]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Layer chicken farming was one of the fastest-growing well-developed sectors in Sri Lanka. However, the growth of the sector was constrained by the multiple crises the sector faced recently. The Easter bomb attack, Covid-10, and the economic crisis were among them. These events caused input shortage, input price escalation, output price fluctuations, and less demand for the egg. The layer chicken industry has been seen as a risky industry at the present. In response to this, some farmers opt to leave the industry while others stay in the industry by utilizing various risk management strategies. This study aimed to identify these risk management strategies and their determinants. The study was conducted in the Kurunegala district, which has the highest poultry population in the country. The Snow-balling sampling technique was utilized to select the farmers. A pre-tested questionnaire was used to collect data from 68 farmers. Data were analyzed using descriptive analysis and binary logit regression. The study found that farmers are well prepared for the risk posed by pests and diseases and less prepared for marketing risks. Hence, 28-layer farmers have temporarily exited the industry. However, healthy risk management strategies, such as giving a low-cost nutritious diet, and pre-purchasing inputs practiced to address new risks that emerged from 2019. Small-scale farmers ($P<0.1$) and risk-averse farmers ($P<0.05$) were found to be the ones who chose to leave the industry temporarily. The study stresses the importance of immediate interventions to support small-scale layer farmers to survive the crisis to ensure the long-term sustainability of the industry.

Keywords: Layer chicken farming, Logit regression, Risk attitude, Risk management, Risk perception

[1]Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

*pradeepakg@agri.pd.ac.lk

Spectral and Thermal Comfort for Plants and People under Selected Shade Trees in Tropical Climate

Makuloluwa M.W.H.B.K. and Beneragama C.K.[*]
Department of Crop science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Tropical regions receive great amount of solar radiation, affecting thermal energy increment. Shade trees play an essential role in changing microclimate by manipulating radiation energy that supports the survival of plants and people. This study compares the effectiveness of *Messua ferrea* L*., Muntingia calabura* and *Amherstia nobilis* as shade trees in landscape planning related to shade creation, radiation modification, and microclimate modifications. In the present study, the transmittance spectrum was measured in the 318-885 nm region using a high-resolution spectroradiometer under the canopy of selected *Mesua, Muntingia* and *Amherstia* trees on bright sunny days. The change in shade casting on ground during the day was modeled. In addition, the temperature, CO_2 and relative humidity were also measured. The light transmittance was reduced when moving from the outer edge of the canopy to the trunk base in horizontal plane in selected tree species. The irradiance levels of blue (B: 400-5000 nm), red (R: 650-680 nm), far-red (FR: 700-885 nm) and ultra violet (UV: 318-400nm) components of the transmittance spectra under canopy were also found significantly low compared to direct sunlight. *Mesua* cuts down 99% of the total spectrum and *Muntingia* and *Amherstia* cut down the same by 92.1% and 97.1% respectively. The measured R: FR ratios that influence growth attributes of floricultural crops of *Mesua* were less than 0.1 and were 0.2 and 0.6 in *Amherstia* and *Muntingia,* respectively during the midday. Under the shaded canopy the temperature reduction was 2◦ C and 1◦ C in *Mesua* and *Muntingia,* respectively. *Mesua* showed 1-2% RH increment and ~20ppm reduction in the CO_2 concentration. There was no difference in RH under the tree canopy at midday in *Amherstia* and *Muntingia*. *Muntingia* was found to be suitable for growing shade-loving plants underneath their canopies and *Mesua* can be recommended for human comfort specially in public places.

Keywords: Landscaping, Microclimate, Radiation spectrum, Shade trees, Transmittance radiation

[*]chalindab@gmail.com

Stabilization of Swine Manure Using Microbial Inoculants at Different Application Frequencies

Ranasinghe P.A.S.K., Deshapriya R.M.C.[*], Karunarathna A.K.[1], and Alahakoon A.M.Y.W.[1]

Department of Animal Science

Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The waste disposal is one of the major constraints associated with swine production because of negative environmental impact. The discharging swine manure from the piggeries takes a long time to decompose hence generates unpleasant odor. Therefore, objectives of the present study were to stabilize and reduce unpleasant odor of swine manure using microbial inoculants, and to find out the most efficient application frequency of the inoculants for accelerated stabilization. Effective microorganisms (EM) and Live-Gro® probiotic solution were used as inoculants, after diluting 1:20 and 1:10 ratios, respectively. The inoculums were applied separately in 2-day, 1-week, and 2-week intervals for 30 days. The control manure samples were added 5 ml water only at the frequency and all treatments were carried out with three replicates. The physicochemical parameters such as pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), salinity, Dry Matter (DM), and Volatile Solids (VS) were taken at a defined time interval. Ammonia nitrogen, soluble nitrate nitrogen, and soluble phosphate concentrations were measured after 14 days to assess the rate of decomposition. ANOVA and Tukey tests were used for data analysis. Manure samples treated with EM and Live-Gro® solution at 2 days interval reached rapid stability (within 10 days) when compared to control showing low pH and higher TDS than in the control. There was a declining trend in DM, VS, Soluble NO_3-N, and soluble NH_3-N with the time of storage in all inoculated samples which were more prominent in 2-day interval application. The samples treated with EM at an interval of 2 days showed a significantly ($p<0.05$) low DM (28.76%) content and ammonia nitrogen (723.7ppm) after 28th day of inoculation. In conclusion, it could be mentioned that the application of EM at 2-day intervals to swine manure could efficiently stabilize and reduce unpleasant odor.

Keywords: Swine manure, Microbial Inoculants, EM, Live-Gro®

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[1]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

[*]cdeshapriya@agri.pdn.ac.lk

Status of Productivity and Their Determinants of Peri-urban Animal Farming Units in Selected Veterinary Ranges of Colombo District

Mederipitiya D.L.S., Silva G.L.L.P.[*], Korale-Gedara P.M.[1], Sarath K.K.[2] and Lasantha E.D.M.[2]

Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Peri-urban animal farming systems have a greater potential to contribute to the sustainable growth of urban food systems. It strongly interacts with a mix of urban, and rural resources in different ways and at different hierarchy levels. Improving productivity at farm level invariably enhance the supply to the food system. This research intended to; (1) Observe species diversity of the animal farms/mixed farms in selected peri-urban areas, (2) Estimate the total factor productivity (TFP) of those farms, (3) Identify determinants of productivity and (4) Outline the issues, opportunities, constraints of peri-urban animal farming. The TFP relates the output to a bundle of inputs, such as capital, labour, land and intermediate inputs, which were measured in this study using Fisher index. The pretested questionnaire was administered to collect data from a total of 115 farmers, where 50, 35 and 30 from *Homagama*, *Padukka* and *Kosgama* veterinary ranges, respectively. Purposive sampling technique was used to draw farmers into the sample. TFP was calculated by considering the variable inputs, viz: labour, feeding, fuel, veterinary, miscellaneous, and outputs; farm products and animal sales. A base farm (TFP = 1) was selected to compare the level of productivity. The mean TFP values for 101 dairy farmers and for 15 commercial and backyard poultry farmers were 1.76 and 0.90. The range varied between 0.04 to 5.24 (± 0.1) and 0.14 to 1.33 (± 0.08), respectively. Ordinary logistic regression was used to identify the determinants of TFP variation across farms. The results reveled that the inclusion of dhal husk and rice bran into rations, availability of own grassland, distance to the main city, and education level of farmers ($P<0.05$) explain the difference in TFP value. TFP was not influenced by animal farming experience and income.

Keywords: Animal Farming, Determinant of Productivity, Fisher Index, Peri-urban, Total Factor Productivity

[1]Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Sri Lanka

[2]Department of Animal Production and Health, Western Province, Welisara, Sri Lanka
[*]pradeepas@agri.pdn.ac.lk

Students' Satisfaction in the Degree Programs Offered by Faculty of Agriculture, University of Peradeniya: Application of Expectation- (Dis) Confirmation Theory

Rinosa A. and Hemachandra S.D.S.[*]

Department of Agricultural Economics and Business Management
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Expectation-disconfirmation theory suggests that satisfaction from a product would be dependent on the (dis)confirmation of the product experience with the product expectation. This study applies the expectation-disconfirmation theory to assess the level of satisfaction of the degree programe offered by the Faculty of Agriculture, University of Peradeniya. A satisfied customer would spread positive word of mouth that builds the reputation for the product offering increasing the demand. An educational institute would have a high demand for the programs offered if they have satisfied students. The study focused on the product offering of a degree program in terms of knowledge, skills, and attitudes the students' expectation on the product offering and what they experienced. Data was collected from the final year students of the three degree programs offered by the Faculty of Agriculture: the Agriculture Technology and Management, Food Science and Technology and Animal Science and Fisheries using a self-administered questionnaire. The data were analyzed using descriptive statistics and structural equation modeling (SEM) using Smart PLS software. The study found that there is a high level of disconfirmation among students with regard to attitudes than with regard to skills and knowledge. There is a significant relationship between satisfaction and confirmation of the expected level of knowledge, skills, and attitudes through experience for all the three degree programs, there is not significant relationship between gender and satisfaction in all three degree programs and there is a significant relationship between CGPA and satisfaction in Animal Science and Fisheries degree program. The study recommends that Faculty strive to understand what the expectation of the prospective students, organize a curriculum and delivery of the of the degree programs to focusing on delivery to meet the students' expectations.

Key Words: Degree programe, Expectation-disconfirmation theory, Satisfaction

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[*]dilinihema@agri.pdn.ac.lk

Effect of Need Fulfilment and Entrepreneurial Orientation on the Progression of Freelancing Career

Hewavidana B.H. and Hemachandra S.D.S[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Online freelancers have the potential to earn foreign currencies while working from home. However, they are an understudied segment of the labour force in Sri Lanka. In this study, the effects of need fulfilment and entrepreneurial orientation on the progression of the freelancing career were studied, based on Maslow's Hierarchy of Needs Theory. No sampling frame was available as the freelancing population in Sri Lanka is not defined. Hence, convenient and snowball sampling techniques were used. Responses were obtained through a questionnaire distributed in social media communities dedicated to freelancers. There, the effect of freelancers' satisfaction with the level of need fulfilment on their willingness to progress as a freelancer and the moderating effect of individual entrepreneurial orientation on that relationship were analysed. Further, Maslow's finding that the fulfilment of lower-level needs affects the fulfilment of higher-level needs was checked here. A pyramid score was calculated to obtain overall satisfaction of needs. Within the sample, only 51% showed a hierarchy in fulfilling needs. Ordinal logistic regression and correlation tests were used in the analysis. Results indicated that there is a significant relationship between satisfaction with need fulfilment and willingness to progress in the freelance career for both the freelancers who follow the hierarchical order and the entire sample (without taking the hierarchy into account). When taken individually, none of the five need types (physiological, security, belongingness, esteem and self-actualization needs) had a significant effect on the willingness to progress in the freelancing career. In any case, entrepreneurial orientation had no moderating effect on the relationship between freelancers' need fulfilment and willingness to progress as freelancers. Moreover, the more each lower-level need is satisfied, the more the next higher-level need is satisfied. The results indicate that the freelancers are a diversified group, and they do not necessarily follow a hierarchy in fulfilling the needs.

Keywords: Career progression, Entrepreneurial orientation, Maslow's hierarchy of needs, Motivation, Online freelancers

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[*]dilinihema@agri.pdn.ac.lk

The Entrepreneurial Decision-Making Approaches of Dried FishProcessing Business Operators in Coastal Sri Lanka

Dharmadasa S.K., Kodithuwakku K.A.S.S.[*], Galappaththi M.[1] and GunaratneL.H.P.

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

The Sri Lankan marine dried fish sector significantly contributes to the country's economy, livelihoods, and well-being of fishing communities. Nevertheless, these individuals who own and operate dried fish processing businesses function in aresource-constrained environment shaped by external shocks and internal stressors. Despite these resource constraints, some Dried Fish Processing Business Operators (DBOs) have managed to survive and grow their businesses. The study aimed to investigate the types of Entrepreneurial Decision-Making (EDM) approaches adopted by DBOs, and whether the EDM types change with the characteristics of business owners and their businesses. In doing so, the study drew on three different concepts ofEDM approaches—causation, bricolage, and effectuation. The research was conducted in fishing communities in Negombo area. The research employed mixed methods including a questionnaire survey with DBOs (n=86) and in-depth interviews with a subset ofthe sample (n=20). Data were analyzed using statistical tests (MANOVA andANOVA) and were supplemented with insights emerged through qualitative data. Thefindings revealed that DBOs adopted all three EDM approaches to different degrees. The results further revealed that these approaches significantly vary with the age and gender of DBOs as well as stage of operation, and size of their businesses ($P<0.05$). Inparticular, younger owners highly adopt effectuation while older owners highly adopt causation. In contrast, younger-female DBOs adopt both effectuation and bricolage. Additionally, experienced owners rely more on the causation approach. Moreover, the findings related to business characteristics showed that effectuation and bricolage approaches are common in small-scale businesses and start-ups, whereas large-scale and developed businesses adopt causation approach. The findings of the study suggestthat policies and interventions that seek to improve dried fish businesses should pay attention to the diversity among DBOs and their approaches to sustain their business by going beyond the usual loan facilities towards business development.

Keywords: Bricolage theory, Causation, Dried fish processing business operators, Effectuation, Entrepreneurial decision-making approaches

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[1]Postdoctoral Fellow, Brock University, Ontario, Canada.
[*]sarathsk@agri.pdn.ac.lk

The Impact of Changes in Regulatory, Economic and Business Environment on Value Chain of CPPM Division, Hayleys Agriculture during 2020-2022: A Case Study

Adhikari A.M.L.S. and Prasada D.V.P.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study, in essence, is an attempt to determine the impact of changes in regulatory, economic, and business environment on the value chain of the Crop Protection and Planting Material (CPPM) division, Hayleys Agriculture. In addition to this primary objective, identifying the effective management practices and modifications in the value chain that maintains positive revenue growth in a turbulent environment are reviewed. The applied methodology of this study is focused on the value chain performance attributes such as efficiency, flexibility, and quality. The ultimate goal is the identification of the critical success factors which help to maintain successful business operations of the CPPM division under the uncertain business environment within Sri Lanka. In-depth interviews were used for data collection. Data was collected directly from the 14 key informants who employed in functional and middle level management of the CPPM Division of Hayleys Agriculture. Qualitative research techniques were used for this case study. In the end, the BCG matrix and McKinsey matrix were developed to identify competitive advantage. CPPM division managed the crisis effect thorough value chain transformation. Continuous improvements in different aspects of value chain components could help to survive in drastically changing market place. Several recommendations could be obtained from the study. CPPM division should develop the following areas to improve internal processes: risk management, customer relationship management, web app optimization, and data visualization across the organization to fit the technology driven modern business world. Further investments in the development of the agro chemical and seed vegetable product portfolios and scaling down the seed paddy business are essential. Important implications could be derived from the study concerning the management of agri-businesses. It is evident that advanced planning and long-term oriented strategy formulation offer a good foundation for the firm to operate under uncertain economic, regulatory, and business environment.

Keywords: Agribusiness, Case study, Strategy formulation, Value chain

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[*]prasada@agri.pdn.ac.lk

The Impact of Planned Power Outages on Television and Social Media Consumers

Amaratunga D.W.O.J., Kodithuwakku K.A.S.S.[*], Gunaratne L.H.P. and Jayathunga M.P.[1]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Media planners are facing challenges in budgeting marketing communication with the changing media consumption behaviour due to power outages, especially during media prime time. The nature of such behavioural changes may vary depending on independent viewer characteristics. Hence it is vital to investigate such behavioural changes and associated characteristics of media consumers for efficient and effective marketing communication during the power outage. The objectives of the current study were; to determine the changes in inter and intra-media consumption behaviour concerning age, socio-economic conditions and different needs (Uses and gratification theory) under power outages. The population was registered voters from the Western province's electoral registry, and the sample consisted of 384 respondents selected randomly. Primary data were collected through face-to-face interviews guided by a pre-tested structured questionnaire. Descriptive statistics and binary logistic regression were used to analyze data and achieve research objectives. The findings revealed that a considerable amount of media consumers had changed their inter/intra media consumption behaviour with media gratifications, Information seeking, entertainment, self-expression, and social interaction. Regarding socio-economic and demographic conditions, age, gender, income, occupation, and district of residence caused the changes in inter/intra media consumption behaviour during the power outage. The study further revealed that most media consumers who previously used media, especially pay TV and non-pay TV during the media prime time, tend to refrain from using media due to the power outage. Finally, the study found that the change is significant among frequent media users rather than rare user segments, especially in non-pay TV and pay TV. Due to these inter/intra media consumption behavioural changes, media planners should revise the budgets allocated for non-pay TV and pay TV, especially during the media prime time.

Keywords: Inter-media, Intra media, power outage, Uses and gratification theory

[1]Third Shift Media (PVT) Ltd, Sri Lanka
[*]sarathsk@agri.pdn.ac.lk

The Short-Term Response of Soil Microorganisms for Input of Microplastics

Liyanage J.M., Dandeniya W.S.[*], Chathurika J.A.S.[1] and Gimhani M.[1]
Department of soil science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Using plastic mulches in agriculture has a number of advantages. However, plastic mulching has become a major contributor ofmicroplastics to agriculturallands. This study was conducted to assess short-term effects of adding microplastics originating from two types of plastic mulching materials on soil biological properties. The effect of previous exposure of a soil toplastic mulching on microbial response to microplastics was also assessed. Two soils, one with previous exposure to plastic mulching (WH) and one without previous exposure to plastic mulching (NH), collected from MahaIluppallama, were used for the study. Each soil was mixed with microplastics from a biodegradableand a conventional mulch at a rate of 0.1%(w/w) separately in triplicates. Unamended soils served as controls. Soils were incubated in dark for nine weeks after applying treatments. Soil microbial respiration, microbial biomass carbon, catalase and urease enzyme activities, soil pH and electrical conductivity (EC) were measured periodically. Surface properties of microplastics before adding to soil and after incubating with soil were analyzed with FTIR technique. Soil pH and EC increased significantly ($P<0.05$) in the microplastic added treatments compared to control at the end of 9th week of incubation. Microplastic treated soils showed a significantly ($P<0.05$) lesser degree of enzyme activity than controls at the end of 9th week. Microplastics from biodegradable mulch reduced catalase activity more than the conventional mulch. Microbial biomass carbon and microbial respiration were significantly ($P<0.05$) changed by microplastic application. Soils with previous exposure to microplastics significantly affect the changes in pH, EC, urease activity and soil respiration responding to new input of microplastics. The study confirmed that addition of microplastics changed soil microbiological properties. Previous exposure of soil for plastic mulching and the type of mulches influenced the nature of response of soil microbial communities to new inputs of microplastics.

Keywords: Biodegradable mulch, Conventional mulch, Enzyme activity, Microorganisms, Microplastics

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[1]Sri Lanka Institute of Nanotechnology (Pvt) Ltd
[*]warshisd@agri.pdn.ac.lk

Undergraduates' Quality of Life and Its Association with Mental Health Symptoms: The Case of the University of Peradeniya

Liyanage N.A. and Kumar S.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Policymakers and university administration are equally concerned about how the current crisis is affecting student wellbeing. Undergraduates find themselves in stressful situations because of their workload and other responsibilities. Mental health symptoms (MHS) are seen as major causes of reduced QOL. This research is conducted to assess the QOL and the presence of MHS, such as depression, anxiety and stress among undergraduates and to determine how MHS are associated with QOL. Social and institutional support systems that are used by undergraduate students was also investigated. To measure QOL across four domains; physical, psychological, social, and environment, the World Health Organization Quality of Life BREF (WHOQOL-BREF) was utilised. The existence of MHS was examined using the 21-item Depression, Anxiety, and Stress Scale (DASS-21). The QOL, MHS, and support services of 471 University of Peradeniya undergraduate students were evaluated using quantitative research techniques and a deductive approach. Data were collected through both online (271 responses) and physical (200 responses) modes. Preliminary analysis indicated that online and physical survey data were not compatible and could not be merged. Therefore, the analyses were conducted on the two groups separately. Descriptive analyses showed that most undergraduates had favourable levels of QOL and normal level of MHS. However, a concerning 15% claimed to have severe and extremely severe levels of depression, anxiety and stress. MANOVA analysis revealed that QOL and MHS are significantly associated (*p<0.05*). Descriptive and tabular analysis showed that QOL reduced with the increment of severity of MHS. Support systems that were used by a majority of undergraduates were informal, such as family, batchmates and outside friends. Only a low percentage of undergraduates sought help from university and other formal support systems. Findings can inform ways to improve QOL and mental health of undergraduates.

Keywords: DASS-21, Mental health symptoms, Quality of life, Undergraduates, WHOQOL-BREF

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[*]skumar@agri.pdn.ac.lk

Vendor and Consumer Perception Towards Artificial Fruit Ripening - A Case Study in Selected Suburbs in Mid Country, Sri Lanka

Gamage S.N.W., Hettiarachchi W.A.B.H., Sawbhagya L.H.N., Sandarenu K.M.S.D., Dasanayaka Y.M.H.M., Attanayake R.M.T.D., Suriyagoda B.M.L.D.B., Galahitiyawa D.D.K.[1] and Kumarihami H.M.P.C.[*]

Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

This study was conducted to evaluate the knowledge, attitude, and health-related aspects of artificial fruit ripening among fruit vendors and consumers in selected suburbs in mid-country, Sri Lanka. The study adopted a questionnaire survey. The individual effect and associations between awareness and respondents' demographic characteristics were statistically analyzed. In case of vendors, most of the respondents belonged to the age category 36-55 years (55%), gender category male (90%), and educational category GCE A/L (41%). For consumers, most of the respondents belonged to the age category 18-35 years, the gender category female, the educational category GCE A/L, and prefer to purchase local fruits. Each respondent was given a score and divided into 3 awareness categories. The awareness of the scientific knowledge, application methods, and health effects of artificial fruit ripening was evaluated. Most of the vendors (62%) were aware of the artificial fruit ripening application methods more than consumers (47%). Most of the vendors (95%) were more aware of the health problems than the consumers (49%). More consumers (85%) were aware of the science behind artificial fruit ripening than the vendors (12%). In relation to the vendors, the gender and education categories showed associations between awareness of artificial fruit ripening and socio-demographic characteristics. According to the consumers, there were no associations between consumers' socio-demographic characteristics and their awareness of artificial fruit ripening.

Keywords: Artificial ripening, Awareness, Consumers, Natural ripening, Vendors

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[1]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya,
 Peradeniya, Sri Lanka
[*]prathibhani@agri.pdn.ac.lk

Vulnerability of the Households in Marginalized Urban Communities to Food Insecurity in the Face of Soaring Food Inflation in Sri Lanka; An Insight from the Poornawatta West GN Division in Kandy District

Weerasinghe P.W.N.T. and Jayaweera A[*]
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

With the ongoing economic crisis in Sri Lanka, people are in a dire struggle to meet their daily household food requirements. There is a lack of evidence-based information on the actual status of food insecurity among marginalized populations of the country. Study, with reference to an economically marginalized urban community in the Kandy district, attempted to provide an insight into the extent to which such urban communities are vulnerable to food insecurity in the face of persistent food price inflation in Sri Lanka. The study was conducted in the Mahaiyawa MC block of the Poornawatta West GN division. Hundred and ten households were randomly extracted for the survey. Study attempted to assess the scope and severity of food insecurity of the households in the target population. Next, the study attempted to investigate any association between different socio-demographic factors and the severity of food insecurity pertaining to the study population. Finally, the study examined the coping responses of the households in the face of increasing food prices and their declining food purchasing power. According to the results, 82.5% of the Mahaiyawa MC population is moderately or severely vulnerable to household food insecurity. Study revealed that households headed by less-educated or female adults are significantly more vulnerable to food insecurity than the rest. Study reports a drastic reduction in the daily intake of essential food groups by the households of the study population. A number of strategies employed by the households to cope with rising food prices were revealed. Increased household food production, decreased quality and quantity of daily meals, changed food purchasing patterns, and reduced food waste were among the changes triggered by such coping strategies.

Keywords: Coping strategies, Food inflation, Household food insecurity

[*]anuradhaj@agri.pdn.ac.lk

Relationship between Water Access, Exogenous Prices, and Poverty of Farm Households in a Surface-Gravity Irrigation System: The Case Study of the *Kirindi Oya* Irrigation and Settlement Project

Harankahawa. H.M.N.S. and Weligamage. P.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Irrigation is vital as a common pool resource in increasing agricultural production. Farmers mostly use surface irrigation as their method of irrigation. *Kirindi Oya* Irrigation and Settlement Project (KOISP) is a major surface gravity irrigation system in the Hambantota District where priority is given to rice cultivation. Currently, its farmers leave paddy farming due to their low income. This study first analyses inequality in the water received by farmers and its relationship with household income and then the effect of exogenous prices and water access on farmers' poverty status. The theoretical basis is the model of profit-maximising farm households. Using published data on the KOISP, descriptive statistics, farm budget techniques, FGT indices and binary logistic regression were used for the analysis. Findings indicate substantial differences in water quantity received by the farmers across seasons and subareas of the system (P<0.05). Around 60% of farmers show poor water access in Maha and Yala seasons in the New Irrigation Area (NIA). The average water quantity received in the Old Irrigated Area (OIA) was 17% higher than the NIA. The changes in household income were simulated by allocating additional water to fulfil the minimum requirement of the rice plant in its vegetative stage. Household income increases with every unit of additional water received (P<0.05). The result of the binary logistic regression indicates that the water access (P<0.05), exogenous prices; agrochemicals (P<0.05); machinery (P<0.05), seeds (P<0.05) and rice (P<0.05) significantly influence the probability that a household will be poor or non-poor. Additional water allocation caused an apparent reduction in the poverty status of farmers in NIA. Changes to exogenous prices caused a distinct reduction in poverty in both seasons of the current period (2020/21), which was more prominent in Maha. However, the number of poor households was higher in OIA than in NIA.

Keywords: Farm budgets, Farm household income, FGT indices, Rice farming, Water access inequality

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[*]parakw@agri.pdn.ac.lk

Water Resources Assessment and Water Productivity Analysis & Mapping in Malwathu-Oya West Sub Catchment, Anuradhapura, Sri Lanka

Karunarathna M.R.D.D., Dayawansa N.D.K.[*], Hemachandra E.M.G.P.

Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Assessment of water resources and water productivity enables in identifying approaches to address the agricultural water demand and water scarcity in dry zone of Sri Lanka. This study was undertaken to asses water resources, analyze and map water productivity in Malwathu-Oya West Sub Catchment using Geographic Information Systems (GIS). The Rainfall Anomaly Index (RAI) was derived by using daily rainfall data for the period of 1989-2018 from *Anuradhapura* and *Mahagalkadawala* rain gauging stations to identify wet (2015), dry (2016) and normal (2017) years for the analysis. Monthly Net primary production (NPP) and Actual evapotranspiration and interception (AETI) data gathered from WaPOR (Water Productivity through Open access Remotely sensed derived data) database of the FAO were used for the water productivity analysis and mapping. The total water availability for 2018 *Yala* and 2018/19 *Maha* seasons were estimated using a simple water balance method and water demand for different sectors was estimated. Spatial and temporal variabilities of Gross Paddy Water Productivity (GPWP) were identified in the analysis. The highest GPWP was reported in 2015, which identified as a wet year and this condition was evident in *Maha* seasons compared to *Yala* seasons of each year because of relatively high water availability. Hence the study revealed that GPWP values are synchronized with the rainfall. The ancient tank cascade systems (*Mahakanumulla, Thirappne, Ulagalla*) show high GPWP even in *Yala* seasons possibly due to better water management practices applied by the farmers. According to the water resources assessment, there is a water shortage of 42.85 million cubic meters (MCM) during *Yala* season even in the normal rainfall year of 2018. As per the water resources assessment, the estimated water demand for domestic, commercial, industrial and irrigation are 3.24, 0.39, 7.73 $\times 10^{-5}$ and 100.02 MCM in 2018 *Yala* season and 4.66, 0.56, 1.06 $\times 10^{-4}$ and 114.16 MCM in 2018/19 *Maha* season. Irrigation sector is the largest water user. The spatial variability of paddy water productivity in this area could be minimized through appropriate interventions to improve paddy production.

Keywords: Geographic information systems, Paddy water productivity, WaPOR data

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[*]ndkdayawansa@agri.pdn.ac.lk

Women's Participation in the Labor Force as a Source of Income Generation in Valikaamam South, Jaffna District

Kajapriya S. and Weerasooriya S.A.[*]
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Jaffna is one of the largest Districts in the Northern Province which has good potential for farming activities. Valikaamam south area is one of the most dynamic divisional secretariats in terms of females seeking employment. The study was undertaken among women in the Valikaamam South. Women play a significant and crucial role in farming, non-farming, and household activities. Several economic and non-economic factors are responsible for women's participation in the labor force. However, the level of women's participation in farming and non-farming activities is often associated with relatively low participation rates. This study focuses on how women's participation rate varies with women's demographic and household characteristics, factors related to farming and non-farming, the role of women's society, and issues such as disturbances, gender gap, and less productivity. The study also focuses on what are the factors influencing the decision to engage in women's participation in farm and non-farm activities and investigates the issues faced by women in the vicinity of the Valikaamam South. A total of 87 households were selected through proportionate random sampling through the Vali-South *Grama Niladari* division by using pre-tested well-structured questionnaires. Heckman's two-sample model was employed to identify the factors that influence women in the labor force as well as factors that influence the decision to engage in income-generating activities. Results showed that education level with A/L, graduate, higher studies, the motive to work, and training significantly influence the wage earned per month. On the other hand, age significantly influences the decision to engage in the labor force. The results imply stronger policy interventions targeted at women to improve and increase their participation in the labor force.

Keywords: Farm and non-farm activities, Female labor force participation (LFP), Heckit model, Income generating activities

[*]senalw@agri.pdn.ac.lk

An Analysis of Potential Effects of Alternative Urea Rationing Options on Paddy Yields and Production in Sri Lanka

Ihalagedara I.H.C.N.K. and Weerahewa J.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Restriction of imports of chemical fertilizers in the midst of the economic crisis of Sri Lanka has caused serious effects on its agricultural production. Even after the lifting of the import ban on chemical fertilizers, provision of urea was inadequate to fulfil farmer demand. As a result, urea became a scarce resource for the paddy farmers. This study analyses potential effects of alternative urea rationing methods on paddy production in Sri Lanka. The specific objectives are to estimate the technical relationship between the paddy production and the usage of raw materials paying special emphasis on urea and to examine the potential to enhance paddy production by allocating limited amount of urea available, among different types of paddy farmers. Data gathered from an island-wide survey conducted among 439 paddy farmers was used for the analysis. Several production functions were estimated in Cobb-Douglas form treating paddy yield as the dependent variable. Even though the results of the estimation showed a positive relationship between paddy yield and urea, a decline in marginal product of paddy with respect to urea was observed when land size increases. These results suggest a higher response to urea among small and medium scale farmers compared to those of large farmers. The simulation analysis performed to ascertain the changes in yields and total production under alternative urea rationing schemes clearly showed significant adverse effects of a blanket reduction of urea on yield as well as total production of small and medium size paddy lands. Accordingly, a higher production was observed when available urea was rationed prioritizing small and medium paddy lands. It is recommended to ration urea prioritizing small and medium category farmers to enhance production of paddy using limited quantity of urea available.

Key words: Land size, Paddy production, Paddy yield, Sri Lanka, Urea

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[*] jeevika.weerahewa@agri.pdn.ac.lk

Effects of Fuel Crisis on Paddy Cultivation in Thoppur Area

Ihshan F.M. and Weligamage P.*

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Paddy cultivation is one of the most important sector in Sri Lanka. Now a day's cultivation needs various types of machineries to perform several kind of farming activities such as land preparation, harvesting and other crop production practices. Therefore, a huge amount of fuel is consumed every year by agricultural sector. Due to the fuel crisis, it brought scarcity and price increasement on fuel. Fuel scarcity effects to perform paddy farming activities in perfect level and appropriate period of time. Fuel price hike effects on the input cost of paddy farming. This focused on the fuel scarcity due to the crisis. The study analyses how people struggle to get fuel and how fuel price hike changed the input cost of paddy farming before and after fuel crisis. This study based on Thoppur division paddy cultivation which includes 12 GN divisions in Trincomalee district. Paddy farmer in Thoppur area was taken as the unit of analysis. Primary data were collected from 35 farmers using structured questionnaire and face to face interviews. Paired t test was performed to compare before and after effects of fuel crisis. The effect of fuel crisis on paddy cultivation in Thoppur division was tested and there are significant differences due to fuel crisis before and after, in the factors such as spending hours in fuel station, number of trips to fuel station, travel distance from home, received amount of fuel, paddy cultivated area and number of rice plot cultivated than the input prices on paddy cultivation due to fuel crisis. There is a significant relationship in land preparation cost and harvesting amount of paddy before and after fuel crisis but there is no such relationship in harvesting cost and labor cost. Finally, the coping strategies followed by farmers to overcome this fuel crisis were analyzed.

Keywords: Coping strategies, Fuel crisis, Harvesting cost, Labor cost, Land preparation cost, Paddy cultivation

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* parakw@agri.pdn.ac.lk

Effect of Work-Life Balance on Quality of Life of Postgraduate Students at University of Peradeniya

Withanage S.D.A. and Kumar S.[*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Postgraduate students (PGS) are students who have obtained a degree from a university and are pursuing studies for a more advanced qualification. PGS have to fulfill multiple roles associated with their academic, work and family lives. Multiple roles cause stress and a lack of work-life balance (WLB). This may lower the quality of life (QoL) of PGS. Therefore, it is aimed to examine students' QoL and WLB; to study the effect of WLB on QoL of PGS and to determine the impact of gender and marital status as moderators on the relationship between WLB and QoL. The World Health Organization QoL BREF (WHOQOL-BREF) model was used to conceptualize QoL with four domains and the model proposed by Fisher McAuley was used to conceptualize WLB with the three domains, work interference with personal life (*w2p*), personal life interference with work (*p2w*) and work-personal life enhancement (*enhance*). The primarily quantitative study was conducted with 250 PGS belonging to all four postgraduate institutes at University of Peradeniya (UoP) as participants. Data were collected through an online questionnaire using a census approach. A follow-up qualitative study was conducted to further understand how PGS experienced WLB. Descriptive analyses revealed that PGS at UoP had relatively high QoL in all domains. Structural equation modeling revealed that there was a significant positive effect of WLB on QoL ($P<0.05$). Moderation analysis revealed that there was no significant moderating effect of gender on the relationship between WLB and QoL ($P>0.05$). The marital status (married with children) compared to unmarried ones, had a significant moderating effect on the relationship between the first two WLB domains (*w2p* and *p2w*) and QoL ($P<0.05$). Follow-up qualitative analysis revealed that many PGS (33.33%) plan successfully to balance their career, studies and personal lives to have a better balance. Implications of the study are discussed.

Keywords: Postgraduate students, Quality of life, University of Peradeniya, WHOQOL-BREF, Work-life balance

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[*] skumar@agri.pdn.ac.lk

Career Preferences of Agricultural Undergraduates under the Economic Crisis Background in Sri Lanka

Rajapaksha R.W.P.M.N.V. and Kumar S. [*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Agriculture has been at the forefront as Sri Lanka has tried to address the effects of the ongoing economic crisis. Therefore, Agricultural undergraduates have a role to play in addressing the crisis. This research aims to study the career preferences of Agricultural undergraduates during the economic crisis in Sri Lanka. Social Cognitive Career Theory (SCCT) was used to conceptualize the factors that affect career preferences. In addition, the effect of demographic factors on career preferences has been explored. Mixed methods, both quantitative and qualitative methods, were used on a sample of 269 Agricultural undergraduates of the University of Peradeniya, University of Ruhuna, Wayamba University of Sri Lanka, and Uva-Wellassa University. Data were gathered through an online questionnaire survey. Descriptive analyses showed that the majority of the participants changed their career preferences during the economic crisis compared to pre-crisis preferences, the main concerns were the lack of hiring into the public sector, market instability and uncertainty, and the desire to leave the country. A majority of students preferred the private sector for their careers after the economic crisis set in. Path analysis was conducted to find the effects of constructs of SCCT and demographic factors on the career preferences of Agricultural undergraduates. Path analysis revealed that self-efficacy and contextual supports significantly affect the outcome expectations of the career (P<0.05) and self-efficacy, outcome expectations, and gender of the participants significantly affect the components of career preferences: the knowledge of possibilities and the trust in future career paths (P<0.05). Contextual barriers and monthly income significantly affect goal clarity (P<0.05). Contextual supports significantly affect both components of career preferences (P<0.05). Self-efficacy and gender did not significantly affect goal clarity (P>0.05). The findings of this study can be used by the university administration, career counselors, and policymakers when organizing career guidance programs for Agricultural undergraduates.

Keywords: Agricultural undergraduates, Career preferences, Economic crisis, Social cognitive career theory

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[*] skumar@agri.pdn.ac.lk

Coping Up with Chemical Fertilizer Import Ban: An Analysis of Adaptation Strategies of Paddy Farmers of Sri Lanka

Thakshaniya.T. and Weerahewa J. [*]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

With the banning of imports of chemical fertilizer in May 2021, all crop cultivations were disrupted due to insufficiency of application of plant nutrients. This study was conducted to ascertain the extent to which paddy farmers adopted to use of organic fertilizers and to determine the factors determining organic and chemical fertilizer use paying attention to the decision to use organic fertilizers, quantities of fertilizer applied, and willingness to pay for fertilizers. Data collected from 463 farmers on the fertilizer application pattern in the Maha seasons of 2020/21, 2021/22, and 2022/23 was used for the analysis. Mean and frequency distributions were used to show the fertilizer pattern and regression models were used to determine the factors affecting fertilizer use decisions. The results indicated that 6.7%, 46.43%, and 39.09% of farmers used organic fertilizer. The result indicated that less educated farmers, having less land size, and part-time farmers are highly significant than that of highly educated farmers, having a large land size, and full-time farmers. For, the use of chemical fertilizers, females, not in a farming organization, educated farmer, and have less land size are significantly higher than males, members of farmer organization, less educated farmers, and have large land size. If a sudden policy change will happen in the future, can consider these variables and provide more priority to these farmers' characteristics without disturbing the paddy production in the country.

Keywords: Chemical fertilizers, Organic fertilizers, Willingness to pay

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[*] jeevika.weerahewa@agri.pdn.ac.lk

Farmer Attitude and Adaptation to Climate Change ResilientApproaches: A Study from *Ihalapalukandewa* GN Division.

Wanniarachchi H.G.I.K., Weerasooriya S.A.[*] and Kumara G.K.T.P.[1]
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

One of the biggest challenges to increasing or even maintaining food production by small-holder farming groups in a nation is climate change. Climate change is one of the biggest issues in Sri Lanka because the country is heavily dependent on agriculture,which is the foundation of rural livelihoods and is based on natural resources. Scientistshave suggested that Sri Lanka's overall rainfall, its known patterns, and the distributionlooks to be changing. Adaptation to climate change resilient strategies increase agricultural productivity and build farmers' resilience simultaneously. In this study, I investigate how smallholder farmers in the *Ihalapalukandewa* GN division, adapt to climate change. Primary data was collected and analyzed using a multivariate probit model. To measure the attitude of farmers, a Likert scale was used to obtain an averagescore and a deviation from the average to measure attitude. To identify constraints, a Likert scale was used to construct a Problem Confrontation Index where ranking was done. According to the results, some adaptation strategies (using organic fertilizer andrainwater harvesting) are interdependent. The use of organic fertilizer and rainwater harvesting allows farmers to increase productivity while building resilience to climate change. The likelihood of farmers' adaptation to climate change resilient approaches depends on the education of farmers, land size, access to extension services, and creditservices, and membership in farmer organizations. Although most of the farmers havea favorable attitude towards climate change and resilient approaches, lack of availablewater, shortage of farm inputs, lack of credit or money, and inadequate extension officers are the major problems in adapting climate resilient strategies. According to the findings of this study, governments should concentrate on supporting relevant infrastructure development, empowering access to extension services, and enabling cost-effective access to agricultural supplies either directly or through credit market interventions.

Key words: Climate change resilient approaches, Multivariate probit model, Problem confrontation index

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[1] Groundwater Recharging for Disaster Preparedness Project, Sri Lanka Red Cross Society, Sri Lanka
[*] senalw@agri.pdn.ac.lk

Why Choose to Shop Physically rather than Online for PurchasingFresh Produce? A Study of Brick-and-Mortar Shoppers in Battaramulla Shopping Strip

Wellagiriya I. K. D. U., Kumar S.* and Rajapaksha C.C.[1]

Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Although traditional shoppers must travel to retail outlets to purchase fresh produce, they can purchase the produce from the convenience of their homes through online platforms. Yet online purchasing rates for fresh produce remain low. This research examines why customers physically visit brick-and-mortar supermarkets. It also examines the extent to which fresh produce is bought online relative to other productsand services, and changes in the use of online retail outlets before, during, and after theCOVID pandemic. Finally, the study explores the reasons for not engaging in purchasing online fresh produce, and identifies the key determinants affecting attitudestowards the intention of purchasing fresh produce online. The conceptual model is builton the Technology Acceptance Model and Theory of Reasoned Action. First, apreliminary study was conducted to develop the questionnaire within the Battaramullashopping strip, the study site. In the main study, using an exit poll method, 218 consumers behaviours and perceptions were studied. Results indicate that onlinepurchasing of fresh produce is lower relative to rates of use of online platforms for banking, purchasing of food and beverages, and textiles. During the COVID-19pandemic, the percentage who used online platforms was higher compared to before or after the pandemic. The reasons for not purchasing online were related to technologicaland quality issues. Hierarchical linear regression analyses on attitudes and intention topurchase online, demonstrated significant effects for age, educational level, occupation, and family size. Further of the variables related to purchasing behaviour only whether online purchasing was done during the COVID-19 lockdown period was significant, and of the attitudinal variables, personal awareness of security, personal innovativeness, and perceived ease of use were predictive ($p < 0.05$). Using these findings e-grocers, retailers can develop better marketing and virtual platforms to develop better online services for their customers

Keywords: Online fresh-produce, Purchasing attitude, Purchasing intention, Technology acceptance model, Theory of reasoned action

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[1] Marketing Division, CIC Seeds PVT LTD, Kandy, Sri Lanka
* skumar@agri.pdn.ac.lk

Perceived Risks and Risk Managing Strategies Adopted by Actors in the Fresh Fruits Supply Chain in Vavuniya

Rilwan. S. and Hemachandra. S.D.S.[*]
Department of Agricultural Economics and Business Management
Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Risks faced by supply chain actors is a major constraint for the development of the supply chain. In improving supply chains, it is important to know the different kinds of risks faced and their relative importance. This study assesses the different types of risks as perceived by the supply chain actors in the fruits supply chain in Vavuniya district. A supply chain actor was interviewed using a structured questionnaire. The actors upstream and downstream of the supply chain were identified starting from the fresh fruit retails shops in Vavuniya town. The data were gathered from 9 farmers, 3 collectors, 3 wholesalers, 9 retailers, 9 consumers. The data were analysed using Fuzzy – Analytical Hierarchy Process (Fuzzy-AHP). The rating was considered valid, when its consistency ratio (CR) value lesser than 0.10. The results revealed that the actors involved in the fresh fruit supply chain are affected by different risks. The highest risk perceived at the retailer and customer levels is the price risk, and its CR values are 0.0057 and 0.0243, respectively. Wholesalers perceived transportation risk and customer loyalty and default risk as the main risks, and its CR value is 0.0059. Collectors perceived transportation risk as the main risk and, its CR value is 0.0119. Farmers perceived price risk and the supply risk of inputs as main risks and, its CR value is 0.0131. Risk managing strategies proposed by supply chain actors include reducing prices to increase number of buyers, collectively use transport facilities, have good storage facilities, understanding the daily demand for fresh fruits, giving a discount on low quality fruits, purchasing the entire fruit requirement at once to cut down on transport and storage costs, sharing information with buyers and sellers, understanding climate change and precautions, trading with buyers and sellers in the nearby areas during fuel crisis, and diversifying to different products

Keywords: Fresh fruits, Risk managing strategies, Supply chain, and Supply chain risks

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[*] dilinihema@agri.pdn.ac.lk

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Assessing Growing Conditions and Ultrasound-Assisted Technique in Optimizing the Extraction of Antioxidants and Polyphenols from Green Tea
Co-authors: Nissanka S.P., Gajadeera H. and Gunawardana M

3MT® (Three Minute Thesis) Competition

Winner: **Hettiarchchi N.N.**
A Critical Review on Effect of Effective Microorganisms (EM) on Methane Emission from Cow Dung
Co-authors: Deshapriya R.M.C. and Karunarathne A.K.

1st runner-up: **Maddumaarchchi S.N.**
Development of Dietary Fiber Enriched Cookies by Incorporating Avena Sativa (Oats), Lasia Spinosa (Kohila), and Banana Blossom
Co-authors: Wijesinghe D.G.N.G. and Lanakachandra S.

2nd runner-up: **Navodani H.H.A.C**.
Online Survey of Self-Reported Food Allergy Among Young Adult Students at the University of Peradeniya in Sri Lanka
Co-authors: Somaratne G.M., Maithreepala S.D. and Weerasinghe L.

2nd runner-up: **Vidyasekara E.V.R.T.**
Potential Use of Microorganisms for the Economic Sustainability of Food Industry: A Review
Co-authors: Samarakoon E.R.J. and Rajawardana D.U.

Invention and Innovation

Winner: **Bandara K.M.L.C.**
Development of a Robot Arm for a Drone Based Selective Tea Harvester
Co-authors: Mohotti A.J., Ranil R.H.G., Amarathunga K.S.P., Abeyrathna R.M.R.D. and Ekanayake E.M.A.C.

1st runner-up: **Fernando W.W.T.K.**
Development of a Module for Smart Android Based on Application n Dairy Farm Planning for Small Holder
Co-authors: Vidanarachchi J.K., Siva G.L.L.P., Weerasooriya S.A., Wijerathna R.M.S. and Dissanayake U.

2nd runner-up: **Madusanka O.W.S.**
Honey Color Analyzing Tool Kit
Co-authors: Somaratne G.M., Rathnayake P., Beligala D.H. and Wimukthi G.G.R.

2nd runner-up: **Chandimal A.S.J.**
Determination and Systematic Tabulation of Shelf-Life of Food Ingredients and Culinary Products used in the Food Catering Industry
Co-authors: Somaratne G.M., Bandara Y.D.M.D.C.Y., Samarasekara M.A. and Thuduwewatta N.D.

Research Brief Competition

English: **Rajapakshe R.M.O.L**.
Toxic and Repellent Effect of Selected Edible Organic Powders on Rice Weevil (Sitophilus Oryzae L.)
Co-authors: Waranasooriya P.G.A.S. and Hemachandra K.S.

Sinhala: **Balasooriya B.M.D.L**.
Effectiveness of Chilli-Brinjal Intercropping in Controlling Leaf Curl Disease of Chilli
Co-authors: Rankoth L.M. and Ranil R.H.G.

Tamil: **Braveena V.**
Current Status of Breeding and Productive Strategies used for Cattle, Goat, and Buffalo Breeding in Sri Lanka
Co-authors: Silva G.L.L.P. and Samaranayake N.

Research Video Competition

Winner: **Rathnayake K.M.K.I.**
Use of Multispectral UAV Images in Precision Agriculture: Weed Controlling Rice
Co-authors: Ariyaratne W.M.T.P., Marambe B., De Silva S.H.N.P., Sivananthawerl T. and Herath S.

1st runner-up: **Wickramarathne N.A.D.L**.
An Inquiry into Propensity of Dwellers in the Udagaldebokka Isolated Forest-Dependent Community to Resettle Off the Forest: A Cultural Consensus Analysis
Co-authors: Jayaweera A.

2nd runner-up: **Hettiarachchi H.A.M.D.**
Systamatic Tabulation of Glysemic Index (GI) of Commonly Consumed Sri Lankan Foods and Development of GI Based Software
Co-authors: Somaratne G.M., Chandrasekara A., Gunasekara D., Abeyrathne T.M. and Vindula I.B.S.

Scientific-Eye Photography Competition

Winner: **Wickramarathne N.A.D.L.**
An Inquiry into Propensity of Dwellers in the Udagaldebokka Isolated Forest-Dependent Community to Resettle Off the Forest: A Cultural Consensus Analysis
Co-authors: Jayaweera A.

1st runner-up: Dissanayake E.J.M.S.K.
Secondary Data-Based Phylogenetic Reconstruction of South Asian Capparis Species to Reveal the Necessity for a Systematic Revision of Sri Lankan Capparis
Co-authors: Jayawardana N.U., Yakandawala D. and Sirimalwatta V.N.S.

2nd runner-up: Senevirathna W.G.S.R.
Development of Collagen-Incorporated Tea (Camellia Sinensis)
Co-authors: Wijesinghe D.G.N.G. and Lankachandra S.

Graphical Abstract Contest

Winner: **Dewapriya I.N.S.**
Changes in Tomato Morphology in Response to Intensity of Greenhouse Environmental Control
Co-authors: Weerakkodi W.A.P. and Bandaranayake P.C.G.

1st runner-up: Manathunga M.R.D.I.
Effect of Different Colored Shade Net on Growth and Development of Greenhouse Capsicum (Capsicum Annum L.)
Co-authors: Ariyaratne W.M.T.P.

2nd runner-up: Navodani H.H.A.C.
Online Survey of Self-Reported Food Allergy Among Young Adult Students at the University of Peradeniya in Sri Lanka
Co-authors: Somaratne G.M., Maithreepala S.D. and Weerasinghe L.

ResearTOON Competition

Winner: **Pramodaya W.G.D.T.**
A Overview of Prevalence, Associated Risk Factors of Mastitis and its Effect on Milk Calcium
Co-authors: Deshapriya R.M.C. and Fernando P.R.M.K.

1st runner-up: Dewapriya I.N.S.
Changes in Tomato Morphology in Response to Intensity of Greenhouse Environmental Control
Co-authors: Weerakkodi W.A.P. and Bandaranayake P.C.G.

2nd runner-up: Kumaratenna K.P.S.
Effect of Mulching on Diversity and Abundance of Natural Enemies and Insect Pests of Brinjal (Solanum Melongena L.) Crop in Maathagama
Co-authors: Weligamage S.S., Waranasooriya P.G.A.S. and Hemachandra K.S.

Research Storybook Competition

Winner: **Kumaratenna K.P.S**.
Effect of Mulching on Diversity and Abundance of Natural Enemies and Insect Pests of Brinjal (Solanum Melongena L.) Crop in Maathagama
Co-authors: Weligamage S.S., Waranasooriya P.G.A.S. and Hemachandra K.S.

1st runner-up: Weerasooriya W.M.T.S.K.
Invitro Rooting of Gyrinops Walla Gaertn. (Wallapatta)
Co-authors: Eeswara J.P. and Sivananthawerl T.

2nd runner-up: Navodya H.A.H.
Testing the Effectiveness of a Urea Based Slow-Release Seed Coating Material in Lowland Rice Cultivation
Co-authors: Senavirathna G.I., Chathurika J.A.S. and De Costa W.A.J.M.

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Prof. J.K. Vidanarachchi (Activity Coordinator)
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Merit Awards for Undergraduate Research
Prof. H.L.J. Weerahewa (Activity Coordinator)
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