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FAuRS - 2020

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Editorial Board

Message from the Vice Chancellor of the University of Peradeniya

It is with great pleasure I write this message on the occasion of the Faculty of Agriculture Undergraduate Research Symposium (FAuRS-2020) scheduled to be held on 13th August 2021.

It is tremendously important and vital to blend the wisdom of young undergraduates in the fields of Agricultural Sciences and Allied Sectors who are capable and enriched with knowledge and skills in addressing the current local and global issues. As the pioneer in agriculture higher education and research in Sri Lanka, the Faculty of Agriculture of the University of Peradeniya has taken the leadership and driving its human resources in the most striking ways in finding viable and effective solutions to many of the challenges in the agriculture sector in collaboration with the stakeholders at all levels, both locally and internationally.

I have no doubts that the FAuRS-2020 will provide a unique platform for young undergraduates, the torchbearers of future humankind to present their research findings, share their knowledge & advances in research and development to build networks of professionals, researchers, academia, and policymakers while exposing to a wider range of audience. Moreover, this unique event will promote forward-thinking, insightful and valuable perspectives on the strategic challenges of the agriculture and allied sectors.

I take this opportunity to congratulate the Dean of the Faculty of Agriculture, this year's FAuRS Coordinator, and the Organizing Committee for their untiring efforts in organizing the event, despite the current global pandemic of Covid-19.

Finally, I wish the FAuRS-2020 of the Faculty of Agriculture a great success.

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

13th August 2021

Message from the Dean Faculty of Agriculture

It is with great pleasure and pride I am forwarding this message on the occasion of the 7th Faculty of Agriculture Undergraduate Research Symposium (FAuRS-2020), University of Peradeniya.

Since its inception, during the last 72 years, the Faculty of Agriculture of University of Peradeniya, as the pioneer and leading agriculture higher education institute in Sri Lanka shoulders responsibility of producing agriculture and related professionals needs for the country to face challenges and also to give the leadership to the sector. To produce leaders in agriculture sector, the undergraduate programs at the Faculty encourages holistic, independent and critical thinking, and use of innovative and problem-solving approaches through integration of modern and traditional blends and technological advancement. The concept of Undergraduate Research Symposia was first introduced to the university system of Sri Lanka in 1993 by the Department of Animal Science, Faculty of Agriculture, University of Peradeniya. Since then, Annual Student Research Sessions had been a tradition of the Faculty. In 2014, the Faculty took another step forward by conducting a common Students Research Symposium for the entire Faculty. The FAuRS is providing a platform for graduating students to present their valuable final semester research findings and interact with experts in the sector, peers and prospective employers. This will no doubt enhance the research culture within the Faculty and the university system.

This year too even with COVID-19 pandemic, which disturbed all activities of the country, the Faculty was determined to conduct the FAuRS-2020 due to its importance to our graduants. Hence, best oral and poster presentations are awarded at the main event of FAuRS-2020. In addition, merit research and winners of several open competitions namely Scientific-eye photography, Videography, Research briefs, Three Minute Thesis (3MT®) competition, ResearTOON, Graphical abstract, Research storybook are awarded. Moreover, inventions and innovations of the final year research projects will be selected and awarded by the Sri Lanka Inventors Commission. I hope that FAuRS-2020 is a fruitful and memorable experience for all participants. I know how difficult it was for the organizing committee to stage the FAuRS-2020 during this COVID-19 period in this glamorous way. I wish to extend my sincere gratitude to the symposium coordinator and her team for their hard work to make this event a successful reality.

I also take this opportunity to congratulate the presenters and the graduating students of all three degree programs.

I wish the FAuRS-2020 a great success.

Professor Gamini Pushpakumara
Dean/Faculty of Agriculture
13th August 2021

Message from the Coordinator of FAuRS 2020

Welcome to the Faculty of Agriculture Undergraduate Research Symposium 2020 (FAuRS-2020)! Over the last seven years, the Faculty of Agriculture has made a tremendous contribution by staging FAuRS as the main event to reflect and reward the most significant achievements and innovations of graduants. Due to the COVID-19 pandemic, FAuRS is a hybrid event this year. Two invited speakers, Dr. Mariano J. Beillard from the United States Department of Agriculture, and Dr. Prativa Pandey, the Founder & Chief Formulator Catalyst Technology Pvt. Ltd of Nepal and majority of participants join us online.

The FAuRS 2020 Proceedings includes 214 edited submissions from all three Degree Programs offered by the Faculty, BSc in Agriculture Technology & Management, BSc in Food Science & Technology, and BSc in Animal Science & Fisheries. The studies cover a wide range of topics related to agriculture and allied areas presented in four themes i.e. Agricultural Production & Productivity Improvement, Technological Interventions & Applications in Agriculture, Food Quality, Safety & Product Development, and Community, Environment & Management. At FAuRS 2020, 56 best presenters selected from eight Departments are given the coveted opportunity to compete for the best oral and poster presentations under the four themes in front of an elite panel of judges and audience. The Merit Awards for Undergraduate Research is a new addition to the FAuRS 2020 to reward the scientific merit of research projects for which a panel of external judges evaluates 28 projects selected from eight Departments under the same four themes. In addition, students had the opportunity to select one or more open competitions based on their interest as there was no limit on the maximum number of competitions a student can participate in. Short research videos prepared on undergraduate projects enter into the "Research Video Competition" and the photographs submitted based on the projects are evaluated at the "Scientific Eye" research photography competition. The research briefs written for the general public in all three languages are judged by a panel of judges, and the best submissions are compiled into "Hantana Blossoms", a magazine dedicated to communicating the research findings to general audience. The Three Minute Thesis(3MT®) competition stages the most effective communicators using a single slide presentation. The Sri Lanka Inventors Commission judges the most innovative research projects and inventions and in addition to the awards, the selected researches are accommodated in the national and international competitions. FAuRS 2020 is introducing four new competitions to provide more opportunities for students to showcase different talents in much boarder spectrum. Students will visualize their research in a cartoon under the "ResearToon" competition. Digital images captured during the project work are compiled into a photo book to be submitted to the "Research Storybook" competition. Students prepare a graphical abstract, a single, concise, pictorial, and visual summary of the main findings of the project and submitted them to the "Graphical Abstract" competition. The best of the best are awarded certificates, prizes, and medals while the others will receive a certificate of participation.

I would like to thank Prof. M.D. Lamawansa, the Vice Chancellor, University of Peradeniya and the Chief Guest and invited speakers, who share their thoughts and visions at FAuRS 2020. Special tributes are due to the Dean Faculty of Agriculture, Subcommittee Chairs, the Editorial Committee Members, Activity Coordinators, FAuRS 2020 Committee, the Session Chairs, Evaluators, Session and Audiovisual Coordinators, generous Sponsors, and everyone who encouraged and supported this event in numerous ways. It is indeed a pleasure to work with them. Enjoy FAuRS 2020.

Professor Pradeepa C.G. Bandaranayake
Coordinator FAuRS 2020
13th August 2021

Table of Contents

Technological Interventions and Applications in Agriculture

Food Quality, Safety and Product Development

Community, Environment and Management

Abundance and Diversity of Phosphate Solubilizing Bacteria (PSB) in Paddy Soil under Different Fertilizer Treatments and their Bio-priming Effect on Seed Germination and Growth Promotion

Gawarammana M.M.J.K., De Costa D.M.* and Dandeniya W.S.[1]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

This study evaluated the abundance and diversity of PSB in paddy soil under six fertilizer treatments, cultivated for two consecutive seasons (2019 *Maha*, 2020 *Maha*) and the bio-priming effect of the isolated PSB on paddy seed germination and growth promotion of seedlings. Soil suspensions at 10^{-3} dilution were spread on Pikovskaya's (PVK) medium to screen PSB. Morphologically different bacterial colonies developed on PVK medium were designated with a code and their abundance, colony forming unit richness, percentage relative abundance and Shannon-Weiner diversity index were calculated. Coded bacterial isolates were cultured on PVK and NBRIP-$Ca_3(PO_4)_2$ media to quantify phosphate solubilizing index (SI). Sixteen PSB isolates developed halos on both media were evaluated for their bio-priming ability using paddy seeds of variety BW 367 on wet paper towels. Germination percentage, plumule length, radicle length and seedling vigor were quantified and root hair density was ranked. Fertilizer treatments had a significant effect on the abundance of PSB (CFU/g of dry soil). Highest PSB abundance was reported by the soil with no nitrogen, no phosphorous and potassium at the recommended level by the Department of Agriculture. Lowest PSB abundance was found in soil having N, P and K levels as recommended by the Nutrient Expert decision tool. No significant difference was reported among the six treatments on CFU richness and Shannon-Weiner Diversity Index. Isolates X and M gave the highest SI on PVK and NBRIP-$Ca_3(PO_4)_2$ media respectively. Germination percentage, plumule length, radicle length, seedling vigor and root hair density differ significantly among the PSB isolates. Germination and growth performance assays identified isolates I, A and LL as the best performing bio-primers. Findings revealed the abundance and diversity of PSB in paddy soil under different fertilizer treatments and their biopriming ability to promote seed germination and plant growth.

Keywords: Abundance, Diversity, Germination, Phosphate Solubilizing Index, Priming

This work was funded by the National Research Council of Sri Lanka (Grant no. TO 16-07)

[1]Department of Soil Science, Faculty of Agriculture, University of Peradeniya, Peradeniya

* dmdcosta@agri.pdn.ac.lk

An Analysis of the Effects of Irrigation on Cane Yield and Quality Parameters of Sugarcane across a Wide Range of Growing Environments

Nigesh V. and De Costa W.A.J.M.*
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Supplementary irrigation is a promising option to increase productivity of sugarcane, which is predominantly grown in regions of lower and/or non-uniformly distributed rainfall. The objectives of this work were to determine the impacts of: (a) irrigation and (b) selected climatic variables on cane yield, sugar yield and juice quality of sugarcane. A meta-analysis of data collected from a review of published literature across a global-scale range of sugarcane-growing regions was done. A compiled data set consisting of 416 observations and 21 variables were analyzed in a linear mixed model. Effects of irrigation (in comparison to rainfed cultivation), irrigation method, amount of irrigation, crop sequence (*i.e.* plant crop, first ratoon, second ratoon) and season (*i.e.* plantings over consecutive seasons) were determined as fixed effects. Variance components due to variety (nested within experiment) and latitude were considered as random effects. Application of the model to the observed variation of cane yield revealed significant effects of irrigation ($p<0.0001$), irrigation method ($p=0.0023$), irrigation amount ($p=0.0076$), crop sequence ($p<0.0001$) and season ($p=0.0009$). In addition, irrigation × crop sequence ($p=0.0408$) and crop sequence × irrigation method ($p=0.0079$) interaction effects were significant. In contrast, region (tropical and sub-tropical) and irrigation × region effects were not significant ($p>0.05$). Among the random effects, the variance component due to latitude was substantially greater than that due to variety. A correlation analysis showed significant ($p<0.05$) positive correlations between cane yield and all quality parameters (sugar yield, Brix%, Pol% and Purity) except POCS%. Linear mixed model analysis of POCS% showed significant effects of irrigation ($p=0.0038$), crop sequence ($p<0.0001$) and irrigation × crop sequence interaction ($p=0.0213$). Multiple regression analysis showed that cane yield is negatively related to annual mean temperature, annual total rainfall and latitude. In contrast, POCS% is positively related to all the above climatic variables.

Keywords: Irrigation, Cane Yield, POCS%, Latitude, Climate

* janendramg@agri.pdn.ac.lk

Analysis of Arthropod Predatory Fauna in Bean Ecosystems at Thibbatumulla, Matale in Sri Lanka

Welagedara W.G.I.K.*, Warnasooriya P.G.A.S., Hemachandra K.S. and Weligamage S.S.[1]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Bean is an important vegetable crop cultivated in Sri Lanka and consumed in different forms. Among the cultivation constraints, insect pest management has been highlighted. Natural suppression of pest population is evident with the action of predators but no systematic investigation has been conducted in bean ecosystem; therefore, this study was conducted with the objective of analyzing the arthropod predator community in bean ecosystems managed under with and without weed management. The study was conducted from April to June in 2021 at Thibbatumulla, Matale. Two different bean ecosystems: with and without weed management were used for predator sampling. Weekly sampling as handpicking and pitfall trapping was continued for six weeks. Four coccinellid beetle species: *Pseudaspidimerus trinotatus, Chilocorus nigritus*, *Micraspis discolor, Rodolia* sp. were found in both ecosystems. Thirty spider species belong to families: Theridiidae, Araneidae, Salticidae, Clubionidae, Oxyopidae, Miturgidae, Pisauridae, Lycosidae and Tetragnathidae were identified and these families had 12, 6, 4, 3, 1, 1, 1, 1 and 1 species respectively. In addition, staphylinid beetle, tiger beetle, ants, brown lacewing, praying mantis, and dragonfly species were found in both ecosystems. The abundance of arthropod predators was significantly different with two ecosystems. Insects and spiders abundance in fields with natural vegetation (67%) was higher than weed managed field (33%). The predator population fluctuated with time and it was significantly different between two fields. Last three samples had high abundance of predators in field with natural vegetation than the weed managed field. Theridiidae, Araneidae, Coccinellidae, Salticidae and Clubionidae were highly diversified families in both fields. The overall results suggest that the field with natural vegetation encourages the abundance and diversity of arthropod predators.

Keywords: Arthropod Predator, Bean ecosystem, Natural vegetation, Weed managed, Abundance

[1]Horticultural Crop Research and Development Institute (HORDI), Department of Agriculture, Gannoruwa, Peradeniya

* ag15138@agri.pdn.ac.lk

Assessment of Growth, Yield and Composition of Selected Maize Varieties in Mid-Country Intermediate-Zone

Ariyarathna A.H.A.T., Kumara Mahipala M.B.P.*, Weerasinghe W.M.P.B.[1] **and Weerathunga M.W.D.C.**[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Improved maize (*Zea mays* L.) provides good fodder source for dairy cows. Present study assessed the growth, yield and composition of selected maize varieties in the mid-country intermediate-zone (MCIZ). Hybrid fodder maize variety PAC-2075720 and PAC-2075920 developed in Thailand are expected to introduce to Sri Lanka whereas CAI-111 is being locally developed. PAC-999SG is a commonly grown variety for silage production and used as a control. These varieties were grown at University Experimental Station - Dodangolla as a Randomized Complete Block Design. Maize seeds were sown in early March, 2021 and managed according to the 0xrecommendations of the Department of Agriculture. The forage was harvested at 80- and 90-days age. Fresh forage weight, plant height, first internode circumference and leaves number per plant were recorded. The first internode was crushed and brix value of the sap was measured. Leaf area index, fresh matter (FMY) and dry matter (DMY) yield were estimated. The dry matter (DM), organic matter (OM), neutral detergent fiber and ash content of the harvest at 90 days were determined. The effect of variety was significant ($P<0.05$) on plant growth parameters. The FMY of CAI-111 was greater ($P<005$) than other varieties at 80 and 90 days (70.25±3.19 and 81.37±7.26 MT/ha, respectively). Although, the DMY of varieties at 90 days were greater ($P<0.05$) than at 80 days (19.50 - 22.93 vs.15.88 - 17.51 MT/ha, respectively), there was no difference ($P>0.05$) among the varieties at the respective age. Low brix value was an indication of the low level of soluble carbohydrates content in CAI-111 ($P<0.05$). The lowest DM and OM contents also recorded in CAI-111 ($P<0.05$). Present results did not justify introduction of PAC-2075720 and PAC-2075920 maize varieties but recommend to promote cultivation of PAC-999SG and harvest at 90 days in the MCIZ. It is suggested to further improve variety CAI-111.

Keywords: Harvesting maize, Harvesting stage, Fresh matter yield, Dry matter yield, Brix value

This research was supported by the National Research Council of Sri Lanka through NRC TO 14-10 research grant

[1]Veterinary Research Institute, Gannoruwa, Peradeniya

* pmahi@agri.pdn.ac.lk

Caryota urens (Kitul): Morphological Diversity of Selected Populations and Assembling a Methodology for Molecular Studies

Wanigarathna K.A.D.T.L., Perera S.A.C.N.* and Bandaranayake P.C.G.[1]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Caryota urens is an underutilized palm having high potential for commercialization. Despite the health benefits, *kitul* tapping for sap is done only in Sri Lanka. Quantity and quality of sap depend on genetic variation and lack of such scientific knowledge is a major limitation in *kitul* cultivation. The current study aimed at assembling a methodology for studying genetic diversity, assessing variation of the barcoding regions, developing a descriptor list for stem and leaf morphology, characterizing of agro-morphological traits and gathering traditional knowledge on high yielding *kitul* germplasm. A comparative analysis was performed with retrieved sequences of *trnH-psbA, matK* and *rbcL* DNA barcoding regions of 7 *Caryota* species including *Caryota urens.* Plant samples were collected from 4 locations; *Beddegama, Verapitiya, Kadugannawa* and *Kotmale* in mid-country. A DNA extraction protocol was optimized using leaf and petiole tissues followed by PCR amplification targeting *trnH-psbA* barcoding region. Descriptor list for stem and leaf morphology of *kitul* was developed. A pool of palms of similar age was characterized for eight agro-morphological traits following the developed descriptor list and data were subjected to Principal Component Analysis (PCA). Traditional knowledge on high yielding palms were collected from *kitul* tappers. Alignment of barcoding region sequences *trnH-psbA* and *matK* displayed noticeable variation while *rbcL* was lacking in diversity. The *trnH-psbA* region of *Caryota* revealed 6 sites of single nucleotide polymorphisms. Accordingly, *trnH-psbA* was the best universal DNA barcoding region for assessing genetic diversity of *kitul*. A workflow was assembled with an optimized CTAB DNA extraction protocol from leaf tissues and PCR optimization with universal *trnH-psbA* primers. PCA results revealed bole, branches, crown morphology and stem as important agro-morphologies contributing to diversity. Traditional knowledge revealed trunk shape to be the determinant of higher yielders. Further research on genetic and morphological diversity would help in deriving information for commercializing *kitul* cultivation.

Keywords: DNA Barcoding, Morphological descriptors, Principal Component Analysis

[1]Agricultural Biotechnology Centre, Faculty of Agriculture, University of Peradeniya, Peradeniya

* chandrikaperera@agri.pdn.ac.lk

Changes in Soil Organic Carbon Pools with the Application of Organic Amendments having High Carbon Content

Samarasuriya W.A.S., Dandeniya W.S.*, Vitharana U.W.A. and Mariaselvam A.A.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Identifying organic amendments to enrich soil organic carbon (SOC) is important for improving soil fertility. This study was carried out to determine the impact of organic amendments (OAs) having a high C content on the temporal variability of SOC pools of a tropical Ultisol. Treatments were formulated with different combinations of cattle manure (CM), rice straw (RS), wood shavings (WS), and sawdust (SD). Accordingly, unamended soil (control) and soils amended with CM, CM+RS, CM+WS and, CM+RS+WS, two months incubated CM+SD, and saw-dust biochar (BC), were used as treatments in a 12-month incubation experiment. The application rates of biochar and other OAs were 0.5% and 1% (w/w), respectively. Total C contents of OAs ranged from 33 to 85% following the order of [CM+RS+WS] < [CM] = [CM+WS] < [CM+RS] < [CM+SD] < [BC]. Total organic carbon (TOC), active organic carbon (AOC), particulate organic carbon (POC) contents were determined and carbon management index (CMI) was calculated after 3, 9, and 12 months of incubation. At three months, average TOC in soils treated with OAs ranged from 12.69 to 15.97 g/kg and values were significantly ($p<0.05$) high compared to the control (10.85 g/kg). However, TOC declined with time and at 12 months, only CM+SD and BC treatments maintained significantly ($p<0.05$) high TOC content (12.55 and 12.67 g/kg, respectively) compared to the control (10.80 g/kg). Only the CM+SD treatment showed a significant increase in POC (0.19%) compared to the control (0.13%). Applying OAs had a significant impact on AOC only at 9months into incubation where CM, CM+RS and BC resulted in significantly ($p<0.05$) higher AOC than the control. Application of OAs significantly increased the CMI with the highest reported for BC (150%). The OAs showed a temporal variability on SOC pools and, CM+SD and BC are the most effective in improving SOC levels.

Keywords: Organic amendments, Soil C pool, Carbon management index

[1]Department of Biosystems Technology, Eastern University of Sri Lanka

* warshisd@agri.pdn.ac.lk

Changes in Tomato Morphology in Response to Intensity of Greenhouse Environment Control

Dewapriya I.N.S., Weerakkody W.A.P.* and Bandaranayake P.C.G.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Protected agriculture or growing crops in greenhouses is a solution for overcoming productivity issues and environmental constraints in the conventional agriculture and thus feeding the rising world population. However, in tropical regions, greenhouse covers accumulate heat from the incidence radiation, rising internal temperature to levels unbearable for the functionality, growth, and production of crop plants. Therefore, it is crucial to accommodate environment control methods for maintaining optimal temperature levels inside greenhouses. This study was conducted to investigate the growth response of tomato crop, variety 'Sylviana' to three greenhouse designs, having differential temperature control. The greenhouse designs were; (T1) a high-intensive greenhouse with a double cladded polythene roof and an Internet of Things (IoT)-based forced-air ventilation (exhaust fans) and evaporative cooling (misting) system, (T2) a semi-intensive greenhouse with a single glass roof and a timer controlled exhaust fans and misting and (T3) a less-intensive greenhouse with a single polythene roof, with natural ventilation (through insect-proof net covered roof and side vents). The results indicate the ability of T1 to maintain a favorable internal air temperature (below 35°C) during daytime for the growing crop, in comparison to high maximum daytime temperatures of T2 and T3 (45°C). Relative humidity inside T1 and T2 fluctuated within 50-92% while T3 was kept within 38-92%. Greenhouse environment control methods did not cause a significant impact on plant height, stem thickness, and leaf number of tomato plants. The flower inhibition was around 15% in T3 while it was 6-8% in T2 and T1. Among three methods, highest mean individual fruit weight (158±4.97g) and the mean fruit diameter (6.06±0.08cm) were observed in T1. Therefore, the environment control system in T1 could be selected based on the high quality of the product and the favorability of the internal environmental conditions.

Keywords: Environment control methods, Internet of Things, Protected agriculture

This work was funded by Organization for Women in Science for the Developing World.

[1]Agricultural Biotechnology Centre, Faculty of Agriculture, University of Peradeniya, Peradeniya

* wapweerakkody@agri.pdn.ac.lk

Characterization of the Nutritional and Botanical Composition of Naturally Grown Pastures in Mahakanumulla Cascade System in North Central Province, Sri Lanka

Godage G.G.C.P., Ekanayake W.E.M.L.J.* and Hulugalla W.M.M.P.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Natural pastures grown in cascade systems in the Dry Zone of Sri Lanka are often the primary source of feed for livestock animals. Characterization of the nutritional and botanical composition of pastures grown in cascade systems is essential for the nutritional planning of these livestock animals. This study was conducted to evaluate the botanical and nutritional composition of natural pastures grown in Mahakanumulla cascade system in Dry Zone of Sri Lanka in 2021. Four out of sixteen man-made water tanks namely *Mahakanumulla*, *Sembukullama, Punchikulama* and *Pahalawewa* were selected systematically in order to represent the cascade system and pasture samples were collected for the analysis of nutritional and botanical composition. The grazing area of the tank was divided into four strips and each strip was divided into three levels against the slope. Quadrant cut samples (n=12, three from each strip) were randomly collected from each tank to estimate the dry matter availability (kg DM/ha). Grab samples (N=12) were collected to estimate the nutritional and botanical composition. A sub sample from each grab sample was estimated for crude protein (CP%), crude fiber (CF), ash (%), dry matter (DM%) and gross energy (MJ/kg). A sub sample of each grab sample was sorted into grass, herbs, weeds & dead matter and oven dried to calculate the botanical composition. The dry matter yield of pastures ranged from 1800-7275 kg DM/ha amongst all the tanks. Crude protein and crude fiber of pastures ranged from 7-10% and 29-34%, respectively, amongst all the tanks. The total energy of pastures was approximately 16 MJ kg/DM. Pastures comprised of approximately 50% of grass, 40% dead matter and 8% weed.

Keywords: Cascade systems, Botanical composition, Nutritional Composition, Naturally-grown pastures

This research was financially supported by the World Bank funded project (AHEAD/ RA3/ DOR/ STEM/ PDN/No 52) administered by the Ministry of Higher Education Sri Lanka

* jayekn@agri.pdn.ac.lk

Comparison of Crossbred Dairy Cattle Genotypes on Economic Traits under Large Scale Semi Intensive Management in Nikaweratiya

Manojan M., Dematawewa C.M.B.* and De Silva V.G.D.T.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Maintaining high performance standards with respect to economic traits such as body weight, milk yield and reproduction is of utmost importance for profitability of a dairy enterprise. The main objective of this study was to determine the performance of various crossbred genotypes with respect to cow birth weight (BW), age at first calving (AFC), no. of services per conception (NoAI), lactation length (LL), lactation milk yield (LY), daily yield (DY) and no. of lactations/cow (NL) under large scale semi intensive management system in Nikaweratiya Divisional Secretariat (DS) of Kurunegala district. A leading state farm in Nikaweratiya DS division was used for the study due to availability of performance records for many years. The animals were provided with well-constructed cattle sheds and feed but sent for pasture plots as well for grazing. After removing the missing data, 389 lactation records of 100 crossbred cows of Sahiwal (SCr), Jersey (JCr), Friesian (FCr) and Australian Friesian Sahiwal (AFSCr) were used for analysis. Genotype and parity were fitted as fixed effects, as appropriate, in the Analysis of Variance model with Duncan's multiple range test for mean comparison. Mean performance values (±SE) of BW, AFC, NoAI, LL, LY, DY and NL were 20.9±2.19 kg, 67.1±7.23 months, 3.4±0.18 services, 287.9±18.94 days, 1155.6±75.87 L, 3.7±0.25 L and 3.9±0.40 parities, respectively. The mean values of crossbred genotypes (FCr, AFSCr, JCr, and SCr) were significantly different only with LY (1846.2, 1259.0, 1014.0, and 1024.9 L, respectively) and DY (4.71, 4.09, 3.19, and 3.47 L, respectively), where FCr and AFSCr were similar but significantly superior to JCr and Scr ($P<0.05$). Parity differences were not significant for any of the economic traits considered ($P>0.05$). Heritability for LY was 0.69 indicating high genetic variability. The current performance figures indicate the great potential existing to reach high performance standards through improved management conditions.

Keywords: Dairy production, Heritability, Intermediate zone, Performance evaluation

This study was funded by International Atomic Energy Agency, Austria (SRL_20666)

[1]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya

* dematawewa@agri.pdn.ac.lk

Comparison of Dairy Sire Breeds and Parities on Production and Reproductive Performances in a Large-Scale Farm in Kuliyapitiya Area

Jayasinghe J.A.L.M., Dematawewa C.M.B.*, De Silva V.G.D.T.[1] and Somarathna H.H.W.M[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Genetically superior dairy bulls (sires) of various breeds are used routinely for genetic improvement of the dairy cattle population in state nucleus herds. The objectives of this study were to determine the effects of sire breed and parity of cow on the production and reproductive performances of dairy cattle raised under a large scale semi-intensive management system in the Coconut Triangle and to estimate heritability of the investigated traits. The study was conducted at a large-scale farm near *Galpokuna* area of Kurunegala district. Performance records of 145 cows born to pure Sahiwal, Jersey, and Australian Friesian Sahiwal (AFS) sires were selected after editing for missing information. Birth weight of cow (CBW), lactation yield (LY), lactation length (LL), age at first calving (AFC), number of services per conception (NoS) were considered as the economic traits. Analysis of Variance procedure was carried out with Duncan's New Multiple Range Test to compare means of different sire breeds and parities. Sahiwal, Jersey and AFS sire breeds were not significantly different ($P>0.05$) with respect to LY (1238.2, 1202.6, and 1075.9 L, respectively), LL (242.9, 236.3, and 216.6 days, respectively), average daily yield (4.86, 4.89, and 4.85 L, respectively), and CBW (19.0, 18.4, 18.1 Kg, respectively). However, with respect to AFC (52.7, 40.4, and 46.6 months, respectively), Jersey crosses showed significantly earlier calving compared with Sahiwal crosses ($P<0.05$). Parity differences were significant only for LL and NoS ($P<0.05$). Chi-square analysis revealed that the percentage of abnormal births decreased significantly ($P<0.05$) from the first parity (20.7%) to the fifth parity (5.31%). The heritability estimates of CBW, LL, LY, and NoS were 0.164, 0.349, 0.246, and 0.148, respectively. The parameter estimates and residuals indicated that the management standards must be improved further for better comparison of genetic potential and suitability of different sire breeds for the above region.

Keywords: Breed comparison, Breeding bulls, Genetic potential, Heritability estimation, Performance evaluation

[1]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya
[2]Galpokuna NLDB farm Kuliyapitiya
* dematawewa@agri.pdn.ac.lk

Comparison of the Performance of Selected Maize Varieties for Fodder Production in Low-Country Dry-Zone Lowlands

Bandara H.R.M.I., Kumara Mahipala M.B.P.*, Weerasinghe W.M.P.B.[1] and Weerathunga M.W.D.C.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Many lowland paddy fields in low-country dry-zone (LCDZ) are kept fallow during the intermediate cropping season in Sri Lanka. Introduction of improved fodder maize (*Zea mays L.*) varieties for these fallow lands may ensure the availability of quality forage for dairy cattle feeding. Performance of four maize varieties for fodder production in LCDZ during intermediate season was assessed. Hybrid fodder maize variety PAC-2075720 and PAC-2075920 developed in Thailand are expected to introduce to Sri Lanka whereas CAI-111 is being locally developed. PAC-999SG is a commonly grown variety for silage production and used as a control. The experimental design was complete randomized design. Maize seeds were shown in Eppawala in early March, 2021 and managed according to the recommendations of Department of Agriculture. Maize forage were harvested at 80 and 90 days. Fresh weight, plant height, first internode circumference and leaf number per plant were recorded. The first internode was crushed and brix value of the sap was measured. Leaf area index (LAI), fresh matter yield (FMY) and dry matter yield (DMY) were estimated. Maize harvested at 80 days were analyzed for composition. There was no effect ($P>0.05$) of harvesting age on plant height, stem circumference, leaf number, LAI, FMY and DMY. The height (220.00±6.67 cm) and stem circumference (6.76±0.14 cm) of CAI 111 variety was greater ($P<0.05$) at 80 days. However, PAC-2075720, PAC-2075920, CAI-111 and PAC-999SG varieties were not different in terms of FMY (61.00±1.85, 59.01±5.23, 73.23±6.19 and 62.88±4.51 MT/ha, respectively) and DMY (19.72±1.53, 20.04±1.92, 19.27±1.77 and 20.11±0.80 MT/ha, respectively) at 80 days ($P>0.05$). None of the maize varieties were superior in terms of composition as well. There is no advantage of introducing PAC-2075720 and PAC-2075920 maize varieties to LCDZ. The study recommends to grow PAC-999SG and harvest at 80 days for fodder production in LCDZ lowlands during intermediate cropping season.

Keywords: Harvesting stage, Fresh matter yield, Dry matter yield, Brix value

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[1]Veterinary Research Institute, Gannoruwa, Peradeniya

* pmahi@agri.pdn.ac.lk

Current Status of Breeding and Reproductive Strategies used for Cattle, Goat and Buffalo Breeding in Sri Lanka

Braveena V., Silva G.L.L.P.* and Samaranayake N.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Reproductive and breeding strategies are used to bring rapid genetic improvement in cattle, goat and buffalo. This study was conducted to assess the present status of using common breeding and reproductive strategies, namely artificial insemination (AI), pregnancy diagnosis (PD) and calving (CL; calving from AI) at national, climatic zone, provincial and district levels in Sri Lanka. Secondary data obtained from the Department of Animal Production and Health for the period of five years (2016–2020) were used for the study. The national AI coverage represented mainly by cattle (96.5%) and then by goat (1.8%) and buffalo (1.7%). There was a slight decreasing trend in number of AI performed during the study period. Compared to the respective breedable populations, only 31.2% of breedable cattle, 1.4% of breedable buffalo and 2.0% of breedable goat were inseminated on average by AI. The AI coverage exceeded 50% of the breedable cattle only in wet zone (53%) followed by intermediate zone (42%) and dry zone (13%). Buffalo and goat AI coverage remained less than 7% of the breedable animals. The AI coverage of individual veterinary surgeon ranges exhibited varying trends during the study period. Following the trends in AI coverage, the total number of PDs carried out in the country were represented mainly by cattle (93.17%) followed by goats (0.16%) and buffaloes (6.67%). A positive and significant association was observed between percentage PD in breedable population and percentage target achievement in CL. However, the association between percentage AI coverage of breedable population and the total breedable population was significantly negative ($P<0.05$). The results of the study indicates that breeding and reproductive strategies have a considerable potential in bringing genetic improvement in cattle, buffalo and goat industries when employed them with a target oriented plan at field level.

Keywords: Artificial Insemination, Pregnancy Diagnosis, Breedable population, Genetic improvement, Target achievement

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[1]Animal Breeding Division, Department of Animal Production and Health, Gatambe, Peradeniya

* pradeepas@agri.pdn.ac.lk

Determination of the Effects of Different Potassium Treatments on Plant Growth, Yield and Health Parameters of Rice

Kumarasiri D.S.U., De Costa D.M.* and Dharmakeerthi R.S.[1]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

A pot experiment was conducted using variety Bg 352 to determine the effects of different potassium (K) treatments on growth and yield parameters of rice plants and the resistance to pests and diseases. Six potassium fertilizer treatments (T1-T6) were used based on the present K recommendation for rice by the Department of Agriculture (DoA) and Nutrient Expert (NE) decision tool considering two criteria, if the field was added with the crop residues or not. Three treatments had zero K levels representing each recommendation. Plant height, area of flag leaf and tiller number were measured as plant growth parameters. Number of days taken for panicle initiation, number of productive tillers and number of panicles per hill were recorded as yield parameters. Another set of plants maintained under the same six treatments were inoculated with *Rhizoctonia solani*, the pathogen causing sheath blight. Number of leaves showing K deficiency, damaged due to leaf eating pests under natural infestations and disease incidence and severity of sheath blight were recorded to determine the resistance of the plant against pest and diseases. Number of leaves with K deficiency was significantly higher in plants under no K and NE decided nitrogen and phosphorous levels at 'no crop residue' condition (T5) than the rest. The lowest number of leaves showing K deficiency symptoms was shown by the plants in the DoA recommendation (T2). There was no significant difference among treatments with respect to growth and yield parameters. Further, no significant difference was reported among the treatments for the incidence and severity of sheath blight and on the number of leaves damaged by leaf eating pests. Findings revealed the possibility of using reduced rates of K without significant effects on the tested growth, yield and host plant resistance parameters of rice.

Keywords: Potassium, Potassium Deficiency, Nutrient Expert, Rice Sheath Blight, Site Specific Nutrient Management

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[1]Department of Soil Science, Faculty of Agriculture, University of Peradeniya, Peradeniya

* dmdcosta@agri.pdn.ac.lk

Determination of the Possible Advantages of Intercropping Finger Millet and Cowpea in Terms of Land Productivity, Resource Capture and Drought Tolerance

Poornima H.T.B., De Costa W.A.J.M.* and Geekiyanage N.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

On the fringes of modern intensive agriculture, intercropping is important in many subsistence or low-input/resource-limited agricultural systems. Two experiments were conducted to determine the advantage of intercropping finger millet, FM, (*Eleucine coracana*) and cowpea (*Vigna unguiculata*) under rainfed and irrigated conditions. In each water regime, FM-cowpea intercrops at 50%:50% sole crop densities were grown with sole crops in randomized complete block designs. Based on their yields, the intercrops recorded land equivalent ratios (LER) of 1.31 (irrigated) and 1.39 (rainfed). Contribution of cowpea to LER was greater with 76% (irrigated) and 59% (rainfed). Intercrop cowpea yield (145.94 gm^{-2}) was not significantly ($p>0.05$) different from the monocrop (159.64 gm^{-2}). In contrast, intercrop FM yield (296.41 gm^{-2}) was significantly ($p<0.05$) lower than its monocrop (681.56 gm^{-2}). In both water regimes, cowpea showed faster early growth in both monocrops and intercrops with greater leaf area index (LAI), radiation interception and total plant biomass at 5 weeks after sowing (WAS). Growth of FM was faster than cowpea from 5 WAS onwards, achieving greater total biomass than their respective intercrops and sole crops. However, only sole FM could exceed the LAI of sole cowpea even after 5 WAS so that LAI and radiation interception of the intercrops were always lower than their sole crops in both water regimes. In both water regimes, leaf water potential (pre-dawn and mid-day), stomatal conductance, light- and dark-adapted quantum efficiency of PSII were higher in cowpea whereas leaf temperature was lower in cowpea. However, these indicators of water stress did not differ between the intercrops and monocrops, except in leaf temperature where the intercrop had cooler leaves than the monocrop. We conclude that: (a) intercropping cowpea and FM increases land productivity; (b) greater productivity of cowpea due to its superior physiological traits is responsible for the greater productivity of the intercrop.

Keywords: Intercropping, Land Equivalent ratio, Rainfed, Irrigated, Water stress

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[1]Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura

* janendramg@agri.pdn.ac.lk

Development of Arthropod Population in Bushita under Insecticide Sprayed and Un-sprayed Conditions

Vitharanage M.U.*, Shyamalee H.A.P.A.[1], Warnasooriya P.G.A.S., Lokuge K.S.[1] and Hemachandra K.S.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Yard-long bean (*Vigna unguiculata* subsp. *sesquipedalis* (L.) Walp) is a popular leguminous vegetable, consumed as fresh and processed. Among the production constrains, management of insect pests has been highlighted. Chemical use for pest control has become popular among bushita growers. However, many negative consequences are associated with the insecticide spraying including the effects on natural enemies. To understand the effect of insecticides on natural enemy populations this study was conducted with the objective of examining the population dynamics of arthropods in bushita with and without insecticide spray. The filed plots were established in Agriculture Research Station at Thellijawila, and maintained under DOA recommendations. Insecticide spray was the treatment. Arthropod populations were sampled using pitfall traps, water pan traps, and sweep nets. Bean fly incidence was evaluated by examining the damage plants. The bushita yield was measured to see the economic loss associated with un-spraying. A total of 2162 arthropods belonging to 21 families and 6 orders (Coleoptera, Hemiptera, Orthoptera, Homoptera, Hymenoptera, and Lepidoptera) were collected from 6 weekly samples. Aphids, lepidopteran larvae, grasshoppers, treehoppers, bean pod-sucking bugs were found and responsible for crop damage at different growth stages of bushita. Coccinellid beetles (24%), ground beetles (16%), tiger beetles (6%), ants (30%), and spiders (24%) were found as natural enemies. Insect pest activity was at peak during four to six weeks after sowing, coinciding with the flowering and pod formation. Significant difference ($P<0.05$) was found between sprayed and unsprayed fields in relation to insect counts in the taxa/groups: Agromyzidae, Platystomatidae, Coccinellidae, Dolichopodidae, Stratiomyidae, Pentatomidae, Scarabaeidae, Carabidae, Gryllidae, Membracidae, and Sparassidae (spider) families. The highest abundance was found in un-sprayed field. No significant difference was found in bushita yields of sprayed and un-sprayed fields (3600 kg/ha). The data reveals the effect of insecticides on arthropod populations in bushita.

Keywords: Arthropods populations, Bushita, Insect pests, Natural enemies, Yard long beans

[1]Agricultural Research Station, Thelijjawila, Matara

* ag15100@agri.pdn.ac.lk

Distribution of Essential Mineral and Toxic Trace Elements in Selected Paddy Soils and Rice Grains in Sri Lanka

Ekanayaka E.M.S. and Suriyagoda L.D.B.*
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Rice (*Oryza sativa* L.) serves as a key source of essential mineral elements to humans. However, the variation of nutrient concentrations in rice grains and paddy soils as affected by genetic, agroclimatic conditions and agronomic management practices adopted by the farmers in Sri Lanka is not clearly understood, and this was tested in the current study. Total of 200 paddy soil and 91 rice grain samples across the country were collected using a stratified random sampling approach. Soil total element concentrations were measured using X-ray florescence, and the available element concentrations (0.01 M $CaCl_2$ extractable) were measured using Inductive Couple Plasma Mass Spectrophotometer (ICP-MS) methods. Grain N, P and K concentrations were measured using Kjeldahl, Colorimetric, and General methods, respectively. Grain N concentration was similar among agroclimatic zones (ACZs), irrigation methods, crops grown in the previous season, and fertilizer management practices ($P>0.05$). Grain P concentration in Low country wet zone was lower than that observed in other ACZs. Rice crops grown in Solodizedsolonetz and solonchaks soils had higher grain K concentration than that observed in grains produced in other soils ($P<0.05$). Moreover, grain K concentration was higher in the fields used to cultivate other crops other than rice in the previous season. Plant available P was similar among ACZs and agronomic management practices ($P>0.05$). Exchangeable and total K concentrations in Mid country Intermediate zone and Up-country Intermediate zone soils were higher than that observed in other ACZs. Soil total K concentration was higher in reddish-brown earths and immature brown loams than that observed in other soils. Soil Na, Mg, Al, Ca, Fe, Co, Cu, Zn, Se, Cd and Pb concentrations in Low country dry zone were higher than those observed in other ACZs ($P<0.05$). This information would be useful in sustainable nutrient management in rice-based cropping systems in Sri Lanka.

Keywords: Agroclimatic zones, Irrigation methods, Soil categories, Total phosphorus, Total potassium

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

Diversity Analysis of Newly Introduced Red-pigmented *Aglaonema* Cultivars

Wijethunge P.W.C.M., Beneragama C.K.*, Bandaranayake P.C.G.[1] and Chandrasekara C.H.W.M.R.B.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Aglaonema cultivars, the red-series in particular, has gained attention in the recent past with a high demand in the floriculture trade as a foliage ornamental plant. Due to its high diversity among the recently introduced red-series, the species are often misidentified, which creates problems in imports and exports. A genetic analysis along with an image color analysis was undertaken to address the issues with misidentification of newly introduced red-pigmented *Aglaonema* cultivars using thirteen cultivars belong to the genus *Aglaonema.* Genetic diversity among cultivar collections was assessed using DNA barcoding. The cultivar collections were categorized into ten groups based on visual observation of color patterns on leaves. A DNA barcoding experiment was performed for the representative samples with *matK kim M13* DNA barcoding region in the chloroplast genome in order to identify the genetic diversity among the cultivar collections and sequence data of identified *Aglaonema spp.* and *Dieffenbachia spp.* extracted from the NCBI nucleotide database were used in the analysis. The dendrograms obtained from both genetic analysis and image color analysis were clearly separated into three clusters and each cluster was divided into sub-clusters. Out of the ten samples used for genetic analysis, seven samples were genetically 100% similar within the cluster and a close relationship was observed between identified *Aglaonema spp.* and two sample cultivars. The *Dieffenbachia spp.* appeared as a separate cluster. According to the Basic Local Alignment Tool (BLAST), all tested cultivar collections belong to a same species within the respective genus except for one cultivar. Results revealed that the DNA barcoding procedure can be used as a routine method in diversity assessment in plant species such as *Aglaonema*.

Keywords: *Aglaonema*, *Aracea*, Dendrogram, DNA barcoding, *matK*

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[1]Agricultural Biotechnology Centre, Faculty of Agriculture, University of Peradeniya, Peradeniya

* chalindab@agri.pdn.ac.lk

Diversity and Morphological Characterization of *Musa* spp. in Sri Lanka

Samarawickrama L.C.N., Ranil R.H.G.*, Samita S. and Amarakoon A.M.A[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Banana (*Musa* x *paradisiaca* L.) is a popular and widely consumed fruit worldwide due to its food, medicinal and important phytochemical properties. Most of the edible bananas originated in the Asian Continent through inter and intraspecific hybridization between *Musa acuminata* Colla (AA genome) and *Musa balbisiana* Colla (BB genome), resulting the generation of many genome groups. Though Sri Lanka is home to a considerable number of exotic and locally evolved cultivars, the lack of authenticated and descriptive guidelines is a major impediment to differentiate cultivars in banana breeding programs. Hence, the aim of this study was to characterize and provide comprehensive field identification guidelines for both farmers and breeders. Thirty-five banana cultivars conserved in field gene banks at Sub Campus, Mahailuppallama and Provincial Agriculture Research Centre, Pallekale were characterized using 35 vegetative and 20 fruit characteristics respectively. The characterization was done based on the guidelines developed by IPGRI. Non-parametric data were analyzed using hierarchical cluster analysis and SPSS (version 22) statistical software was used for the data analysis. The results revealed that tested 35 cultivars were clearly grouped into two major clusters and eight sub-clusters based on vegetative characters. Also, two distinct clusters were observed when clustering of 24 cultivars using fruits characteristics. Dwarfism, pseudostem color, underline color, petiole canal shape, and blotches at the petiole base were the most variable and determined vegetative characters. The peel color of mature fruits and pedicel length were the most important fruit characters that can be used to differentiate banana cultivars morphologically. Further genomic characterization is needed for validation of the above grouping. Based on the results an identification key and detailed morphological descriptions were prepared for each cultivar. The results will provide useful information to identify different banana cultivars and select superior germplasm for the future banana breeding programs.

Keywords: Banana, Breeding, Diversity, Morphological characterization

[1]Department of Agriculture - Central Province, Peradeniya, Sri Lanka

* rrajapaksha@agri.pdn.ac.lk

Effect of Agroclimatic Zone and Variety of Maize on Quality of Silage

Jayawardhana M.V.R., Kumara Mahipala M.B.P.*, Weerasinghe W.M.P.B.[1] and Weerathunga M.W.D.C.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Agro-climate and variety influence forage yield and composition thereby the quality of silage. Silage quality of four maize varieties (PAC-2075720, PAC-2075920, CAI-111 and PAC-999SG) grown in mid-country intermediate-zone (MCIZ) and low-country dry zone (LCDZ) was compared. The former two varieties are hybrid varieties which are expected to introduce to the country whereas CAI-111 variety is being locally developed. PAC-999SG is a commonly used variety for silage production and used as a control. Silage was prepared from each fodder maize variety harvested at milking stage. Dry matter (DM) and organic matter (OM) contents of fodder and brix value of the sap of crushed first internode was determined. The DM, soluble carbohydrate, lactic acid and ammonia nitrogen content and pH of silage were measured. The effect of variety was significant on DM, OM and brix value while the effect of agro-climatic zone was significant on OM and brix value of fodder maize ($P<0.05$). Neither the variety nor the agro-climatic zone affected on pH in silage ($P>0.05$). Fodder maize grown in MCIZ had a higher brix value while the silage prepared showed more DM and less ammonia nitrogen content than those grown in LCIZ ($P<0.05$). However, fodder and silage qualities of PAC-2075720, PAC-2075920 and PAC-999SGS varieties were not different within the agro-climatic zone ($P<0.05$). In MCIZ, fodder from CAI-111 variety was low in DM, OM and brix value while their silage was low in DM ($P<0.05$). In the LCIZ also, CAI-111 was poor in terms of DM and OM in forage and ammonia nitrogen content in silage ($P<0.05$). The results did not justify introduction of PAC-2075720 and PAC-2075920 varieties to MCIZ and LCDZ. The study recommended promoting PAC-999SG variety for silage production in both zones. Better quality silage can be produced from PAC-999SG grown in MCIZ.

Keywords: Brix value, pH, Soluble carbohydrate, Lactic acid, Ammonia nitrogen

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[1]Veterinary Research Institute, Gannoruwa, Peradeniya

* pmahi@agri.pdn.ac.lk

Effect of Amino Acids Enriched Live Feed (Rotifer) on the Survival and Growth of Catla (*Catla catla*) Post Larvae

Pushpakumara J.W.S., Athauda A.R.S.B.* and Withanage P.M.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The survival and growth rates of pond culture fish are extremely low in early stages due to various factors. Although, the protein requirement in fish feed for early larval stage is around 45%, most commercial fish feed contains around 40% crude protein. The effect of amino acid enriched live feed (rotifer) on the survival and growth of *Catle catla* post larvae were studied. Commercial fish feed with methionine enriched rotifer supplement (T1), lysine enriched rotifer supplement (T2), methionine and lysine enriched rotifer supplement (T3), and commercial fish feed alone (control, C) were experimented. Feeding experiment was carried out using cement tanks with 170 L capacity (n=3). Five days old 75 *Catla catla* post-larvae fish were stocked in each tank during the 28 days rearing period. The specific growth rate (SGR, %), feed conversion ratio (FCR), length gain (%), weight gain (%) and survival rate (%) were measured during the experimental period. The weight gain of the post-larvae fed with T3 (10695±11.35) was significantly (p<0.05) higher compared to T1 (8973.55±13.25), T2 (8805.66±10.55) and C (7777.03±15.55). The body length gain of the fish larvae fed with T3 (280.04±10.03) were significantly (p<0.05) higher compared to T1 (259.96±10.27), T2 (269.58±11.51) and C (247.22± 10.53). The SGR of the fish larvae fed with T3 (7.256± 0.03) were significantly (p<0.05) higher compared to the T1 (6.988±0.18), T2 (6.962± 0.11) and C (6.771±0.13). Moreover, the survival rates of fish fed with T3 (99.55±0.50) and T2 (99.77±0.38) were significantly (p <0.05) higher compared to T1 (89.22±4.04) and C (85.52±4.04). The water quality parameters remained without any significant difference (p>0.05) throughout the experiment. Methionine and lysine enriched rotifer supplement feed is the best for growth and survival of *Catla catla* post larvae during the nursery period.

Keywords: Enriched Live feeds, Methionine, Lysine, Rotifer

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[1]Aquaculture Development Centre, National Aquaculture Development Authority, Udawalawe

* sbathauda@agri.pdn.ac.lk

Effect of Chemical Fertilizers on the Residual Phosphorous and Potassium Availability in Paddy Growing Soils in the Dry Zone of Sri Lanka

De Silva P.D., Dharmakeerthi R.S.*, Attanayake C.P., Kulasinghe H.P.G.T.N.[1] and Vitharana U.W.A.
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Residual effect of fertilizers has long-term, but indirect benefit for the following crop. This study investigated the effect of chemical fertiliser application on residual P and K contents in soil and their subsequent impact on growth of rice in the dry zone of Sri Lanka. Data collected in a previous experiment, that had been conducted over 3 growing seasons during 2017 and 2018 using 71 farmer fields with 3 fertilizer treatments (i.e., all NPK added, NK without P, and NP without K), were used for this study. Soil parameters [i.e., Olsen-P (O-P), Exchangeable K (Ex-K), soil organic carbon, and pH] and plant parameters [i.e., grain yield, straw yield, and total dry matter] at the beginning and/or end of the season had been measured. About 29% and 62% of fields were below the optimum O-P (5-10 mg/kg) and Ex-K (80-160 mg/kg) levels by the end of the growing season, respectively.Application of P recorded 31% higher residual O-P content (P_r) compared to that of without P treatment (8.16 mg/kg). The P_r was significantly ($p<0.05$) higher in the *Maha* (October to February) season (8.72 mg/kg) compared to that of two *Yala* (March to September) seasons (6.79 mg/kg). Residual Ex-K contents and plant parameters were affected only by cropping season ($p<0.01$) with the *Maha* season recording higher values compared to the 2 *Yala* seasons. When initial O-P content was >10 mg/kg and Ex-K content >50 mg/kg, the difference between residual and initial soil O-P and Ex-K contents became negativeirrespective of P and K additions. Plant growth parameters were not significantly correlated with initial or residual nutrient contents. Therefore, even if plants do not respond to P and K applications in paddy growing soils with high O-P and Ex-K levels, their application is essential to arrest depletion of available P and K pools.

Keywords: Residual nutrients, Plant available nutrients, Fertilizer application, Growing season, Paddy

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[1]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya

* dharmakeerthirs@agri.pdn.ac.lk

Effect of Different Coloured Shade Nets on Growth and Development of Capsicum (*Capsicum annuum* L.)

Manathunga M.R.I.D. and Ariyaratne W.M.T.P.*
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Manipulation of quality, quantity, duration and direction of light can be used to improve the quality and quantity of vegetable yield. Coloured shade nets can be used to control the light intensity and radiation spectrum. This experiment was conducted to identify the effect of different coloured shade nets on the growth and development of *Capsicum annuum* L. Plants were exposed to four shade net treatments(70% shade intensity); Silver (T_1), Green (T_2), Black (T_3) with controlled (T_4)-(no shade net), from the nursery period to harvesting stage. The experiment was conducted in a greenhouse at University Experimental Station, Dodangolla (IM3a) .Plant height, leaf area, number of flowers, Plant dry weight, average yield per plant and yield quality parameters were measured. Seed germination, plant height, leaf area, number of flowers per plant and average number of days to 50% flowering under four treatments did not show any significant difference ($P>0.05$).Total plant dry weight was significantly higher ($P<0.05$) in T_4 compared to that of T_1, T_2 and T_3. The lowest shoot dry weight was observed under the T_2 which was significantly different from other treatments ($P<0.05$). Fruit diameter in T_1 (9.4±0.2cm) was significantly higher ($P<0.05$) compared to other treatments and there was no significant difference ($P>0.05$) among T_2, T_3 and T_4.T_4 had the lowest fruit weight (22±1.1g) which was significantly different to T_1, T_2, T_3, ($P<0.05$). The highest yield per plant (1098.9±88.8g) was observed in T_3 whereas T_4 showed the lowest yield per plant (506.0±34.1g). From this study it can be concluded that, the unchanged spectral composition under the black coloured shade nets can increase the yield in greenhouse grown *Capsicum* plants.

Keywords: Capsicum, Coloured shade nets, Solar radiation, Growth parameters, Yield

* mojith@agri.pdn.ac.lk

Effect of Mulching on Diversity and Abundance of Natural Enemies and Insect Pests of Brinjal (*Solanum melongena* L.) Crop in Mawathagama

Kumaratenna K.P.S.*, Weligamage S.S.[1], Warnasooriya P.G.A.S. and Hemachandra K.S.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

In Sri Lanka, most vegetable farmers use agrochemicals to control insect pests. Insecticide spraying has adverse effects on the environment and human health; hence, a search for non-chemical methods is needed. Mulching of soil affects pests and natural enemies. The effects of mulch on natural enemies and pests have been poorly documented locally; hence, this study was conducted with the objective of assessing the effect of mulch on natural enemies and pests in brinjal fields at Mawathagama from May to July 2021. Four mulches: rice-straw, gliricidia leaves, weed residues, and black polythene were applied in a RCBD with three replicates. Unmulched plots, with and without weeds, were used as the controls. Soil inhabitants were caught using pitfall traps, and soil sampling, and foliage insects by sweep-netting. The catch was counted and identified to a possible taxonomic level. Of the total of natural enemies (127), the highest abundance was on spiders (44.09%), followed by coccinellids (18.89%), carabid beetles (17.32%), rove beetles (11.02%), and earwigs (9.45%). Of the pests (1070), the highest abundance was on aphids (81.21%), followed by leafhoppers (7.94%), treehoppers (5.88%), flea beetles (4.29%), leaf-footed bugs (0.46%), and rice ear head bugs (0.18%). The total number of natural enemies was significantly ($F_{(5,120)}=5.928$, $P<0.05$) varied among treatments. The highest abundance of natural enemies was found in rice-straw mulch, followed by weed residues, gliricidia, and black polythene. Plots with weeds showed a higher mean number of natural enemies (1.29±0.26/plot) than plots without weeds (0.43±0.29/plot). Pest abundance was significantly ($F_{(5,120)}=3.897$, $P<0.05$) varied among treatments. The highest abundance was found in unmulched plots, followed by weed residues, gliricidia, straw, and black polythene. The overall results suggest that mulching affects insects differently, straw mulching favors natural enemies, while black polythene reduces pest abundance. The presence of weeds enhances the abundance of natural enemies.

Keywords: Mulch, Natural enemies, Insect pests, Brinjal

[1]Horticultural Crop Research and Development Institute (HORDI), Department of Agriculture, Gannoruwa, Peradeniya

* ag15118@agri.pdn.ac.lk

Effect of Rice Husk Biochar on Nitrogen Use Efficiency, Growth and Yield of Rice

Ranawana R.W.M.S.C. and Dharmakeerthi R.S.*
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Rice is the staple food for more than half of the world's population. With the increase in population, the productivity of paddy fields needs to be increased in future. Biochar application could improve the growth of the rice plant, yield and use efficiency of nitrogen fertilizers. Although biochar can be produced from various organic residues, rice husk is the most commonly available feedstock for rice cultivating farmers. This study investigated the effect of Rice Husk Biochar (RHB) application on growth and yield of rice and agronomic nitrogen use efficiency in paddy growing soils. The data from published articles related to RHB rate, NPK fertilizer rate and rice yield were extracted from the year 2000 to 2021. The resulted dataset had RHB application rates ranging from 0 to 50 Mg/ha (n =75), nitrogen fertilizer rates from 0 to 150 kg/ha (n=65) and rice grain yield from 1.2 to 11.2 Mg/ha (n=75). Stepwise regression analysis was conducted to quantify the effect of RHB rate, NPK fertilizer rate, N fertilizer rate on rice yield and agronomic N Use Efficiency (ANUE). Results revealed that the yield of rice was significantly ($P<0.05$) influenced by rates of RHB and NPK fertilizer application. Increasing RHB rate by 1Mg/ha has increased the rice yield by 0.083 Mg/ha while increasing NPK fertilizer by 1kg/ha has increased the yield of rice by 1.8 Mg/ha. Results also revealed that the ANUE has significantly ($P<0.05$) improved with the increase of the rate of RHB and this relationship was not observed with the N fertilizer. Thus, RHB application can be identified as a pragmatic option to increase global rice production in a sustainable manner.

Keywords: Rice Husk Biochar, Rice yield, Nitrogen Use Efficiency, N fertilizer

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* dharmakeerthirs@agri.pdn.ac.lk

Effect of Temperature and Soil Moisture Stress on Chlorophyll Fluorescence in Nursey-grown TRI 2025 and TRI 3019 Tea Cultivars

Sanjeewa P.D.L., Weerasinghe K.W.L.K.* and Geekiyanage N.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Measuring chlorophyll fluorescence from intact plants and strengthening the understanding on potential changes in leaf fluorescence characteristics relate to physiological status have led to a widespread use of chlorophyll measurements in plant stress physiological studies. However, such detailed information is limited in relation to tea (Camellia sinensis) cultivars which experience atmospheric warming and soil moisture stress. Thus, chlorophyll fluorescence in fully expanded recently mature leaves of two tea cultivars; TRI 2025 and TRI 3019 grown at average growth temperature of 26.2±0.2 ^{o}C under field capacity (FC) and soil moisture stress condition (WS i.e. <50% of the available water) were measured at 28 ^{o}C and 32 ^{o}C leaf temperatures respectively using a Pulse Amplitude-Modulated fluorometer to investigate how above stress conditions affect on specific components of the photosynthetic process. Results revealed that water splitting activity was affected in both TRI 2025 and TRI 3019 cultivars at 32 ^{o}C leaf temperature when compared to 28 ^{o}C under water stressed conditions with TRI 3019 showing greater reduction in water splitting activity when compared to TRI 2025. Further, maximum quantum yield of PSII (F_v/F_m) significantly ($P<0.05$) decreased when leaf temperature increased from 28 ^{o}C to 32 ^{o}C in both cultivars irrespective of the water treatment. However, the degree of decrease was greater in TRI 3019 cultivar under water stress conditions. Moreover, a significant ($P<0.05$) decrease in Performance Index was observed in both tea cultivars at 32 ^{o}C leaf temperature when compared to 28 ^{o}C under FC and WS conditions. Overall, TRI 2025 cultivar appears to be less susceptible to combine effect of soil moisture and temperature stress when compared to TRI 3019. Thus, chlorophyll fluorescence provide in-depth understanding on the underlying steps of the photosynthetic process enabling faster screening of tea cultivars against the combined effects of soil moisture and temperature stress.

Keywords: *Chlorophyll fluorescence*, *photosynthesis*, *temperature*, *tea*

[1]Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura

* lasanthaw@agri.pdn.ac.lk

Effect of Thousand Seed Weight on Seed Quality Parameters in Selected Vegetables

Madushika W.P.S.*, Fonseka R.M., Priyantha M.G.D.L.[1] and Samita S.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Seed size is an important physical indicator of seed quality that is linked to vegetative growth, yield, market grade factors, and harvest efficiency. Environmental conditions, field conditions, and agronomic practices cause variation in seed size within the same variety. Also, the seed size determines how much-reserved food can be given to the growing seedling. The 1000 seed weight, which mainly depends on the seed size is the major standard of seed quality, which is effective on other seed quality parameters. Therefore, this study aims to establish a relationship between 1000 seed weight and seed quality parameters (i.e. physical purity, moisture content, germination percentage, and seed vigor) of selected vegetables; Winged bean (*Psophocarpus tetragonolobus* (L.)DC.), Mae (*Vigna unguiculata* L.), Okra (*Abelmoschus esculentus* (L.) Moench), Snake gourd (*Trichosanthes anguina* L.), Bitter gourd (*Momordica charantia* L.) and Luffa (*Luffa acutangula* (L.) Robx,). Seed samples were collected representing one popular variety of each vegetable. The seed quality parameters were tested and evaluated according to the ISTA rules and the data were analyzed using SAS statistical software. Results showed that 1000 seed weight has a significant ($p<0.05$) relationship with moisture content, seed vigor, and germination percentage of winged bean, and the germination percentage of bitter gourd and luffa. No significant ($p<0.05$) relationships were observed between 1000 seed weight and other seed quality parameters of other vegetables. In conclusion, the information obtained from this study could be used to get an idea to improve the seed quality and seed storability to predict the performance of seed lots in the field.

Keywords: 1000 seed weight, seed quality parameters, vegetables

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[1]Seed Certification Service, Department of Agriculture, Gannoruwa, Peradeniya

* ag15056@agri.pdn.ac.lk

Effectiveness of Chilli-Brinjal Intercropping in Controlling Leaf Curl Disease of Chilli

Balasooriya B.M.D.L.*, Rankoth L.M. and Ranil R.H.G.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Chilli (*Capsicum annuum* L.) is an important spice and vegetable crop in family *Solanaceae*. Chilli is sensitive to a variety of diseases, including viruses, which cause significant yield losses. Leaf curl disease of chilli (LCDC) is the most problematic viral disease in terms of incidence and yield loss in Sri Lanka. The purpose of this study was to examine the effectiveness of two distinct methods of chilli-brinjal intercropping in reducing LCDC. The experiment was carried out at the Sub-campus, Mahaillupplama, University of Peradeniya which belongs to the DL1b agro-ecological region from April to August 2021. For this experiment, MICH-1(chilli) and *Raveena* (Brinjal) varieties were used in RCBD design with four replicates. The three treatments were chilli monocropping (T_1), additive intercropping (T_2), and replacement intercropping (T_3). Department of Agriculture recommended chemical fertilizers were applied but no any pesticide, fungicide or weedicide were used throughout the experimental period. The disease severity index (DSI), yield and plant morphological characteristics such as plant height etc. were used to compare the treatments. The DSI in T_1 was significantly greater ($P<0.0001$) compared to T_2 and T_3 with values of 0.45, 0.24 and 0.23 respectively. That shows the greater occurrence of LCDC in chilli monocropping compared to both intercropping types. The Land Equivalent Ratio (LER) was not significantly different between T_2 and T_3. The overall cumulative results showed that both intercropping types were significantly effective ($P<0.05$) in reducing the LCDC incidence compared to chilli monocropping and chilli-brinjal intercropping can be considered as a promising agronomic practice in controlling chilli leaf curl disease in the Dry Zone of Sri Lanka.

Keywords: Chilli leaf curl complex, Intercropping, Disease severity index (DSI)

* Ag15008@agri.pdn.ac.lk

Effects Of Biochar And Compost On Soil Hydrological Dynamics In An Alfisol Cultivated With Corn In Dry Zone In Sri Lanka

Edirisinghe G.E.A.S.J., Vidana Gamage D.N.*, Dharmakeerthi R.S. and Munasinghe S.T.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Biochar is porous and more recalcitrant than nonpyrolyzed organic materials such as compost. Therefore, single time applied biochar apparently causes more persistent alterations in soil hydrology than multiple times applied compost. However, impacts of single time applied biochar and multiple times applied compost on soil hydrological dynamics are poorly understood, especially under tropical cropping systems. This study examined the impacts of single time applied biochar and multiple times applied compost on soil hydrological dynamics at surface depths of a four-year-old experimental site located at Grain Legume and Oil Crop Research and Development Center in *Agunakolapellassa,* Sri Lanka. The treatments included a control with zero amendments, compost applied at a rate of 10 Mg/ha and repeated every season, and corn-cob biochar applied at a rate of 34 Mg/ha only once in 2017. A portable Time Domain Reflectometry probe was used to measure soil water content (SWC) at 4,8,12 and 20 cm depths over three cropping seasons. Soil water content of biochar and compost treated plots showed no significant ($P<0.05$) increases at any depths in *Maha* and *Yala* seasons of 2019 and 2020. However, SWC increased by 20 % ($P<0.05$) at 12 cm depth of biochar amended plots, only during certain time periods of the *Maha* season of 2021. Further, SWC showed no significant temporal changes ($P<0.05$) in biochar and compost amended plots during wetting or drying events in all three seasons. Results suggested that four years' time period is shorter to induce any significant changes in soil hydrology after single application of corn cob biochar at a rate of 34 Mg/ha or repeated application of compost at a rate of 10 Mg/ha in a tropical cropping system. The future studies should collect SWC data over long-term to better explain the impacts of biochar and compost on soil hydrology.

Keywords: Corn cob biochar, Compost, Hydrological dynamics, Soil water content

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[1]Grain Legume and Oil crop Research and Development Centre, Department of Agriculture, Angunakolapellasa

* dumindavidana@agri.pdn.ac.lk

Effects of Breed, Parity and District on Daily Milk, Fat and Protein Yields of Pure Jersey and Jersey x Sahiwal Crossbred Cows in Smallholder Farms

Kalaiamirthanah M., Dematawewa C.M.B.* and Ramanayake U.D.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Evaluation of production performance of candidate genotypes at the small-scale farmer level is crucial for precise breeding policy formulations for dairy cattle. The objective of this study was to compare milk, fat, and protein yields of dairy cattle in small herds with respect to their breed, parity and geographical location (Kurunegala and Anuradhapura districts). A total of 1823 daily milk yields (DMY) from 278 lactations of 181 cows of pure Jersey, 50% Jersey and 50% Sahiwal (JS), and 75% Jersey and 25% Sahiwal (JJS) genotypes were recorded by visiting each farm monthly. Fat % (FatPct) and Protein % (PrtPct) were measured using *Lactoscan*® milk analyzers. Lactation records were truncated to 305 days. Daily fat yield (DFY) and protein yield (DPY) were derived using DMY, FatPct and PrtPct values. Analysis of variance procedure (PROC GLM in SAS®) was carried out with Duncan's New Multiple Range Test for mean comparison. Mean DMY of JJS and JS (6.89 and 6.80 L, respectively) were significantly greater ($P<0.05$) than that of pure Jersey cows (5.52 L). Third and fourth parity cows reported significantly greater ($P<0.05$) DMY (7.50 and 7.48 L, respectively) compared with the first, second and >4th parity groups (5.31, 6.92 and 6.78 L, respectively). Patterns of breed and parity differences for DFY and DPY were similar to those of DMY. Means of FatPct and PrtPct were not significantly different among the three genotypes ($P>0.05$). Cows in Kurunegala district recorded significantly greater ($P<0.05$) mean DMY (6.89 L) than those of Anuradhapura (5.71 L). Genotype x District interaction effect was not significant for any trait ($P>0.05$). DMY had significant phenotypic correlations ($P<0.05$) with DFY, DPY, FatPct and PrtPct (0.92, 0.97, -0.05, and -0.09, respectively). Accordingly, JS and JJS genotypes could be recommended over pure Jersey for smallholder farms in Kurunegala and Anuradhapura Districts.

Keywords: Breed comparison, Dairy cattle, Milk yield, Performance evaluation, Phenotypic correlations

[1]Animal Breeding Division, Department of Animal Production and Health, Gatambe, Peradeniya

* dematawewa@agri.pdn.ac.lk

Effects of Potting Media and Pinching on Growth and Flowering of *Clitoria ternatea (*Butterfly Pea)

Sopiga K., Fonseka R.M.*, Senaratne M.M.D.J.[1], Kumarihami H.M.P.C. and Sivananthawerl T.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Clitoria ternatea L. (Family Fabaceae), commonly known as 'Butterfly pea' is a perennial twinning herbaceous plant originated from the Asian tropics. It produces deep blue to purple solitary flowers that are rich in nutritional properties such as antioxidant, antidiabetic, anti-proliferative, antibacterial, and anti-compulsive activities. The slow growth of the plant, excessive stem elongation, and uneven flowering pattern are some of the limitations to expand the cultivation of this underutilized crop. Present study was conducted to find out suitable potting media for commercial cultivation and the effect of pinching on growth and flowering of *Clitoria ternatea* L., with the objective of enhancing the vine growth and branching, and the number of flowers per vine. Fourteen-day-old *Clitoria ternatea* L.seedlings were planted in five different potting media combinations, *i.e.,* sand: garden soil: compost (1:1:1), sand: coir dust: compost (1:1:1), sand: coir dust (2:1), sand: compost (2:1), sand: garden soil (2:1). Plants were trained under pinching (P) and non-pinching (P0) practice. The N, P, K, fertilizers were applied at different growth stages as per the recommendations of the Department of National Botanic Gardens, Sri Lanka. The results revealed that the plant height, number of primary/ secondary lateral shoots, and days taken to first flowering were greatly affected by pinching ($P \leq 0.05$). Potting media composition significantly affected the height of the plant (vine length), the number of leaflets with pinching, primary lateral shoots without pinching, and secondary lateral shoots with pinching ($P \leq 0.05$). The highest growth performances were observed in the potting medium containing sand: compost (2:1) while pinching enhanced the number of flowers per vine. Thus, sand: compost (2:1) potting medium and pinching can be recommended for optimum growth and flowering of the tested *Clitoria ternatea* L. species.

Keywords: *Clitoria ternatea* L., flowering, pinching, plant growth, potting media

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[1]Department of National Botanic Gardens, Royal Botanic Gardens, Peradeniya

* ramyamf@agri.pdn.ac.lk

Evaluating the Effects of Selected Biopesticides for Controlling Chilli Leaf Curl Complex

Delgoda K.H.B.H.*, Rankoth L.M., Hitinayake H.M.G.S.B., Ranil R.H.G., Suriyagoda L.D.B. and Sivananthawerl T.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Chilli (*Capsicum annuum* L.) is a major cash crop grown in Sri Lanka. However, at present, chilli cultivation has faced a serious threat due to chilli leaf curl complex (CLCC). The yield loss due to CLCC is great and thereby the farmers are moving out of chilli cultivation leading to large amounts of chilli imports to the country annually. This study was designed to test two liquid biopesticides made out of plant materials on the effectiveness of CLCC control. The experiment was conducted at the University sub-campus, Mahaillupplama, University of Peradeniya which belongs to the DL1b agro-ecological region during the period of April to August 2021. The chilli variety MICH1 was tested under three treatments; Garlic (*Allium sativum*) and Bird's eye chilli (*Capsicum frutescence*) fruit mixture (T_1), Neem (*Azadirachta indica*) seeds and Holy Basil (*Ocimum tenuiflorum*) leaves mixture (T_2) and Department of Agriculture (DOA) recommended pesticide (control/T_3). The experiment was conducted in a RCBD with four replicates and the relevant treatment solution was sprayed once a week to the plants. The number of infected leaves and number of total leaves were counted from third week after planting onwards and the Disease Severity Index (DSI) was calculated. The DSI was not significantly different ($P<0.05$) between treatments during first seven weeks after planting. Further, the number of infected leaves were similar in all the treatments during that period. This implies that both the plant extracts have acted similar to the DOA recommended synthetic pesticide. The yield during first two picks were not significantly different ($P<0.05$) between treatments. According to the overall results, the two plant extracts have responded similarly to the commercial pesticide (control). Thus, there is a great potential of developing those natural plant extracts as effective biopesticides in controlling CLCC in Sri Lanka.

Keywords: Chilli Leaf Curl Complex, Garlic extract, Neem extract

* ag15014@agri.pdn.ac.lk

Ex-vitro Rooting of *Gyrinops walla* Gaertn. (*Walla patta*)

Rajapaksha R.M.P.I.*, Eeswara J.P. and Sivananthawerl T.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Gyrinops walla Gaertn. (*Walla patta*) is an endemic, woody perennial belongs to the family Thymelaeaceae found commonly in the Wet Zone of Sri Lanka.*G. walla* is generally used as a traditional medicine and is popular due to its capacity to produce fragrant resin. With the identification of production of agarwood resins by *G. walla* and its monetary value, demand for planting materials has been increased over the past few years. Micropropagation techniques can be used to ensure a higher, uniform and fast plant production. At the present study *G. walla* shoots multiplied under *in-vitro* conditions with full strength, MS medium (Murashige and Skoogs' Medium) supplemented with 4% Sucrose and solidified with phytagel were used for the rooting. Ability of root induction under *ex-vitro* condition with the use of either IAA (Indole-3-acetic acid) 1000 ppm or IBA (Indole-3-butyric acid) 1000 ppm for two different pulsing periods (15 and 30 minutes) at two different growth conditions (Sand bottles and Single propagators) were tested. Another set of shoots were maintained without providing any auxin (control). After 8 weeks of shoot establishment, the highest survival rate (100%) and the percentage of rooted shoots (94.4%) were observed in control samples in sand bottles. The highest average root length per shoot (1.79 ± 0.17 cm) was observed in shoots treated with IAA for 30 minutes and the highest average number of roots per shoot (4.00 ± 0.61) was obtained in the shoots treated with IBA for 15 minutes under the same growth condition. Survivals of shoots cultured in the single propagators were significantly lower than that of in sand bottles ($P<0.05$).

Keywords: *Gyrinops walla* Gaertn, IAA, IBA, Pulsing Treatment, *Ex-vitro*

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* ag15071@agri.pdn.ac.lk

Feed Digestibility and Blood Metabolites of Friesian × Jersey Crossbred Cows at Early Lactation Fed Diet Supplemented with a Yeast-based Additive

Dilshan H.K.L., Ekanayake W.E.M.L.J.* and Vidanarachchi J.K.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Feed additives are being used to improve the feed palatability, intake, and digestibility of dairy cows around the world. However, dairy cows have shown inconsistent responses to those commercially available feed additives due to environmental and animal specificities. Effects of a well-known yeast-based feed additive 'Hokovit Dairy Pro' on feed digestibility and blood metabolites of Friesian × Jersey crossbred cows at early lactation were evaluated in this study. The study was conducted in Heritage dairy farm in Up-country, Sri Lanka. Ten cows at early lactation with an average live weight of 482.9 ± 42.50 kg were randomly allocated to two dietary groups: 1. Cows (n=5) fed on total mixed ration (Control) and 2. Cows (n=5) fed on total mixed ration & 'Hokovit Dairy Pro' additive (Trt). The experiment was conducted in a two-period crossover design each period consisting of a ten-day adaptation period and a three-day sample collection period. Feed samples were analyzed for crude protein (CP), crude fat (CF), organic matter (OM), ash, and dry matter contents. Feed digestibility was measured using the acid insoluble ash indicator method. Blood samples collected at the end of the sample collection period were analyzed for non-esterified fatty acids (NEFA) and beta-hydroxybutyrate (BHBA). 'Horovitz Dairy Pro' had no significant ($P>0.05$) effect on dry matter digestibility, CP digestibility, OM digestibility, NEFA, and BHBA tested. The effects of the feed additive may have not been shown due to the shorter testing time (~ one month), therefore, a study to test the long-term effects of the additive on feed digestibility and blood metabolites is recommended.

Keywords: Feed Digestibility, Non-esterified fatty Acid (NEFA), Beta-hydroxybutyrate (BHBA), Feed additives, Dairy cows

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* jayekn@agri.pdn.ac.lk

Genetic Diversity as Revealed by Cytochrome C Oxidase Subunit I gene in Inherently Small Indigenous Cattle in Sri Lanka

Thilakshika H.M.M., Silva G.L.L.P.*, Kurukulasuriya M.S.[1], Hathurusinghe H.A.B.M.[2] and Bandaranayake P.C.G.[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Farm animal genetic resources and diversity are important aspects in sustainable improvement in livestock sector. Genetic information of indigenous farm animals is vital in this regard as they harbor wealth of genetic diversity. Indigenous cattle in Sri Lanka is mostly a neglected resource in commercial perspective, and will become soon endangered if not conserved. Therefore, a study was conducted to genetically describe geographically isolated inherently small indigenous cattle (SIC) population in Northern Province of Sri Lanka. The mitochondrial gene, cytochrome C oxidase I (COI) was used to determine divergence of the SIC compared to reference genotypes. Sanger sequence data were generated for COI region from the SIC populations in Mannar (04) and Jaffna (04) Districts, and pure Friesian (01) cattle. Reference sequences of *Bos taurus* (02), *Bos indicus* (03), Yak (*Bos grunniens*-01, *Bos mutus*-01), Gaur (01) and Gayal (01) from National Center for Biotechnology Information database were also included in phylogenetic analysis. Further, COI sequence of Friesian cattle was also considered as a reference and phylogenetic relationships were estimated by employing maximum likelihood method and Tamura-Nei model. The phylogenetic clustering pattern identified the SIC from two geographical regions in the same cluster together with *Bos indicus*, and separating from *Bos taurus* cattle creating two monophyletic clades. Friesian reference cattle clustered with *Bos taurus* cattle. The Yak, Gaur and Gayal reference sequences were separated out distinctly. This study suggested that the genetic differentiation of COI gene clearly identifies the maternal origins of SIC distinct from *Bos taurus* Yak, Gaur and Gayal, and depicts the evolutionary connections with *Bos indicus*. The findings of this study will help the conservation efforts of indigenous genetic resources of the country, particularly in decision-making at policy level.

Keywords: Small Indigenous Cattle, Cytochrome C Oxidase I (COI), Genetic Diversity, Phylogenetic Relationship

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

[2]Agricultural Biotechnology Centre, Faculty of Agriculture, University of Peradeniya, Peradeniya

* pradeepas@agri.pdn.ac.lk

Genetic Purity Analysis of Capsicum Hybrid *Prarthana* using Molecular Markers

Abeyrathne R.M.S.D.L., Wasala S.K.[1], Ubeysekera N.M.[2] and Perera S.A.C.N.[*]

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

The development of hybrid varieties is an important strategy to increase the production and productivity of capsicum (*Capsicum annuum* L.) in Sri Lanka. Genetic purity is an essential quality parameter of hybrid seeds and a requirement in the commercialization of hybrids. The Grow-Out Test (GOT) is a conventional method for confirming hybrid purity based on morphological characters of the hybrid. However, it is time-consuming, labor-intensive, expensive, and highly influenced by the environment. The present study aimed at identifying informative Simple Sequence Repeat (SSR) and Random Amplified Polymorphic DNA (RAPD) markers to confirm the genetic purity of capsicum hybrid *Prarthana*. Genomic DNA was extracted from 20 individuals of the hybrid population and its parents. Twelve SSR markers and fourteen RAPD markers representing the capsicum genome were tested to find their potential to test the hybrid purity. Among the SSR markers, CAMS 162 showed polymorphism between the parents of the hybrid in 8 % polyacrylamide gel but with poor resolution while the rest of the SSR loci were monomorphic. Among the RAPD markers, OPAE 15 and OPX 4 showed polymorphism between the parents and showed potential for detecting the genetic purity of hybrid variety *Prarthana*. The RAPD markers OPAE 15 and OPX 4, are recommended to be used to develop Sequence Characterized Amplified Regions (SCAR) markers which act as co-dominant markers to detect the hybrid purity. These findings will aid in determining the genetic purity of capsicum hybrid *Prarthana* with greater precision in a shorter period.

Keywords: Capsicum hybrid, Hybrid purity, Polymorphism, SSR markers, RAPD markers

[1]Department of Agriculture - Central Province, Peradeniya, Sri Lanka

[2]Plant Genetic Resources Center, Department of Agriculture, Gannoruwa, Peradeniya

* chandrikaperera@agri.pdn.ac.lk

Growth and Yield Response of Tomato and Cowpea Cultivated under Moisture Stress during Reproductive Growth

Jananda J.S.M.N.L.*, Dissanyake D.M.S.B., Ranil R.H.G. and Suriyagoda L.D.B.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

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 impact of moisture stress during different phases of reproductive growth of cowpea (*Vigna unguiculata* L.) and tomato (*Solanum lycopersicum* L.). A pot experiment was laid as Completely Randomized Design (CRD) in a poly-tunnel moisture stress was imposed during flowering, pod initiation, and pod filling stages of cowpea, and flowering and fruiting stages of tomato. All pots were maintained at 80% of field capacity until the drought treatments were imposed. The plants were kept till wilting after imposed of the drought treatments in each phase and then supplied with half amount of water to that of control. The impact of moisture stress on plant growth, nutrient uptake, and yield of both crops were measured. Moisture stress did not cause a significant impact on plant height and number of leaves of both crops. Plants grown under moisture stress during reproductive growth, particularly in grain filling stage recorded an increment of total rooting depth compared to well-watered condition. Accumulation of phosphorous (P), and potassium (K) in shoots of cowpea was enhanced under moisture stress while this tendency was noted only for shoot P in tomato exposed to drought in fruiting stage. There was a greater reduction of grain yield of cowpea when grown under drought stress in all studied phases of reproductive growth compared to that of well-watered condition. However, accumulation of grain nutrients did not change in response to moisture stress in any phase of the reproductive growth. The findings indicate a considerable variation of growth, nutrient accumulation, and yield of tomato and cowpea cultivated under moisture stress during different phases of reproductive growth.

Keywords: Cowpea, Drought, Moisture stress, Reproductive growth, Tomato

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* ag15123@agri.pdn.ac.lk

Growth Performance and Survival Rate of Catla (*Catla catla*) Fry Rearing in a Cage Culture System using Cost Effective Feed

Jayasekara S.W.T.D., Athauda A.R.S.B.* and Withanage P.M.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

This study was conducted to observe the growth performance and survival rates in the fry to fingerling stages of *Catla catla* using a cage culture system as fingerling production very low Sri Lanka and higher consumer preference. Two different types of feed rations were prepared as treatment 1 (T1) and treatment 2 (T2) using low-cost ingredients available and these two feed formulations were formulated as Isoprotein, Isoenergic feed. Commercially produced fish feed (38% Crude protein super feed no.00) was used as the control diet. 120,000 of Catla fry were stocked in 6 cages at the rate of 400 fry per m^3 for two treatments and control with 20,000 fry each replicate. Catla fry were fed with two treatments for 30 days at the rate of 7%, 5%, and 3% of body weight for the first, second, and third two-week periods, respectively. Growth and water quality parameters were measured every 6 days and data were statistically analyzed (CRD). The formulated feed rations fed as the treatments showed significantly higher values ($P< 0.05$). Specific Growth Rate (SGR), Body Weight Gain (BWG), and Body Length Gain (BLG), when compared to commercial control feed, fed group, while there was a significant difference ($P<0.05$) in T1 diet compared to both T2 diet and the Control diet. The highest SGR was recorded in the Catla fry with T1 diet. Treatment diets had no significant effect ($P>0.05$) on survival rate and water quality parameters throughout the experimental period. The cost-effectiveness of each experimental diet was significantly different ($p<0.05$) and the highest weight gain per unit price was recorded with the Catla fry fed with treatment 1 diet. In conclusion, T1 diet can be recommended to achieve better growth performance in a cage culture system rearing of fry to fingerling stage of *Catla catla*.to obtained better growth performance.

Keywords: Commercial feed, *Catla catla*, Fry, Cage culture, Performance

[1]Aquaculture Development Centre, National Aquaculture Development Authority, Udawalawe

* sbathauda@agri.pdn.ac.lk

Identification of Whiteflies and their Associated Insect Species of Coconut Palms in Kegalle, Gampaha and Colombo Districts

Rumeshika R.P.T.*, Aratchige N.S.[1], Warnasooriya P.G.A.S. and Hemachandra K.S.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The whitefly (Hemiptera: Aleyrodidae) is a group of homopteran insects that infest on a wide range of hosts including coconut palms (Arecaceae) and other annual and perennial crops. Whitefly infestation on coconut became apparent recently. However, no studies on species identification and no reports on local ecological or biological studies. In a preliminary study, whitefly has been detected in Kandy, Kegalle, Matale, Colombo, Ratnapura and Gampaha districts. Identification of whitefly species and their natural enemies is essential for formulation of suitable control measures. Hence, this study was conducted with the objective of identification of the whitefly species and associated insect species in selected districts. Samples of whiteflies were collected from several locations in Kegalle, Gampaha and Colombo districts. The sampled whiteflies were identified as per the procedure, and taxonomic key described by Martin in 1987. Three species of whitefly were identified as *Aleurodicus dispersus, Paraleyrodes minei* and *Aleurotrachelus atratus*. Populations of *Aleurotrachelus atratus* represented 55.7% of the total population. *Jauravia pallidula* was found as a natural enemy associated with *A. atratus. Panonychus ulmi* (European red mite), *Brevipalpus californicus* (scarlet mite) and mealybug species were also identified as insects associated with coconut whiteflies. Abundance of whitefly as a group was not significantly varied among districts. However, the abundance of the individual species significantly varied among districts, among locations and even among palms. A significant difference was not detected in abundance of *Jauravia pallidula* among districts. Abundance of mealybug species, scarlet mites and European red mites were significantly varied among districts and a significant difference was not detected in abundance of mealybug species, scarlet mites and European red mites among locations.

Keywords: *Aleurotrachelus atratus*, *Aleurodicus dispersus*, *Paraleyrodes minei*, Whitefly

[1]Crop Protection Division, Coconut Research Institute, Lunuwila

* ag15112@agri.pdn.ac.lk

Identifying the Best Soil Incorporation Stage of Sunn hemp (*Crotalaria juncea* L.) as Green Manure

Maduwanthi S.D.C.*, Rankoth L.M., De Silva S.H.N.P., Ranil R.H.G. and Suriyagoda L.D.B.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Green manures are plant materials incorporated into soil while still in green basically to improve the soil fertility and land productivity. Sunn hemp (*Crotalaria juncea* L.) is a leguminous annual plant with a higher growth rate. It considered to have originated in South Asia and used as a green manure in many countries. Even though Sunn hemp is used as a green manure, the best soil incorporation stage of it under Sri Lankan conditions is not elucidated in literature. Therefore, the aim of the present study was to identify the best stage of soil incorporation of Sunn hemp as green manure. Sunn hemp seeds were broadcasted evenly over 16 plots at a rate of 100 kg ha^{-1} and left to grow with proper irrigation and weed control. Then the plants were cut and biomass was mixed into soil at each treatment stage. The four treatment stages were; emergence of primary inflorescence (T_1), inflorescence completely emerged but no bloomed flowers (T_2), minimum one bloomed flower is present (T_3) and completion of flowering in the inflorescence (T_4). Soil samples were obtained in two and four weeks after each treatment stage at 0-15 and 15-30 cm depths and analyzed for nutrients. Simultaneously, plant samples were collected weekly from the 4th week after planting to soil incorporation stage. The results revealed that, the greatest ($p<0.05$) plant dry matter addition of 8659 kg ha^{-1} was observed in T_4.Both T_3 and T_4 provided significantly greater ($p<0.05$) amounts of N which were 51 and 49 kg ha^{-1} respectively. Also, the plant dry matter in T_4 stage showed significantly greater ($p<0.05$) amounts of K and Ca than that of other treatments. Thus, considering overall effects, the T_4 stage was identified as the best stage to incorporate Sunn hemp plant materials into soil as green manure.

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

* ag15166@agri.pdn.ac.lk

In-vitro Rooting of *Gyrinops walla* Gaertn. (*Walla patta*)

Weerasooriya W.M.T.S.K.*, Eeswara J.P. and Sivananthawerl T.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Gyrinops walla Gaertn. (*Walla patta*) is an endemic and resinous producing plant in Sri Lanka. Due to its capability of producing highly expensive agarwood, large-scale illegal felling and smuggling of trees has posed a serious threat to the survival of the species. Seed propagation is inadequate to meet the present demand of *Gyrinops walla* seedling supplies due to lack of seed production, low germination rate and long-life cycle. Therefore, micropropagation techniques can be used for large-scale commercial plant production and as a conservation method. This experiment attempted to identify a suitable *in-vitro* rooting medium for *G. walla.* The effect of full and ½ strength MS medium at three concentrations of Indole Acetic Acid (IAA -0, 0.5 and 1.0 mg/L) and two levels of sucrose (3 and 4%) on *in-vitro* rooting was evaluated. The cultures were incubated under 1000 lux light intensity for 16 hours per day and at 25 ˚C temperature. Survival rate, rooting percentage and average length of roots per shoot were recorded after 8 weeks. The highest survival rate after 8 weeks was recorded in the control medium which did not contain IAA (100%) followed by full MS rooting medium with 1 mg/L IAA, and 3% sucrose (86.7%). The highest rooting percentage and the highest average root length per shoot was observed in 1 mg/L IAA, half MS and 4% sucrose medium resulting 51.1% rooting percentage and 6.15±1.5 cm average root length per shoot. Therefore, 1 mg/L IAA, half MS and 4% medium can be considered as the best *in-vitro* rooting medium for *Gyrinops walla*.

Keywords: *Gyrinops walla*, micropropagation, MS media, IAA

* ag15103@agri.pdn.ac.lk

Inter-specific Competition between *Eleusine coracana* and *Panicum maximum* for Nutrient Uptake under Nutrient-limited Soil Conditions

Jayamanna H.H.P.*, Dissanyake D.M.S.B., Ranil R.H.G., Marambe B. and Sivananthawerl T.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Presence of multiple plants in nutrient-limited environments can induce strong intra- and inter-specific competition for such nutrients among the co-existing plants. Nutrient uptake by crops when they co-exist with weeds under nutrient-limited conditions are still poorly understood. Hence, this study was aimed at investigating nutrient uptake of finger millet (*Eleusine coracana* L.) in the presence of the upland weed, guinea grass (*Panicum maximum* L.), under nutrient-limited conditions. A pot experiment was conducted in a complete randomized design using fertilized and unfertilized soils with different neighbor-densities of two species including monocultures and mixed cultures, with three replicates. Monocultures comprised of one and three plants of the same species in a given pot. Mixed culture system contained finger millet:guinea grass plant combinations of 1:2 and 2:1. The effect of inter-specific competition on nutrient uptake and growth of finger millet were measured. Varied plant combinations impacted ($P<0.05$) on plant dry weight, nutrient uptake and rooting depth of finger millet. Root and shoot dry weight of finger millet was reduced by 39% and 61%, respectively, in the presence of guinea grass compared to that when neighbors are from the same species. The same tendency was observed for the accumulation of nitrogen (N), phosphorus (P), and potassium (K) in root and shoot system of the crop. The greatest reduction of tissue nutrient concentration of finger millet was recorded in finger millet:guinea grass plant combination of 1:2. Except for shoot N concentration, there was no change in P and K accumulation of finger millet plant between the monocultures having one and three plants per pot ($P>0.05$). The results suggest that the growth and nutrient uptake of finger millet is suppressed when it co-exists with guinea grass indicating the strong inter-specific competition between the species under nutrient-limited conditions.

Keywords: Interspecific competition, Nutrient uptake, Nutrient-deficient condition , Finger millet, Guinea grass

* ag15124@agri.pdn.ac.lk

Investigation of Production and Management Conditions of Local Cattle Herds in Kokkaddichcholai Veterinary Range, Batticaloa

Achopana K. and Dematawewa C.M.B.*
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

A survey was conducted to investigate the current status of local cattle production and management, socioeconomic conditions of local cattle farmers and the constraints for dairy farming in Kokkaddicholai veterinary range. A set of 150 local cattle farmers were randomly selected from 15 villages (10 farmers/village) for the survey. Socioeconomic, production and management information were collected using a pre-tested structured questionnaire. Farmer families accounted for 87.33 % of the population of the range, with an average age (mean±SE) of 51.1±0.03 years. About 16.67% of the surveyed farmers had no formal education while 40.0 % received primary education, and 35.33% reported dairying as their primary source of income. Mean land area was 1.89±0.01 ha, which was mainly utilized for paddy and seasonal crop cultivation. All farmers had their own houses with electricity and television, and 90.6% had a motorbike or larger vehicle. All practiced extensive cattle rearing with provision of straw and agricultural byproducts during night paddocking. Mean herd size was 30.4±0.9 heads including 7.7 milking cows, 8.6 dry cows, 4.6 heifers, 7.7 calves and 1.8 bulls. Mean milk yield was 9.49 L/herd/day (1.23 L/cow/day). Regression analysis showed that the total herd yield increased significantly with the herd size ($P<0.05$). Chi-square analysis revealed that lesser educated farmers had greater proneness for selecting dairying as primary occupation ($P<0.05$). However, Analysis of Variance procedure showed the choice of selecting dairying as primary or secondary occupation was not dependent on their land area, herd size or milk yield ($P> 0.05$). The majority (96.67%) followed Hinduism and allowed only bulls to be sold for meat (85.33%) or else for breeding purpose. Lack of regular grazing lands (100%), artificial insemination (100%) and training (100%), shortage of labour during paddy cultivation (100%) and shortage of capital (86.67%) were the primary constraints for dairy farming

Keywords: Dairy production, Dry zone, Extensive system, Farming systems, Indigenous cattle

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* dematawewa@agri.pdn.ac.lk

Key Factors Affecting the Catch Rate of Inland Fisheries: A Case from the Periyamadu Tank

Kirupthika J. and Weerasooriya S.A.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Mannar is one of the largest Districts in the Northern Province which has potential for inland fisheries. Periyamadu tank is one of the medium-size tanks which is located in the Manthai-West Divisional Secretariat. The fish production level in this tank is often associated with relatively low catch rates. Thus, this study focuses on how fisherman's catch rate varies with fisherman's demographic, household characteristics, factors related to fishing, the role of fishery society in fishing, and challenges such as disturbances from crocodiles, marketing constraints, lack of tools and, perception of low yield. The study also focuses on what are the factors that influence the decision to engage in inland fishing and investigates the challenges faced by supply chain actors in the vicinity of the Periyamadu tank. Data on 45 fishermen and 45 non-fishermen were collected from the Periyamadu *Grama Niladari* Division by using pre-tested questionnaires. Heckman's two-stage model was employed to identify the factors that influence the catch rate of fishermen as well as factors that influence the decision to engage in inland fishing. Results show that household size and income significantly affected the decision to engage in inland fishing ($P<0.01$) while, income, challenges such as disturbances from the crocodiles, perception of low yield significantly affected the catch rate of fishermen ($P<0.05$). In addition, training programs, fishing days per week, marketing constraints significantly affected the catch rate of fishermen ($P<0.01$). Data on tenderers, wholesalers, cycle sellers were collected through direct and telephone interviews. The absence of proper storage, yield fluctuations, absence of proper transport facilities are the main challenges faced by the supply chain actors. This study provides insights into inland fisheries of a medium-size tank which would have important policy implications and developmental activities in the future.

Keywords: Inland fisheries, Constraints to inland fishing, Fisherman's catch rate, Decision to fish, Heckman's two-stage model

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* senalw@agri.pdn.ac.lk

Morphological and Molecular Characterization of Nilaparvata lugens (Stål) Reported from Different Locations in Sri Lanka

Priyashantha W.K.P.*, Senanayake D.M.J.B.[1], Jayawardana N.U., Sarathchandra S.R.[1], Dhammika A.W.R.[1] and Madduma A.[1]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Brown Plant Hopper (BPH) *Nilaparvata lugens* (Stål) (Hemiptera: Delphacidae) is a major rice pest in Sri Lanka and the South Asian region. It is a phloem feeder and can cause economic yield losses up to 100% in rice cultivation. Most of the pervious BPH resistant varieties in Sri Lanka have become susceptible to BPH in the recent years. Occurrence of such situations may be due to the emergence of new biotypes of BPH populations in Sri Lanka. Therefore, the present study was carried out to find out the differences in insect populations of BPH at morphological and molecular level. Adult insect samples were collected from five selected locations in Anuradhapura, Ampara, Narammala, Kurunagala and Polonnaruwa. Antennae, wings, hind legs, thorax and abdomen of the collected insects were observed using a dissecting microscope. Interestingly, the number of plaque organs of antennae, the number of setae on wings, the number of teeth in spur and the number of tarsal spines in hind leg segment 1 were found to vary among insects. Number of insects showing spot like or stripe like pterostigma varied among the five locations. However, no differences were found in the number of segments in antenna, antennal sensilla on pedicel, venation, number of segments on hind leg, presence of tarsomeres in tarsus, color of thorax segment, color of abdomen and absence of hair in the abdomen. Genomic DNA extracted from five morphologically different BPH was amplified with universal COI primers and will be sequenced. The morphological analysis results indicated that there are variations in BPH populations found in different locations of Sri Lanka.

Keywords: BPH, Biotypes, *Oryza sativa*, COI region

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[1]Rice Research and Development Institute, Bathalegoda, Ibbagamuwa

* ag15069@agri.Pdn.ac.lk

Morphological and Physiological Characters of Selected Traditional Rice (*Oryza sativa* L.) Varieties in Sri Lanka

Kularathna H.A.J., Weerasinghe K.W.L.K., Beneragama C.K. and Ariyaratne W.M.T.P.*
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Rice (*Oryza sativa* L.) is one of the vital cereal food crops in the world and the staple food for more than half of the world's population. Morphology and physiology of rice plant exhibit a direct link with plant growth and productivity. Therefore, this study was formulated to investigate the morphological and physiological characters of selected traditional rice varieties in Sri Lanka. Four traditional rice varieties (*Suwendel, Kaluheenati, Pachchaperumal, and Pokkali*) and two Newly Improved Varieties (BG 300 and BG 352) were used for the experiment. Experiment was conducted as a Completely Randomized Design with five replicates. Plant height differed among the rice varieties with *Pokkali* being the tallest (146.2±1.0 cm) while BG 352 being the shortest (101.3±1.0 cm). Maximum rooting depth was significantly ($P< 0.05$) higher in *Kaluheenati* (31.4±0.5 cm)and BG 300 (30.3±0.4 cm) when compared to other varieties. Number of tillers per plant was similar among the rice varieties. *Pachchaperumal* showedearly flag leaf emergence (41.8±1.3days) than other rice varieties. *Suwendel* showed the lowest Net Photosynthetic rate (16.3±1.3 $\mu molCO_2 m^{-2}s^{-1}$). Among the chlorophyll fluorescence parameters, PI_{ABS} (Performance Index) of a normal rice leaf during the midday was significantly higher in both *Suwendel* (2.0±0.6) and BG 300 (1.6±0.4) while *Kaluheenati* showed the lowest (0.4±0.1). Among 3 month varieties in flag leaf of a rice plant, PI_{ABS} was significantly higher in *Suwendel* (1.4±0.3) relative to BG 300 (1.0±0.5). Among the 3 1/2 months varieties *Pachchaperumal* (0.6±0.1) showed significantly higher PI_{ABS} values relative to BG 352 (0.5±0.3). These observations can be used to explain the underline factors affecting photosynthetic capacity of rice, and be used in future rice breeding programs to develop new rice varieties.

Keywords: Performance Index (PI_{ABS}), Traditional rice varieties, Photosynthetic rate, Chlorophyll fluorescence, Morphological characters

* mojith@agri.pdn.ac.lk

Nursey-grown TRI 2025 and TRI 3019 Tea Cultivars Exhibit Thermal Acclimation of Photosynthesis to Increase in Growth Temperature

Abeysinghe S.D., Weerasinghe K.W.L.K.* and Geekiyanage N.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The capacity of plants to adjust their photosynthetic characteristics to changes in growth temperature, *i.e.*temperature acclimation, is imperative for modeling plant growth responses under global warming. A rise in average growth temperature coupled with soil moisture stress is observed in recent years across tea growing areas in Sri Lanka. Therefore, it is worthwhile to explore how photosynthetic characteristics of popular tea cultivars response to increase in both growth temperature and soil moisture stress conditions. Thus, temperature response of rate of light saturated net photosynthesis (A_{sat}) was determined in two tea cultivars of TRI 2025 and 3019 at nursery stage grown under two average growth temperatures;26.2±0.2^{o}C (herein referred as low growth temperature – LGT) and 28.4±0.2^{o}C (herein referred as high growth temperature – HGT) under field capacity (FC) and water stress conditions (WS i.e.<50% of the available water). Under FC, both TRI 2025 and TRI 3019 exhibited a significant ($P<0.05$) increase in optimum temperature (T_{opt})of photosynthesis from LGT to HGT without showing a substantial change ($P>0.05$) in rate of A_{sat}. However, neither TRI 2025 nor TRI 3019 exhibited a significant ($P>0.05$) increase in both T_{opt} and $A_{sat}$from LGT to HGT in water stressed plants. Interestingly, change in the shape of the temperature response curves of A_{sat} were evident in both TRI 2025 and TRI 3019 cultivars from LGT to HGT under water stress conditions. Moreover, both cultivars revealed a lower A_{sat} under water stress conditions when compared to their FC grown counterparts. Given above it can be concluded that maintaining available soil moisture > 50% would lead to get the advantage of thermal acclimation of photosynthesis even during rising growth temperature of TRI cultivars 2025 and 3019.

Keywords: Acclimation, Photosynthesis, Tea, TRI 2025, TRI 3019

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[1]Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura

* lasanthaw@agri.pdn.ac.lk

Nutritional Composition of Hydroponically grown Green Maize (*Zea maize*) Fodder as a Pure Stand and Mixture with Sunn hemp (*Crotalaria juncea*)

Jayasinghe K.S.H., Vidanarachchi J.K., Hulugalla W.M.M.P. and Ekanayake W.E.M.L.J.*
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Growing green fodder hydroponically can be an alternative solution for year-round production of high-quality forages for livestock animals in Sri Lanka. This study was conducted 1). to examine the nutritional quality of hydroponically-grown maize fodder at different harvesting days (raw maize seeds, 5, 6, 7, 8, 9 and 10 days from planting to harvesting) and 2). to examine the nutritional quality of maize fodder grown hydroponically in mixture with Sunn hemp:)Maize 100% and Sunn hemp 0% (T1);) Maize 0% and Sunn hemp 100% (T2);) Maize 95% and Sunn hemp 5% (T3) and) Maize 90% and Sunn hemp 10% (T4). Pure stands of maize and mixture of maize and Sunn hemp were grown in three replicates and harvested separately to estimate the nutritional quality, dry matter (DM%), crude protein (CP%), crude fiber (CF%), ash (%) and gross energy (MJ/kg). The harvesting time of maize grown as a pure stand had a significant effect on ($p< 0.05$) on DM%, CP%, Energy, CF% and Ash%. Raw maize seeds had the highest CP (16%) compared to maize fodder at all the harvesting dates (8.4- 9.7%). DM content increased from 90% of raw maize seeds to 98% of green fodder from fifth day of harvesting. CP of Sunn hemp (29%) was significantly ($p<0.05$) higher than pure maize fodder (8.7%). CP of maize grown in mixture of 5% and 10% Sunn hemp was 11.4% and 12.8%, respectively. Highest DM (99%) was achieved when maize was grown with 10% of Sunn hemp compared with raw maize and Sunn hemp. Gross energy did not differ ($p>0.05$) between any of the treatments. It is therefore, recommend to grow maize with 10% Sunn hemp hydroponically in order to produce green fodder with 12.8% of CP as a source of quality forage for livestock animals in Sri Lanka.

Keywords: Hydroponic fodder, Maize, Sunn hemp, Nutritional quality

* jayekn@agri.pdn.ac.lk

Nutritional Requirements for the Improvement of Pigmentation in Ornamental Fish

Western R D.S. and Athauda A.R.S.B.*
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The information of nutritional requirements in ornamental fish species is required to improve the ornamental fisheries sector. However, available information on nutritional requirement for ornamental fish species is scare or extrapolated from non-ornamental fish species. The objective of this review is to identify the specific nutritional requirements to improve the economical and productive potentials of freshwater ornamental fish. Correct diet formulation for ornamental fish improve the nutrient digestibility and supply the metabolic needs while reducing the maintenance cost. Furthermore, water pollution also reduces. Inert food such as meal powder, flakes, milk powder, bovine heart, bovine liver, worms have been used extensively in ornamental fish feeding for achieving rapid growth. Live food like rotifers, Artemia and Moina have also been introduced with a diverse range of nutritional values. For ornamental fish, skin pigmentation is a mandatory characteristic. They cannot synthesize color-producing carotenoid pigments. Hence the use of dietary supplements with carotenoids is recommended. For economic benefits from the ornamentals fisheries, pigmentation is a critical requirement. Hence importance of Carotenoids was also concerned in this review. Based on the review, improved balanced feed formulations and utilization of natural carotenoids were identified as the major requirements for the improvement of pigmentation in ornamental fish.

Keywords: Ornamental fish, Fish nutrition, Growth, Pigmentation, Color

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* sbathauda@agri.pdn.ac.lk

Performance Evaluation of Jersey and Sahiwal Breeds and Their Crosses in IL-1 Agro-Ecological Zone

Sanjeewa M.G.I.P., Dematawewa C.M.B.* and De Silva V.G.D.T.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Performance evaluation studies help to determine the most suitable genotypes for different environments and management conditions. This study was undertaken to compare pure and crossbred cows in different parities with respect to production and reproductive performance under semi-intensive management system in IL-1 agro-ecological zone. A large state dairy farm in Narangalla, Kuliyapitiya was randomly selected for the study. The records on no. of lactations (NL), lactation length (LL), lactation milk yield (LY), daily milk yield (DY), age at sexual maturity (ASM), no. of services per conception (NSC), age at first calving (AFC) and calf birth weight (CBW) were collected from 116 cows of Jersey (n=42) and Sahiwal (n=18) breeds and JerseyxSahiwal (JS) crosses (n=56). Analysis of Variance procedure with Duncan's New Multiple Range Test was used to determine differences among the genotypes and parities. Mean performance values (±S.E.) of NL, LL, LY, DY, ASM, NSC, AFC and CBW were 2.89±0.24, 262.41±6.50 days, 1789.10±65.31 litres, 6.54±0.15 litres, 28.38±1.20 months, 1.46±0.06 services, 42.72±1.01 months, and 20.71±0.17 Kg, respectively. The differences among Jersey, Sahiwal and JS were not significant for LL, LY, DY and NSC ($P>0.05$). The mean NL of Sahiwal (4.22 lactations) was significantly ($P<0.05$) greater than those of Jersey and JS cows (2.41 and 2.86, respectively). Sahiwal and Jersey cows reached sexual maturity significantly ($P<0.05$) earlier (23.5 and 24.4 months) than JS cows (35.6 months). Sahiwal and JS cows produced significantly ($P<0.05$) heavier calves (20.63 and 21.23 Kg, respectively) compared with Jersey cows (19.65 Kg). Furthermore, percentages of abnormal births of Jersey, Sahiwal and JS (20.0%, 12.2% and 6.2%, respectively) were significantly different according to the Chi-square analysis ($P<0.05$). Heifers produced significantly smaller calves compared to the older cows but required fewer NSC ($P<0.05$). Thus, Sahiwal breed has shown superior overall performance over Jersey and crossbred cows under the given conditions.

Keywords: Breed comparison, Parity, Performance, Production, Reproduction

[1]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya

* dematawewa@agri.pdn.ac.lk

Phenotypic and Genotypic Screening of Marker Assisted Backcross Breeding Population BC_5F_5 for Submergence Tolerance in Rice

Sobarathne S.S., Udawela U.A.K.S.[1], **Madduma A.**[1] **and Perera S.A.C.N.***
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Rice is susceptible to submergence from germination to the early vegetative stage and affects wetland paddy cultivation in Sri Lanka. A majority of rainfed areas in Gampaha, Kalutara, Ratnapura, Colombo, and Galle districts are affected by flash floods. There are a few landraces that are tolerant to submergence but their yields are low. To date, there are no locally available improved rice varieties that are submergence tolerant. *Bg 360* is an elite rice variety in Sri Lanka but it is submergence susceptible. Accordingly, this research was designed to evaluate 9 lines of a BC_5F_5 population, derived from the recurrent parent *Bg 360* and the donor parent *Sambamahsuri Sub-1* for submergence tolerance. One hundred and twenty seeds of each of the parents and the 9 lines were germinated. The height of 10-day old seedlings was recorded followed by the submergence of seedlings for two weeks at a 1.5 m water level. Out of a total of 1080 seedlings, 760 survived and the elongation of the survived seedlings was recorded. Ten survived seedlings from each line were screened at the microsatellite locus RM 23869 to identify the plants carrying *Sub-1A1* allele conferring submergence tolerance. Covariance analysis of height measurements revealed significant similarity of the BC_5F_5 population to the submergence tolerant donor parent *Sambamahsuri Sub-1*. Duncan's mean separation analysis revealed 3 of 9 lines to be superior compared to *Sambamhasuri Sub-1*. SSR marker analysis revealed the successful introgression of the *Sub-1A1* allele and the morphological screening confirmed the submergence tolerance in the BC_5F_5 population. It is recommended to further advance the three superior lines to develop a submergence tolerant rice variety.

Keywords: *Bg 360*, Molecular breeding, Rice (*Oryza sativa* L.), *Sambamahsuri sub-1*, submergence tolerance

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[1]Rice Research and Development Institute, Bathalegoda, Ibbagamuwa

* chandrikaperera@agri.pdn.ac.lk

Potential Uses of Effective Microorganisms in Sustainable Animal Production: A Review

Handunwala S.S. and Wijayagunawardena M.P.B.*
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Rapid human population growth leads to substantial development of animal industry. Thus, high amount of synthetic products are used to meet the demand for animal products. However, heavy usage of chemicals, pesticides and antibiotics creates a burden on the environment, destroys the micro-fauna and flora in soil, and causes threats to animals and humans health. Therefore, organic animal production has gained a global interest. Among many ways, application of effective microorganisms (EM) play a vital role in organic animal production, and have been widely spread throughout the world. The EM is fermented mixed culture of naturally occurring species of beneficial microorganisms, which includes photosynthetic bacteria (*Rhodopseudomonas* spp.), lactobacilli (*Lactobacillus* spp.), yeast (*Saccharomyces* spp.) and actinomycetes (*Streptomyces* spp.) in an acidic medium (pH below 3.5). In this review, the use of EM for the achievement of sustainable animal production has been summarized in the areas such as malodor reduction and animal waste management, and the potential uses of EM as a feed additive in poultry, livestock and aquaculture industries. The EM is eco-friendly, cost-efficient and safe thus, make them suited in organic animal production. Some recent scientific evidences were selected to emphasize the current situation and advancements. Most of the information related to the use of EM in animal husbandry has not yet been published or are at the experimental stage. Thus, more in-depth studies should be directed towards the application of EM in sustainable animal production and the environment protection.

Keywords: Effective Microorganism, Livestock, Poultry, Aquaculture, Sustainable Environment

* missaka@agri.pdn.ac.lk

Problems Affecting on Milk Productivity of Buffalo Farms in Two Veterinary Divisions in Moneragala District

Iresha P.G., Prasanna P.H.P.* and Weerasooriya S.A.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

This study was conducted to find problems affecting milk productivity (MP) of buffalo farms in the Thanamalvila and Sewanagala veterinary divisions in the Moneragala district in 2021. Fifty farmers were surveyed using a pretested questionnaire and the information on household and social status, buffalo management and management systems, marketing of milk and milk products, buffalo reproduction aspects, health condition of buffalo and information about buffalo milk production were collected. The descriptive data were analyzed using SPSS software and Excel. The multiple linear regression (MLR) analysis was used to study the relationship between milk productivity and input variables. According to the survey data, the involvement of male farmers was prominent (98%) and most of them practiced an extensive farming system. Social recognition of this area was high. The variation of herd size was between 12-287 animals. Selling raw milk was the main milk marketing method. Existing veterinary services were at an insufficient level. The MLR analysis was used to identify the relationship between dependent and independent variables and to recognize the significant factor. MP per cow per day(Y) was a dependent variable while labor hours per day(X1), age of the farmer(X2), feed requirement per cow(X3), the average cost for medicine per cow(X4) and land area per cow(X5) were independent variables. According to the regression result, Y increased by 0.583 and 0.318 when X1 and X3 increased respectively by one unit and Y decreased by 0.010, 0.006 and 4.932 when X2, X4 and X5 increased respectively by one unit.

Keywords: Problems, Buffalo milk productivity, Buffalo management

* phpprasanna@agri.pdn.ac.lk

Provision of Yeast Extract-based Supplementation to Crossbred Jersey-Friesian Dairy Cows in an Intensive Dairy Farming System in Sri Lanka did not Influence the Milk Yield or Composition

Wijemanna B.U.R., Vidanarachchi J.K.*, Ekanayake W.E.M.L.J., Hulugalla W.M.M.P., Mangalika U.L.P.[1], Lokuge G.M.S.[2], Priyashantha H.[3], Fernando G.K.V.[4] and Jayarathna W.N.[4]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The present study evaluated the effect of providing a yeast extract-based supplement on milk yield and composition of 10 multiparous Jersey x Friesian crossbred cows (97±46 days postpartum) in a crossover design. Hokovit Dairy Pro ® yeast extract-based supplement was provided for 28 days with a 38 days washout period in-between. The two treatments were basal total mixed ration (control diet) and control diet supplemented with Hokovit Dairy Pro® at 25 g/cow/day (test diet). The average milk yield for the cows fed the test diet (16.80±0.87 kg) did not differ significantly (P>0.05) from the control diet (16.70±0.84). Early lactating cows tend to be more positively influenced by the Hokovit Dairy Pro® supplementation compared to mid-lactating cows, although the effect was not significant (P>0.05). Further, fat content, protein content, lactose content, and solid non-fat (SNF) content of milk were not affected (P>0.05) due to the yeast-based supplementation. The average somatic cell count of milk from cows fed test diet (157±32x10^3/mL) was numerically higher than that of cows fed with the control diet (137±29x10^3 /mL). The average milk urea nitrogen content for the cows fed test diet (10.30±0.91 mg/dL) did not differ (P>0.05) from the control diet (11.00±0.85 mg/dL). Overall, in contrast to our expectation, the Hokovit Dairy Pro® supplementation did not influence the milk yield or composition in crossbred Jersey x Friesian cows under intensive management conditions in an up-country farm, Sri Lanka. Observed results are likely to be associated with cows' genetic merits, nutritional status of early stages, or on-farm management practices. However, further research would be needed to evaluate the reasons behind unexpected results. In such experiments, a larger herd with various breeds and parity should be considered.

Keywords: Jersey x Friesian, Hokovit Dairy Pro®, yeast extract, milk yield, milk composition

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[1]Veterinary Research Institute, Gannoruwa, Peradeniya
[2]Department of Food Science, Aarhus University, Denmark
[3]Department of Molecular Sciences, Swedish University of Agricultural Sciences, P.O. Box 7015, SE-750 07 Uppsala, Sweden
[4]CMC Engineering Export GmbH, No. 08, Rodrigo Mw., Nawala Road, Rajagiriya, Sri Lanka
* janakvid@agri.pdn.ac.lk

Relationship Between the Morphological Characters of Rice Plant and BPH Resistance

Senthurselvan V., Hemachandra K.S.*, Jayasinghe W.H. and Bulathsinhalage V.N.D.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Rice is one of the widely grown cereal crops in the tropical areas which acts as a host to many insects. Brown Plant Hopper (BPH), *Nilaparvata lugens*, is one of the most serious insect pests of paddy demanding intensive population management. Breeding rice for host plant resistance is a durable and cost-effective means of controlling BPH. However, phenotypic screening of rice plants for BPH resistance is a time consuming tedious job. Thus, this study was conducted with the objectives of identifying the possible correlations present between morphological characters of rice plant and resistance level to BPH. The examined morphological characters include leaf angle, leaf color, plant height, number of tillers, number of leaves and sheath color. Twelve different rice varieties which include five moderately resistant rice varieties, five moderately susceptible rice varieties, a resistant check and a susceptible check were used in this study. The rice cultivars were grown in pots in Jaffna with six replicates for each variety. Morphological characters were measured 30 days after planting. Data was subjected to normality test and one way ANOVA followed by Tukey's pairwise comparison test and Chi-square test. The results showed that, out of the different morphological parameters tested, only the amount of red and green colors present in leaves showed significant differences between the groups of susceptible and moderately resistant rice varieties ($P < 0.05$). The highest mean red values and green values of the leaf was shown by the susceptible check variety (Bg-380) and the lowest red and green value were shown by moderately resistant rice varieties (Bg-369, Bg-357, Bg-300, At-311 and H-10). However, in the Chi-square test for association, no significant correlation was observed between the amount of red and green colors present in leaves and the BPH resistance levels.

Keywords: Brown Plant Hopper, Morphological-parameters, Rice, Host-plant resistance

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* ks_hemachandra@agri.pdn.ac.lk

Residual Effects of Biochar on Soil Fertility and Yield of Maize (*Zea mays* L.) Grown in Tropical Alfisol

Wickramasinghe P.G.H.S., Dharmakeerthi R.S.* and Munasinghe S.T.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Declining soil fertility has resulted a decrease in productivity in maize growing Alfisols of Sri Lanka. Some studies suggest that compost application is an answer to this problem. However, repeated application of compost in large quantities is a major drawback. Biochar application can be used as an alternative technology, but residual effects of a single application of biochar to improve long-term soil fertility and productivity still need to be investigated. To achieve that objective, data collected from an ongoing long-term field experiment, which had been initiated in 2017 at the Grain Legume and Oil Research and Development Center, *Agunakolapelassa*, Sri Lanka, were used. Four treatments were considered for this study: one-time application of 17 Mg/ha of corn cob biochar or rice husk biochar, repeated application of 10 Mg/ha of compost, and a no organic amendment control. All four treatments received NPK fertilizers every season. Selected soil properties and maize yield were measured over seven growing seasons. Repeated measures ANOVA showed that application of amendments significantly increased soil organic carbon, Olsen P, exchangeable K contents, and maize yield compared to the control treatment but the magnitudes varied with time. There were no significant differences ($P>0.05$) among soil amendments on their effect on yield. Soil pH significantly ($P<0.001$) reduced with time in all treatments. According to stepwise regression analysis, only soil pH and Olsen P content significantly influenced along with amendments maize yield ($P<0.001$). The findings of this study conclude that both biochar+NPK and compost+NPK have a better potential to increase soil fertility and productivity than the NPK only treatment. Since the effects of a single application of biochar were comparable to that of repeated application of compost during the studied seven seasons, biochar can be used effectively as a better soil management technology in maize growing Alfisols of Sri Lanka.

Keywords: Residual effects, Biochar, Soil fertility, Maize yield, Alfisol

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[1]Grain Legume and Oil crop Research and Development Centre, Department of Agriculture, Angunakolapellasa

* dharmakeerthirs@agri.pdn.ac.lk

Risk in Layer Industry: Responses by Farmers and Their Determinants

Liyanagamage I., Perera W.N.U.* and Korale-Gedara P.M.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The layer industry in Sri Lanka is one of the most important subsectors in the poultry sector. Despite the growth in the industry, layer farmers are experiencing many risks, such as frequent fluctuation of prices, animal diseases, and market disruptions that might lead to detrimental effects leaving the industry unattractive. This study investigated the responses of layer farmers to seasonal income fluctuations and the respective determinants of these responses. Data were collected from 50 layer-farmers through a primary survey using a questionnaire, and data were analysed using descriptive statistics and Probit regression models. The results revealed that, the most common response (48%) to income decline was selling the half or whole batch of birds. In addition to this, 40% utilized their saving, and 10% of the farmers changed the feed into a low-cost ration. The response of selling flock is alarming as it threatens the sustainability of the small-scale layer industry in Sri Lanka. The Probit models indicated that the scale of operation, production per month, education level of the farmer, age of the business, and income diversification influence the risk response. The response of selling half or the whole batch of birds was negatively influenced by the scale of production, production per month and income diversification ($P<0.05$). The response of changing the feed into a low-cost ration was positively influenced by the education level of farmers and market type ($P<0.05$). Accordingly, it was obvious that small-scale farmers have a high tendency to adopt unhealthy responses. However, the education and market type promote the adoption of healthy responses. Thus, programs are needed to provide knowledge and skills to farmers for adopting healthy responses in averting risks.

Keywords: Egg, Seasonality, Risk, Determinants, Layer farmer

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[1]Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Peradeniya

* nipunap@agri.pdn.ac.lk

Root Growth Plasticity of Finger millet and Cowpea in Response to Heterogeneous Nutrient Availability

Widanagamage D.*, Dissanyake D.M.S.B., Ranil R.H.G. and Suriyagoda L.D.B.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Nutrient distribution in soil is heterogeneous which makes root growth plasticity a promising trait for successful patch exploitation for nutrient uptake. Whether the root system of different crops has the plasticity to adjust with nutrient availability and its influence on growth and nutrient uptake remains unclear. The aim of this study was to investigate the root growth plasticity of finger millet and cowpea when nutrients are heterogeneously distributed within the soil profile. A pot experiment was conducted in a complete randomized design in greenhouse with four patterns of nutrient distribution in soil creating nutrient rich and nutrient poor soil layers across the soil profile in pot; (i) nutrient rich soil as control, (ii) sand in upper layer and soil in bottom layer, (iii) soil in upper layer and sand in bottom layer, and (iv) sand in right side half and soil in left side half of the pot. The impact of soil nutrient heterogeneity on plant growth, nutrient uptake, and yield were investigated. There was a significant reduction in root dry weight, number of nodules and phosphorus (P), and potassium (K) accumulation of roots in cowpea when grown under different spatial nutrient distribution patterns. Cowpea maintained similar root nitrogen (N) concentration irrespective of the pattern of nutrient distribution in soil profile. Furthermore, nutrient heterogeneity did not affect biomass accumulation of cowpea shoots and yield components except the pod dry weight. In finger millet, biomass accumulation and N, P, and K concentration of both roots and shoot were greatly decreased when plants are grown in pots having different soil and sand layers compared to the plants grown with only soil. The results highlight that both crops used in the study are not capable of investing more root biomass to nutrient rich patches when they are grown under nutrient heterogeneity.

Keywords: Root, Plasticity, Nutrient heterogeneity, Finger millet, Cowpea

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* ag15050@agri.pdn.ac.lk

Secondary Data-based Phylogenetic Reconstruction of South Asian *Capparis* Species to Reveal the Necessity for a Systematic Revision of Sri Lankan *Capparis*

Dissanayake E.J.M.S.K., Jayawardana N.U., Yakandawala D.[1] and Sirimalwatta V.N.S.*
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Capparis is the largest and most diverse genus of the family *Capparaceae*. To date, only a few compilations have been published on Sri Lankan (SL) capers, and thus not many studies are done on focal species. Hence, information is lacking for characterization and identification of them. This study used secondary data to reconstruct the phylogeny of South Asian (SA) *Capparis* to establish a baseline for prospective SL *Capparis* systematic studies. We found 39 SA capers, most of which (92%) were confined to India and Sri Lanka. Based on NCBI GenBank data availability, 15 (40%) species were assessed using the *rbcL* and *matK* genes, and eight (20%) species are found in SL. Multiple sequence alignments of 33 *rbcL* and 34 *matK* revealed 89% and 77% sequence similarity among species. We used Maximum Parsimony (MP), and Maximum Likelihood (ML) methods for Phylogenetic reconstruction with 10,000 bootstrap replicates. All four analyses were incongruent with each other except for a few relationships. According to our results, *matK* is a good candidate gene to resolve most species relationships than *rbcL*. Both MP and ML analyses of *matK* were able to resolve most species relationships with good branch support (>70%). A set of species formed a unique clade in the phylogeny, with samples from India and China. There were few subclades due to similar genetic patterns of species. *Capparis* species that are also found in SL were evenly distributed throughout the phylogeny, implying multiple origins of different species. As the second phase of the study, we built a morphological description for an unverified SL medicinal species, *Kalu wellangiriya*. Then identified it as dissimilar to any recorded species, suggesting molecular identification. More research should be directed towards a comprehensive taxonomic revision of SL *Capparis* with more sampling and combined molecular and morphological data analyses.

Keywords: *Capparis*, *Kalu wellangiriya*, *matK*, Phylogeny, *rbcL*

[1]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya

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

Sri Lankan Yams: Genetic and Biochemical Diversity among the Accessions

Disanayaka D.M.S.K., Nissanka S.P.*, Chandrasekara C.H.W.M.R.B.[1] and Bandaranayake P.C.G.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Dioscorea spp. is an important tropical tuber crop that ensures the food security of millions of people. The genus Dioscorea consists of about 630 species and more than 40 cultivars are cultivated in Sri Lanka. Thus, the characterization of the genus is vital. This study was carried out to assess the genetic and genotypic diversity using some molecular and biochemical characters of 42 *Dioscorea* cultivars found in Sri Lanka belongs to *Dioscorea alata*, *D. esculenta*, *D. obouneta*, *D. sativa*, *D. oppositifolia*, *D. koyamae*, and *D. bulbifera* species. To assess the genetic diversity, 9 Dioscorea cultivars were selected. The leaf DNA extracted using the CTAB method was assessed with one inter simple sequence repeats (ISSR) region UBC 842. A total number of 16 loci were observed in 2% agarose gels. 100% polymeric results suggest a high genetic diversity among assessed cultivars. The UPGMA dendrogram with binary data showed a clear pattern. Biochemical characterization revealed that tuber moisture content across cultivars varies from 42.8-87.7% and cultivar *Udala* recorded the highest. The lowest soluble sugar content was found in the *Damdinu* cultivar (0.0067% dry weight basis [DWB]) and the highest was in *Kukulala* (6.4% [DWB]). Starch content ranged between 4.7-95.0%, and cultivar *Hingurala* had the highest. The antioxidant activity measured using DPPH method varied greatly among cultivars (217.4 –19293.0 µMTE/g wet weight basis [WWB]) and cultivar C-05 recorded the highest. Tuber protein content also ranged between 1.0-21.5% [DWB] and the cultivar *Kirikadol* recorded the highest while cultivars *Thirunuththuwalli*, *Madakalapuwarasawalli*, *Udala*, *Kidala,* and *Hingurala* contained more than 10% protein in their tubers. In conclusion, intra and inter-species variations can be found in *Dioscorea* spp. in terms of molecular and biochemical characters, exhibiting a greater potential for exploiting for further health and nutritional benefits.

Keywords: *Dioscorea*,, ISSR, Molecular characterization, Biochemical characterization

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[1]Agricultural Biotechnology Centre, Faculty of Agriculture, University of Peradeniya, Peradeniya

* spn@agri.pdn.ac.lk

Sulphur Fertilization to Enhance Growth of Capsicum (*Capsicum annum* L.) under Controlled Environment

Sivakajan S., Silva N.R.N.[1] **and Fonseka R.M.***
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Capsicum (*Capsicum annum* L.) is a Solanaceous vegetable grown in Sri Lanka for its high value, pungent fruit commonly known as "Malumiris" which is used in various culinary preparations. Fruits are a superior source of wellbeing related compounds for human health. Sulphur is currently perceived as the 4th significant plant nutrient and interactions with other nutrients have a direct impact on crop physiological response and nutrient absorption and utilization. Positive and beneficial responses to sulphur fertilization had been reported in various crops. Therefore, this study was aimed to evaluate the sulphur fertilization effect on the growth of Capsicum and determine the best source of sulphur for Capsicum. A pot experiment was conducted during April – July, 2021 in the greenhouse at Horticultural Crop Research and Development Institute, Gannoruwa, Peradeniya. The experiment was laid as a completely randomized design with four replications. The treatments were consisted of three different sources of sulphur; i.e., elemental sulphur, Potassium Sulphate and organic manure and four levels (30, 60, 90, 120 kg/ha) of sulphur were applied with respect to elemental sulphur and Potassium Sulphate while organic manure was applied at the rate of 10 kg/ha. The growth parameters and plant nutrient concentrations were measured. Initial growth of the plant was significantly greater with Potassium Sulphate while the elemental sulphur showed greater impact on plant height, canopy diameter and chlorophyll content towards end of the vegetative stage. Addition of organic sulphur resulted higher calcium and magnesium concentrations in plants. Significant ($P<0.05$) greater concentrations of sulphur, iron, copper and manganese were found where elemental sulphur was used. Elemental sulphur at the rate of 90 kg/ha showed promising results with respect to plant growth and nutrient absorbance.

Keywords: Elemental sulphur, Capsicum, Fertilization, Potassium sulphate

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[1]Horticultural Crop Research and Development Institute (HORDI), Department of Agriculture, Gannoruwa, Peradeniya

* ramyamf@agri.pdn.ac.lk

The Effect of Temperature and the Source of Nitrogen on the Effectiveness of Nitrification Inhibition by Dicyandiamide (DCD) in Soil

Konara K.M.B.M., Dandeniya W.S.* and Hansika K.D.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Dicyandiamide (DCD) is a nitrification inhibitor but climatic and edaphic factors could affect its performance. This study was conducted to determine the effect of temperature and sources of nitrogen (N) on the effectiveness of nitrification inhibition by DCD in soil. Two experiments were conducted. In the first experiment, samples of Red Yellow Podzolic (RYP) and Regosol great soil groups were incubated with and without urea and DCD, under 3 different temperatures (21±1, 24±0 and 29±1 °C) for 48 h and soil NO_3^- concentration was analyzed. In the second, a leaching column experiment was conducted at 29±1 °C with Regosol applied with different N sources namely urea, compost and poultry manure with and without DCD and NO_3^- release was measured over 9 days. In overall, significantly ($P<0.001$) high NO_3^- concentration (32.3±1.28 mg/kg) was observed in RYP compared to Regosol (18.1±1.59 mg/kg). Temperature level had a significant ($P<0.02$) effect on NO_3^- formation only in Regosol. The application of urea and DCD had a significant ($P<0.05$) effect on the concentration of NO_3^- at 48 h into incubation only at 21±1 and 24±0 °C in RYP and only at 24±0 and 29±1 °C in Regosol. Application of urea with DCD reduced NO_3^- concentrations in both soils. At 24 h into the incubation, NO_3^- release from soils applied with N sources were in the order of urea>poultry manure>compost>control (77.3±3.67, 56.9±0.92, 37.5±0.98 and 37.5±3.54 mg/kg, respectively). Application of DCD significantly ($P<0.05$) reduced the NO_3^- release only in soils applied with urea. From the NO_3^- formed during the incubation, nearly 92% released during the first 24 h. Results indicated that effectiveness of DCD at different temperatures is inconsistent among soil types. Further DCD is effective in suppressing nitrification in Regosols when applied with urea but not with compost or poultry manure.

Keywords: Dicyandiamide, Temperature, Nitrification, Urea, Compost

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[1]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya

* warshisd@agri.pdn.ac.lk

Thermal Acclimation Potential of Leaf Dark Respiration of Nursey-Grown TRI 2025 and TRI 3019 Tea Cultivars to an Increase in Growth Temperature

Anushka P.H., Weerasinghe K.W.L.K.*, Geekiyanage N.[1] and Sivananthawerl T.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Leaf dark respiration (*R*) is sensitive to changes in leaf temperature (*T*) on daily basis as well as to the variations in leaf thermal environment over longer time scales from weeks, and months to years. Though thermal acclimation of *R* to prevailing growth temperatures is common, such information is scarce with regard to tea (*Camellia sinensis*). Generating precise temperature response function of *R* on both short and long-time scales would be a key to identify existing and future *R* dynamics under atmospheric warming and soil moisture stress. Thus, temperature sensitivity of the leaf dark respiration (Q_{10}) was determined for 25-35 ^{o}C leaf temperature range in two tea nursery cultivars; TRI 2025 and TRI 3019 grown under two growth temperatures; 26.2±0.2 ^{o}C (herein referred as low growth temperature – LGT) and 28.4±0.2 ^{o}C (herein referred as high growth temperature – HGT) under field capacity (FC) and water stress conditions (WS *i.e.*, <50% of the available water). Under FC, both TRI 2025 and TRI 3019 grown in both LGT and HGT exhibited increasing rates of leaf *R* with increasing leaf *T*, however, the response found to be inconsistent beyond 34 ^{o}C. Under WS condition, inconsistency of rates of leaf *R* was observed beyond 32 ^{o}C while exhibiting an increase in rates of leaf *R* upto 32 ^{o}C. Within the 25-35 ^{o}C measurement range, both cultivars demonstrated a declining trend in Q_{10} indicating decreasing rates of carbon loss with increasing leaf *T*. When measured at a common temperature (27^{o} C) both cultivars grown at HGT, irrespective of water treatment exhibited significantly higher ($P<0.05$) rates of leaf *R* without indicating potential acclimation of leaf *T* to enhance growth temperature. Further investigation is needed exposing variety of tea cultivars to broader growth temperature differences and if acclimated such can be recommended for elevation categories prone to increasing growth temperatures.

Keywords: Acclimation, Leaf respiration, Tea, TRI 2025, TRI 3019

[1]Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura

* lasanthaw@agri.pdn.ac.lk

Use of Probiotics in Aquaculture - A Review

Vithanage V.H.P. and Athauda A.R.S.B.*
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Diseases in fish are a major concern, and they cost the aquaculture industry millions of dollars each year. Probiotics may be an effective way to lower the disease risk while also increasing productivity. Various positive elements of probiotics use in aquaculture sectors were discovered in this review. Probiotics are thought to be innovative functional agents with the ability to affect the gut microbiota of any aquatic organism and have been shown to have a wide range of actions in the fish body. A prebiotic is a non-digestible food element that has a favorable effect on the host by encouraging the growth and/or activity of one or a few bacteria in the colon. Despite the potential health and performance benefits observed in various terrestrial animals, the prebiotics are widely used in aquatic feeds. The prebiotics can have a positive effect on growth, feed conversion, gut microbiota, resistance to pathogenic bacteria, and innate immune parameters of fish and can lead for sustainability of aquaculture production. Several articles in 2017 have been identified the benefits of prebiotic regarding the alternative complement activity, lysozyme activity, natural haemagglutination activity, respiratory burst, superoxide dismutase activity, and phagocytic activity of fish. Probiotics may have the potential to boost the efficiency and sustainability of aquaculture production if they cause health responses in fish to become more clearly displayed. Probiotic microorganisms have a wide range of beneficial impacts on their hosts, as well as the methods used, effects and mechanism of action of probiotics on the reproductive performance and gonadal development of aquatic organisms are discussed in this review. However, there are significant information gaps. To understand the total effects of adding probiotics in fish diets, further research efforts are needed to investigate impacts and mechanisms of action of probiotics on aquatic organisms' reproductive performance and gonadal development.

Keywords: Probiotics, Aquaculture, Growth, Gut microbiota, Nutrient

* sbathauda@agri.pdn.ac.lk

Whiteflies (Hemiptera: Aleyrodidae) and Their Parasitoids on Guava and Cassava on Selected Locations in Kandy and Matale Districts

Wijethunga K.G.N.A.B.*, Nishantha K.M.D.W.P.[1], Warnasooriya P.G.A.S. and Hemachandra K.S.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Whitefly (Aleyrodidae) is one of the major pest groups in many vegetable and fruit crops and on ornamental plants, and they are found across the country. The use of chemicals in controlling the whiteflies has many limitations; therefore, biological control was proposed as an alternative controlling strategy. Mass rearing and releasing of parasitoids are one of the successful approaches in biological control. It is less risky to use locally available parasitoids in augmentative biocontrol; hence, this study was conducted to examine the locally available parasitoids and their field performance. Guava (*Psidium guajava*) and cassava (*Manihot* spp.) plants had high levels of whitefly infestation as per an initial field survey. Field samples were collected from guava and cassava plants at weekly intervals from selected locations in Kandy and Matale, representing both organic and conventional farming systems. The puparia were reared to assess the parasitism as well as to assess the parasitoid guild structure. Four species of whitefly: *Aleurodicus disperses* Russell, *Aleurocanthus woglumi* Ashby, *Aleurocanthus citriperdus* Quaintance & Bakerand *Aleurothrixus trachoid* Quaintance & Baker were found in whitefly-complex associated with cassava and guava. There were 3 species of parasitods: *Encarsia guadeloupae* Viggiani, *Encarsia cibcensis* Lopesand *Eretmorcerus califonicus* Howard associated with whitefly complex. Whiteflies collected in organically managed fields had 30.67% parasitism while that of in conventional fields was 3.65%. The population density of whiteflies was significantly ($P<0.05$) different between two management methods, as well as the crops. *E. guadeloupae* was the most abundant parasitoid species, parasitizing 33% of whitefly puparia. Based on the data *E. guadeloupae* is a potential species to promote as a biocontrol agent to manage whitefly population.

Keywords: Biological control, Parasitoids, Parasitism level, Population density, Whiteflies

[1]Horticultural Crop Research and Development Institute (HORDI), Department of Agriculture, Gannoruwa, Peradeniya

* ag15903@agri.pdn.ac.lk

Wood-Boring Beetles Associated with Tree Plants in Mid-Country of Sri Lanka

Himansa W.G.K.R.*, Warnasooriya P.G.A.S. and Hemachandra K.S.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

A wide range of insects are associated with trees damaging different parts of the plant. Among them, wood-boring beetles are considered as important considering the damage caused. Most of the wood borers are coleopterans, and damage to the soft and hard wood of the trees. No systematic studies were conducted in Sri Lanka on wood boring insects; therefore, this study was conducted with the objective of identifying the wood boring insect species associated with trees, in selected areas of mid-country, Sri Lanka. A total number of 178 trees were examined during May to July 2021 in five locations: Peradeniya, Mirissala, Ankumbura, Matale, Ovilikanda, and Hettipola in the mid-country area. The infested tree branches were cut into 20 cm long pieces and beetles were collected pealing the bark. Out of 178 trees, 61 trees (34.26%) were found infested with bark beetles. Among the trees surveyed, the trees: *Mangifera indica* (mango), *Anacardim occidentale* (cashew), *Persea americana* (avocado), *Camelia sinensis* (tea), *Gliricidia sepium* (gliricidia), *Ricinus communis* (castor) and *Macaranga peltata* (kenda) were found frequently infested (46%). Eleven different insect species were found as bark beetles in the survey. They were *Euwallacea fornicates, Euwallacea destruens, Euwallacea maloti, Treptoplatypus micrurus, Xyleborus ferrugineus, Xylosandrus amputates, Xylosandrus compactus, Xylosandrus germanus, Xylosandrus morigerus, Amasa* spp., and *Dendroctonus micans.* No significant relationship was found between plant species and wood borer infestation (p=0.607). The wood borer infestation was significantly different among locations (p=0.003). The thickness of the branch and insect number associated with were positively correlated, when considered the wood boring insects collectively.

Keywords: Host plants, Mid-country, Wood-boring beetles

* ag15029@agri.pdn.ac.lk

A Critical Review on Effect of Effective Microorganisms (EM) on Methane Emission from Cow Dung

Hettiarachchi N.N., Deshapriya R.M.C.* and Karunarathna A.K.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Methane (CH_4) is a greenhouse gas (GHG) generated when cattle manure decomposes under anaerobic conditions. Thus, effective manure management plays an important role in reducing methane emission from livestock sector. Literature reveals that CH_4 from livestock manure contributes for the agricultural GHG emission in Sri Lanka by 5.3%. In Sri Lankan context, majority of the cattle are reared in small-scale operations under low input system where alternative effective cattle manure management systems such as biogas production and slurry aeration will not be applicable to most of the rural cattle farms. Generally, small-scale farmers tend to collect cattle manure on land or store in storage tanks without applying any controlling measure for CH_4 emission. This study was conducted to review the use of effective microorganisms (EM) as an alternative technique for reducing CH_4 emissions from cattle manure. The EM was first developed by Prof. Teruo Higa as an accelerator for organic waste decomposition; however, EM is presently used for many waste management applications. Early studies had shown that EMs either as a mixture or single culture has minimal effect on CH_4 reduction from stored or fresh cow dung. Self-acidification via addition of higher concentrations of EM with readily fermentable carbon substrates such as glucose, sugar, milk, or any carbohydrate significantly reduces CH_4 emission by 27% at 30 in slurry storage. Addition of simple carbon source can generate lots of organic acid and, fermentation is faster than complex carbohydrate and protein due to the shorter breakdown period. Furthermore, the addition of EM at high concentrations replaces methanogens with non-methanogenic microbes. EM application to slurry crusts could not consistently improve CH_4 oxidation though this was identified as a potential technique. Therefore, addition of EM with a readily available carbon substrate is a feasible way of reducing CH_4 emission from cattle manure.

Keywords: Cattle manure, effective microorganisms (EM), CH_4

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

* cdeshapriya@agri.pdn.ac.lk

An Overview of Therapeutic Approaches for Liver Cirrhosis

Withanachchi W.D U.S. and Wijayagunawardena M.P.B.*
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Cirrhosis is the final stage of liver fibrosis that changes the healthy liver architecture into an abnormal fibrous structure. The two stages of cirrhosis are compensated cirrhosis and decompensated cirrhosis, which are identified by a picture of ascites, variceal bleeding, encephalopathy, hepatorenal syndrome, and hepatopulmonary syndrome. The objectives of the present study are to identify the main etiologies of cirrhosis, understand the pathophysiology and biochemistry of liver fibrosis, recognize the diagnostic approaches, and identify the different treatment protocols used for liver cirrhosis. The common etiologies of cirrhosis are the viral hepatitis, non-alcoholic fatty liver disease, and chronic alcoholism. The activation of hepatic stellate cells due to the damaged hepatocytes results in liver fibrosis, and thus the portal hypertension. The extent of fibrosis can be diagnosed with serum markers, ultrasound scans, molecular markers, and liver biopsies. Western treatments for liver cirrhosis are mainly associated with antifibrotic drugs, gene therapies, and liver transplantation. The traditional herbal medicine is an alternative approach of treating liver diseases in many countries of the world, though, the scientific evidence on their mode of action has not fully elucidated. However, the available literature revealed that the identified herbal plant extracts are effective in reversing the liver fibrosis. In this context, it is necessary to proceed with more scientific approaches to treat liver diseases using traditional herbal protocols.

Keywords: Liver fibrosis, Cirrhosis, Antifibrotic drugs, Liver transplantation

* missaka@agri.pdn.ac.lk

Application of OJIP Chlorophyll Fluorescence Transient Analysis to Study the Postharvest Changes in Photosynthetic Apparatus in Cut Foliage Species

Wijethunga W.M.U.D., Kumarihami H.M.P.C. and Beneragama C.K.*
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Chlorophyll fluorescence (ChlF) is a non-invasive technique that can potentially be used in postharvest research to gain useful information on early responses to postharvest stresses. Three ornamental foliage species, *i.e*. red and green cultivars of *Cordyline fruticosa*, *Dracaena sanderiana*, and *Nephrolepis exaltata* were selected. Salicylic acid (100 and 300 mgL^{-1}), glucose (10 gL^{-1}), and their combinations were tested with a control (distilled water) at room temperature (25±2°C). Vase life was evaluated using OJIP analysis. Major parameters of OJIP analysis, *i.e*. specific energy fluxes per reaction center (ABS/RC, TR/RC, ET/RC, and DI/RC), flux ratios [maximum quantum yield of primary photochemistry (φPo), electron transport efficiency (ψo), and quantum yield of electron transport (φEo)], and performance index (PI) were recorded every other day throughout the vase life, using a portable fluorometer (FluorPen-100). Leaf chlorophyll contents of all species and anthocyanin contents of two cultivars of *C. fruticosa* were determined on the first and last day of the experiment. The foliage quality was assessed using a scale score (suitability for floral arrangement). Data were subjected to ANOVA in a Completely Randomized Design. Mean separation was done by Duncan's Multiple Range Test at $p \leq 0.05$. Scale score data were analyzed using the Friedman test. Clear variations in ChlF were observed in all foliage species along with the vase life. Further, OJIP analysis showed species-depended variations. Along with the storage time, the higher ABS/RC and DI/RC were recorded for *D. sanderiana* and *N. exaltata* compared to the PI of those species. At the end of the vase life, the leaf chlorophyll contents decreased while the anthocyanin contents increased. Consequently, chlorophyll fluorescence changes in photosynthetic apparatus can be used for the prediction of the postharvest stresses and longevity of cut foliage.

Keywords: Chlorophyll fluorescence, Cut foliage, OJIP, Performance index, postharvest

* chalindab@agri.pdn.ac.lk

Assembling a Workflow for Assessing the Genetic Diversity of Binkohomba (*Munronia pinnata* (Wall.) W. Theob.) and Comparative Molecular Docking with its Substitute Heen Binkohomba (*Andrographis paniculata* (Burm. f.) Nees)

Nethma H.H.*, Jayawardana N.U. and Bandaranayake P.C.G.[1]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Binkohomba (*Munronia pinnata*) is a threatened species native to Sri Lanka. Heen Binkohomba (*Andrographis paniculata*) has been used as a substitute for Binkohomba in Ayurvedic medicine. Depending on the geographical location, the vegetative and reproductive characteristics of Binkohomba vary. At least three different morphotypes of Binkohomba are recorded in Sri Lanka and their genotypic background is not known. Therefore, a workflow was assembled to assess the genetic diversity among them using Chloroplast *trnH-psbA* region. Both plant species are known to have anti-inflammatory activity. Therefore, this study also aimed to evaluate the molecular interaction of phytocompounds of both plants with one of the most common target proteins of anti-inflammatory drugs, through molecular docking. Selected phytocompounds were docked to the target COX-1 protein by using AutoDock Vina 1.2.0 to determine their binding affinity values compared to the native ligand, Indomethacin. The results revealed that the chemical compound with the best binding affinity in Binkohomba was Campesterol (-8.3 kcal/mol) whereas, in Heen Binkohomba, it was 7-O-Methylwogonin with a binding affinity of -8.8 kcal/mol. Both chemical compounds showed better binding affinity compared to that of Indomethacin (-8.1 kcal/mol). Ligand-based pharmacokinetics, target prediction, and toxicity prediction were evaluated using SwissADME, Swiss Target Prediction, and pkCSM online tools. Out of the two compounds with the highest binding affinity, 7-O-Methylwogonin was predicted to have the best drug-likeness properties. Therefore, the present study suggests that 7-O-Methylwogonin is a promising compound to pursue further by using advanced computational methods and *in vitro* experiments to explore its potential against inflammation.

Keywords: Anti-inflammatory, COX-1, Ligand, Pharmacokinetics, Phytocompound

[1]Agricultural Biotechnology Centre, Faculty of Agriculture, University of Peradeniya, Peradeniya

* ag15061@agri.pdn.ac.lk

Assessing Growing Conditions and Ultrasound-Assisted Technique in Optimizing the Extraction of Antioxidants and Polyphenols from Green Tea

Hettiarachchi H.A.I.T., Nissanka S.P.*, Gajadeera H.[1] and Gunawardana M.[2]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Globally, competition for Ceylon tea has been increasing due to emerging market competitors. To face such challenges, the scale of production of the Sri Lankan tea industry must be expanded by introducing new value addition methods. Tea (*Camellia sinensis* (L.) O. Kuntze) is rich in polyphenols that serve as antioxidants. Tea polyphenols have numerous health benefits and could be exploited as a value addition venture. Polyphenol content in tea leaves is affected by a variety of factors such as tea cultivar, fertilizer application, shade levels and ambient conditions. This experiment was designed to assess the extractable total polyphenol contents of green tea produced from different tea types and shade levels in the upcountry tea fields. The study also compared the Ultrasound-Assisted Extraction (UAE) of tea polyphenols and antioxidants with hot water extraction. Green tea samples were prepared from tea leaves plucked from seedling fields (ST), vegetatively propagated fields (VP), and organically and conventionally (inorganic) grown tea fields, under different shade levels. The antioxidant activity (AA) and the total polyphenol content (TPC) of brewed tea were measured. When brewed for 5 minutes using boiling water, green tea produced from organic fields recorded a significantly higher ($p<0.05$) AA (1529.5 µM TE/g). When the samples were subjected to UAE, green tea produced from seedling tea fields showed a significantly higher ($p<0.05$) AA (2039.70 µM TE/g) whereas samples from VP fields showed a significantly higher TPC (7853.9 ppm GAE). Interestingly, UAE showed 2-3 times higher AA extractions compared to hot water extraction, even though the TPC did not show a significant increase ($p<0.05$). Though the leaf chlorophyll content was similar across treatments, the quality of green tea showed a declining trend with the increase of shade levels.

Keywords: Green tea, Organic tea, Shade levels, Tea polyphenols, Ultrasound extraction

[1]Bestie Beverages Pvt. Ltd., Galathara, Ittapana
[2]Sri Lanka Institute of Nanotechnology (SLINTEC), Pitipana, Thalagala Road, Homagama
* spn@agri.pdn.ac.lk

Assessing the Possibility of using Gene Expression in Response to Auxin to Improve Indirect Organogenesis in *Oryza*

Witharana E.P.*, Jayawardana N.U. and Bandaranayake P.C.G.[1]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Genus *Oryza* consists of 22 wild rice species and two cultivated rice species. Wild relatives are a valuable source of genetic resistance and efficient regeneration protocols are essential for functional characterization and genetic engineering work. Protocol optimization using conventional tissue culture methods entails large factorial experiments with several plant growth regulator (PGR) combinations. A similar preliminary experiment was laid out for indirect organogenesis from two different explant types of the endemic wild rice species, *Oryza rhizomatis*. For callus induction, MS medium was supplemented with different treatment combinations of auxins, 2,4-D (3.5–5.5 mg/L) NAA (1.5–3.5 mg/L), and IAA (0.5–2.5 mg/L). In the sterilization procedure, contamination was observed only in 20% of seed cultures treated with 0.05% $HgCl_2$ for 7 min and 33% of the leaf cultures treated with 10% Clorox for 15 min. A comprehensive understanding of the expression of genes responsive to exogenous application of PGR would increase the efficiency of the protocol optimization. For this analysis, a transcriptome data set of *O. sativa* subsp. *japonica* roots with 1, 7, and 14 days post-treatment (dpt) with 50 μM 2,4–D was selected from the SRA data available at NCBI. A standard transcriptome analysis was performed to identify the expression pattern of main auxin-responsive genes involved in somatic embryogenesis compared to the non-treated control. The expression of *BABY BOOM1* (*OsBBM1)*, a key regulator in cell totipotency was up-regulated at all three-time points. The expression of auxin biosynthesis genes, *OsYUCCA2* and *OsYUCCA5* which are downstream targets of OsBBM1, increased over time. Furthermore, *OsYUCCA5* was up-regulated at both 7 dpt and 14 dpt whereas *OsYUCCA2* was down-regulated. This study provides a foundation for an informative way of conducting *indirect organogenesis* in *Oryza*, taking into consideration the gene regulatory patterns in response to the exogenous application of auxin.

Keywords: Wild rice, Plant Growth Regulators, *OsBBM1*, Totipotency

[1]Agricultural Biotechnology Centre, Faculty of Agriculture, University of Peradeniya, Peradeniya

* ag15180@agri.pdn.ac.lk

Assessment of the Diversity of an Irrigation Command Area using Remote Sensing and GIS – A Study in Mahakanumulla Village Tank Cascade System

Dissanayake R.D.J.S., Dayawansa N.D.K.* and Hemachandra E.M.G.P.
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Spatial and temporal diversity can be observed in irrigation command areas due to natural and human induced factors. This study was conducted to assess the usefulness of Remote Sensing (RS) and Geographic Information System (GIS) to identify the spatial and temporal diversity within an irrigation command area and the causative factors. The study area was *Mahakanumulla* irrigation command area in Anuradhapura District of Sri Lanka. Farmer organization records, key person interviews with the officials of farmer organizations and the Department of Agrarian Development, a questionnaire survey with farmers were used to collect primary data. Sentinel 2A and Landsat 8 satellite images representing *Yala* and *Maha* seasons from 2014 – 2020 were used as secondary data. Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI) were derived using satellite data to identify the status of crop biomass and moisture availability in two cropping seasons within the study period. Daily rainfall data at *Maha-Illupallama* rain gauging station was analyzed to obtain temporal rainfall variations. The study identified a considerable spatial and temporal diversity in paddy crop within the irrigation command area mainly due to inadequacy of irrigation water availability as a result of low and uneven temporal distribution of rainfall. Impacts from soil and topographic characteristics and human elephant conflict were also observed. The land ownership has an impact on the yield variations since tenant farmers obtain relatively a better yield in both *Yala* and *Maha* compared to farmers who own the paddy lands. Study identified the usefulness of RS and GIS to identify and map the diversity of the irrigation command area to explore underlying causative factors in proposing suitable management interventions such as water management strategies, water distribution technologies and diversification of crops etc.

Keywords: Spatiotemporal Diversity, GIS, Remote Sensing, NDVI, NDWI

* ndkdayawansa@agri.pdn.ac.lk

Beef Adulteration in Kandy Municipal Council (KMC) Area: PCR Assay and Morphological Identification

Rajapaksha G.D.S.P., Jayawardena B.C.*, Bandaranayake P.C.G.[1], Kodithuwakku M.[2], Hathurusinghe H.A.B.M.[1] and Wettasinghe P.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Meat adulteration is taking place in many countries including Sri Lanka. In Sri Lanka, only cattle meat (*Bos taurus*) is allowed to use for producing beef, and buffalo (*Bubalus bubalis*) slaughtering is banned by law. The adulteration of beef with buffalo meat has become a practice since it is difficult for consumers to differentiate cattle and buffalo meat. Therefore, the objective of the present study was to develop a method to differentiate cattle and buffalo meat using a mitochondrial DNA marker. Meat samples (n=27) were collected from the Kandy Municipal Council (KMC) area. The pH, water holding capacity, and L* a* b* colour values of meat were analyzed. According to the cluster analysis results (Minitab 17.1 software), the samples were clustered into two main clusters based on the similarity between pH, WHC and L* a* b* values. Meat authentication was done by PCR amplification of mitochondrial D loop gene by using species-specific primers that produce 226 bp and 126 bp product amplicons for buffalo and cattle meat, respectively. According to the study, 18.5% of the analyzed samples were buffalo meat samples. In comparison with cluster analysis results, all the samples that were identified as buffalo meat by PCR belonged to the same cluster. However, only the redness colour value (a*) was different ($P<0.05$) between meat samples identified as cattle and buffalo. During the present study, an effective in-house meat DNA extraction method was developed and it was identified that the species-specific annealing temperature of mitochondrial D loop primers as 65 ^{o}C for a simplex PCR assay. Thus, this technique can be applied to verify the presence of buffalo meat in beef. Most importantly this study will create awareness among the regulators, processors, consumers on the current situation of the Sri Lankan beef market.

Keywords: Beef adulteration, Species identification, PCR, Buffalo meat, Beef colour

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[1]Agricultural Biotechnology Centre, Faculty of Agriculture, University of Peradeniya, Peradeniya

[2]Veterinary Department, Kandy Municipal Council

* baranaj@agri.pdn.ac.lk

Comparison of Phosphorus Species in Gypsum-Amended Soils under Snow-Melt and Summer Flooding: A Thermodynamic Approach

Kumari K.M.P.P., Attanayake C.P.*, Dharmakeerthi R.S. and Kumaragamage D.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Phosphorus (P) release from flooded agricultural fields to surface water bodies contributes to eutrophication. According to our past studies, P release from soils during summer flooding (at 25 ^{o}C) is higher than that during flooding caused by snow-melt (at 4 ^{o}C). Gypsum ($CaSO_4.2H_2O$) amendment reduces P release from flooded soils at both temperatures and the effects of temperature and gypsum on P release vary depending on soil properties. The underlying reasons for the above observations are poorly understood. The objective of this study was to predict the P speciation in flooded soils under summer and snow-melt temperatures in acidic-sandy (pH=5.95, Sand=70%) and alkaline-clay (pH=7.59, Clay=56%) soils, collected from flood-prone agricultural fields in Manitoba, Canada, with and without gypsum amendment. Visual MINTEQ software was used to predict P minerals in soils based on soil solution composition using thermodynamic principles. Composition of soil solution [*i.e.*, dissolved reactive P (DRP), pH and concentrations of Ca, Mg, Fe, Mn, F^-, Cl^-, SO_4^{2-} and NO_3^-] and soil redox potential at 0, 35 and 70 days after flooding was obtained from a previously conducted incubation experiment; where, unamended and 0.25% (w/w) gypsum-amended soils were incubated under +4 ± 1 ^{o}C and +25 ± 1 ^{o}C temperatures. Reductive dissolution of strengite (Fe(III)phosphate) and ferrihydrite caused P release from soils. It was more favored at 25 ^{o}C than 4 ^{o}C, explaining higher P release at 25 ^{o}C. In acidic-sandy soil, increase of soil pH during flooding favored formation of hydroxyapatite (HA) at both temperatures. In alkaline-clay soil, β-tricalcium phosphate (TCP) and HA were present from the beginning in both amended and unamended soils at 4 ^{o}C; and additionally, α-TCP and octacalcium phosphate were formed at 25 ^{o}C. Formation of Ca-P minerals was more favored in gypsum-amended soils, explaining their lower P release compared to that in unamended soils.

Keywords: Phosphorus speciation, DRP, Pore water, Flooded soil

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[1]Department of Environmental Studies and Sciences, University of Winnipeg, Canada

* chammiatt@agri.pdn.ac.lk

Comparison of the Effectiveness of Postharvest Treatments for Banana (*Musa* AAB Cv.) and Red Lady Papaya (*Carica papaya*) to Meet the Requirements of the Export Market

Pathirana P.C.G., Senarathne S.M.A.C.U.[1*] and Rajapakse R P.N.P.
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Extension of postharvest life of fruits prepared for the export market play an important role in maintaining the required quality attributes. Therefore, the effectiveness of different postharvest treatments needs to be considered depending on the type of fruit and the quality attributes expected by the specific export market. The recommended procedure of postharvest treatments for most of the exported fruits comprised of hot water dip treatment to overcome fruit fly incidence, cold storage to extend the shelf life and artificial ripening to market the product with required quality attributes. In this study, the effectiveness of different postharvest treatment combinations were compared with the recommended postharvest treatments in relation to the physiochemical parameters of the fruits. Sour banana (var. ambul) and red lady papaya were selected at two different maturity levels to study the postharvest treatments. Days after flowering and peel colour were used as the maturity indices of banana and papaya respectively. Physiochemical parameters such as peel colour, pulp colour and disease incidence were evaluated qualitatively and weight loss, firmness, titratable acidity, total soluble solids and vitamin C content were evaluated quantitatively after the postharvest treatments when the fruits reach the table ripen stage. One way ANOVA and Fisher's pairwise statistical comparisons were used to analyse the results. Results revealed that the cold storage treatment in all postharvest treatment combinations significantly ($P \leq 0.05$) reduced the weight loss and titratable acidity of banana, improving its postharvest quality attributes. When papaya was treated at the maturity level with yellow stripe on the skin, total soluble solid content was maintained at a significantly ($P \leq 0.05$) high level, improving its shelf life and eating quality. In conclusion, cold storage for sour banana and the correct maturity stage of red leady papaya improve the postharvest quality effectively.

Keywords: Postharvest treatment, Cold storage, Maturity stage, Quality attributes

[1]Food Research Unit, Department of Agriculture, Gannoruwa, Peradeniya

* upulasen@gmail.com

Compost Increase Arsenic Bioaccessibility in Soils: Evidence from X-Ray Absorption Near-Edge Structure Spectroscopy

Iromi D.M.A., Attanayake C.P.* and Hettiarachchi G.M.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Arsenic (As) and lead (Pb) are common co-contaminant in urban soils, due to the past use of As-Pb pesticides. Compost is often used, when growing vegetables in urban soils. The objectives of the research were to assess the effect of incorporation (44 kg m^{-2}) of four organic amendments (i.e., mushroom compost, composted biosolid, leaf compost and non-composted biosolids) on As speciation in an urban soil in short-term (7 days) and long-term (1 and 2 years), to relate bioaccessibility to As speciation in soils, and to assess the changes of As speciation during an in vitro bioaccessibility test. A field experiment was undertaken at an urban garden, contaminated with As (25-72 mg kg^{-1}) and Pb (300-500 mg kg^{-1}). Bulk X-ray Absorption Near-edge Structure (XANES) spectroscopy was used to determine As speciation in soils and residues left after in vitro bioaccessibility extraction. Data was collected at 5-BMD beamline at Argonne National Laboratory, USA. All compost-amended soils had higher As bioaccessibility (10-50%) than unamended soils. This difference was statistically significant (p<0.05) for mushroom compost at 7 days and composted-biosolid at 1 year. Unamended soils had As(III) adsorbed on to pyrite (~60%) and As(V) adsorbed on to Fe oxy(hydr)oxides (~40%). The latter was reduced to 15-26% in all the amended soils, except in composted biosolids-amended soil. As(III) on pyrite and Fe oxy(hydr)oxides increased in those soils. Composted biosolids did not change As speciation in soils, despite increase of As bioaccessibility. During the in vitro bioaccessibility study, Pb-arsenate was formed, except in composted biosolid-amended soil, explaining overall low bioaccessibility (7-13%) in the tested urban soil. Compost addition increased As bioaccessibility by reducing As(V) adsorbed onto metal oxides or interfering formation of Pb-arsenate during the in vitro extraction.

Keywords: Arsenic bioaccessibility, Speciation, Urban soil, Compost, XANES

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[1]Department of Agronomy, Throckmorton Plant Sciences Center, Kansas State University Manhattan, KS 66506, USA

* chammiatt@agri.pdn.ac.lk

Design and Development of a Coffee Roaster and a Controlling System to Follow Roasting Profiles

Wickramahewa W.H.T.D.*, Amaratunga K.S.P., Abeyrathna R.M.R.D., Mowjood M.I.M., Kariyawasam H.K.P.P.[1] and Ekanayake E.M.A.C.[2]
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya

At the moment, there is a need for a suitable coffee roaster and a controlling system for Specialty coffee processing in Sri Lanka. Therefore, this study was conducted to develop the essentials to produce a fully functional automated specialty Coffee roaster that roasts coffee with higher uniformity, with a maximum capacity of 2 kg per batch. A roasting cylinder, cyclone separator, quenching pan, inlet funnel, mainframe, and a temperature controlling system with a heat source are included in the roasting machine design. The control program was written using python language on a Raspberry Pi to measure the real-time temperature every 25 ms and control the heating element by automatically changing the pulse with modulation (PWM) considering the difference between the set value and the actual real-time temperature value. Calibration of the software by giving ranges of PWM in different frequencies was done by using a miniature model of a roaster with the help of a standard curve obtained from a roast master. During the roasting process, the temperature control system could maintain the roasting temperature with the Standard Error of Estimate (SSE) +2 °C throughout the standard temperature curve. Therefore, a Specialty coffee roaster with this software can roast the green coffee sample to the desired roasted degree with good results.

Keywords: Coffee Roasting, Coffee Roaster, Roasting profile, Temperature controlling system, Specialty coffee

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[1]Department of Agricultural Technology, Faculty of Technology, University of Colombo, Colombo

[2]Faculty of Agriculture, University of Peradeniya, Peradeniya

* ag15104@agri.pdn.ac.lk

Design and Development of a Far-Infrared Tea (*Camellia sinensis*) Dryer

Sandanuwan W.I.*, Amaratunga K.S.P., Mowjood M.I.M., Abeyrathna R.M.R.D., Kariyawasam H.K.P.P.[1] and Ekanayake E.M.A.C.[2]
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Tea contributes greatly to the economy of Sri Lanka, with more than a million people depend on the tea industry directly or indirectly. The tea drying is a crucial step in the black tea production process with regards to product quality. Different dryers are used for tea drying; Endless chain pressure dryer, Fluidized bed dryer, and Conventional dryer. Although Far-Infrared Radiation (FIR) drying has its unique advantages such as uniform heating and higher efficiency, it is not used in industrial drying of tea. This study was conducted to design and fabricate FIR tea dryer, and to study the drying characteristics of dhool with FIR drying and to evaluate the quality of dried products. A circular cylindrical chamber with 23 cm radius and 62 cm length was used to dry 4 kg of fermented tea leaves under FIR. Bulk temperature readings were taken using three thermocouples. Inside air temperature of the chamber was maintained at 90 °C during the entire cycle of drying. Maximum temperature of the bulk was 60+ 4 °C. The initial moisture content of fermented tea dhool was 70.39% (wb). Moisture content was decreased up to 3.56% (wb) at the end of the drying and it was in the optimum moisture range. The specific moisture extraction ratio (SMER) was 0.74 kg/kWh under FIR drying. This study revealed that FIR based tea dryer can be used for tea drying while achieving optimum conditions required for drying tea.

Keywords: Tea drying, FIR drying, SMER

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[1]Department of Agricultural Technology, Faculty of Technology, University of Colombo, Colombo

[2]Faculty of Agriculture, University of Peradeniya, Peradeniya

* ag15080@agri.pdn.ac.lk

Design and Development of a Mobile Learning Application to Facilitate Extension and Advisory Services among Orchid Growers in Homagama AI Region

Akila Deshan D.A. and Dissanayake U.I.*
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Providing extension services in the floriculture sector has been constrained by limited number of extension officers to cater to information needs of the growers. Covid -19 pandemic has restricted the traditional on-ground extension activities thus it is important to explore innovative extension approaches. This study was conducted to design, develop and evaluate a mobile learning application to provide extension and advisory services for orchid growers in the *Homagama* AI region. ADDIE (Analysis, Designing, Development, Implementation, and Evaluation) instructional design model was followed. Information needs of the study community was assessed using a telephone survey (n=35) and key informant interviews. Mobile application was developed for Android platform using KODULAR software. Technical contents were validated by subject experts. A short-term extension campaign was launched to implement the application. Fifty out of 60 Orchid growers in *Homagama* AI region were recruited for the implementation. A WhatsApp messenger chat forum was used to facilitate advisory sessions among the extension agent and growers. The effectiveness of the mobile application was evaluated through a telephone survey (n=50) and two focus group discussions. According to the findings, majority of the users were satisfied with the functionalities of mobile application (82%) and the advisory chat forum (63%). About 58% reported that the mobile application was successful as an educational platform while 44% reported that the application is easy to use. The study concludes that mobile applications can be successfully used in providing agriculture extension and advisory services among orchid growers in the study area and in similar contexts. Interactive forums can facilitate discussions among extension agents and farmers helping them to solve cultivation and management issues. The functionalities of the application can be further enhanced to include an in-built discussion forum and multiple user groups.

Keywords: Mobile learning, ADDIE model, WhatsApp messenger chat forum, Orchid cultivation, Smartphones

* uvasara@agri.pdn.ac.lk

Determination of the Combined Effect of Selected Parameters Affecting the Quality Retention of a Ceylon Black Tea Blend

De Silva K.T.I., Mendis B.E.P., Karunathilake V.[1]*, Ekanayake E.S.K.[1] and Fernando K.R.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The aim of this study was to determine the combined effect of the elevation level and moisture content of incoming tea, blending formula and the storage condition of the end product on the quality retention of Ceylon black tea blends, instead of studying their individual effects separately. Tea blends were prepared by mixing incoming tea with different origins (high-grown and low-grown) and moisture contents (7±2%). Tea grades, Dust-1 and BOPF were used in different ratios for blending (Formula1; 50% Dust-1, 35% BOPF and formula 2; 35% Dust-1, 50% BOPF) together with Dust (7%) and Fanning's-1 (8%). Finally, the prepared blends were packaged and stored in two types of storage conditions (ambient at 26.8±1.4 °C and air-conditioned at 20.6±0.6 ^{o}C). Total color of tea subjected to different treatment combinations was determined using UV-visible spectrophotometry. Combined treatment effects on moisture content and water activity were assessed over 7.5 weeks of storage. The analysis of total color, final moisture content, final water activity and differences in moisture contents and water activities showed interaction effects ($P<0.05$) at four-factor level. The results showed significant differences ($P<0.05$) between most of the treatment combinations. Final moisture content and water activity of the treatment combination "high-grown, low moisture, formula 2 in air-conditioned storage" resulted in the lowest values. The analysis of difference in moisture contents exhibited moisture desorptions and absorptions in different treatment combinations and both gradual rises and falls in the trend line analysis. Sensory analyses revealed that the best combination ($P<0.05$) out of the 16 treatment combinations was "low-grown, low moisture, formula 1 in air-conditioned storage". According to the total color analysis the treatment combination "high-grown, low moisture, formula 2 in ambient conditions" resulted in the darkest infusion whereas the treatment combination "low-grown, low moisture, formula 2 in air-conditioned storage" resulted in the lightest infusion.

Keywords: Ceylon black tea blends, Quality retention, Treatment combinations, Combined effect, Blending formula

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[1]Quality Assurance Department, Dilmah Ceylon Tea Company PLC, 111 Negombo Road, Peliyagoda

* vajira.karunathilake@dilmahtea.com

Developing an Herbal Extract Formulation to Control Aphids

Sewwandi P.L.P.*, Jayasinghe W.H., Warnasooriya P.G.A.S. and Hemachandra K.S.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Aphids are one of the most destructive pests in crops and insecticides spraying are generally required for population suppression. As an alternate for synthetic insecticides, we examined the effectiveness of some selected botanical extracts against green peach aphid; *Myzus persicae* (Sulzer) grown on eggplant in both *in-vitro* and *in-vivo* conditions. Botanical formulations were prepared using the extracts of ginger rhizome (*Zingiber officinale*), tobacco leaves (*Nicotiana tabacum*), garlic cloves (*Allium sativum*) and kochchi fruits (*Capsicum frutescens*) and different combinations of above extracts. The mortality rate of green peach aphids and LC_{50} values of each treatment were evaluated under laboratory conditions. The experiment was laid as completely randomized design (CRD) with three replicates and 15 treatments. Among all 15 treatments, the mortality was significantly different. The highest mortality was recorded with T_{15}; ginger: tobacco: garlic: kochchi (20: 5: 20: 10 g in 100 ml of water) which caused 91.3% mortality with a 1.001 g/ml of LC_{50} value. Both pot and ground experiments were laid to test the efficiency of T_{15} under field conditions. In the pot experiment, the mean aphid mortalities on the first, second and third days after application of T_{15} treatment were 97.83, 99.51 and 100% respectively, while those of in the ground experiment were 97.94, 99.67 and 100% respectively. Thus, this study suggests that the botanical mixture in T_{15} has a high potential to use in controlling aphids.

Keywords: Green peach aphids, Botanical mixture, Formulations, LC_{50} value, Mortality rate

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* ag15113@agri.pdn.ac.lk

Development of a Module for Smart Android Based Application on Dairy Farm Planning for Smallholder Farmers in Sri Lanka

Fernando W.W.T.K., Vidanarachchi J.K.*, Silva G.L.L.P., Weerasooriya S.A.[1], Wijerathna R.M.S. [2] and Dissanayake U.[3]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

In Sri Lanka, small-scale dairy farmers experience several challenges in obtaining suitable extension assistance. Involvement of the youth in dairy farming is also inadequate. Technology based extension services enhance the effectiveness of the services while motivating the youth. Hence, a study was conducted to develop and implement an Android-based information system for dairy farm planning and establishment, targeting small-scale dairy farmers and young entrepreneurs interested in dairy farming. The incremental model which consists of conception, architecture, requirements gathering & analysis, designing, coding and testing was used to develop the "*Handaya"* Android application. The architecture was composed of a mobile application for the use of farmers' in planning a small-scale dairy farm. Requirement gathering was conducted using 50 dairy farmers. The *"Handaya"* consists of seven main features namely breeds, cattle shed, purchase, feed plan, equipment, financial support and veterinary support. "Kodular" online platform was used to code the Android app. The user friendliness of "*Handaya*" was validated using 10 dairy entrepreneurs including 2 farm managers. Technology Acceptance Model was used to evaluate the product. Results revealed that the majority of dairy entrepreneurs (9 out of 10) either agreed or strongly agreed that *"Handaya"* was easy to use and useful for small-scale dairy farm planning and establishment. Farm managers (2 out of 2) agreed that it was useful for young entrepreneurs who are interested in dairy farming. Thus, the dairy entrepreneurs, validated and accepted the *"Handaya"* Android application revealing the successfulness of the developed tool according to the Technology Acceptance Model. This study revealed that the basic scientific information on Android applications is a user-friendly tool in dairy farm planning and establishment. Further modifications could be made to launch it as a social e-hub for farmers.

Keywords: Small-scale dairy farming, Android-based application, young entrepreneurs

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[1]Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Peradeniya
[2]Department of Agricultural Extension, Faculty of Agriculture, University of Peradeniya, Peradeniya
[3]Cargills (Ceylon) PLC, 40, York St, Colombo
* janakvid@agri.pdn.ac.lk

Development of a Novel Glazing Method to Polish Parboiled Rice

Sandaruwan N.B.L., Prasantha B.D.R.* and Abeysiriwardena D.S.D.Z.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Rice (*Oryza sativa*) is the staple food in many Asian countries in the world as well as including in Sri Lanka. More than 70% of the population consumes parboiled rice in Sri Lanka. The glossy appearance of parboiled rice is an important quality attribute that enhances the market demand for rice. This study was conducted to develop a new rice polishing method to enhance the glossy appearance of parboiled rice using cassava and corn flour (15g/250g). Glossy appearance of the surface of polished parboiled rice samples was evaluated using non-parametric ranking tests. Grain whiteness value and broken grain percentage were also used to assess the final quality of rice. All the treatments with two rounds of rice polishing recorded the lowest whiteness value, however, flour treatments with 2 rounds of polishing gave resulted in the lowest broken rice percentages (8.2%). The highest broken rice percentages (54%) were recorded for the 4 rounds of polished rice samples. Overall acceptance was based on the best glossy appearance of the surface, higher whiteness value and lowest broken rice percentage. Two rounds of polishing with cassava flour and the third round of polishing without cassava flour were ranked as the best rice polishing treatment with moderate percentage of broken rice (36%).

Keywords: Glaze Polishing, Parboiled Rice, Rice, Rice Polishing

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[1]CIC Agri Businesses (Pvt) Ltd., Palwehera, Dambulla

* bdrp@pdn.ac.lk

Development of a Robot Arm for a Drone based Selective Tea Harvester

Bandara K.M.L.C.*, Mohotti A.J., Ranil R.H.G., Amaratunga K.S.P.[1], Abeyrathna R.M.R.D.[1] and Ekanayake E.M.A.C.[2]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Tea in Sri Lanka is mainly selectively harvested by hand, which has a direct bearing on the high quality of the produce and the yield of the tea plant. Only the shoots containing 2-3 leaves with adjoining apical active bud, and shoots containing 1 leaf with a dormant (banji or 'wangi) apical bud should be plucked in selective harvesting, leaving the rest of the shoots not being plucked. However, labour is becoming unavailable and more expensive, prompting mechanization. There are many plucking machines available in the market, which are non-selective. Therefore, there is an urgent need of a selective tea harvester. In the present study, a Drone-based selective tea harvesting robot arm was developed. The robot arm was developed as a fully functional automated Drone-based selective tea harvesting robot armthat harvests tea shoots selectively. The arm was 3-D printed in plastic. The control program was written using python language on a Raspberry Pi microcontroller. Haar-cascade algorithm was used to select the pluckable tea shoots through image processing technology, and the images were processed using a small camera mounted on the arm. Servo motors were used to control through the same microcontroller. The robotic arm was used to evaluate performance during tea plucking. Preliminary work showed no damage to the tea shoots. Further development and comparisons are required of the plucking machine for sustainable tea production.

Keywords: Haar-cascade, Selective Tea Plucking, Robot Arm, Image Processing, Object Tracking

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[1]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Peradeniya
[2]Faculty of Agriculture, University of Peradeniya, Peradeniya
* ag15148@agri.pdn.ac.lk

Development of Nutrient Enriched Hydrochar by Hydrothermal Pyrolysis of Food Waste

Fernando L.P.S.K., Karunarathna A.K.* and Alahakoon A.M.Y.W.
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Food waste occupies a significant proportion of organic wastes generated both domestically and commercially. However, this nutrient-rich waste source is currently being underused, though it could be effectively recycled back to the environment. Hydrothermal conversion (HTC) is a thermal treatment process that converts the moisture-rich biomass into solid (hydrochar), liquid and gaseous products. Thereby in this study, food waste was hydrothermally converted to nutrient enriched hydrochar while recovering nutrients from vaporous products. A laboratory scale HTC reactor was used and the operational temperature was maintained between 400˚C and 500˚C with a self-generated pressure between 0.05 MPa and 0.3 MPa. One-hour retention time was used with six different wet mixing ratios of food waste: fish waste; 1:0, 3:1, 1:1, 1:2, 1:3 and 0:1. Two bubbling scrubbers were designed to condense vaporous products in water, which produces a nutrient rich liquid. Characteristics of produced hydrochar, liquid product and syngas were analyzed and compared. Results revealed that the hydrochar with food: fish waste ratio of 1:3 has the highest available nitrogen (709 mg/kg), while the highest available phosphorus (5,040 mg/kg) content was with 1:2 ratio. Produced hydrochar with 1:2 ratio had the highest average biochar recovery of 31.2% (wb). The proximate analysis of hydrochar showed a decreasing pattern of fixed carbon with the fish waste ratio. Generally, hydrochar had a basic pH, which increased as the fish waste ratio increased. The highest available nitrogen (6 mg/L) and phosphorus (4 mg/L) contents in liquid product were obtained by 1:2 ratio mixture. The produced syngas consisted of CO_2, H_2, CO, CH_4, and hydrocarbon. According to the results, nutrient enriched hydrochar and nutrient rich liquid can be optimised by increasing the fish waste ratio of the feedstock. This study showed that HTP is a feasible way of recovering nutrients in problematic wastes like food and fish.

Keywords: Food waste, Hydrochar, Nitrogen, Phosphorus, Pyrolysis

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* anujica@agri.pdn.ac.lk

Effect of Non-destructive Repellent Methods on Sri Lankan Monkey (*Toque macaque*)

Isuru V.P.T., Ekanayake W.E.M.L.J.* and Hulugalla W.M.M.P.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Farmers loose a significant amount of their crop produce due to raiding by wild animals. Monkeys course a tremendous damage to crop cultivation in Sri Lanka. Several repellent techniques have been adapted to limit or eliminate the crop-raiding by monkeys in Sri Lanka. The success of these techniques, however, has been unsatisfactory due to high cost and welfare concerns. Therefore, the objective of the present study was to evaluate the effects of three non-destructive repellent methods: use of a repellent mask; use of a mixture of neem (*Azadirachta indica*) and adathoda (*Adhatoda vasica*) extract and use of leopard (*Pantherapardus*) dung as an olfactory repellent. This study was conducted near Akbar Bridge University of Peradeniya, Sri Lanka, where monkeys are abundant. Two sites, control and treatment, selected were ~ 100 m away from each other to avoid interactions. During the three-day adaptation period, and two data collection periods (3 days per each period) 2 kg of banana (*Musa acuminate*) was placed in both sites in morning and afternoon. Treatments were applied twice to avoid the site-specificity and similar experimental procedure was followed for each treatment separately. Total visits of monkeys per day and time spent to consume 2 kg of banana in both control and treatment sites were recorded using a CCTV camera. Rate of raiding (visits/hr) was calculated using total visits and time spent to consume a known amount of banana. Display of repellent mask significantly ($p<.0.05$) reduced the total visits of monkeys (7±3) compared to control treatment (17±3). Application of a mixture of Neem and Adathoda and leopard dung, however, had no effects on either total visits or raiding rate of monkeys. Therefore, the use of repellent mask to control raiding by monkeys is recommended, however, a study to evaluate the long-term effects of these repellent techniques is recommended.

Keywords: Monkey, Repellent methods, Crop raiding

* jayekn@agri.pdn.ac.lk

Effect of Phosphine Gas Fumigation on Postharvest Protection of Rice: A Review

Madushan H.D. and Prasantha B.D.R.*
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Postharvest protection of rice is one of the major concerns in the rice-processing industry. Control of fungal and insect infestations can be achieved through enhancing the quality of products, store management, and good hygienic practices. However, fumigation is the ultimate solution for unavoidable high infestations of stored product insects. Phosphine (PH_3) gas is known as residue-free and low-cost fumigant which has a simple application technique. The PH_3 applications as fumigant must be used above the lethal concentration for an appropriate period of time to eliminate all life stages of insects. According to the available data, recommended dosage of PH_3 and exposure time are in the ranges of 0.5-5 g/ m^3 and 3-30 days, respectively. However, fumigation efficacy depends on the ambient temperature, pest species and their life-stages. Some stored product insects such as *Sitophilus spp.*, *Trogoderma spp.,* and *Tribolium spp.* have been recorded as PH_3 resistant strains elsewhere in the world since 1976. Insect resistance may have developed as a result of poor fumigation and failures to adhere to some basic fumigation practices. Even small deviations of required PH_3 concentrations may result in significant increase of the survival rate of less susceptible egg and pupae stages. Such survivors may later develop resistant populations after several generations of similar fumigation. Therefore, procedures of gas sealing, lethal dosage, exposure time, and physical properties of sealing materials may significantly contribute to the success of PH_3 fumigation. However, no studies have been conducted to find out the effectiveness PH_3 fumigation in Sri Lankan food industry. This review focuses on studies reporting current issues related to the development of PH_3 resistance of stored products insects and post-harvest protection of rice.

Keywords: Fumigation, Rice, Phosphine, Insect resistance

* bdrp@pdn.ac.lk

Effective Microorganisms: An Approach to Reduce Antibiotic Residues in Poultry Litter

Herath H.M.A.O., Wijayagunawardena M.P.B.* and Karunarathna A.K.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Poultry litter is one of the leading sources that release substantial amounts of antibiotic residues into the environment. Thus, natural soil micro flora is not only acquires antibiotic resistant, but also further disseminates the resistance to other microorganisms through horizontal gene transfer. These antibiotic resistant microorganisms, antibiotic resistant genes, and even antibiotic residues could enter into the food chain through crops grown on the manure amended soils. The antibiotic resistant bacteria and genes reduce the effectiveness of therapeutic potential of human and veterinary antibiotics too. Antibiotic resistant bacteria even have the potential to penetrate into tissues, and cause acute immune reactions, and infectious diseases. Therefore, reducing the antibiotic residues in the poultry litter prior to the land application is crucial. In this review the potential use of effective microorganisms (EM) as a method of reducing the antibiotic residues in the poultry litter is discussed. The EM is a mixture of different coexisting, beneficial, naturally occurring anaerobic and aerobic microorganisms. It contains, predominately lactic acid bacteria, followed by yeasts, photosynthetic bacteria, actinomycetes and fermenting fungi. EM enhances the quality of the soil and produces beneficial compounds. Biodegradation is an important process of EM that breakdown, degrade, detoxify or transform pollutants in the environment. Though antibiotics have limited biodegradability, the ability of EM to degrade antibiotic residues has not been studied very extensively, except the studies based on individual microorganisms. The biodegradability potential is strongly depends on the characteristics of the antibiotics. On the other hand, there are evidences that lactic acid bacteria can be affected up to some extent by the antibiotic residues. However, the possibility of reducing antibiotic residues using EM in the poultry litter is evident. Hence, further research should be carried out on the underlying mechanisms and effectiveness of EM on the antibiotic residues in the poultry litter.

Keywords: Antibiotic residues, Effective Microorganisms, Poultry litter, Antibiotic resistance, Biodegradability of antibiotics

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

* missaka@agri.pdn.ac.lk

Effectiveness of Locally Available Botanical Extracts to Control Crazy Ants (*Paratrechina longicornis* Lattreille)

Warakaulle D.I.*, Warnasooriya P.G.A.S. and Hemachandra K.S.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Crazy ant (*Paratrechina longicornis* Lattreille) (Formicidae) is highly abundant in agricultural areas and households throughout the world. Their nesting and foraging behavior has made them nuisance pests. Insecticide spray has been a common practice but it is associated with negative consequences; therefore, there is an interest on use of botanicals for ant management. The objective of this study was to investigate the effectiveness of extracts of locally available botanicals that could be prepared domestically to manage *P. longicornis*. Extracts of *Allium sativum, Capsicum frutescens* and *Mentha piperita* were prepared taking 10 g of grounded plant materials in 20 mL of water. Botanical extract of 20 mL was mixed with 5 mL bee honey to prepare the testing formulations. Test formulations were allowed to feed by ants passing in trail and the strength of trail was measured at 0, 6, 12, 24, 48, 72, 96, and 120 h. The percent of reduction of trail strength was analyzed to evaluate the comparative efficacy of the botanicals. All three botanicals were found significantly effective ($F_{(3,8)}$=4.97 P<0.05) to suppress the foraging trail of *P. longicornis*, 120 h after treatment. The efficacy significantly varied with the type of botanical. The extracts of garlic bulb (*Allium sativum*) and kaputu kochchi fruits (*Capsicum frutescens*) showed 30.1 and 41.2 % reduction of foraging ants respectively while extracts of *Mentha piperita* leaves found to be the most effective with a 64.8 % reduction. Upon a test, using different concentrations of *C. fruitescens* against ants no evidence was found to suggest a significant correlation between concentration and percent reduction of ant movement. The highest level of ant suppression was observed with botanicals of *Mentha piperita*, but it did not produce complete disappearance of trails. Therefore, further studies are necessary to improve it as a control agent.

Keywords: *Allium sativum*, botanical extracts, *Capsicum frutescens*, *Mentha piperita*, *Paratrechina longicornis*

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* ag15902@agri.pdn.ac.lk

Effects of Nitrogen Fixing Bacteria Inoculants on Growth and Yield of Rice and Beans

Baddegama R.N. and Rajapaksha R.M.C. P.*
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Two field experiments were conducted to assess the potential of providing nitrogen by seed inoculants of an indigenous Azospirillum strain to rice and a Rhizobium strain to the common bean. Bean seeds were inoculated with a Rhizobium strain two weeks before seeding and grown along with recommended P, K and i.e. ½ or 0 recommended N fertilizer in a field at Watthegama. Growth parameters, root nodulation and pod yield were recorded at the 4th and 8th weeks of seeding, respectively. The treatment added with inoculant at seeding recorded significantly higher plant height and number of leaves and pod yield (55.7 g/plant) than all other inoculated treatments (21.1 g/plant), only recommended fertilizers (19.4 g/plant) and farmer practice (18 g/plant). Results suggested that the tested Rhizobium strain increased nodule formation and thereby supply N to the bean crop equivalent to half of the recommended N fertilizer. Germinated rice seeds were inoculated with an Azospirillum strain and grown in wetland fields in Aralaganwila along with recommended P and K fertilizers and 2/3 of the recommended N fertilizer. Plant and yield parameters of the inoculated treatment were compared with a non-inoculated treatment grown with recommended fertilizers. The Number of panicles and weights of shoot and 1000 seeds were significantly higher in inoculated than the non-inoculated treatment but grain yields of inoculated (7.76 ton/ha) and non-inoculated treatment (7.45 ton/ha) did not differ significantly. The tissue N levels correlated significantly with shoot weight (r=0.75) and grain yield (r=0.78) whereas soil N with shoot weight (r=0.71) and 1000 grain weight (r=0.60). Results suggested that the tested Azospirillum sp. could be used as an effective seed inoculant for wetland rice along with 2/3 of recommended N fertilizer.

Keywords: Azospirillum, Bean, N fertilizer, Rice, Rhizobium

* chandir@agri.pdn.ac.lk

Estimation of On-farm Enteric Methane Emission from Dairy Cows Under Intensive Farming Situation in the Mid Country of Sri Lanka

Dilshani A.B., Silva G.L.L.P.*, Punyawardane B.V.R.[1] and Marambe B.[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Methane (CH_4) is a greenhouse gas with global warming potential of 23-times higher than CO_2. Ruminants are one of the main CH_4 emission sources in agriculture sector. Methodology provided by the Inter-governmental Panel on Climate Change (IPCC) is widely used for estimating enteric-CH_4 production by cattle. No attempt has been made to estimate a country-specific value for CH_4 emission from dairy cattle in Sri Lanka. National estimates thus far were based on default values provided by IPCC Tier-1 based on basic gain-loss method. The IPCC Tier-2 is more accurate method, demanding complex set of activity data than IPCC Tier-1. A study was carried out to estimate and compare CH_4 emission factor (MEF; kg CH_4/head/year) for enteric fermentation of dairy cattle at Mawelawatta Livestock Field Station (LFS), University of Peradeniya, based on location-specific data (T2F) and national data in literature (T2L), using IPCC Tier-2 method. The T2F estimates were 90.31, 89.18, and 90.17 kg CH_4/head/year for mature dairy cows, heifers and overall herd, respectively. The respective T2L estimates were 87.88, 98.37 and 89.19 kg CH_4/head/year. No significant differences were found in MEF for enteric fermentation of dairy cattle between the two estimates ($P>0.05$). The 10.3% higher estimate in T2L than in T2F could be due to low body weight of Frisian cattle at LFS compared to national average. MEF for overall herd estimated by T2F and T2L was higher than that of Tier-1 (46.0 kg CH_4/head/year). This could be due to higher gross energy intake estimated with real time data in Tier-2 method compared to Tier-1 which also do not consider feeding system for different agro-climatic zones. Results highlight the need for developing country-specific methodology for emission factor estimation of dairy cattle in different agro-climatic zones of Sri Lanka instead of using default value given by IPCC on enteric CH_4 estimation.

Keywords: Methane emission factor, Enteric fermentation, IPCC guidelines, Dairy cattle

[1]Natural Resources Management Center, Department of Agriculture, Peradeniya
[2]Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Peradeniya
* pradeepas@agri.pdn.ac.lk

Evaluation of HYDRUD 1D Hydrological Model to Simulate Soil Water Content Dynamics in a Tropical Alfisol Cultivated with Corn (*Zea mays*)

Rathnasiri G.A.G.I., Vidana Gamage D.N.*, Dharmakeerthi R.S. and Munasinghe S.T.[1]
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Information on soil water content (SWC) dynamics is fundamental for efficient management of irrigation water. However, SWC is highly variable in space and time, which makes it difficult to measure and monitor at different spatial and temporal scales. Hydrological models are recognised as valuable tools to simulate soil water content dynamics. However, the performance of such hydrological models needs to be evaluated for local cropping systems in Sri Lanka. This study evaluated the performance of the HYDRUS 1D hydrological model in simulating the SWC dynamics at multiple surface depths of a corn cultivated field located at the Grain Legumes and Oil Crops Research and Development Centre, *Angunakolapellassa,* Sri Lanka. A portable Time Domain Reflectometry probe was used to measure soil water content at 4, 8, 12, and 20 cm depths over the *Maha* and *Yala* 2020 and *Maha* 2021 seasons. Daily rainfall, evaporation, air temperature, wind speed and direction and sunshine brightness were also measured onsite. The model was calibrated using data from the *Maha* 2020 season, while SWC data from the *Yala* 2020 and *Maha* 2021 seasons were used to validate the model. Indices such as root mean square error (RMSE), coefficient of determination (R^2), and modelling efficiency (EF) were calculated to evaluate the performance of the model. The results showed that RMSE ranged from 2% to 4%, indicating a satisfactory predictive accuracy of the model. Further, R^2 value ranged from 0.53 to 0.98, indicating a strong agreement between predicted and measured SWC data. Further EF values ranged from -3.65 to 0.70, showing a good efficiency of the model. Overall, the results suggested that the HYDRUS 1D model is a useful tool for simulating SWC dynamics of surface soil of an Alfisol cultivated with corn in the dry zone of Sri Lanka.

Keywords: HYDRUS 1D, Soil water content, Alfisol, Modelling

[1]Grain Legume and Oil crop Research and Development Centre, Department of Agriculture, Angunakolapellasa

* dumindavidana@agri.pdn.ac.lk

Field Efficiency of Salicylic Acid and Sodium Bicarbonate to Manage Rough Bark Disease of Cinnamon and their Effect on Epiphytic and Endophytic Fungi Associated with Cinnamon Stem

Pathirana W.P.A.M., De Costa D.M.* and Jayasinghe G.G.[1]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Rough bark disease (RBD) of cinnamon reduces the quality of the final product. The present study was conducted to determine the field efficiency of 1 mM Salicylic acid (SA) and 2% Sodium bicarbonate (SB) in comparison to the present recommendation of Tebuconazole for managing RBD and to determine the effect of SA and SB on endophytic and epiphytic fungi in treated cinnamon stems. Just after harvesting, the cut surfaces of 15 bushes were applied separately with SA, SB and Tebuconazole in triplicate at monthly intervals while maintaining controls with no chemical application. Number and the length of newly-emerged shoots were recorded over a six month period to determine the phytotoxic effect of SA and SB. Incidence and severity of RBD were quantified on newly emerged shoots six months from the first application. Further, abundance and diversity of epiphytic and endophytic fungi associated with the newly-emerged shoots were quantified by standard microbiological methods. Similarly, the fungal abundance and diversity were evaluated in one year old cinnamon seedlings subjected to the same treatment structure. Significantly higher shoot number in SA and SB treated-bushed compared to other two treatments indicated no phytotoxic effect by SA and SB. RBD incidence and severity were significantly low in SA and SB treatments compared to control and by the SB treatment compared to fungicide. Abundance and richness of taxonomic groups of the endophytic and epiphytic fungi did not differ significantly among treatments. However, relative abundance of *Pestalotia*-like fungi was considerably low in stems treated with SA and SB than those with fungicide and control treatments. Two percentage SB inhibited colony growth of two *Pestalotia*-like spp. and a *Botryodiplodia*-like sp. by 76, 87 and 78%, respectively. Findings revealed the field efficacy and antifungal ability of 1 mM SA and 2% SB in reducing the RBD incidence and severity.

Keywords: Endophytic fungi, Epiphytic fungi, Rough bark disease, Salicylic acid, Sodium bicarbonate

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[1]National Cinnamon Research and Training Centre, Palolpitiya, Thihagoda, Matara

* dmdcosta@agri.pdn.ac.lk

Freeze-thawing Stability of Green Chili (*Capsicum annuum* L.)

Iddamalgoda I.P.U.E., Prasantha B.D.R.* and Rathnayake K.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Green chili (*Capsicum annuum* L.) is an important vegetable crop in Sri Lanka. There is a big demand for green chili during the off-season. MICH-Hybrid-01 is known as a hybrid chili variety, popular in Sri Lanka because of its high yield, pungency and suitability for green chili production. This research was conducted to study the physical, chemical and microbial stability of green chili after the freezing and thawing process. The effects of four treatments with two packaging methods (vacuum-sealed LDPE and non-vacuum sealed LDPE pouches), hot water blanching (at 75 ^{o}C for 2 min) and calcium chloride ($CaCl_2$) as chemical pretreatment were experimented. All the samples were subjected to air-blast freezing (-21 ^{o}C) and stored for 10 days at -21±1 ^{o}C temperature. The samples of frozen chili were thawed at ambient temperature (30±2 ^{o}C) and evaluated for total soluble solid (TSS) content, pH, dry matter content, colour, freeze damage index, drip loss and microbial loads (total plate count, yeast and mold, enterobacteria, and coliforms). The result shows that TSS and dry matter content were remained unchanged ($P>0.05$), however pH values were significantly increased in all treatments ($P<0.05$). All treatments were significantly affected ($P<0.05$) on colour (chroma and total color difference ΔE) of freeze-thawed chili. Blanching prior to freezing, reduced the initial microbial load significantly ($P<0.05$) but had a significant effect on green colour deterioration and firmness reduction of the freeze-thawed chili samples. Irrespective of the packaging treatments and pre-treatments of fresh chili, freeze-thawed samples showed higher drip loss and freeze damage index. However, vacuum packaged freeze-thawed green chili samples were shown the lowest drip loss (2.4%) and physical damage compared to the other treatments. Blanching and $CaCl_2$ treatments were unable to retain the colour and overall quality of green chili samples.

Keywords: Green chili, Freezing, Blanching, Vacuum packaging, Pre-treatments

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[1]HJS Condiments Limited, Export Processing Zone, Biyagama

* bdrp@pdn.ac.lk

GIS Based Assessment of Land Use and Land Cover Change in the *Kapiriggama* Tank Cascade System

Lasanthika K.A.G.A. and Vitharana U.W.A.*
Department of Soil Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

A tank cascade system (TCS) is one of the ancient irrigation systems. The components of the TCS and associated land use and land cover (LULC) determine the functioning and sustainability of the system. However, numerous socio-economic factors could lead to human involved alteration of the TCS and the associated environment. This study assessed the LULC changes that occurred in *Kapiriggama* tank cascade system during the past 10 years (2010-2020) using Geographical Information System (GIS) tools. Historical satellite images (2010 and 2020) obtained from the Google Earth platform were analyzed using GIS spatial analysis methods to quantify the temporal changes of two components of TCS, *Gasgommana*, and *Kattakaduwa*, downstream paddy lands and LULC within 1.5 km buffer zone from tanks. The human influence on the key components of the TCS was evidenced by the decrease in *Kattakaduwa* (8.3%) and *Gasgommana* (4.5%) extents. The area of paddy lands irrigated by the TCS has been increased from 4.91 km^2 to 5.57 km^2 (13.5%) within the 10-year period. The analysis of LULC of the buffer zone revealed a drastic decrease in the shrub land cover by 71% (9.94 km^2 in 2010 to 2.28 km^2 in 2020). Further, the natural forest cover has declined by 11% (13.70 km^2 in 2010 to 12.20 km^2 in 2020). The extent of paddy lands within the buffer zone has increased from 7.60 km^2 to 8.60 km^2 (13.2%). The greatest expansion has occurred in the extent of annual crop cultivated fields which changed from 1.27 km^2 in 2010 to 8.36 km^2 in 2020. Further, a 27% increase in the extent of built-up lands was observed within the buffer zone. This study revealed a significant impact of human activities on the TCS and associated catchment area thus regulatory actions are needed to assure the long-term sustainability of the tank cascade system.

Keywords: Tank cascade system, Land use, Buffer analysis, GIS, Google Earth

* uvithara@agri.pdn.ac.lk

Harnessing Natural Variation to Decode the *Cis*-regulatory Architecture of *TGA10* in Rice

Tennakoon A.B., Jayathilake D.V. and Herath H.M.V.G.*
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Rice (*Oryza sativa* L.), is an economically important crop and it is consumed widely as a staple food. The productivity of rice is highly affected by abiotic stresses. Identification of key functional and regulatory genes in abiotic stress signaling pathways is important for understanding the molecular basis of abiotic stress tolerance towards developing tolerant varieties. TGA10 is a bZIP transcription factor (TF) involved in cold and oxidative stress tolerance. Exploring variations in the promoter region is important to understand the regulatory dynamics of *TGA10* expression under abiotic stress conditions. Hence, promoter haplotypes were defined by identifying single nucleotide polymorphism (SNP) sites in a 1,500 bp region upstream of the transcription start site (TSS). The promoter region of *TGA10* in rice was retrieved from the SNP Seek sequence repository for a panel of 2,900 rice accessions representing 86 countries and 12 subpopulations. The alignment of the promoter region revealed 7 SNPs with ≥ 5% occurrence frequency. Based on these SNPs in the promoter, 7 novel promoter haplotypes (PH1 to PH7) were defined. The *TGA10* promoter has a moderate haplotype diversity (Hd=0.58) and low nucleotide diversity (π=0.32). Subpopulation data revealed the predominant occurrence of PH1 in *indica* subspecies and PH3 in *japonica* subspecies. Promoter analysis was conducted to identify *cis*-regulatory elements and to determine if any of the 7 predominant SNPs (S1 to S7) detected in the *TGA10* promoter had an impact on those elements. At the S2 SNP site, the major allele was associated with a C_2H_2 zinc finger transcription factor binding site (TFBS), while the minor allele was associated with a WRKY TFBS, resulting in altered function. Similarly, the S1 and S4 sites revealed loss of TFBSs resulting in differential regulation. These findings provide useful insight into understanding the functional and evolutionary diversity of *TGA10*.

Keywords: Abiotic stress, *TGA10*, *Cis*-regulatory elements, Haplotypes

* venura@agri.pdn.ac.lk

Identification of Biological Processes Associated with Drought and Salinity Stress Response in *Oryza sativa* L. by Transcriptome and Meta-analysis

Weerasinghe B.A.L.C.*, Jayawardana N.U. and Ariyarathna H.A.C.K.[1]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Drought and salinity stress significantly affect agricultural crop productivity and the impact is on the increase due to climate change. This report explored the biological processes that are affected by drought and salinity stress. Public domain transcriptome data was retrieved from Gene Expression Omnibus of NCBI. Differentially expressed genes (DEGs) in drought and salinity stress were identified using GEO2R tool and analyzed with Venn software. AgriGO tool was used to analyze gene ontology (GO). KEGG pathways were visualized using Kyoto Encyclopedia of Gene and Genome and further studied using literature. Transcriptomes: GSE24048, GSE25176, GSE26280, GSE41647, GSE83378, and GSE3053, GSE4438, GSE13735, GSE16108 GSE58603 that were associated with drought and salinity stress respectively were retrieved. The transcriptomes identified 699 DEGs, including 479 up–regulated genes that were significantly enriched under 11 biological process GOs, 2 molecular function GOs, but none in cellular component. Similarly 220 down–regulated genes were enriched significantly in 2 biological process GOs, but none in molecular function or cellular component. KEGG pathway analysis identified, 35 up–regulated and 15 down–regulated pathways that were associated with 4 biological processes: respiration, photosynthesis, ROS scavenging pathways, and fatty acid desaturation. Abiotic stress decrease the cytochrome respiration pathway while increasing alternative pathway, maintaining a viable state of the plant. Red chlorophyll catabolite reductase associated with pophyrin and chlorophyll metabolism was up-regulated reducing photosynthesis. Pathways related to production of scavengers for Reactive Oxygen Species: proline, spermidine, lignin, fumarate, valine, and isoleucine were enriched. Pathways related to fatty acid desaturation were enriched, modifying membrane fluidity. This provides evidence that during drought and salinity, regardless of genotypes, growth stage, and growth conditions biological processes associated with the differentially expressed genes act as antioxidant systems providing protection against oxidative damage.

Keywords: Alternative oxidase, Fatty acid desaturation, Reactive Oxygen Species

[1]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya
* ag15184@agri.pdn.ac.lk

Infrared Thermography as a Method to Evaluate the Heat Stress in Weaned pigs: Relationship between Infrared Measured Body Surface Temperature and Rectal Temperature in Weaned Pigs

Prabath W.M.H.J., Samarakone T.S.*, Hulugalla W.M.M.P., Abeyrathna R.M.R.D.[1], Silva F.H.C.A.[1] and Ekanayake E.M.A.C.[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Infrared thermography (IRT) is a useful tool which, helps to identify the thermal stress of animals. Weaned pigs were used to study the relationship between the measured body surface temperature (BST) using IRT with their rectal temperature (RT) and respiratory rate (RR). A key objective of this study was to identify the best anatomical region of the animal from IRT image captured. Six weaners were housed with an environmental control system (ECS), while the other group (n=6) was housed in a normal pen. The ECS was programmed using an ARDUINO-NANO board to maintain the set air temperature inside the pen ranging from 16 °C to 28 °C. The sensor inside the pen with the ECS was detecting the real-time temperature and according to the value read and the set value, the controlling system could determine the ON and OFF time of the air conditioning unit (AC). Separately relative humidity (RH) and air temperature (T) were logged throughout the study period to compute the Temperature Humidity Index (THI) by occupying a thermal model. Measurements were performed starting with the physiological parameters at 6-time intervals. BST was measured using IRT images, particularly in the ear, eye, belly, rump, ham, forelegs and rear legs. A strong correlation ($p<0.05$) was warranted between THI and BST measured on ear, rump and ham ($r=0.73$, 0.71, and 0.63 respectively). The correlation coefficients of mean and maximum ear temperatures to RT were 0.74 and 0.69 and were 0.64 and 0.63 to RR, all showing the highest as compared to other body region temperatures with RT and RR respectively. Thus, it can be concluded that BSTs are sensitive to thermal environments similar to RT, suggesting the variability of BST to reflect body core temperature. In addition, the ear is a relatively reliable region to assess the heat stress reflecting RT.

Keywords: Infrared thermography, Thermal stress, Rectal temperature, Respiratory rate

[1]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Peradeniya
[2]Faculty of Agriculture, University of Peradeniya, Peradeniya
* thusiths@agri.pdn.ac.lk

Is *Dracaena sanderiana* a Facultative CAM Species? – Evidence From Diurnal Variation in Chlorophyll Fluorescence Under Simulated Stress Conditions

Jayasooriya L.S.H., Beneragama C.K.* and Kumarihami H.M.P.C.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Chlorophyll fluorescence (ChlF) is one of the most popular rapid and non-invasive techniques used in plant physiological studies, including stress physiology. This study was conducted to examine the stress responses of *Dracaena sanderiana* L.under three simulated stress conditions. *D. sanderiana* cuttings were subjected to water stress (no water), osmotic stress (200 mM NaCl), and heavy metal stress (100 µM $HgCl_2$), under two different light levels, *i.e*. 22,500±2,000 lux and 750±200 lux. The cuttings held in distilled water served as the control. The chlorophyll fluorescence data were collected through OJIP analysis using a portable fluorometer (FluorPen, FP 110). The measurements were recorded four times a day (9 am, 12 pm, 3 pm, and 6 pm) and the data were collected continuously for four days commencing from the first day of treatment application. The major parameters derived from the OJIP analysis, including specific energy fluxes per reaction center (ABS/RC, TR/RC, ET/RC, and DI/RC), flux ratios (maximum quantum yield of primary photochemistry-φPo), electron transport efficiency (ψo), and quantum yield of electron transport (φEo), and performance index (PI) were recorded. ChlF data showed a clear unimodal diurnal variation in plant performances of *D. sanderiana* at 22,500±2,000 lux. Further, an apparent circadian variation in ChlF measurements was observed in water-stressed, and osmotic-stressed cuttings compared to heavy metal-stressed, and non-stressed cuttings. The circadian variation was reported for all measured ChlF parameters except the ψo, TR/RC and ET/RC. Based on these circadian variations of ChlF, it can be concluded that *D. sanderiana* displays a facultative CAM pathway as an adaptation to the stressed conditions.

Keywords: Chlorophyll fluorescence, Diurnal variation, Facultative CAM, Photosynthesis, Stress condition

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* chalindab@agri.pdn.ac.lk

Isolation of Lactic acid bacteria (LAB) Inoculum for Ensiling Forage

Uthpali N.A., Dissanayake L.M.J.N.K., Senanayaka S.D.[1], Rajapakshe R.G.S.C.[1], Jinadasa H.R.N.[2], Weerasinghe W.M.P.B.[3] and Kumara Mahipala M.B.P.*
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Forage conservation through ensiling is accelerated by inoculation with lactic acid bacteria (LAB). Present study isolated LAB to be used as an inoculum for forage silage production. Maize (*Zea mays* L.), sorghum (*Sorghum bicolor*) and guinea grass (*Panicum maximum*) silage samples (10g) were blend in distilled water (100mL) and inoculated (1mL) into MRS broth. Three bacterial cultures were isolated using MRS agar at 40ºC. The bacterium was characterized by Gram's staining and biochemical tests. They were Gram positive but slightly varied in shape (bent short, bent long, short pleomorphic rods). They positively responded for sugar fermentation tests. The isolates confirmed as *Lactobacillus spp.* Further, DNA sequence analysis of the 16S rRNA gene using the 63f and 1387r primers followed by BLAST search identified the isolates. Lactobacilli in maize, sorghum and guinea grass silage were *Lactobacillus plantarum* subsp. *Plantarum, Lactobacillus rhamnosus* and *Lactobacillus oris*, respectively. Their anaerobic lactose fermentation potential at 40ºC was assessed. Lactose fermented without lactobacilli was used as the control. The pH, titratable acidity (TA, %) and remaining lactose (%) were measured at 0, 18 and 30 hours. At zero hours pH, TA and lactose were 6.76, 0.17% and 3.64%, respectively. The pH of the ferment with *L. plantarum* (4.70), *L. rhamnosus* (4.79) and *L. oris* (5.07) were less compared to control (5.75) at 30 hours ($P<0.05$). Contrary, the TA of ferment with *L. plantarum* (0.66%), *L. rhamnosus* (0.64%) and *L. oris* (0.55%) were greater compared to control (0.48%) at 30 hours ($P<0.05$). The remaining lactose content in the ferment with *L. plantarum* (2.38%) and *L. rhamnosus* (2.45%) were less ($P<0.05$) than other treatments. Further, *L. plantarum* changed the pH and TA faster than other treatments ($P<0.05$). The study confirmed greater potential of *L. plantarum* isolated from corn silage to be used as an inoculum for ensiling forages.

Keywords: Silage, Maize, DNA sequencing, pH, Titratable acidity

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[1]Department of Molecular Biology and Biotechnology, Faculty of Science, University of Peradeniya, Peradeniya

[2]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya

[3]Veterinary Research Institute, Gannoruwa, Peradeniya

* pmahi@agri.pdn.ac.lk

Method Validation and Determination of Heavy Metals in Banana *(Musa paradisiaca)* Using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) Method: A Review

Edirisinghe E.A.A.S., Wimalasiri K.M.S.* and Magamage C.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Contamination of soil by heavy metals occur due to anthropogenic activities such as land application of fertilizers and pesticides, use of leaded gasoline and paints, coal combustion in power plants etc. Bioaccumulation of heavy metals occurs in all living organisms due to the exposure to heavy metals in environment. Among these, most of the heavy metals exert advanced effect on renal and liver function and some are carcinogens. Accordingly foods contaminated with heavy metals are identified as a threat for food safety, highlighting the importance of detecting the availability of heavy metals in banana *(Musa paradisiaca)* which is the mostly consumed fruit in Sri Lanka. The objective of this review is to identify methods of heavy metal contamination of banana, adverse effects of heavy metals on human health, identifying a suitable analytical method for determination of heavy metals in banana with high accuracy, precision and its process parameters. The Inductively Coupled Plasma Mass Spectroscopy is selected as the analytical method. The performance characteristics of validated method include measurement range, measurement uncertainty of results, accuracy, limit of detection, limit of quantification, recovery and linearity. Determination and acceptance criteria for above parameters were scrutinized. Availability of Arsenic (As), Mercury (Hg), Lead (Pb), Cadmium (Cd), and Selenium (Se) in banana were reviewed. The provisional tolerable daily intake for Arsenic and Mercury are 0.002 mg/kg body weight and 5 µg/kg body weight respectively, as recommended by the joint expert committee of World Health Organization and Food and Agriculture organization. WHO permitted maximum level of lead is 0.1 mg/kg for banana. Most of the studies reported lower heavy metal contents in banana than the maximum allowable limits while some studies conducted on samples from close proximity to industrial cities around the world have reported higher heavy metal contents which exceeded these maximum allowable limits.

Keywords: Banana, Heavy metals, Contamination, Hazard, ICP-MS

[1]Horticultural Crop Research and Development Institute (HORDI), Department of Agriculture, Gannoruwa, Peradeniya

* swarnaw@agri.pdn.ac.lk

Modeling and Simulation of the Temperature Profile Inside Coffee Beans Roasted under Far-Infrared Radiation

Amarasinghe A.A.P.S.*, Amaratunga K.S.P., Abeyrathna R.M.R.D., Mowjood M.I.M., Kariyawasam H.K.P.P.[1] and Ekanayake E.M.A.C.[2]
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Use of Infrared heating for roasting coffee could lead to better quality and energy efficiency due to the rapid heating rate and high controllability of Infrared radiation. To optimize the usage of infrared heating for roasting coffee, a clear understanding of heat transfer through a coffee bean is essential. The temperature change in the center of a coffee bean was theoretically modeled in this study when a single bean is heated using Far-infrared radiation (FIR). A simple mathematical model was used to predict the center temperature of a coffee bean roasted with FIR and the model was compared with experimental values ranging from 150 to 300 °C. FIR heating exhibited rapid heating; beans were heated to roasting temperature, 225°C in 22.8±1.2 seconds. The temperature rising phase of heating was able to simulate by an exponential type equation. The coefficient of temperature of the heating phase followed an Arrhenius type relationship with the internal bean temperature.

Keywords: Coffee Roasting, Far-infrared heating, Heat transfer, Modeling bean temperature, Temperature coefficient

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[1]Department of Agricultural Technology, Faculty of Technology, University of Colombo, Colombo
[2]Faculty of Agriculture, University of Peradeniya, Peradeniya
* ag15004@agri.pdn.ac.lk

Molecular Detection of Haemoparasites in Goats of Horakelly Farm, Sri Lanka

Ranaweera A.A.S.K.A., Deshapriya R.M.C.* and Anupama N.M.T.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Goat farming is a widespread industry throughout the world. Haemoparasitic diseases are a major problem in goat industry and the main haemoparasites in goat blood are *Anaplasma* sp., *Theileria* sp. and *Babesia* sp. Haemoparasitic diseases have direct impact on animal health and production, sometimes leading to death and rejection of some body parts at meat inspection. Proper understanding of the haemoparasites is essential for effective prevention and control programs. The objectives of the current study were to detect *Anaplasma ovis*, *Theileria ovis* and *Babesia* sp. in goat blood samples collected randomly from Horakelly farm (n=24) using molecular identification methods, and to calculate the prevalence of haemoparasitic diseases in the farm. From the samples, Packed Cell Volume (PCV) and Differential Count (DC) were determined and DNA was extracted using Biospin Virus Nucleic acid Extraction Kit. Polymerase Chain Reaction (PCR) was carried out using specific primers for specific target genes of the parasitic species. Amplified DNA samples were visualized by using 1% Agarose gel electrophoresis. The relative DC of goats was 71% lymphocyte, 18% neutrophil, 6% eosinophil and 5% monocyte and 87.5% of goats showed normal range of PCV (22-38%). Even though the packed cell volume was normal, out of the total 24 samples tested, 19 samples were positive for *Anaplasma ovis*. Thus, the prevalence of *A. ovis* was 79.17%. Ten samples were positive for *Theileria ovis*. Prevalence of *T. ovis* was 41.67% which is considerably low prevalence than *A. ovis. T*he data suggests that goats were in the subclinical level. All blood samples tested were negative for *Babesia* sp. indicating zero prevalence of this disease and it is not a huge problem to Horakelly farm. Further studies are in progress to evaluate species by the sequence analysis of *A. ovis* and *T. ovis f*ound in Horakelly farm.

Keywords: *Anaplasma ovis*, *Theileria ovis*, *Babesia* sp., PCV, PCR

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[1]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya

* cdeshapriya@agri.pdn.ac.lk

Molecular Identification of Okra Wild Relatives using DNA Barcoding

Gunawardhana G.H.R.A., Wasala S.K.[1*], Ubeysekera N.M.[2] and Jayathilake D.V.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The genus *Abelmoschus* includes the vegetable crop okra (*A. esculentus* L.) and about nine other species. In Sri Lanka, the natural vegetation harbours several *Abelmoschus* spp. Wild relatives of crop species often carry unique and essential genes that make them adapted to adverse environmental conditions. Especially, these crop wild relatives are known to carry genes conveying resistance/ tolerance to biotic/ abiotic stresses. In order to utilize these desirable genes for the genetic improvement of okra, proper identification and characterization of these wild relatives are essential. The existing morphology-based taxonomic keys are unable to identify all *Abelmoschus* spp. found in Sri Lanka to species level. In the current study, DNA barcoding was used to confirm the species identity of *Abelmoschus* spp. found in Sri Lanka and to examine the taxonomic affinity of *Abelmoschus* spp. which could not be identified based on the existing taxonomic keys. DNA was extracted from *A. esculentus, A. ficulenes*, *A. angulosus, A. moschatus,* and 2 unclassified *Abelmoschus* spp. collected from Sri Lanka.Barcoding genes representing chloroplast DNA (*ribulosebisphosphate carboxylase* largesubunit (*rbcL*),*maturase K* (*MatK*), *trnL* (UAA) intron) and nuclear DNA (ribosomal internal transcribed spacer(*ITS*) sequence)were PCR amplified from the extracts. Of these, the *rbcL* gene amplicons were sequenced and aligned with all available *rbcL* sequences of *Abelmoschus* spp. retrieved from GenBank. The alignment revealed only a single nucleotide polymorphism (SNP), which clustered the accessions of *A. esculentus* and *A. ficulenes* into one group and the rest to another. Apart from this SNP site, no other intraspecific sequence differences were observed, and hence, the discriminating power of *rbcL* is not sufficient to reliably use it for DNA barcoding of *Abelmoschus* spp. It is recommended to assess the suitability of the remaining barcoding genes to differentiate the *Abelmoschus* accessions to species level.

Keywords: *Ribulosebisphosphate carboxylase* large subunit, *Abelmoschus esculentus*, Crop wild relatives, DNA barcoding

[1]Department of Agriculture - Central Province, Peradeniya, Sri Lanka
[2]Plant Genetic Resources Center, Department of Agriculture, Gannoruwa, Peradeniya
* samanthiwasala@gmail.com

Selection and Optimization of qPCR Primers for Expression Analysis of Four Catechin Biosynthesis Genes in Tea (*Camellia Sinensis* (L.) O. Kuntze)

Wijewardhana M.P.H.M.*, Jayawardana N.U., Niranjan M.[1] and Ranathunga M.A.B.[1]
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Tea (*Camellia sinensis* (L.) O. Kuntze) is one of the major export crops in Sri Lanka. Tea polyphenols are flavonoid compounds synthesized in tea leaves through the flavonoid biosynthesis pathway. Among polyphenols, catechins are important constituent as it has health benefits, and play a significant role in tea plant defense against pest and diseases. Information on expression levels of catechin biosynthesis genes in the Sri Lankan tea germplasm under various environmental conditions is unavailable. The selection of suitable primers to amplify genes of interest is a prerequisite in gene expression studies using qPCR. Designing specific qPCR primers is difficult as the sequence information is not available for Sri Lankan tea germplasm. Therefore, the objective of this study was to screen available primers in the literature and optimize identified primers for local tea germplasms. Sixty-six primer sequences for 10 genes in the flavonoid biosynthesis pathway were identified using published literature, and 10 primers out of 66 were selected using the IDT Oligo Analyzer tool and NCBI Primer-BLAST tool. Ten primers were optimized in the laboratory with gradient PCR and qPCR. Only 4 primers for genes; *Chalcone Synthase* (*CHS*), *Flavonoid 3'-Hydroxylase* (*F3H*), *Anthocyanidin Reductase* (*ANR*), *Anthocyanidin Synthase* (*ANS*), and a housekeeping gene *Glyceraldehyde-3-Phosphate Dehydrogenase* (*GAPDH),* performed satisfactorily. Optimum annealing temperatures of the primers of *ANR, ANS, F3H, CHS,* and *GAPDH* genes, which showed high band intensity without non-specific products and primer dimers were 62^{o}C, 58^{o}C, 56^{o}C, 58^{o}C, and 58^{o}C, respectively. Melt curves of all primers showed a single peak. Primer dimers were not observed in any of the primers used. Average C_T values of *ANR, ANS, F3H, CHS,* and *GAPDH* genes were 26.12, 31.50, 27.29, 24.54, and 24.86. Therefore, the selected 5 primers can be used to study the expression of Cathechin Biosynthesis genes in the Sri Lankan tea germplasm.

Keywords: Catechins, PCR, Primer optimization, Primer selection, qPCR

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[1]Tea Research Institute of Sri Lanka, Talawakelle

* ag15111@agri.pdn.ac.lk

Testing the Effectiveness of a Urea-Based Slow Release Seed Coating Material in Lowland Rice Cultivation

Navodya H.A.H., Senavirathna G.I.[1], Chathurika J.A.S.[1*] and De Costa W.A.J.M.
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Nutrient-enriched seed coating has emerged as a novel strategy for enhancing crop productivity via establishing a strong, healthy seedling. The objective of this study was to test the effectiveness of three seed coating materials produced by the Sri Lanka Institute of Nanotechnology, namely, C1: urea with growth-promoting carboxylic acid (GPCA), C2: urea with GPCA and phosphorus, C3: urea with phosphorus, potassium and zinc, on seed germination and seedling growth of lowland rice variety Bg352. A germination test was performed to select the best concentration of coating material for further studies. Seeds were coated with each material at 5, 15, and 25 mg/75 seeds, while a treatment without coating was the control. Germination percentage, germinated count on the second day, germination speed, and germination energy were not significantly (p>0.05) different among treatments. Therefore, coating at 25 mg/75 seeds was selected to ensure maximum nutrients to germinating seeds. A seedling evaluation was conducted on acid-washed sand for three weeks with the same treatments. Here, C1 (53.5±1.6 mg) and C2 (58.8±3.4 mg) treatments showed greater (p<0.05) seedling dry weight than the control (37.1±1.6 mg) while C3 (38.7±2.5 mg) remained similar to the control. A pot experiment was conducted with factorial treatment combinations of C1, C2 and C3 with and without the recommended first application of urea (20 kg ha^{-1} at two weeks after sowing). Urea only at recommended level and zero fertilizer were included as controls. Plant height and relative chlorophyll content at two weeks after sowing (WAS) showed significant (p<0.05) variation among treatments. Phosphorus incorporated in C2 and C3 and phosphorus, potassium and zinc in C3 significantly increased plant height at 2 WAS, whereas GPCA in C1 decreased it. Furthermore, phosphorus in C2 increased the relative chlorophyll content. These results indicate the importance of including phosphorus in slow-release fertilizer coating material.

Keywords: Seed coating, Multi-nutrient, Slow-releasing, Rice

[1]Sri Lanka Institute of Nanotechnology (SLINTEC), Pitipana, Thalagala Road, Homagama
* suranic@slintec.lk

Therapeutic Potential of a Herbal Emulsion for Control Mange in Pigs

Edirisinghe W.T.G. and Wijayagunawardena M.P.B.*
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Mange is a highly contagious skin disease, which can cause severe economic losses to farmers if not controlled well. In this study effectiveness of a herbal emulsion prepared using a traditional herbal recipe for controlling the mange infestation in pigs was investigated. Herbal materials having antibacterial, antifungal, antiseptic, anthelmintic properties, and wound healing abilities were used as ingredients. Prepared herbal emulsion was applied as a spray and evaluated the prognosis of mange infested pigs for 15-day period at 5-day intervals. Efficacy was evaluated using a numerical scale based on severity of the clinical symptoms and behavioral signs at the initial treatment. Score 0 was given to pigs with no symptoms while score 10 was given to pigs shown severe clinical symptoms. Scores between 0-10 were given accordingly to pigs in between. The post treatment evaluation was done using the same scale. The duration for the complete recovery from mange was evaluated. The results showed that herbal preparation significantly decreases the mange infestation in pigs at day 15 ($P<0.05$). In conclusion, a herbal emulsion effective for controlling mange infestation in pigs is prepared, and the emulsion is highly effective for controlling general skin wounds too. Therefore, this herbal emulsion preparation has a potential for commercialize to control the mange and skin wounds in pigs.

Keywords: Mange control, Antimicrobial herbs, Skin diseases

* missaka@agri.pdn.ac.lk

Toxic and Repellent Effect of Selected Edible Organic Powders on Rice Weevil (*Sitophilus oryzae* L.)

Rajapakshe R.M.O.L.*, Warnasooriya P.G.A.S. and Hemachandra K.S.
Department of Agricultural Biology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Rice weevil (*Sitophilus oryzae*) is a major pest of stored rice, grains and grain products. The management of rice weevil is challenging due to the application limitations of insecticides and other control strategies. Pest control using botanicals has been proven successful; hence, this study was conducted with the objective of assessing the toxic and repellent effects of edible plant powders; turmeric (*Curcuma longa*), ginger (*Zingiber officinale*), pepper (*Piper nigrum*), and cinnamon (*Cinnamomum verum*) against rice weevil. Mortality and LD_{50} were evaluated by keeping ten rice weevils in 20 g of rice mixed with edible powders (0.1-2 g) in a vial. LD_{50} values of pepper, turmeric, ginger and cinnamon were 75.4, 584.9, 6140.9, and 14405.9 mg/kg of rice respectively. Upon the treatment, increasing mortality was detected over 10 days and the mortalities varied with the treatment concentrations (0.5-10%) and the type of powder ($F_{(19,4)}=7.49$, $p<0.05$). The pepper powder was found as most effective and it produced the maximum mortalities: 27.5, 57.5, 85 and 100% at the concentrations 0.5, 1, 1.5, 2 (w/w) respectively. The 10% concentration of turmeric, ginger, and cinnamon produced the cumulative mortalities: 82.5, 20 and 17.5% after 10 days. Repellent effect of botanical powders was assessed by keeping 40 adult weevils with 1% treated rice in a container, and burying it in another container filled with cleaned rice. The wall of the inner container had holes to facilitate the free movement of weevils. The number of weevils moved through was counted after 24 hours. Repellency were significantly different ($F_{(4,4)}=25.14$, $p<0.05$) among treatments. Pepper (80±4.2%) had the highest repellent effect followed by ginger (70.83±6.0%), turmeric (59.16±4.8%), and cinnamon (47.5±3.9%). As per the overall results, pepper powder has a potential to suppress the rice weevils, so that pepper could be improved to use in rice weevil management.

Keywords: Botanicals, LD_{50}, Repellent, Rice weevil, *Sitophilus oryzae*

* ag15170@agri.pdn.ac.lk

Use of multispectral UAV images in precision agriculture: Weed control in rice

Rathnayake K.M.K.I., Ariyaratne W.M.T.P.*, Marambe B., De Silva S.H.N.P., Sivananthawerl T. and Herath S.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Integrated Weed Management (IWM) with the use of Unmanned Aerial Vehicles (UAVs) enables site-specific weed management (SSWM), which is both cost-effective and environmentally-friendly. A study was conducted to develop maps for early detection of weed patches in broadcasted rice fields using images captured by a UAV. Ten rice varieties (Bg 250, Bg 251, Bg 300, At 311, Bg 352, Bg 359, Bg 360, At 362, Bg 403, Bg 450) with different maturity periods and two grass weeds (*Echinochloa crusgalli*, *Ischaemum rugosum*) and a sedge (*Cyperus iria*) were used. Plants were grown in field plots of 2.5 m × 6 m at the Rice Research and Development Institute, Batalagoda, Sri Lanka. Treatments were arranged as rice only, rice + weed species (3:2 plant density), and a weed species only in separate plots in three replicates. The UAV with a multispectral sensor was flown to collect data over the experimental plots at a height of 12.2 m (40 ft) once in every three days from sowing to harvesting. The image processing was done using trial version of the software PIX4Dfields® 1.9. The commonly used Normalized Difference Vegetation Index (NDVI) images generated could not separate weed patches clearly from paddy plants in broadcasted fields even up to crop harvest. Nevertheless, Red-Green-Blue (RGB) reflectance maps generated with appropriate modifications made for parameters of the Excess Green (ExG) Index (2g-r-b), *i.e.* by using normalized values for 'g' (G), 'r' (R) and 'b' (B) selected from the software (2G-R-B), was able to detect 10 paddy varieties separately from three weed species as early as 21 days after broadcasting seed paddy. The modified ExG Index method used in this study can effectively be adopted as a precision agriculture technique for IWM in broadcasted paddy fields.

Keywords: Precision agriculture, Unmanned aerial vehicle, Modified Excess Green Index, Normalized Difference Vegetation Index, Site specific weed management

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[1]Rice Research and Development Institute, Bathalegoda, Ibbagamuwa

* mojith@agri.pdn.ac.lk

Validation of Implexx Sap Flow Sensor to Determine the Crop Water usage of Oil Palm (*Elaeis guineensis*)

Chandrasekara K.A.H.D., Nissanka S.P.*, Abeyrathna R.M.R.D.[1] and Vidana Gamage D.N.[2]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Assessing water use by perennial crops is important to select appropriate crops and cultivation regions to minimize any negative impacts on the environment, though it is difficult due to their spatiotemporal, biotic/abiotic influences and management complexities. The Implexx Sap Flow Sensor (ISFS) is a thermometric sensor that employs the heat pulse technique to assess sap flow and plant water relations of perennial plants. Since the cultivation of oil palm has been criticized for higher water consumption and drying out of the landscape, this experiment was conducted as an initial validation of the ISFS technique to determine the crop water usage of oil palm under field conditions. First, ISFS measured the Total Sap Flow (TSP) and compared it against the gravimetrically measured TSP using oil palm petiole-segments in the laboratory. The experimental setup generated a broad spectrum of TSP measurements from 3.24 mL/hr to 22.57 mL/hr by changing the water head of the setup from 55 cm to 175 cm. Data were analyzed using simple linear regression and the root mean square error (RMSE) was calculated. The results showed that the R^2 value ranged from 0.79 to 0.98 indicating a strong agreement between the ISFS and gravimetric measurements. Further, the RMSE value ranged from 0.08% to 0.32% indicating a satisfactory accuracy of ISFS measurements. After the validation, three sensors were installed in 3 leaf petioles of a mature oil palm tree and measurements were carried out for 5 consecutive days. The average water usage of an oil palm petiole was around 633 mL/day at an average ambient temperature, RH, wind speed and solar intensity of 24 °C, 80%, 2.5 km/hr and 101 W/m^2,respectively. Measuring the water usage of oil palm using ISFS was challenging and need to repeat the experiments at field conditions under varying climatic conditions to make representative conclusions.

Keywords: Crop water usage, Heat pulse velocity, Implexx Sap Flow Sensor, Oil Palm

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

Value of Improved Weather Forecasts in Agriculture: A Discrete Choice Experiment with Maize Farmers in Minipe, Sri Lanka

Ranaweera T.M.T.G.M.P.J. and Gunaratne L.H.P.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Weather forecasts are essential decision-making tools at all levels of the agricultural production systems especially in the presence of climate change risk. In this context, this study estimated the economic value of improved agro-met advisories for strengthening the resilience of farmers to combat climate variability and risk. The study introduced an improved agro-met advisory package to the maize farmers to estimate the value of different characteristics of the introduced agro-met advisory package and the overall willingness to pay for improved weather forecasts, using a Discrete Choice Experiment approach. The attributes of the agro-met advisory package included specificity (crop or area-specific), update frequency (seasonal or short-term update), additional information (selling price and market location or quantity demanded), mode of delivery (App or Interactive Text Response System), and amount of willingness to pay (LKR 100/season or LKR 150/season). The choice sets were selected based on a Partially Balanced Incomplete Block design, to manage the number of stimuli. The choice modeling questionnaire was administered to 30 randomly selected maize farmers in the Minipe area. A generalized binary logistic model was fitted, and then part-worth utilities were estimated. The analysis found that the advisories with market information were the most important attribute. The most preferred bundle of improved agro-met advisory services included disseminating through Interactive Text Response system, information on selling price and market locations, crop-specific and seasonally updated weather information. The overall willingness to pay estimates for the improved weather forecasting system was LKR 393.69/season. The study sheds light on important characteristics of agro-met advisory services that may improve their acceptability and usability among farmers. It also highlights the importance of packaging additional services including digital and ICT-based solutions, and market information along with agro-met advisories to promote demand-driven delivery systems.

Keywords: Rain fed farmers, Improved agro-met advisories, Discrete Choice Experiment, Binary Logistic Regression, Part-worth utility value

* lhpgunaratne@agri.pdn.ac.lk

A Comparative Study on Physicochemical and Sensory Properties of African Butter Seed Fat and Cocoa Fat and their Potential Food Applications

Jayathissa N.P.S., Silva A.B.G.[1], De Silva P.G.S.M.[1] and Madhujith W.M.T.*
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

African butter tree (*Pentadesma butyracea*), originally inhabited in Western African regions is a plant bearing seeds rich in edible fat. Cocoa butter is an expensive product obtained from fermented and dried cocoa beans. Extraction of fat from these two sources was done physically by using screw expellers and extracted fat was used for evaluation of sensory properties and for preparation of cookies. Furthermore, fat was chemically extracted using hexane in Soxhlet apparatus and resultant fat used for the determination of physicochemical properties. The slip melting points of African butter seed fat and cocoa fat were 37°C and 35.5°C while smoke points were 225°C and 238°C respectively. The colour values were read to be L*= 60.47±0.36, a*= -2.84±0.56 and b*= 24.14±0.16 for African butter fat and L*= 47.05±0.68, a*= 2.74±0.55 and b*= 12.36±0.16 for cocoa fat. Acid value, free fatty acid value and iodine value of African butter seed fat were 1.05±0.17 mg KOH/g, 0.53±0.09% and 48.65±3.03 g I_2/100 g respectively while the corresponding values of cocoa fat were 2.26±0.14 mg KOH/g, 1.14±0.07% and 34.31±0.97 g I_2/100 g. Solid fat content (SFC) values ranged from 31.8±0.05% to 6.85±0.07% at a temperature between 25°C to 30°C for African butter seed fat and 36.14±0.87% to 11.15±0.11% for cocoa butter. In the sensory evaluation of two raw fat samples, there was a significant difference ($p<0.05$) in preference for colour, flavour, texture and overall acceptability. In the sensory evaluation of cookies prepared by incorporating African butter seed fat and cocoa fat separately, there was a significant difference in the preference ($p<0.05$) for colour while there was no significant difference with respect to the preference for flavour, texture and overall acceptability ($p>0.05$). There is a high potential to develop African butter seed fat as a baking fat, a margarine and as a cocoa butter alternative.

Keywords: African butter seed fat, Cocoa fat, Physicochemical properties, Sensory properties, Cookies

[1]Medical Research Institute, Colombo 08, Sri Lanka

* tmadhujith@agri.pdn.ac.lk

A Survey on Effort in Quality Delivery by Copra and Traditional Coconut Oil Processors in Kurunegala District

Herath H.M.N.U., Dimbulkumbura T.C.[1] **and Samarakoon E.R.J.***
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Traditional coconut oil processing using copra is one of the ancient methods which is still widely practiced in Sri Lanka. Kiln drying method is considered the most suitable for Sri Lanka in terms of economical aspects, however, fungal development, aflatoxin production, and PAH accumulation could occur if recommendations are not followed. With the conundrum of some imported coconut oil consignments to Sri Lanka in early 2021, the authenticity of locally produced copra-based coconut oil was also questioned. The survey was conducted as a root cause analysis to investigate the processor's status of following recommendations on raw material handling and process control, with reference to good practices in coconut oil processing. Higher percentages of processors weren't following recommendations on raw material preparation in relation to sun-drying (69%) and kiln drying (56%), storage (62%), supplier control (62%), control of operation (72%), packaging and labeling (76%), and quality assurance (83%). But the majority was following recommendations with respect to incoming raw material inspection (54%), pretreatment (100%), oil extraction (57%), filtration (59%), and storage (86%). Household-level processors were following good practices to avoid contamination coming from mold-grown copra, significantly ($P<0.05$) compared to commercial-level processors. In addition, processors who target local and export market followed recommendations on process control significantly ($P<0.05$) compared to processors who target only local market. A significant positive correlation ($P<0.05$) was observed for disagreement on the myth; some types of molds grown could be removed upon washing, among processors with a higher level of experience. The study revealed that, critical stages; copra kiln drying and storage weren't according to recommendations, bringing out the possibility of developing mold growth and production of aflatoxins at prolonged storage. Therefore, an effective third-party regulatory process is an utmost requirement to authorize and improve the processing practices to ensure the quality and safety of coconut oil.

Keywords: Coconut oil processing, Copra, Good practices, Myths

[1]Nara Cocoland (Pvt) Ltd., Dankotuwa.

* rasanjalis@agri.pdn.ac.lk

An Overview of Prevalence, Associated Risk Factors of Mastitis and its Effect on Milk Calcium

Pramodaya W.G.D.T., Deshapriya R.M.C.* and Fernando P.R.M.K.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Mastitis is the most economically important disease in lactating cows, that causes a significant reduction in both quality and quantity of milk. This review focuses on the prevalence of mastitis, associated risk factors, and changes occur in milk calcium due to mastitis. About 30% of less productivity per quarter and 15% of less production per cow could be observed in mastitis affected cows whereas 20% of milk is recorded to be discarded from chilling centers. In addition, the keeping quality of processed products is drastically reduced with mastitis. The prevalence of mastitis of any given period differs among countries and regions. Irrespective to the management condition, subclinical mastitis which is characterized by invisible clinical signs and diagnostic difficulties, shows 15%-40% times higher prevalence than clinical mastitis. Clinical mastitis is often focused on a single animal, whereas subclinical mastitis is recognized as a herd problem. In addition to the two forms of mastitis chronic mastitis cases are also reported. Furthermore, mastitis is caused by different categories of microorganisms. However, bacteria are responsible for most of the reported mastitis cases. *Streptococcus agalactiae* and *Staphylococcus aureus* areresponsible for most of the mastitis cases. Management practices also has a significant influence on occurrence of mastitis whereas animals under intensive management systems show the highest (56.8%) susceptibility to mastitis. Apart from management, cow related factors such as breed, parity, stage of lactation are associated with mastitis infections. Subclinical mastitis with more than 200×10^3 Somatic Cell Count (SCC) results an 18% decrease in milk calcium content and the clinical mastitis condition with more than 800×10^3 SCC cause a 35% reduction in calcium. Although there are evidence to confirm the impact of management practices on mastitis and the reduction of milk calcium with mastitis, further research on relationship between milk calcium and mastitis is needed to draw solid conclusion.

Keywords: Mastitis, Somatic Cell Count, Milk, Mineral, Calcium

* cdeshapriya@agri.pdn.ac.lk

Application of Green Banana Flour as a Functional Food Ingredient: A Review

Sewwandi S.S.S., Samarakoon E.R.J.* and De Silva A.B.G.C.J.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Banana is an edible, nutritive fruit in the genus *Musa* and is consumed in fresh or processed forms. Green banana flour (GBF) is a gluten-free alternative for wheat-based products and is used in a variety of food applications. Annual banana production in Sri Lanka is around 780,000 metric tonnes and postharvest losses account approximately 28.8%. As a sustainable solution for postharvest losses, GBF manufacturing has been developed in many bananas growing countries and is claimed as a rich source of resistant starch, total dietary fiber, slowly digestible starch, and phenolic compounds. Since functional food application is one of the most intensively and widely promoted areas in the food industry, many studies have been accomplished to investigate the health benefits of GBF incorporated products. The objectives of this review are to discuss criteria regarding GBF production, maturity indices, raw material selection, specifications, quality and safety standards, and investigate as a functional food ingredient in different applications in the food industry. Previous research findings have shown that the health benefits of GBF are related to gastrointestinal and non-communicable diseases. In comparison to the products made with 100% of wheat flour, these products have positive effects in digestibility, human health, and biological functions namely stimulation of gut health, immunostimulatory effect, and prebiotic effect. As a rich source of prebiotics, GBF is known to have a synergetic effect with beneficial bacteria on inflammatory bowel diseases. However, not all the GBF-based products that were aimed to perform functional properties were supported by well-founded research evidence to clarify such claims. Therefore, further clinical studies are required to investigate specifications related to varietal differences, standardized dosages and age limits regarding GBF incorporated foods to emphasize better detailing of possible health effects and to investigate the mechanisms thereof.

Keywords: *Musa*, Green banana flour, Resistant starch, Functional food ingredient , Prebiotics

[1]Industrial Technology Institute, Halbarawa Garden, Thalahena, Malabe

* rasanjalis@agri.pdn.ac.lk

Assessment of Health-Safety of Ecologically Grown Vegetables

Sugathas S., Weerakkody W.A.P.* and Gunawardane C.R.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Nowadays, Sri Lanka is moving towards organic agriculture. The rejection of synthetic agro- chemicals is one of the main drivers of choice when people choose to buy organically produced foods. However, earlier studies have shown that organic crop produces are apparently free of pesticide residues. To examine this possibility for field vegetables grown Anuradhapura district, the present study was conducted taking vegetables grown under GAP (Good Agriculture Practices) certification and conventional agriculture as other treatments. It was aimed to generate awareness about the lethal effects of these pesticides on human beings as well as estimate the potential health risks associated with the pesticide. Three selected fresh vegetables species with each three replicates namely, brinjal (eggplant), long bean and chilli, for determining pesticide residues from edible parts using anhydrous sodium sulphate and ethyl acetate as the aqueous phase. Pesticide residues were determined by Thermo Scientific trace 1310 Gas Chromatography with Mass Spectrometry (GCMS). The results indicated that one long bean sample from organic or ecological origin was contaminated with Acetamide pesticide residues whereas others were free of pesticide residues. From conventional samples, acetamide, milbemycin insecticide and dithiocarbamate residues were found in long bean and only the acetamide was found in Chilli. Whereas, Gibberellic acid (plant growth regulator) was found in brinjal and long bean. However, any pesticide residue was not found in GAP vegetables. The methodology applied to the extraction procedure should be developed further to find out multiple pesticide residues in vegetables. Based on the observations made in these studies, it is proposed that more extensive monitoring, investigation covering all vegetables in all regions in Sri Lanka should be carried out to find the exact position of pesticide residues find in agriculture.

Keywords: Pesticide Residues, Vegetables, Organic, Conventional, GAP

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[1]National Institute of Post-Harvest Management, Anuradhapura

* wapweerakkody@agri.pdn.ac.lk

Bioethanol Production by Cassava Fermentation; Assessment of Pretreatment Methods

Jayasena G.K.T.A., Karunarathna A.K.* and Silva F.H.C.A.
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The global search for alternative energy sources, particularly in the transportation sector, has been motivated by rising energy demand and environmental concerns. One of the most promising alternative biofuels is ethanol produced by different sugar and starchy crops. Cassava (*Manihot esculenta*) has a strong potential as a bioethanol feedstock because of its high carbohydrate yield and ability to thrive on marginal lands. This study was conducted to produce bioethanol by fermenting heat pretreated, acid pretreated and fresh raw cassava flour using 3 types of yeast: bakery yeast, wild yeast (Kitul palm toddy sludge) and waste yeast (excess yeast from beer production). Heat pretreatment was done by heating a mixture of water and cassava flour at 60 °C for 1 hour. Acid pretreatment was done by keeping a mixture of 0.2 M H_2SO_4 and cassava flour for 90 minutes, heating up to 70 °C and neutralizing using 0.5 M NaOH up to 6-7 pH. Pretreated and raw cassava flour samples were mixed with water and 3 L of fermentation broths were prepared and 2.5 g of bakery yeast, 5% (v/v) wild yeast and 5% (v/v) waste yeast were added separately. Urea, $K_2H_2PO_4$, $ZnSO_4$, sugar, $MgCl_2$ and $CaCl_2$ were added as yeast nutrients. Ethanol production by bakery yeast and wild yeast were within the range of 1.4 - 1.7% (v/v). Ethanol production by waste yeast was ranged between 1.49 and 10.90% (v/v). Among used pre-treatments, the highest ethanol yield was obtained by acid pretreated samples and the lowest yield was obtained by the samples without pretreatment. The highest ethanol production (10.90%) was obtained by fermenting acid pretreated cassava flour by waste yeast after 72 hours of fermentation. The study revealed that acid pre-treated cassava fermentation with waste yeast is a promising method to convert the starch in cassava to ethanol.

Keywords: Bioethanol, Cassava, Fermentation, Pretreatment, Yeast

* anujica@agri.pdn.ac.lk

Calcium Fortification of Tofu with Eggshell Powder and Moringa *(Moringa oleifera)* Leaves: Physical, Chemical Properties and Sensory Evaluation

Jayasinghe K.H., Wanninayake W.M.D.P.K.[1], Himali S.M.C.[*] and Illeperuma D.C.K.[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Inadequate calcium intake, which is a major problem among many people with lactose intolerance, milk protein allergies, low income and vegans, is associated with chronic diseases such as preeclampsia, hypertension and osteoporosis. Thus, the aim of this study was to fortify tofu with calcium by incorporating eggshell powder (ESP) and dried Moringa leaf powder (MP) into soymilk as calcium fortificants. Three levels (0.2%, 0.4% and 0.6% [w/v]) of ESP or MP were incorporated into soymilk as treatments to prepare tofu samples (tofu-ESP and tofu-MP). Their sensory attributes (appearance, colour, flavour, texture and overall acceptability) were evaluated using 31 consumer panellists and a 5-point hedonic scale. Tofu-ESP and tofu-MP prepared using soymilk containing 0.2% ESP or 0.2% MP were the most preferred, as revealed by sensory evaluation. Yield, water holding capacity (WHC), calcium%, pH, thiobarbituric acid reactive substances (TBARS) and crude fat and total ash contents of the control, tofu-ESP (0.2%) and tofu-MP (0.2%) were assessed (n=3). No difference ($P>0.05$) in the yield and WHC among the three tofu types was evident. Calcium% of tofu-ESP was 1.041±0.07% (wb), and there was no difference ($P>0.05$) in the calcium% between the control and the tofu-MP. Tofu-ESP had the highest ($P<0.05$) pH. No change ($P>0.05$) in pH of the control, tofu-ESP and tofu-MP was evident during storage for 3 weeks at 4ºC. Tofu-ESP had the lowest ($P<0.05$) and the control had the highest ($P<0.05$) TBARS values. Tofu-ESP contained the lowest ($P<0.05$) amount of crude fat and the highest ($P<0.05$) amount of total ash. Even though incorporation of 0.2% ESP or 0.2% MP into soymilk did not affect the sensory attributes of tofu, preparation of tofu using soymilk containing 0.2% ESP can be recommended based on the effects of such an incorporation on increased calcium content and reduced rate of lipid oxidation of tofu.

Keywords: TBARS, soymilk, osteoporosis, preeclampsia, sensory evaluation

[1]DPO Lanka (Pvt.) Ltd., Wattala

[2]Department of Food Science & Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya

* smchimali@agri.pdn.ac.lk

Can Essential Oils be used as an Alternative for Antibiotic Growth Promoters in Improving Growth Performance and Meat Quality in Broilers?

Jayarathna Y.V.A.H.M., Perera W.N.U.*, Vidanarachchi J.K., Himali S.M.C. and Priyankarage N.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The use of antibiotic growth promoters (AGPs) in the broiler industry is banned worldwide due mainly to their residues in animal products and the consequent development of resistance against pathogenic bacteria that can reduce natural immunity. Phytogenic compounds have gained recent attention as alternatives for AGPs due to their antioxidant and anti-microbial properties. The objective of this study was to evaluate the comparative efficacy of a commercial phytogenic product [*Essencial ONE* (ES)] containing a mixture of essential oils and plant extracts, and a commercial AGP product (*Agimycin 200 WSP*) consists of chlortetracycline (CTC). The treatments were control (without ES or *Agimycin 200 WSP*); ES-1 = 0.05% v/v of ES; ES-2 = 0.1% v/v of ES; and CTC = 0.25 g/L of *Agimycin 200 WSP* and administered in drinking water. A total of 120 male 1-day-old Cobb-500 broilers (5 cages/treatment; 6 birds/cage) were used in the experiment. Growth performance, gizzard pH and meat quality of broilers reared for 35 days were evaluated. At d 35, weight gain (WG) was different by treatment ($P<0.05$). Birds provided with ES-1 had the lowest WG ($P<0.05$), while the WG of birds in Control, ES-2 and CTC were similar ($P<0.05$). Neither feed intake nor feed conversion ratio (FCR) was influenced at d 35 ($P>0.05$). However, from d 28 to d 35, FCR was different by treatment ($P<0.05$) and compared to ES-1, birds given ES-2 and CTC had the lowest FCR ($P<0.05$). Even though gizzard pH was not significantly affected ($P>0.05$), a numerically lower gizzard pH in birds given ES-1 was observed. The malondialdehyde concentration of the breast meat was the lowest ($P<0.05$) in birds given ES-2. *Essencial ONE* at 0.1% v/v can be used as an alternative for AGP in drinking water to improve WG and reduce the fatty acids peroxidation level in broiler chicken.

Keywords: Antibiotic growth promoters, Broiler, Growth performance, Meat quality, Phytogenic compound

[1]Department of Animal production and Health, Gatambe, Peradeniya

* nipunap@agri.pdn.ac.lk

Characterization of Composite Flour of Coconut Testa Flour and Wheat Flour Using Fourier Transform Infrared (FTIR) Spectroscopy

Jayasundara J.M.P.D., Arampath P.C., Marikkar J.M.N.[1*] and Gunarathna K.M.R.U.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Fourier Transform Infra-red (FTIR) spectroscopy is an emerging tool for analyzing quality parameters of food and food ingredients. Characterization of composite coconut testa flour (CTF) and wheat flour (WF) by AOAC methods and FTIR spectroscopy was performed. In this study, correlation between FTIR spectroscopic and proximate compositional data of CTF obtained from five coconut cultivars (Tall× Tall, *San Ramon, Ran Thambili, Gon Thambili* and commercial hybrid), WF of six brands and their composite mixtures. The FTIR analysis performed within the range of 4000-500 cm^{-1}. The results showed, peaks in the spectral bands were indicative of organic functional groups associated with protein, fat and carbohydrate in the samples. The spectral features of CTF were more or less similar with slight variations in intensity. When compared to CTF, the spectra of WF were found to exhibit some variations in band frequencies and intensity. The spectral features of CTF and WF indicated dissimilarities in regions of 2853-2855 cm^{-1} and 1747-1748 cm^{-1} due to differences in proximate composition. However, the peaks responsible for major biological molecules were matching. Variations in the spectra of composite flour were mainly due to the proportional differences of the carbohydrate, protein and fat contents. The calibration models were derived by partial least square regression using the calibration data set. The developed models were validated using validation data set. The model characteristics for protein, and moisture were root mean square error of calibration (RMSEC) = 1.6, root mean square error of prediction (RMSEP) = 1.6, determination coefficient (R^2) of calibration = 0.93 and RMSEC = 0.63, RMSEP = 0.88, R^2 calibration= 0.94 respectively. The correlation shown by the calibrated and validated data confirmed the statistical models based on FTIR spectral data are accurate, rapid, and convenient for the analytical authentication of composite flour of CTF and WF.

Keywords: Analytical authentication, Flour mixtures, FTIR spectral analysis, Proximate analysis, Statistical models

[1]National Institute of Fundamental Studies, Hantana Road, Kandy

* nazrim.ma@nifs.ac.lk

Constraints Faced by Farmers in Production of Buffalo Milk-Based Products in Three Divisional Secretariats in Kandy District

Senevirathna S.T.N., Prasanna P.H.P.* and Weerasooriya S.A.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

This study was conducted to asses the main constraints faced by buffalo farmers which potentially could lead to less interest of them in producing buffalo milk-based products. The study was conducted in three divisional secretariats of Kandy district namely; Pathadumbara, Panwila, and Kundasale. Information on buffalo farming and farmers' involvement in producing and selling buffalo milk products were gathered from 54 buffalo farmers using a pre-tested questionnaire. Buffalo rearing was the secondary income source for most farmers. Semi-intensive and extensive management were prominent in the area where 83% of the farms were semi-intensive with the herd size between 3 to 5. Friedman test was used to rank the constraints and comparison of constraints was done using Wilcoxon sign-rank test. Low milk production was the major constraint ($P<0.05$) of buffalo rearing which followed by lack of good breeding animals and less involvement of young generation in buffalo farming. There was no significant difference among the constraints faced by farmers in the processing ($P>0.05$). However, the technological barriers was found to be the highest-ranked constraint. Lack of skills, credit facilities, good quality raw materials and appropriate milk storage facilities were found to lead to less involvement of farmers in processing buffalo milk-based products.

Keywords: Constraints, Milk production, Breeding animals, Credit facilities, Technological barriers

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[1]Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Peradeniya

* phpprasanna@agri.pdn.ac.lk

Cultivation, Processing and Value-added products of Chili: A Review

Jayarathna S.P. and Arampath P.C.*
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Chili peppers (*Capsicum* spp.) are extensively utilized as a spice, vegetable, flavoring components, natural colorants, and in traditional remedies since ancient times. Chili pepper production of the world has been around 34.5 million tons. Annual production of dry chili in Sri Lanka has been around 57,000 metric tons. Both sweet and spicy types are consumed in a broad range of methods around the world. Some of them are green and red chili powders, green and red chili pastes, red and green chili pickles and sauces *C. annuum*, which exhibits a large variety of variations, is the most important hot pepper on a global scale, in terms of commercial production. This review presents history, production, chili cultivars, phytochemicals (capsaicinoids) and uses of chilies. Extensive scientific publications are available on health risks, diseases, effect on drying, nutraceutical and medicinal potential, constrains, future trends and solutions to problems associated with chili cultivation and industrial application including quality control of value-added products. Chili contains significant amounts of pigments that may have health benefits as well as other beneficial chemical substances such as vitamins (Vitamin C 175 mg/100 g), minerals (Calcium 15 mg/100 g), and capsaicinoids. This compound has shown to be beneficial to human health. Dietary chili and capsaicinoids, particularly capsaicin has shown potential body weight loss and anti-obesity effects and a remedy for, urinary problems. It has been recognized to exhibit antioxidant, antimicrobial, anticancer, and analgesic capacity. Chili peppers are traditionally dried using solar radiation, exposure to direct sun light, or mechanical heat drying. The effect of these drying methods on natural ingredients are discussed in this review.

Keywords: Chili pepper, Phytochemicals, Capsaicinoids, Antioxidants

* arampath@agri.pdn.ac.lk

Detection, Isolation and Identification of *Salmonella* spp. in Raw Chicken, Pork and Beef Available in Retail Outlets in Nattandiya Area

Thakshani H.S., Mendis B.E.P., Pathirage S.[1]*, Sandeepani S.A.N.[1] and Rupasinghe B.A.K.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

According to the World Health Organization, almost 1 in 10 people in the world fall ill after eating contaminated food. The most frequent causes of foodborne illness are diarrheal disease agents that account for high number of deaths. Pathogenic *Salmonella* species also cause diarrheal and invasive disease and considered one of the major causes of foodborne related fatalities. The pathogen can be transmitted mainly through contaminated meat and meat products. The consumption of meat has increased in Sri Lanka during past decades. Further, there are reports providing information about higher prevalence of salmonellosis in Sri Lanka. This research was conducted to evaluate the prevalence of *Salmonella* contamination in raw chicken, pork, and beef available for sale at retail outlets in Nattandiya, Sri Lanka. Nattandiya area was selected as it is a multicultural and multi-religious society having relatively high meat consumption pattern. Total of 25 meat samples including 19 chicken samples, 4 pork samples, and 2 beef samples were collected from randomly selected 22 retail outlets. Identification of *Salmonella* spp. was performed using horizontal method described in ISO 6579: 2002. The overall prevalence of *Salmonella* contamination in chicken samples was 10.52 % and *Salmonella enterica* serovar Kentucky was identified from those isolates. One sample out of two beef samples was tested positive for *Salmonella* and it was identified as *Salmonella enterica* serovar Newport. Contamination of *Salmonella* was not identified in pork samples obtained from the same area during the study period. It is recommended that measures be taken to reduce the contamination of raw meat with *Salmonella* as it is a vital public health concern at present. In addition, suitable food safety awareness programmes must be carried out to educate food handlers.

Keywords: Foodborne diseases, *Salmonella*, Prevalence, Detection, Isolation

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[1]Department of Food and Water Microbiology, Medical Research Institute, Colombo 08

* chansujat@yahoo.com

Determination and Systematic Tabulation of Shelf-life of Food Ingredients, and Culinary Products used in the Food Catering Industry

Chandimal A.S.J., Somaratne G.M.*, Bandara Y.D.M.D.C.Y.[1], Samarasekara M.A.[1] and Thuduwewatta N.D.[2]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Cinnamon Hotels and Resorts is a leading Sri Lankan food service industry which manages 15 four-star and five-star hotels across Sri Lanka and the Maldives. As a well-established large scale food service industry in the country, it utilizes around 2000-3000 different types of food ingredients daily to cater the demand of customers. In addition to daily use of large number of food ingredients, new packages of food ingredients are opened daily to prepare food cuisines and the remaining part is stored or ingredients from previously opened packages are utilized. There is a possibility of arising food ingredient related quality and safety-issues after opening the packages, which are mainly related to the biochemical changes of remaining food ingredient and its exposure to spoilage and pathogenic microorganisms. This research study aims to concentrate the attention of chefs on shelf-life, secondary shelf-life, storage conditions, perishability, modes of spoilage, and allergenicity information in relation to food ingredients used in Cinnamon Hotels and Resorts. The research is based on information gathered from the published international and industry data sources and the hands-on experience and inputs from chefs and key stakeholders engaged in the food quality and safety aspects of Cinnamon Hotels and Resorts. The research results consist of a guidebook (ISBN 9786245887002) and a custom-build electronic database. Both the guidebook and the electronic database provide a feasible guide of handling food ingredients for the chefs within the catering sector. This research concludes with the overall summary of information for each food ingredient category, which provides convenience of using this guidebook/software for the chefs. Outcome of the research generated a harmonized and standardized procedure among the chefs to manage the storage and associated secondary shelf-life of food ingredients and culinary products.

Keywords: Cinnamon Hotels and Resorts, Secondary Shelf-life, Perishability, Spoilage, Food Service Industry

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[1]Health, Safety and Environment, Cinnamon Hotels and Resorts, Sir Chittampalam A Gardnier Mawatha, Colombo 02

[2]Sri Lanka Institute of Information Technology, Malabe Campus, Malabe.

* gsomaratne@agri.pdn.ac.lk

Determination of an Optimum Warehouse Storage for Better Quality Retention of a Blended Ceylon Black Tea Standard

Fernando A.L.H.M., Karunathilake V.[1]*, Fernando K.R.[1], Ekanayake E.S.K.[1] and Mendis B.E.P.
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Ceylon tea maintains a good reputation in the global market. Due to higher competition among tea supplying countries, assurance of quality becomes a growing priority to get a competitive advantage. Tea storage is a key factor that determines the quality of tea. This research was conducted to determine an optimum warehouse storage for a blended black tea standard to optimize tea quality while reducing the cost of storage. The specificity of this study is that the determination of storage takes account of possible quality changing patterns of tea during main storage transitions along the value chain. Packed tea samples were stored at three cold room storage conditions and ambient storage condition, having temperature and relative humidity (RH) combinations of 20-21 ^{o}C/ 32-34%, 23-23.5 ^{o}C/ 38-42%, 24.5-25.7 ^{o}C/ 63-69 % and 27-29 ^{o}C/ 66-76% respectively. Tea quality parameters were analysed first by continuously storing tea samples for total of seven weeks at the respective warehouse storage conditions. Analysis of the same was continued by moving the samples through simulated main storage transitions that includes warehouse, shipment and final destination country storages. Tea samples from both approaches were analysed for moisture, water activity and total colour. Sensory quality parameters; flavour, colour, aroma and overall acceptability were analysed employing hedonic ranking tests. Tea stored at ambient storage condition resulted the highest quality deviations, compared to tea stored at cold room storage conditions. Among the cold room storage conditions, tea stored at temperature and RH of 20-21 ^{o}C/ 32-34% and 23-23.5 ^{o}C/ 38-42% resulted the most desirable levels of all tested quality parameters. Those two conditions were not significant at $p>0.05$ for most of the tested quality parameters. By considering both quality optimization and storage cost reduction, this study determined 23-23.5 ^{o}C temperature and 38-42% RH combination as the optimum warehouse storage condition

Keywords: Black tea, Warehouse storage, Quality, Value chain

[1]Quality Assurance Department, Dilmah Ceylon Tea Company PLC, 111 Negombo Road, Peliyagoda

* vajira.karunathilake@dilmahtea.com

Determination of Antioxidative Properties in Selected Cyanobacteria: *Chroococcidiopsis* spp., *Gleocapsa* spp., *Merismopedia* spp., Isolated from Water Bodies in Sri Lanka

Kathyana K.G.K., Jayawardena B.C.*, Liyanage R.[1], Magana-Arachchi D.N.[1] and Sewwandi S.M.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Synthetic antioxidants like butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are widely used in food industries. But some studies have indicated the adverse health impacts of consuming artificial antioxidants. On the process of discovering natural sources of antioxidants cyanobacteria takes a prominent place for its higher availability of bioactive components and the fast growth rate. This study was carried out to determine the antioxidative properties of *Chroococcidiopsis* spp., *Gleocapsa* spp., *and Merismopedia* spp., isolated from water bodies in Sri Lanka. Pure cultures were grown under laboratory conditions in BG11 medium and harvested after 1 month period. Separate extraction of water and 1:2 (V/V) methanol was carried out to each species to obtain the cell free extract. Cell free extract was examined for Total Phenolic Content (TPC), Total Flavonoid Content (TFC) and antioxidant capability by previously described methods. Water extraction of *Chroococcidiopsis* spp. had the highest TPC (2.26 ±0.09 mg GAE/g DW). Highest TFC (0.87±0.18 mg CE/g DW), highest 2, 2- diphenyl-1-picrylhydrazyl (DPPH) antioxidant activity (IC_{50}= 15.21 mg/ml) and Oxygen radical antioxidant capacity (ORAC) (112.50 ± 5.80 milimole TE/g DW) was discovered in methanol extract of *Merismopedia* spp. The water extract of *Chroococcidiopsis* spp. had the highest 2, 2'-azinobis-(3-ethylbenzothiazoline-6-sulfonate) (ABTS) antioxidant activity (13.28 milimole TE/g DW). Total flavonoid content was positively correlated ($p<0.05$) with ABTS and ORAC values, and negatively correlated ($p<0.05$) with DPPH values. *Merismopedia* spp. showed a higher antioxidant capacity than the other two species and all the three species of Cyanobacteria are rich sources of antioxidants and could be used to extract natural phenolic compounds for many industrial applications especially for food and pharmaceutical industries.

Keywords: Cyanobacteria, Antioxidants, Extracts, Applications

[1]National Institute of Fundamental Studies, Hantana Road, Kandy

* baranaj@agri.pdn.ac.lk

Development of a Paneer using Natural Coagulants with Enhanced Organoleptic Properties

Sewwandi W.A.N.W., Deshapriya R.M.C.* and Dissanayake L.M.J.N.K.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Low paneer consumption is associated with less organoleptic properties and usage of synthetic acids for milk coagulation thus this study was conducted to identify natural coagulants and organoleptic properties enhancers for paneer. A complete randomized design was conducted with lime and vinegar: 4% (v/v), 6% (v/v) and 8% (v/v) concentrations while citric acid 2% (v/v) used as the control to produce paneer with cow milk followed by sensory evaluation and analysis for fat%, protein%, moisture%, ash%, pH and titratable acidity%. Selected concentrations of natural coagulant were used to prepare paneer for the enhancement of organoleptic properties using condiments (6%w/v): T1 (cumin), T2 (garlic), T3 (pepper), T4 (cumin+pepper), T5 (cumin+garlic), T6 (garlic+pepper), T7 (cumin+garlic+pepper) and compared with the control (zero condiments). Paneer products were stored at 4 °C and titratable acidity (TA)%, pH, total aerobic plate count (CFU/g) were measured. Paneer produced with 6% vinegar and added garlic and pepper (T6) obtained the highest consumer preference (5 point hedonic scale with 25 panelists). However, paneer produced with natural coagulants showed less (p<0.05) yield%, fat%, protein% & moisture% compared to the control. TA% of the products except lime (8%v/v) were lower (p<0.05) compared to the control (2% citric). All condiment-based paneer showed lower (p<0.05) fat% and protein% compared to the control. There was a significant effect for pH, TA%, and microbial counts by the storage period. TA% of all the products were lower (p<0.05) compared to the control with storage period (12 days) and TA% of paneer with added garlic and pepper (T6) had no difference (p>0.05) from day 4-12. TPC and the yeast-mold count increment of the condiment-based products were not different compared to control (p>0.05). Hence, there is a potential for making paneer using 6% vinegar and added garlic and pepper (6%w/v) with enhanced organoleptic properties for Sri Lankan consumers.

Keywords: Paneer, Organoleptic properties, Natural coagulants, Condiments

* cdeshapriya@agri.pdn.ac.lk

Development of a Quality Management System for Nikakotuwa Estate Dairy Processing Plant

Senanayake K.S.W.M.R.V.P., Vidanarachchi J.K.* and Priyashantha H.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Increasing demand for safe and high-quality dairy products have led to the implementation of quality management systems in dairy processing plants. Hazard Analysis Critical Control Point (HACCP) system systematically prevents hazards throughout the food production process. The objective of this study was to develop a HACCP plan for yoghurt (yoghurt, Greek yoghurt, labneh), cheese (paneer, mozzarella, cream cheese) and processed milk (pasteurized milk, low-fat milk) manufactured by Nikakotuwa Estate Dairy Processing Plant, which is having a greater need for improving food quality and safety. Prior to developing the HACCP plan, the existing pre-requisite programs, the nutritional composition of products and their labels were evaluated, and suggestions were made for improvements. As the first step in developing the HACCP plan, products were described based on their analyzed composition. Process flow diagrams were developed for each product to identify potential biological, chemical and physical hazards associated with each step in the production processes. The significance of the identified hazards was determined using a risk assessment level. A Critical Control Point (CCP) decision tree was used to identify the CCPs. The final HACCP plan was developed by establishing critical limits, monitoring procedures, corrective actions, reports and verification procedures for the CCPs. According to the findings of this study, the important CCPs includes the milk pasteurization temperature, incubator temperature and cold storage temperature. By comparing the analyzed nutritional composition of the products with the Sri Lanka Standard Institute Standards for yoghurt, cheese and processed milk, it was found that paneer, mozzarella and low-fat milk have failed to comply with the standard requirements in terms of the fat content. Implementation of improved pre-requisite programs, HACCP plans, standard labelling methods with nutritional information and milk fat standardization methods would improve the quality and safety of products manufactured by Nikakotuwa Estate Dairy Processing Plant more cost-effectively.

Keywords: Food safety, HACCP, CCPs, Dairy products

[1]Department of Molecular Sciences, Swedish University of Agricultural Sciences, P.O. Box 7015, SE-750 07 Uppsala, Sweden

* janakvid@agri.pdn.ac.lk

Development of Collagen-Incorporated Tea (*Camellia sinensis*)

Senevirathna W.G.S.R., Wijesinghe D.G.N.G.*, Jayawardene L.P.I.N.P.[1] and Gunathilaka W.L.C.M.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Tea is the second most popular beverage in the world. Collagen is the most abundant protein in the body which degrades with time leading to aesthetic, functional and health problems. Due to the busy lifestyle of consumers, it is hard to take all the required ingredients adequately through foods. Therefore, in the modern world, technology is used to find more effective and efficient products for the society. Objectives of the present research were to develop collagen-incorporated tea and evaluate its consumer acceptability. From the preliminary sensory tests, the suitable collagen type was selected. Suitable tea type for collagen incorporation was identified from the paired preference test. The BOPF black tea and BOPF green tea were the most consumer preferred tea types ($p<0.05$). The sensory attributes, color, aroma, flavor and overall acceptability were evaluated in 2 dosages of collagen (0.83 g and 1.25 g) incorporated tea with 2.5 g of tea as the control sample using Friedman test. With collagen incorporation, there was a significant difference ($p<0.05$) for color, aroma and overall acceptability of black tea samples. In green tea samples, there was no significant difference ($p>0.05$) in color, aroma, flavor and overall acceptability. Mean comparison results revealed that in black tea, color and aroma were highest in the control sample while flavor and overall acceptability were highest in 1.25 g collagen-incorporated sample. In green tea, color and overall acceptability were almost the same while the flavor and aroma were highest for the control sample and 1.25 g collagen-incorporated sample, respectively. The results of this study reveal that for a standard BOPF tea bag of 2.5 g, 1.25 g of collagen can be incorporated without affecting sensory properties.

Keywords: Collagen, Oral supplement, Protein synthesis, Sensory evaluation, Tea

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[1]Aletek International (Pvt) Ltd., Ranaviru Prabhath Cooray Mawatha, Rajagiriya

* wijeng@agri.pdn.ac.lk

Development of Dietary Fiber Enriched Cookies by Incorporating *Avena sativa* (Oats), *Lasia spinosa* (Kohila), and Banana Blossom

Maddumaarachchi S.N., Wijesinghe D.G.N.G.* and Lankachandra S.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Dietary fibre is known to provide several health benefits including a lower risk for developing certain gastrointestinal diseases, coronary heart disease, obesity, stroke, and diabetes. This study was designed to formulate ready-to-eat cookies by incorporating rolled oats, banana blossom flour and kohila rhizome flour. These ingredients were selected considering their nutritional and health benefits. Five points hedonic test was carried out to evaluate the consumer acceptance of the final 3 products made using the above ingredients, which were selected during preliminary studies. Oats powder (15%) was common to all 3 products. In addition, each product contained either 15% kohila flour, 15% banana blossom flour or 7.5% each of kohila flour and banana blossom flour. The remainder of the dough mixture constituted of wheat flour, corn starch, margarine, sugar and baking powder. Cookies were evaluated using thirty un-trained consumer panelists for sensory attributes: colour, taste, mouthfeel, aroma, texture and overall acceptability. There was a significant difference ($p<0.05$) in the overall acceptability of 15% kohila and 15% oats incorporated sample compared to other two samples, and there was no significant difference ($p>0.05$) in overall acceptability between the other two samples. According to sensory analysis, 15% kohila flour and 15% oats incorporated cookies obtained the highest consumer acceptability, and the content of dietary fiber in these cookies was 4.3 g/100 g. Findings of this study revealed that 15% kohila and 15% oats incorporated sample can be used as a source of dietary fiber which was beneficial to improve the health of the consumers. Analysis of Fe, vitamin A and glycemic index of the cookies is recommended for further studies.

Keywords: Dietary fiber, Cookies, Kohila, Oats, Banana blossom

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[1]S.A.Silva & Sons Lanka (Pvt) Ltd., Lolluwagoda, Gampaha

* wijeng@agri.pdn.ac.lk

Development of Low-Fat, Spicy Probiotic Greek-Style Yoghurt Spread

Hettiarachchi A.M.L.C., Jayawardene L.P.I.N.P.[1] **and Madhujith W.M.T.***
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Greek-style yoghurt, also known as concentrated yoghurt or strained yoghurt is a fermented semisolid milk product resulting from draining away a part of its water-soluble components. Straining generates whey with high lactic acid content. Unless properly disposed of, it can cause serious environmental problems. This study aimed at developing a low-fat Greek-style yoghurt spread, incorporating probiotics, pepper (*Piper nigrum) and* garlic (*Allium sativum* L.) as spices to give a novel experience to Sri Lankan consumers while reducing acid whey generation during manufacturing. Minimizing the accumulation of acid whey at the point of origin is an effective method to control acid whey generation. Elevation of total protein content in the initial milk base can prevent the accumulation of acid whey and can avoid straining step in manufacturing. To attain desirable characteristics in the final product and to increase the total protein content, skim milk, whole milk powder, skim milk powder, and milk protein concentrate (MPC85) were added and obtained 6.8, 7.0, 7.2, 7.4 and 7.6% total protein content in the initial milk base. Based on the consumer-oriented sensory test and Physico-chemical evaluation, the best protein incorporation (7.2%) was selected. The proximate composition of the final product on a dry weight basis was 65.3% of moisture, 1.5% of fat, 7.2% of protein, and 26.0% of total dissolved solids. The final product was considered as a low-fat spread. The pH level of the final product was within the permitted level of the WHO after one week and it has the potential of 28 days of shelf life. Further increase of protein content in the initial milk base, reduced the generation of acid whey during manufacturing and it leads to the very thick consistency of the final product which has sticky nature that results in reduced consumer acceptability.

Keywords: Acid Whey, Greek-Style Yoghurt, Milk Protein Fortification, Product Development, Sensory Test

[1]Aletek International (Pvt) Ltd., Ranaviru Prabhath Cooray Mawatha, Rajagiriya

* tmadhujith@agri.pdn.ac.lk

Development of *Strychnos potatorum* (Inginee) Incorporated Chicken Sausages: Physicochemical and Sensory Properties

Ranaraja R.W.M.R.K.V., Himali S.M.C.* and Wanninayake W.M.D.P.K.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Strychnos potatorum (Inginee) is used in Ayurveda and herbal preparations because of its many health benefits. The aim of this study was to investigate the effects of incorporation of *Strychnos potatorum* roasted seed powder (SPSP) and aqueous extract (SPAE) on physicochemical and sensory properties of precooked chicken sausages. Two sensory evaluations were conducted to find out the best levels of SPSP and SPAE to be incorporated to sausages along with the control sample. The sensory evaluations revealed that sausages prepared with of 1% SPSP w/w (T1:1-SP), 24% (w/w) of SPAE obtained from 0.25 g SPSP/mL (T2:0.25-AE) and 24% (w/w) of SPAE obtained from 0.50 g/mL SPSP (T3: 0.5-AE) were preferred by the panelists. The pH, water holding capacity (WHC), cooking loss (CL), 2-thiobarbituric acid reactive substances (TBARS), total viable plate counts (TVPC), proximate composition (n=3) and sensory evaluation of treatments and control sausages were assessed. The highest and the lowest (p<0.05) pH were recorded with 0.25-AE and 1-SP sausages, respectively. The WHC decreased with increasing incorporation of SPAE while 1-SP showed no (p>0.05) difference compared to the control. All three treatments showed significantly lower CL compared to the control. The 1-SP sausages recorded the lowest TBARS value (p<0.05). Incorporation of *Strychnos potatorum* powderor extracttosausages significantly reduced the TVPCs compared to the control. The dry matter, crude protein and crude fiber contents significantly varied among the control and the treatments. Results of the sensory evaluation revealed that panelists preferred 0.25-AE sausages with holding the highest (p<0.05) median scores for appearance, taste and overall acceptability attributes. It can be recommended that incorporation of 24% (w/w) SPAE obtained from of 0.25 g SPSP/mL can be effectively used to produce chicken sausages with improved sensory properties and antimicrobial effect for precooked chicken sausage production

Keywords: Seed powder, Sensory, TBARS, Cooking loss, Antimicrobial

[1]DPO Lanka (Pvt.) Ltd., Wattala

* smchimali@agri.pdn.ac.lk

Development of Sugar-Free Flavored Instant Iced Tea Premix

Hettiarachchi A., Wijesinghe D.G.N.G.*, Jayawardene L.P.I.N.P.[1] and Gunathilaka W.L.C.M.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Tea (*Camellia sinensis*) is a world popular beverage with many health benefits. Iced tea is a cold, Ready to Drink (RTD) tea beverage. Development of iced tea premixes using instant tea powder is convenient, cost effective and has the expected chemical and health properties of tea, in addition to its good reconstitution and high solubility. This study was conducted with the objective of developing sugar-free iced tea premixes to be introduced to the market. Iced tea premixes were developed using instant black tea powder, ascorbic acid, tri-sodium citrate, citric acid, sucralose and maltodextrin with four flavors: apple, ginger, bergamot and cardamom. After several preliminary trials, 2 formulations were prepared for each flavor by slight alterations of the above ingredients. To identify the sensory properties of tea premixes, colour, aroma, mouthfeel and overall acceptability were determined using a five-point hedonic scale with thirty in-house semi-trained panelists and based on the analysis the best out of the 2 formulations was selected for each flavor. Data analysis was done using SPSS 26 statistical software with $p < 0.05$ level of significance. For the iced tea premixes, panelists preferred formulation 2 for apple flavor, formulation 1 for ginger flavor and formulation 2 for cardamom flavor but for bergamot flavor none of the formulations were preferred. Regarding flavors, apple flavor was the most preferred followed by ginger, cardamom and bergamot flavor, respectively. Based on sensory analysis, three flavors were identified as suitable for the development of instant iced tea premix. Further improvements of selected premixes and analysis for physicochemical properties during storage are needed before introducing them to the market.

Keywords: Iced tea, Sugar-free, Instant tea, Premix, Sensory analysis

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[1]Aletek International (Pvt) Ltd., Ranaviru Prabhath Cooray Mawatha, Rajagiriya

* wijeng@agri.pdn.ac.lk

Effect of Calcium Fortification with Chicken Eggshells on Physicochemical and Sensory Characteristics of Toffee

Karaputugala K.G.A.C.T.C., Himali S.M.C.* and Chamal H.G.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Chicken eggshell has become a new candidate among natural calcium fortifying agents in food industry because of the high bioavailability of Calcium in chicken eggshell. The objectives of this study were to develop toffees fortified with calcium from chicken eggshell powder (ESP) and to investigate them for physicochemical and sensory attributes. The ESP (particle size <32 µm) was prepared in sterile form using white chicken eggshells with membranes. Five levels of ESP (0.375%, 0.75%, 1.5%, 3%, and 6% w/w) incorporated toffees were prepared and the best levels of 0.375%, 0.75% and 1.5% ESP were selected through preliminary trials. Toffees with selected ESP levels and the control sample were subjected to analysis of moisture, pH, total soluble solids (TSS), reducing sugars and Calcium contents. The sensory evaluation was conducted with 35-untrained panelists by using 5-point hedonic scale. With increasing levels of ESP in toffees, a decreasing (p<0.05) trend of the moisture contents was observed. The lowest pH was recorded with the control (6.68 0.05) while the pH increased (p<0.05) from 8.30 0.01 to 8.55 ± 0.00 with increasing levels of ESP. The highest (p<0.05) TSS content (12.92 0.27 °Brix) was recorded in the control sample, while the lowest (12.37 °Brix) was observed in 1.5% ESP incorporated toffee. Incorporation of ESP, has increased the Calcium contents from 0.11 0.01%to 0.16 0.00% (p<0.05) in toffees. The reducing sugar contents showed inconsistent variation among toffee samples. The sensory evaluation revealed that the toffee incorporated with 0.375% ESP had high scores for flavor, mouthfeel and overall acceptability and similar score for colour compared to the control toffee. With increasing levels of ESP, the pH, TSS and sensory attributes of toffees were affected. Thus, toffees can be fortified with 0.375% level of ESP.

Keywords: Bioavailability, Sensory, Mouthfeel, Total soluble solids, Reducing sugars

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[1]YEZ Beverage Pvt Ltd, Ceylon Lion Confectionery (Pvt) Ltd

* smchimali@agri.pdn.ac.lk

Effect of Chemical Interesterification on Physicochemical Properties of Rice Bran Oil and Palm Stearin Blends

Edirisuriya P.W., Arampath P.C.*, Gangodavila N.[1] **and Sewwandi S.D.C.**[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Chemical interesterification is one of the major processes used in the production of commercial fat-based products. Palm stearin (PS) is the higher melting fraction of *palm oil,* with a higher proportion of saturated fatty acids. Rice bran oil (RBO) is a healthy, low melting oil composed of unsaturated fatty acids. The main objective of this study is to determine the effect of chemical interesterification on physicochemical properties of rice bran oil and palm stearin blends. In this research, blends of rice bran oil and palm stearin at different proportions were chemically interesterified using sodium methoxide catalyst. The subsequent determinations were conducted on iodine value, peroxide value, free fatty acid content (FFA) and slip melting point (SMP) before and after the interesterification reactions. The bakery margarine was prepared using interesterified and physical blends and SMP was compared. Statistical analysis was performed with an independent sample T-test to compare the means and Post hoc Tukey's test to compare the differences. The iodine value and peroxide value of the interesterified fat were decreased, while FFA content was increased. The research findings indicated that all interesterified blends had a low SMP value compared to the non-interesterified blends due to extensive rearrangement of fatty acids among the triacylglycerol's. Further, chemical interesterification are effective techniques to modify the physicochemical properties of RBO, PS, and blends. The iodine values of all interesterified blends of palm stearin to rice bran oil (40:60, 50:50, 60:40 and 70:30) were not significantly different ($p<0.05$). The peroxide values of RBO: PS, 40:60 and 70:30 interesterified mixtures were unchanged. There was no significant difference between 40:60, 60:40 and 70:30 interesterified mixtures for FFA. The SMP of the 40:60 and 50:50 interesterified blends remained unchanged ($p<0.05$). Resulted interesterified fat has a potential to use in manufacture fat spread and margarine.

Keywords: Iodine value, Margarine, Oil blends, Peroxide value, Slip melting point

[1]Raigam Marketing Services (Pvt) Ltd, Homagama

* arampath@agri.pdn.ac.lk

Effect of Moisture Loss and Egg Quality Characteristics on Commercial Hatchery Performance of Broiler Breeders

Hasinthara H.A.W.M., Dematawewa C.M.B.*, Wickramarachchi M.K.[1], Lakmini A.[1], Nandadasa K.[1] and De Silva V.G.D.T.[2]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Superior hatchery performance is crucial for maximizing profits in poultry breeder operations. This study was conducted in a commercial hatchery in the North Western province to determine the effect of yolk index (YolkIND), shape index (ShapeIND), shell thickness (ShellTH), moisture loss (MoistureLS), and yolk to albumen ratio (YARatio) on fertility % (FertPCT), hatchability % (HatchPCT), hatch of fertile % (HoF) and chick yield (ChickYLD,) as well as the effect of egg size (grade) and age of breeder hens on the above egg quality parameters. A total of 56,376 eggs from Arbor Acres broiler breeder hens in two commercial breeder farms were used in the study. The eggs were graded into 3 groups (ST: 52-57 g, PR: 58-64 g, and PA: 65-72 g). Breeder hens belonged to two age groups; 38 weeks and 56 weeks, and recording was continued for 8 weeks. YolkIND, yolk weight, albumen weight, egg weight, and ShapeIND were recorded randomly from eggs of each age and grade group before setting eggs. Egg weights were measured at the setting and at the point of transfer to the hatcher (19th day) to calculate MoistureLS. ShellTH and ChickYLD were measured at hatching. Overall means of FertPCT, HatchPCT, HoF, ChickYLD, YolkIND, ShapeIND, and MoistureLS were 91.81%, 87.87%, 95.61%, 0.67, 0.39, 77.6%, and 10.12 g, respectively. Results of the regression analysis revealed significant increases in FertPCT with YolkIND, and HatchPCT with ShapeIND as well as with ShellTH ($P<0.05$). Significant reductions could be observed in ChickYLD with MoistureLS, and HatchPCT with YARatio ($P<0.05$). The results of analysis of variance confirmed that FertPCT, HatchPCT, ChickYLD, and ShellTH increased with egg grade while YolkIND, ShellTH, and YARatio dropped significantly ($P<0.05$). As hens became older, significant reductions could be seen in HatchPCT, YolkIND, ShapeIND, and ChickYLD while MoistureLS, ShellTH, and YARatio increased significantly ($P<0.05$).

Keywords: Chick yield, Hatchability, Moisture loss, Shell thickness, Yolk index

[1]CIC Hatchery, Nabiriththankadawara, Welipennagahamulla

[2]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya

* dematawewa@agri.pdn.ac.lk

Evaluation of Grain Quality Characteristics of Selected Rice Breeding Lines with that of Selected Rice Varieties

Bandara E.M.S.M., Mendis B.E.P., Priyantha W.S.[1*], Wanisekara W.M.C.D.[1] and Silva N.R.N.[2]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Development of new rice varieties targets to improve grain quality traits suitable for consumption, processing and product development. This study was conducted to evaluate grain quality characteristics of six selected rice breeding lines with that of six selected rice varieties aiming to recommend for consumption or rice-based product processing. Physical properties, cooking and eating properties, sensory and nutritional properties were assessed and compared within same grain type categories. Except for true density, porosity, ash and moisture percentages, all the other parameters of tested breeding lines showed significant difference ($p<0.05$) compared to that of tested rice varieties. All the rice breeding lines except *MA2* and *Bg 19-3093* and tested rice varieties except *Pusa Basmati* exhibited intermediate gelatinization temperatures (70-74 ^{o} C). Rice lines except *MA2* and *Bg 19-3093* and all the examined varieties exhibited high amylose (25-33%) content. Crude protein content was not significantly different *(*$p>0.05$) within same grain type rice lines and varieties while fat percentages were significantly different ($p<0.05$) within same grain type lines and varieties. Same grain type rice lines and varieties did not exhibit any significant difference ($p>0.05$) for both water absorption and volume expansion ratios. Sensory evaluation was conducted using six-point hedonic test to compare taste, aroma, appearance, cohesiveness and tenderness of varieties and lines. Considering tested quality parameters, this study confirmed that *Bg 19-3093* rice line can be used as a substitute for *MA2* rice line, which is already in use commercially for the preparation of snacks. Also, *Bg 19-2935* rice line can be used as a substitute for same grain type *Bg 360* (*Keeri Samba*), which is a variety currently having high market demand. Furthermore, the results of this study support in deciding the use of these new rice breeding lines upon releasing for consumption and food product processing.

Keywords: Grain quality, Rice, Lines, Varieties, Evaluate

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[1]Rice Research and Development Institute, Bathalegoda, Ibbagamuwa
[2]Horticultural Crop Research and Development Institute (HORDI), Department of Agriculture, Gannoruwa, Peradeniya
* keenawalapriyantha@yahoo.com

Fish Processing Technologies and Fish Consumption Patterns among Inland Reservoir-based Fishing Community in Kalawewa Reservoir, Sri Lanka

Senevirathna S.G.M.N.J., Dissanayake U.I.[1], Edirisinghe U.[2] and Himali S.M.C.*
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Fish processing technologies and fish consumption of fishing community based on Kalawewa area were studied. A self-administered questionnaire was used to collect information from randomly selected 50 fishermen from 3-fish landing sites out of 5-fish landing sites of Kalawewa Reservoir. Binary logistic and ordinal logistic regression analysis were conducted to find out determinants that affect fish processing and consumption. There were 26 fishermen engaged in fish processing while 38% of them preserved fish at monthly frequency and all of them practised fish smoking (100%). Whereas 53% engaged in salting and sun drying of fish. The most common fish species used for smoking was Tilapia (32%). Household smoking kilns were used for fish smoking and, 46% of fishermen smoked fish and generated an extra income. The use of fish processing technologies had a significant positive relationship with availability of fish storage facilities ($p<0.05$). The amount of inland fish consumption/week and the number of fishing days had a positive relationship. Out of total fishermen, 42% of their households consumed 2-3 kg of inland fish/week, whereas 66% of families rarely consumed marine fish. The most commonly practised inland fish cooking method was cooking of fish with chili and other spices (*Mirisata*) (100%), followed by cooking with spices and coconut milk (*Kirata*) (76%) and cooking after deep frying with coconut oil (76%). Preparation of devilled-fish (46%) and sour fish (*Ambulthial*) (36%) was less common. Major challenge faced by fishermen was lack of fish harvest due to high density of tank cleaners (*Hypostomus plecostomus*) and aquatic plants. In Kalawewa fisheries community, the inland fish processing is positively related to the availability of fish storage while, fish consumption is positively related to the number of fishing dates. Smoking of fish is the main processing technology practised and cooking fish *Mirisata* is highly popular.

Keywords: Smoking, Salting, Drying, Tilapia, Cooking methods

[1]Department of Agricultural Extension, Faculty of Agriculture, University of Peradeniya, Peradeniya
[2]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya
* smchimali@agri.pdn.ac.lk

Formulation of a Sausage Analogue using Ash Plantains, Mushrooms, Carrots, Oats and Chickpea Flour

Wathsala H.M.J.W., Himali S.M.C.* and Illeperuma D.C.K.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Number of consumers turning towards plant-based lifestyles has increased due to religious norms, parental and peer influences and issues concerning animal welfare, environment and health. Limited types of sausage analogues are available in Sri Lanka for consumers to choose from. Therefore, the objective of this research was to formulate a sausage analogue using ash plantains, mushrooms, carrots, oats and chickpea flour as the main ingredients. Key sensory attributes of three formulae containing varying amounts of main ingredients (12-15% of ash plantains, 5-10% mushrooms, 10-13% of carrots, 5.0-7.5% of oats and 5-10% of chickpea flour) as treatments were compared with a market sample, using 30 consumer panellists and a 5-point hedonic scale. The formula possessing the most preferred sensory attributes (appearance, colour, aroma, flavour, texture, juiciness and overall acceptability) was selected. Proximate composition and cooking loss of the selected formula were assessed. Moisture, crude protein, crude fat, crude fiber and total ash contents of 57.47 ± 2.50, 29.47 ± 0.55, 36.70 ± 0.58, 9.34 ± 0.95 and 5.31 ± 1.29%, respectively, and cooking loss of 0.53% were evident in sausage analogue. Water holding capacity, pH and 2-thiobarbituric acid reactive substances (2-TBARS) value of the selected formula evaluated after storage for 1 week at -18 ^{o}C were 51.98 ± 0.83%, 6.8 ± 0.09 and 0.57 ± 0.06 mg of malondialdehyde/kg, respectively. Total viable plate count (TVPC) of the formula after storage for 2 weeks at -18 ^{o}C was 4.36 ± 0.00 log CFU/g. The formula containing ash plantains (12%), mushrooms (9%), carrots (10%), oats (5%) and chickpea flour (5%) can be recommended as main ingredients for manufacturing sausage analogues possessing preferable sensory attributes. Conducting further research on shelf life is required, as revealed by 2-TBARS value and TVPC, to find out the need for incorporation of preservatives.

Keywords: Sausages, Vegetable based, Vegan, Oat, Chickpea

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[1]Department of Food Science & Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya

* smchimali@agri.pdn.ac.lk

Impact of Deficit Irrigation and Addition of Biochar in Coco-peat Medium on Growth and Development of Tomato

Dangalla D.U.I., Weerakkody W.A.P.* and Gunasena A.[1]
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Biochar is an amendment which improves the water and nutrient status in the growing media, ultimately contributing to crop productivity. A greenhouse experiment was conducted to investigate the effects of biochar amendment in coco-peat media in combination with deficit irrigation on growth and development of tomato. Four different biochar application rates (M1=10:0, M2=8:2, M3=6:4, and M4=4:6; coco-peat: Biochar) were tested in combination with three irrigation regimes (W1=100%, W2=75% and W3=50% of the reference field capacity) for tomato (*Solannum lycopersicon* L.). In W1, the plants were irrigated daily upto the field capacity while in W2 and W3, the irrigation were restricted to 75% and 50% of the W1, respectively. The total water used in nursery stage was 128 ml for W1, 91 ml for W2 and 74 ml for W3 while in the 8 weeks after transplanting stage the same were 7.34, 5.505 and 3.67 L per plant, respectively. The experiment was conducted in 3 replicates using the biochar produced from coconut shell pyrolysis (at 1000-1200°C). According to overall performance, the highest plant growth, reproductive parameters and leaf N and leaf P were found in M2, followed by M1 and M3, compared to M4 in irrigation regimes, W1 and W2. Media nutrient content, pH and EC were significantly ($p<0.05$) higher in M3 and M4. All parameters were significantly less in W3 in all four media except media nutrient content, root length and EC. Research concluded that, M2 was the best biochar amendment rate, followed by M1, M3 when combined with W2 with respect to crop growth and development and also the irrigation water use efficiency. Therefore, integration of biochar along with deficit irrigation can be considered as an effective technology for greenhouse tomato cultivation.

Keywords: Biochar, Coco-peat, Deficit Irrigation, Protected Tomato Culture

[1]Jiffy Products S.L. (Pvt) Ltd., Kobeigane

* wapweerakkody@agri.pdn.ac.lk

Milk Clotting Properties of *Bryophyllum pinnatum*, *Calotropis gigantea*, and *Solanum incanum* Crude Proteases on Bovine, Buffalo, and Goat Skimmed Milk

Hettiarachchi H.T.M., Vidanarachchi J.K.* and Priyashantha H.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Plant proteases are in increasing demand to coagulate milk in cheesemaking, as an alternative to calf rennet (CR), due to limited availability, dietary restrictions, and high price. The present study investigated the milk clotting properties of crude protease extracts from immature leaves of *Bryophyllum pinnatum* (BP), tender stems of *Calotropis gigantea* (CG), and ripened fruits of *Solanum incanum* (SI) on skimmed cow, buffalo, and goat milk compared to CR. Milk samples were incubated at 37°C for 5 minutes before the addition of proteases, and the time taken to the appearance of the first visible milk clots within 60 minutes were recorded. Further, milk samples were incubated at different temperatures (28, 37, 45, 50, and 60°C) to determine the effect of temperature on milk clotting activity (MCA) of crude proteases. The lowest (p<0.05) proteolytic activity (PA; 2.19±0.23 Units/mL) was observed in BP, while CS, SI, and CR showed similar (p>0.05) values. Crude proteases of BP showed the highest (P<0.05) MCA (3523.39±68.68 Units/mL) and milk clotting index (MCI; 1608.85±31.36) on goat milk compared to all other milk samples. Calf rennet and BP showed the same (p>0.05) MCA on cow milk; however, the MCI of BP was higher due to low PA. Only BP, SI, and CR showed MCA on buffalo milk. All the crude proteases showed their optimum MCA on cow milk at 60°C while, optimum MCA on buffalo milk was observed at 50°C. Crude proteases of BP showed the optimum MCA on goat milk at 60°C and appeared to be the best source for goat milk. The study provides evidence of MCA associated with all the crude proteases; however, BP proved to be the most suitable rennet substitute for cheesemaking. Nevertheless, further studies will merit the optimisation of conditions and casein hydrolysing patterns of crude proteases and their suitability for cheesemaking.

Keywords: Plant proteases, Vegan coagulants, Milk clotting activity, Milk Coagulation, Cheesemaking

[1]Department of Molecular Sciences, Swedish University of Agricultural Sciences, P.O. Box 7015, SE-750 07 Uppsala, Sweden

* janakvid@agri.pdn.ac.lk

Mineral and Amylose Content of Selected Popular Rice Varieties in Sri Lanka

Herath H.M.W.U., Senanayake D.M.J.B.[1*], Wimalasiri K.M.S. and Silva N.R.N.[2]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Rice (*Oryza sativa*) is the staple food of Sri Lankans. This study was carried out to investigate the Fe and Zn content, milling quality, physical quality, cooking quality and sensory attributes of the most popular rice varieties grown in Sri Lanka. According to the cultivating extent ten most popular rice varieties namely, At 362, Bg 352, Bg 300, Bg 360, Bg 366, Bw 367, Bg 94-1, Bg 358, At 308 and Bg 359, were selected for this study. Brown rice, semi-polished rice and completely polished rice of each variety were used to analyse different attributes. Milling quality of rice were determined using hull percentage, head rice percentage and degree of milling. The results indicated that density of rice increased, while porosity changed in reverse fashion, with milling extent. The water absorption ratio of rice varieties were increased gradually with the polishing time and the volume expansion ratio of rice varieties was affected considerably by variety and polishing extent. All the varieties were categorized as high amylose content in completely polished condition. The rice flour samples, were analysed for the moisture, amylose content, Fe and Zn contents. Mineral content was analysed using inductively coupled plasma - optical emission spectrometry (ICP-OES). Mineral contents were higher in brown rice than in polished rice. There was a significant difference in Fe content and Zn content among varieties ($P<0.05$). The highest Fe and Zn contents were observed in Bw 367 and At 308 varieties, respectively. In comparison to all rice varieties analysed, Bg 360 was found to have low Fe and Zn contents, while Bg 360 was the most consumer preferred variety which showed the best cooking quality.

Keywords: Mineral content, New improved rice varieties, Brown rice, Polished rice

[1]Rice Research and Development Institute, Bathalegoda, Ibbagamuwa
[2]Horticultural Crop Research and Development Institute (HORDI), Department of Agriculture, Gannoruwa, Peradeniya
* dmjbsenanayake@gmail.com

Nutritional, Physicochemical, and Sensory Properties of Kithul (*Caryota urens*) Flour Incorporated Chicken Sausages

Bandara M.G.K.S., Jayawardena B.C.*, Liyanage R.[1] and Fernando P.R.M.K.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The consumption of convenient food products such as sausages has increased its demand over the last few decades due to the change of lifestyles in Sri Lankan population. However, the consumers' concerns about healthy foods compel the meat processors to incorporate locally available natural ingredients with various functional properties into meat products to improve their quality. Kithul (*Caryota urens)* flour is one of the locally available starch sources with known health benefits. However, its application at the industrial level is limited. Therefore, this study evaluated the potential of incorporating Kithul flour (KF) as a starch source instead of wheat flour to improve the health attributes of chicken sausages. In this study, nutritional, physicochemical, and sensory properties of KF incorporated chicken sausages were evaluated. Chicken sausages were prepared by replacing wheat flour with KF at three different levels; Treatment 1 (3% KF), Treatment 2 (5% KF), and Treatment 3 (7% KF), and compared with the control (C), added 5% wheat flour. Three percent KF incorporated sausages was identified as the most preferred by sensory evaluation and supported by higher ($P<0.05$) crude fiber, and pH compared to the control. However, water holding capacity (WHC) and colour (L* value) were lower ($P<0.05$) in 3% KF incorporated sausages compared to the control. Decreased values for thiobarbituric acid reactive substances (TBARS) (0.2123 mgMA/kg) and shear force (6.43 N) were observed in 3% KF incorporated sausages compared to the control. There was no difference ($P>0.05$) in drip loss and cooking yield of 3% KF incorporated sausages compared to the control. This study identifies the significant antioxidant potential of KF at a level of 3% in chicken sausages without having any adverse effects on nutritional, physicochemical, and sensory properties.

Keywords: Kithul flour, Chicken sausages, Physicochemical, Nutritional, Sensory properties

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[1]National Institute of Fundamental Studies, Hantana Road, Kandy

* baranaj@agri.pdn.ac.lk

Online Survey of Self-Reported Food Allergy among Young Adult Students at the University of Peradeniya in Sri Lanka

Navodani H.H.A.C., Somaratne G.M.*, Maithreepala S.D.[1] and Weerasinghe L.[2]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Food allergy is a growing global health concern. It has become potentially a life-threatening condition that requires prompt action. Although the studies in Sri Lanka have addressed the food allergy prevalence among children and adolescents, there is a paucity of information on the prevalence, severity, and associated factors of food allergies among young adults of 19-29 years. This study aimed at filling the gap using undergraduates of the University of Peradeniya. A questionnaire was distributed amongst undergraduates via emails and other online platforms. Self-reported data obtained from 1169 undergraduates with a male to female ratio of 2:5; were statistically analysed. The prevalence of food allergies among undergraduates was found to be 17.5% which is considerably higher than similar studies reported from other Asian countries. It was higher among females (n=167, 20.3%) than males (n=37, 10.6%). Among socio-demographic variables gender, and average monthly family income were associated significantly with food allergy prevalence with $P<0.005$. The most commonly reported food allergens were crustaceans (5.8%), fruits (5.8%), meat (5.6%), followed by fish (3.9%), vegetables (3.8%) and milk and dairy products (2.0%). Specified allergic food types were vivid and distinctive as administered by multiple symptoms. The majority of the food allergy participants were associated with moderate symptoms manageable with western medication (49%). Currently, food allergy respondents denoted a higher level of depression ($P=0.003$) as assessed by the PHQ-9 self-administered mentality screening tool. Additional studies are required to confirm the adverse effect of food allergy on mental well-being. These findings suggest that food allergy is crucial among young adults in Sri Lanka and has impaired the quality of life. Further studies are necessary to reveal the relationship between food allergy and various associated factors in the Sri Lankan context.

Keywords: Self-reported food allergy, High-risk behaviour, Young adults, University of Peradeniya

[1]Department of Nursing, Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya, Sri Lanka
[2]Category Management Department, Jaykay Marketing Services (Pvt) Limited., Sri Lanka
* gsomaratne@agri.pdn.ac.lk

Overview of the Production Process of Tomato Paste at Commercial Level

Kumari A.S.W., Wimalasiri K.M.S.* and Senarathne S.M.A.C.U.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Tomato (*Solanum lycopesicum* L.) belongs to the Solanaceae family and it is the second most important fruit/ vegetable crop in the world. It is cultivated targeting both fresh and processed products markets. There is a high demand for tomato products especially tomato paste and tomato sauce in the fast-food industry, owing to the high popularity of tomatoes and tomato products around the world. The fast-food industry is growing rapidly and thereby the demand for tomato paste and tomato sauce will be significantly increased in the future. Tomato paste is the most popular tomato product and it is mainly used as an intermediate product. It is the initial industrial raw material for the production of reconstituted tomato sauce and ketchup. Processing of tomatoes into tomato paste is advantageous in several ways. In many countries, there is a significant surplus during tomato season. But tomato is perishable and it has a limited shelf life of 2-4 weeks. By processing tomatoes into a paste, it can be preserved for more than 12 months while reducing the post-harvest loss. Therefore, the industrial preparation of tomato sauce and ketchup could be continued with the tomato paste as the raw material even in the off-season. This review provides an overview of the current understanding of commercial-scale processing methods and appropriate processing conditions. Possible quality losses that occur during processing and storage of tomato paste were also evaluated. Viscosity, flavours, colours, and vitamin C content of tomato are severely affected in the processing. The most significant quality loss is occurred due to the loss of viscosity. The pre-heating (breaking) and evaporation were identified as the most important steps in the tomato paste processing.

Keywords: Tomato paste, Processing, Breaking, Concentration, Quality loss

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[1]Food Research Unit, Department of Agriculture, Gannoruwa, Peradeniya

* swarnaw@agri.pdn.ac.lk

Physicochemical Characterization of Bee Honey based on the Geographical Origin in Sri Lanka

Madusanka O.W.S., Somaratne G.M.*, Rathnayake P.[1], Beligala D.H.[2] and Wimukthi G.G.R.[3]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Honey is a natural sweet ingredient produced by honey bees. The present study aimed to evaluate physicochemical characteristics of honey from different geographical origins in Sri Lanka and to develop a tool to analyse quality of bee honey based on colour, for Sri Lankan beekeepers. Honey samples were collected from Ududumbara, Bandarawela, Anuradhapura, Welimada, Jaffna and Bibila. Microstructure, moisture level, pH, and water activity of honey from different geographical origins showed a wide variability. Colour analysis was performed using CIE method. The colour ranged from amber (Ududumbara and Bibila) to golden brown (Bandarawela and Welimada). The Lab values obtained were re-synthesised using a colour converter software (DATACOLOR Tools Plus) and the standard set of colour cards were printed for each geographical location. A toolbox to analyse the color of bee honey was developed in which the printed standard colour cards can be loaded into a standard chamber and the unknown bee honey can be placed on another chamber. With the help of the light source, the evaluator can assess the colour quality of unknown sample compared to the standard honey colour. It can be used to identify the geographical location of the honey and any type of inferior quality bee honey. This colour analysis toolkit needs further improvements to identify bee honey colour relationship with its floral origin. A survey was undertaken to assess the strengths, weaknesses, opportunities, and threats (SWOT) for beekeepers in Sri Lanka. Accordingly, beekeeping in Sri Lanka is characterised by use of traditional methods and underutilization of marketing channels. The potential for developing beekeeping enterprise is immense given the abundance of natural resources and availability of technical support. Therefore, this study advocates the need for intervention measures to promote production of quality honey and boost Sri Lankan apiculture industry.

Keywords: Bee honey, Beekeepers, Microstructure, CIE colour, SWOT

[1]Division of Applied and Natural Sciences, University of Vocational Technology, University College of Matara
[2]Department of Molecular Biology and Biotechnology, Faculty of Science, University of Peradeniya, Peradeniya
[3]Beekeeping Development Unit Bindunuwewa, Department of Agriculture
* gsomaratne@agri.pdn.ac.lk

Planning and Implementation of ISO 22000:2018 Food Safety Management System for Cinnamon and Cocoa Processing Centers

Adhikari A.A.A.L., Prasantha B.D.R.* and Wanniarachchi S.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Ceylon cinnamon and cocoa are considered as highly demanded agricultural produces in Sri Lanka. Compliance with the food safety management systems (FSMS) and regulations is required to ensure the product quality and safety. ISO 22000:2018 FSMS was established and executed in cinnamon and cocoa processing centers in Sri Lanka. The FSMS is complying with the regulatory, food safety and management criteria established by the International Organization for Standardization (ISO). Appropriate Good Manufacturing Practices (GMP) were designed and established during planning of the Standard Operating Procedures (SOPs). Preliminary steps of the Hazard Analysis and Critical Control Points (HACCP) plan were constructed based on the information and data obtained from the industry experts, farmers, legal specifications, and literature according to the ISO 22000:2018 guidelines. The potential hazards at each steps in cinnamon quills making and production of fermented dried cocoa beans were identified using hazard analysis and risk assessment. The Critical Control Points (CCPs) were identified using the decision tree. HACCP in the ISO 22000:2018 FSMS ensure the safety of cinnamon quills and fermented dried cocoa beans.

Keywords: ISO 22000:2018, Cinnamon, Cocoa, GMP, HACCP

[1]Control Union Inspections (Pvt) Ltd., Narahenpita, Colombo, Sri Lanka.

* bdrp@pdn.ac.lk

Plant Based Prebiotics as Functional Foods

Tharuka K.A.S. and Rajapakse R P.N.P.*
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Prebiotics are non-digestible, short chain carbohydrates that act as fermentative substrates for the health promoting beneficial human gut microflora, such as bifidobacteria and lactobacilli. The composition and the relative abundance of gut microflora present in an individual are mainly dependent on the types and the amount of prebiotics that are consumed through the diet. Therefore, it is very important to add an adequate amount of good quality prebiotics to everyday meals to maintain a balanced gut microflora profile and a healthy body. Oligosaccharides, some polysaccharides, resistant starch, sugar polyols, non-digestible dietary fibers and specifically, inulin and fructooligosaccharides are the most commonly found prebiotics in food. Many plant based food materials have been identified as natural sources of prebiotics including, root and tuber crops, fruits, vegetables, cereal and pulses. Prebiotics are commercially produced employing several techniques such as extraction, enzymatic and chemical synthesis and chemical hydrolysis. Commercially prepared prebiotics and natural prebiotics present in the food materials are used in developing functional foods targeting better performance of gut microflora. Therefore, incorporation of prebiotics enhances the nutritional and health benefits of processed foods, while providing numerous physico-chemical and sensory properties. Food applications of prebiotics can be achieved through a wide variety of processed products of milk, meat, fruits, vegetables, cereals and pulses. Beverages, bakery products, confectionaries, cereal mixers and infant formulations are few examples for processed food products that have been incorporated with prebiotics under different brand names available in the market. This review is a comprehensive compilation of the published information available on the plant based prebiotics, their health benefits, mechanism of actions and applications in the food industry.

Keywords: Prebiotics, Non-digestible carbohydrates, Functional foods, Gut microflora, Health promotion

* niranjanp@agri.pdn.ac.lk

Potential of Citrus Fiber as a Fat Replacer for Bakery and Confectionary Industries in Sri Lanka

Kiriwaththuduwa K.D.J.D., Jayawardene L.P.I.N.P.[1] **and Madhujith W.M.T.***
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Fat is a key ingredient in bakery and confectionary industry as it affects many functional and sensory properties of baked foods. In Sri Lanka, palm oil and imported palm oil-based shortenings are mostly utilized as the fat sources in bakery industry. High import duties levied on these bakery fats are one of the main challenges the bakery industry faces at the moment. Furthermore, the high total fat intake is associated with non-communicable diseases such as coronary heart diseases, obesity, type-2 diabetes and some cancers. This study was conducted to evaluate the potential of citrus fiber as a fat replacer in butter cakes. Palm oil content in one of the industrial butter cake formulations was replaced at three different levels: 25, 30 and 35%, using citrus fiber at both 0.5 and 0.6% levels with additional water. The percentage baking loss, cake height and consumer acceptability of reduced-fat cakes were compared with full-fat cake in order to determine the most acceptable fat reduction level and the citrus fiber incorporation level. Experimental designs for cake preparation and sensory evaluation were Completely Randomized Design and Randomized Complete Block Design respectively. In comparison with control, 25, 30 and 35% reductions showed a significant increase in percent baking loss ($p \leq 0.05$). There was no significant difference in cake height between all the experimental formulations ($p \leq 0.05$). Sensory evaluation results indicated that there was no significant difference in consumer acceptability for appearance, taste and texture ($p \geq 0.05$). Acceptability for moistness was higher in reduced fat formulations than the that of the control. Butter cake with 0.5% citrus fiber (30% fat reduction) showed the highest overall acceptability. In conclusion, citrus fiber can replace palm oil in butter cake formulations up to 30% at 0.5% incorporation level, without adversely affecting important physical properties and consumer acceptability.

Keywords: Citrus fiber, Fat replacer, Butter cake, Sensory evaluation

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[1]Aletek International (Pvt) Ltd., Ranaviru Prabhath Cooray Mawatha, Rajagiriya

* tmadhujith@agri.pdn.ac.lk

Prevalence of *Bacillus cereus* Toxins in Ready-to-Eat Foods in Asian Countries

Keerthi A.A.C.L.T., Rajapakse R P.N.P.* and Pathirage S.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Food poisonings due to toxins present in food are medically concerned reasons of morbidity as well as mortality in both developing and developed countries. Microorganisms are a major cause of food poisoning incidences reported worldwide, and it can occur at any stage of the food production chain due to their ubiquitous nature. Among frequently reported pathogenic microorganisms, *Bacillus cereus* can be considered as an opportunistic human pathogen, which leads to two specific diseases namely emetic and diarrheal syndromes and other systematic infections. The study of *Bacillus cereus* in relation to food has gained significance in the light of its ability to form heat-resistant endospores and capacity to grow and produce toxins in a wide variety of foods. Their spores may be present on various types of raw and cooked foods, and their ability to survive at high cooking temperatures necessitates that cooked foods be served hot or cooled rapidly, to prevent the growth of this bacteria. Moreover, secondary contamination of ready-to-eat (RTE) food with *Bacillus cereus* becomes more serious since there is no chance of destroying the microorganism or its preformed toxins prior to consumption. In getting this bacterium into foods and feed, soil is the initial source of contamination. This comprehensive review focuses on the hazardous nature of the toxins released by the bacterium, foods associated with two types of syndromes, its prevalence in RTE foods in the Asian countries, roots of contamination throughout the food production chain and prospective control measures that need to be implemented to provide microbiologically safe foods to the consumers.

Keywords: *Bacillus cereus*, Food poisoning, Ready-to-eat foods, Prevalence, Toxin

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[1]Department of Food and Water Microbiology, Medical Research Institute, Colombo 08

* niranjanp@agri.pdn.ac.lk

Probiotics in Foods: A Review

Rajapaksha H.P.S.L.P., Prasanna P.H.P.* and Vidanarachchi J.K.
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Probiotics are live microorganisms that are used to have various health benefits. Several genera of bacteria are from human or non-human origins and some yeasts are used as probiotics in the food industry. The common bacterial genera are used in the food industry include *Lactobacillus, Bifidobacterium, Pediococcus, Lactococcus* and *Bacillus.* The selection of probiotic microorganisms to be used in the food industry should be carried out carefully and it is done by evaluating different characteristics. These characteristics can be categorized as safety, technological and functional criteria. The application of probiotics in functional food product development is popular in the world due to their health benefits and their applications in the food industry can be categorized into two main areas like dairy and non-dairy applications. Most of the research and development activities of application of probiotics in dairy industry have been carried out with products such as yoghurt, cheese, fermented beverages, ice cream, *Meekiri* and *Deekiri*. There is a trend of using probiotics in non-dairy foods such as fruit-based products, vegetable-based products, cereal-based products and meat products. The development of foods with adequate doses of probiotics at the time of consumption is a challenge, because several factors during processing and storage affect the viability of probiotic organisms. Encapsulation has been widely researched to improve the viability of probiotics in different food systems. The development of novel, economical and technologically feasible dairy and non-dairy products that satisfy consumer demands should be the focus of future research efforts. In this review, characteristics and selection criteria of probiotics, their applications in the health and food areas & challenges, problems and new trends in probiotic foods are presented.

Keywords: Probiotics, Functional foods, Fermented, Dairy, Non-dairy

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* phpprasanna@agri.pdn.ac.lk

Reduction of Postharvest Losses of Pineapples in the Supply Chain

Karunarathna S.N.M.H.S., Arampath P.C.* and Herath H.M.S.L[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Reduction of postharvest losses of pineapples in the supply chain is economically benefitted in the industry. Root causes of the postharvest losses were visually inspected at field, harvesting, fruit handling, transportation and industrial processing of pineapple. Based on the Pareto analysis, flesh translucency disorder of fresh fruits and pineapple black rot disease were recorded as 80% losses. Physiological and physiochemical changes at the postharvest stage has caused for 7-8% weight loss. Pineapple black rot disease were successfully controlled by treated the stem cut of peduncle of fresh cut fruits with *Gliricidia sepium* wood ash (T_1) or heated at 400^{o}C for 2 minutes (T_2). Weight loss of fresh fruits was controlled by de-crowning, thus reduce the loss of water by evaporation (T_3). Pineapples were stored at the ambient environment (31±1 °C, 65±5% relative humidity) for 6-7 days after the treatments. Results of T_1 and T_2 were analyzed using categorical data analysis while data analysis of T_3 and biochemical analysis of treated samples were analyzed by ANOVA ($p<0.05$) using Minitab 20.1.2. *Gliricidia sepium* wood ash (T_1) was highly effective in controlling pineapple black rot caused by *Chalara paradoxa* (De Seyen.) Sacc.(syn.) *Thielaviopsis paradoxa* (De Seyen.). However, heating of the trimmed surface of cut peduncle at 400^{o}C for 2 minutes (T_2) was not effective to control black rot disease. De-crowned pineapples show reduction of weight loss by 3% during storage. A significant difference was not observed in-between treated and untreated controls in pH and total soluble solids contents. Data was analyzed by Dunnett's comparison ($p<0.05$). Mean pH of treated pineapples was 3.6-3.8 and mean total soluble solids content was 13.9-14.1^{o}Bx. The values were within the acceptable level for processing of pineapples for canning.

Keywords: Transpiration, Fungi, Black rot, Pineapple, Flesh translucency

[1]Tropical Health Food (Pvt) Ltd., Heraliyawala Industrial Park, Malkaduwawa, Kurunegala

* arampath@agri.pdn.ac.lk

Study on the Effect of Feeding Method on the Fatty Acid Profile of Bovine Milk in Sri Lanka

Ranasinghe U.I., Weerasinghe W.M.P.B.[1*] and Madhujith W.M.T.
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The present study was carried out with the aim of investigating the effect of different feeding methods on fatty acid composition of bovine milk from four agro-climatic zones of Sri Lanka. Bovine milk samples (n=32) were collected from grazed cows (n=10), cows fed with cut and fed method (n=11) and cows fed with total mixed rations (TMR) (n=11). Fat from bovine milk samples was extracted, methylated and analyzed using gas chromatography following standard methods. The results indicated that feeding system has a significant effect (p<0.05) on certain fatty acids. Accordingly, milk samples obtained from grazed cows showed significantly (p<0.05) higher concentrations of monounsaturated fatty acids (MUFA) including C18:1 (oleic acid) and C15:1 (Cis-10 pentadecanoic acid). Their concentrations were 16.14±0.89% and 0.51±0.02 % respectively. Furthermore, agro-climatic zone also showed a significant (p<0.05) effect on the fatty acid composition. The highest MUFA concentration was observed in milk from the low country wet zone (LCWZ). C15:1 concentration (0.58±0.02%,) was significantly higher (p<0.05) in LCWZ compared to other agro-climatic zones. C18:0 and C18:1(elaidic acid) concentrations were also significantly higher (p<0.05) in the LCWZ compared to those of upcountry (UC) and low country dry zone (LCDZ). Their concentrations were 2.88±0.13% and 1.35±0.09% respectively. No significant differences were observed in saturated fatty acid (SFA) and trans fatty acid (TFA) content. It can be concluded that grazing could be a good strategy to improve the FA profile of bovine milk.

Keywords: Agro-climatic zones, Cut and fed, Gas chromatography, Grazing, Total mixed ration

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[1]Veterinary Research Institute, Gannoruwa, Peradeniya

* piyatilakw@yahoo.com

Systematic Tabulation of Glycemic Index (GI) of Commonly Consumed Sri Lankan Foods and Development of GI Based Software

Hettiarachchi H.A.M.D., Somaratne G.M.*, Chandrasekara A.[1], Gunasekara D.[2], Abeyrathne T.M.[3] and Vindula I.B.S.[4]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Systematic tabulation of Glycemic index (GI) and Glycemic load (GL) tables is not available several countries including Sri Lanka. It is an important requirement since every country has a cuisine style comprise with several locally produced foods. The goal of this research was to develop a systematic tabulation of the GI and GL of regularly consumed foods in Sri Lanka and the development of GI and GL-based E-database which is beneficial for both consumers and the researchers. This E-database further includes a custom-built software for calculating GI values that provide an overall summary of the GI and/or GL data along with its information of the GI study (i.e., reference food, number of subjects, preparation or cooking method, overnight fasting hour, and available carbohydrate of the food). To complete this task, 208 GI data entries were used for locally available foods from several verified published sources. This study covered 12 food categories including common and traditional rice varieties, basmati rice varieties, rice-based mixed diet, processed starchy based foods, dairy products, porridges, legumes, yams and tubers, sweeteners, bakery products, and Sri Lankan tropical fruits. The GI values of different food categories including rice, starchy foods, porridges, traditional sweeteners, legumes, and fruits were tabulated systematically. The results suggest that there are several foods categories that are required for future investigation of the postprandial glycemic response including several traditional sweets, tropical underutilized fruits, starchy vegetables and underutilized yams and legumes etc. This systematic E-database management system based on GI and GL of commonly consumed Sri Lankan foods will not only improve the quality and quantity of GI data available for research and clinical practice but also promote healthy food selection among the general population.

Keywords: Glycemic index, Glycemic load, Carbohydrates, Diabetes, E-database management system

[1]Department of Applied Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila
[2]CIC Food and Nutrition Research Laboratory, CIC Seed Farm, Pelwehera, Dambulla.
[3]Sri Lanka Institute of Information Technology, Malabe Campus, Malabe.
[4]Department of Computer Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya

* gsomaratne@agri.pdn.ac.lk

Technological Advancements to Mitigate Frequently Found Mycotoxins in Food that Pose a Risk to Human Health: A Review

Senarathne K.N.K. and Mendis B.E.P.*
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Mycotoxins are toxic secondary metabolites of fungi that may frequently contaminate food and feed and considered a major challenge to supply safe food all over the world. Mycotoxins in food present a significant health risk for consumers with potential carcinogenic, genotoxic, teratogenic, nephrotoxic and hepatotoxic effects at very low levels of exposure. The toxicity of these compounds and the existence of regulations in many countries specify the need of controlling these contaminants to ensure food safety. Current strategies to reduce mycotoxins in food include both prevention and decontamination. A combination of novel processing technologies together with physical and chemical approaches have been investigated to achieve the complete mitigation of mycotoxins in food while preserving the nutritional quality and sensory appeal. The present study provides a holistic update on recent research focusing on mycotoxin decontamination by post-harvest strategies, physical methods, chemical methods and novel processing technologies. Post-harvest strategies discussed in this review include sorting, sieving, cleaning, separation, dehulling, polishing and washing. Physical methods include thermal treatments, extrusion cooking and irradiation. Chemical treatments include nixtamalization, ammonization, ozonation and other chemical agents. Novel technologies that are covered in this study include photocatalytic degradation, electron beam irradiation, pulsed electric light, cold plasma and ultrasound waves. Discussion includes an introduction on prevention or decontamination mechanism, degradation efficiency, advantages and disadvantages of specified technologies. There are no previous publications that take account of decontamination of all frequently found mycotoxins in one article. This review concludes that, thermal and chemical treatments are not adequate to ensure complete mitigation of mycotoxins in food commodities, however combination of novel and conventional strategies are effective in degrading mycotoxins in food and can be successfully used to ensure food safety. The toxicological effects of degraded products resulted in novel processing technologies need to be studied further to develop a broader understanding.

Keywords: Mycotoxins, Food, Risk, Decontamination, Technological advancements

* ereshamendis@agri.pdn.ac.lk

Traditional Fermented Food in Sri Lanka

Navodika K.U.I.S., Madhujith W.M.T.* and Silva B.G.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Together with drying and salting, fermentation is one of the oldest methods of food preservation, embedded in traditional cultures and village life. Traditional fermented foods have been an integral part of the Sri Lankan diet for centuries. They are prepared either naturally or by adding starter culture. Lactic acid bacteria and yeasts are the major groups of microorganisms used for fermentation. The functional microorganisms in the ferment, break down the chemical constituents in raw materials of plant/animal sources, enhancing sensory properties of the food and improving bio-availability of nutrients, while degenerating toxic components and anti-nutritive factors like phytic acid in cereal grains. They produce antioxidants and antimicrobial compounds that impart bio-preservative effects, improving the food safety. Some of these microbes in fermented foods serve as probiotics. They help to maintain homeostasis within the intestinal micro biota, and provide a wide range of health benefits to the consumer. Fermented foods and beverages span a wide diversity range of cereals, pulses, palm sap, vegetables and fruits, as well as animal products such as meats, fish and dairy. Fermented foods can be classified into groups based on the substrate (raw material) used from plant or animal sources. In Sri Lanka, most of these fermented foods are prepared at household level according to knowledge passed down from generation to generation. Therefore, there is a huge possibility for them to play an important role that contributes for improving the livelihoods of rural and peri-urban dwellers alike, through enhanced food security, and income generation as a valuable small-scale enterprise option. The focus of this article is to review manufacturing process, chemical and microbiological composition, processing, compositional and functional modifications taking place as a result of microbial and enzymatic effects, their nutritional benefits, safety and opportunities for industrialization of traditional fermented products in Sri Lanka.

Keywords: Fermentation, Traditional Fermented Food, Lactic Acid Bacteria, Probiotics

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[1]Department of Nutrition, Medical Research Institute, Borella

* tmadhujith@agri.pdn.ac.lk

Traditional Plant Based Fermented Foods and Beverages in Asian Region

Sandanika D.W.N. and Rajapakse R P.N.P.*
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Fermentation is a metabolic process involving chemical breakdown of organic materials through the action of enzymes or microorganisms. Microbial fermentation is widely applied in the food industry to preserve food and to produce diversified and value added fermented foods and beverages. The aim of this review is to describe production, properties, nutritional and health benefits associated with the plant-based fermented foods reported in the Asian region. In the Asian region, many plant materials are used as substrates for fermentation and among them, grains, fruits, vegetables, tea and bamboo shoots are predominant. Soybean based fermented food products such as kinema, hawaijar, miso, natto and soy sauce have been originated and become popular in the East-Asian region. Grain-based fermented food products such as idli, dosa, sake, selroti and angkak are delicacies in the South and East Asian populations. Gundruk, sauerkraut, tempoyak and sinki are examples for fruits and vegetable-based fermented foods available in many parts of Asia. The tea-based fermented food products such as kombucha, puer tea and fuzhuan brick tea and bamboo-based fermented food products such as mesu, soidon and soibum are popular among many nations in the Asian region. The method of preparation, microorganisms involved, physicochemical characteristics and sensory properties of these fermented food products vary from one to another. In common, most of the fermented foods have a prolonged shelf life, improved organoleptic properties, increased digestibility and improved nutritional and health promoting values. It is evident that some plant-based fermented foods are capable of modulating the gut microbiota, suggesting their potential use to improve gut dysbiosis and thereby assisting disease prevention. Thus, this review suggests that further studies on traditional fermented foods and their impacts on the microbiome and human health will be useful in broadening the research scope of food fermentation.

Keywords: Microbial fermentation, Plant-based food, Health benefits, Microbiome

* niranjanp@agri.pdn.ac.lk

Ultra Performance Convergence Chromatography-Tandem Mass Spectrometry to Detect Adulteration of Coconut Oil

Jayantha J.B.S.K., Vidanarachchi J.K., Bergquist J.[1] **and Ubhayasekera S.J.K.A.**[1*]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The authenticity of cooking oils has a vital contribution in our day-to-day diet due to their nutritional and economical values. Some cooking oils are expensive which makes appealing to adulterate them with lower priced oils and fats to get more profit. The need of authentication is an important phenomenon in cooking oil industry. Therefore, it is necessary to use advanced and suitable methods to detect adulteration of cooking oil. In this study, the applicability of Supercritical Fluid Chromatography Tandem Mass Spectrometry (SFC-MS/MS) was tested to profile phytosterols and fatty acids in coconut oil. A targeted sensitive 3 minutes long SFC-MS/MS methods for quantifying seven phytosterols and twelve fatty acids in coconut oil were developed and validated after simple liquid-liquid extraction with relevant internal standards. The quantification of analytes was performed using multiple reaction monitoring mode. The linearity of the method was obtained over the concentration range 20-1000 ng/mL and 50-1000 ng/mL with correlation coefficients (r^2) 0.9911 and 0.9874 for phytosterols and fatty acids, respectively. The analysis of triplicate data points of authentic coconut and palm oil samples revealed significant ($P<0.05$) differences between the contents of brassicasterol, δ-5-avenasterol and stigmasterol both in free and total phytosterols. From the twelve analyzed fatty acids, significant differences were observed for lauric, myristic, palmitic, stearic, linoleic and eicosenoic acids between the two authentic oils. The principal component analysis further proved that the two authentic oils can be categorized into two distinguish groups based on total phytosterol and free fatty acid profiles, showing the possibility of this method for the determination of coconut oil quality or authenticity. This powerful, fast, green, analytical technique could be applied for the detection of coconut oil adulteration, and potentially beneficial to the oil industry.

Keywords: Fatty acids, Phytosterols, Principal component analysis, Supercritical Fluid Chromatography, Tandem mass spectrometry

[1]Department of Molecular Sciences, Swedish University of Agricultural Sciences, P.O. Box 7015, SE-750 07 Uppsala, Sweden

* kumari.ubhayasekera@kemi.uu.se

Utilization of Fruits and Vegetables Processing Leftovers in Developing Food Processing Ingredients as Commercial By-Products

Cooray P.L.A.N.A. and Rajapakse R P.N.P.*
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Food processing industry generates a large amount of leftovers and a great potential exists to utilize these as raw materials in developing a variety of value-added by-products. However, only a little fraction of the food processing leftovers are effectively converted into commercially important by-products. In a year, approximately half of the fruits and vegetables produced globally are wasted during processing as leftovers or due to postharvest losses along the food chain. The above waste consists of both solid and liquid fractions such as peels, seeds, stones, stems, leaves and residual pulp or liquor. Some industries develop animal feed or compost from the leftovers of fruits and vegetables processing as byproducts that can be developed without much effort. At the same time, fruits and vegetables processing industry spends considerable amount of money to dispose waste with a minimum impact to the environment. However, fruits and vegetables processing leftovers are rich in economically valuable food grade compounds and that has drawn the attention of industrialists to develop commercial food processing ingredients. For many years, researches are being carried out to optimize the extraction and improvement of the quality of such food processing ingredients, including colorants, flavoring agents, dietary fiber, phenolic compounds, texturing agents and *etc*. The demand for natural food processing ingredients is increasing due to the safety concerns on synthetic food ingredients. Moreover, use of fruits and vegetables leftovers as a source of food processing ingredients is an ecofriendly and economical way of waste management in the food industry. This review comprehensively discusses the potential utilization of fruits and vegetables processing leftovers as sources of developing food processing ingredients and their applications.

Keywords: Food processing ingredients, By-products, Processing leftovers, Food waste

* niranjanp@agri.pdn.ac.lk

A Review of Global Human - Elephant Conflict Mitigation Strategies

Sandakelum W.S.C. and Samarakone T.S.*
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

In elephant habitat countries, human-elephant conflict is a key conservation concern. For preventing and minimizing human-elephant conflict, a variety of management measures have been developed and are used at various scales. This review discusses the effectiveness of existing conflict mitigation techniques in the field, as well as the primary constraints in application and recommendations for improving them. The research publications reviewed were from field experiments and applications. According to the nature of the mitigation method, existing conflict mitigation strategies were divided into three categories: early warning systems such as wireless sensor-based equipment which alarms the presence or intrusion of elephants to farming communities or wildlife authorities, physical barriers such as fencing and digging of trenches which prevent the overlapping of humans and elephants, and deterrents such as cultivating chili fences and unpalatable crops which elephants perceived not to cross over. The review discovered that elephant habituation is a common constraint for nearly all mitigation strategies and interferes with elephant natural behavior, as well as rural economy. Even though some promising results have been reported, the effectiveness of each mitigation strategy has not been sufficiently characterized for long-term site specific global applications. Human-elephant conflict continues to be widespread since most existing prevention techniques are based on site-specific variables that only offer short-term solutions and usually shift conflict potential from one site to another. It is concluded that integrating the mitigation strategies may produce some good results over time, and community participation is recommended at every level of implementation of mitigation.

Keywords: Human -Elephant, Mitigation, Conflict, Management, Strategies

* thusiths@agri.pdn.ac.lk

A Comparative Study on the Effectiveness of Radio Marketing in Sri Lanka

Ranasinghe H.A.P.B., Kodithuwakku K.A.S.S.*, Hemachandra S.D.S. and Jayathunga M.P.[1]
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The potential usage of radio medium and its implication to marketing has not been explored extensively in the Sri Lankan context. Media expenditure in the media industry in Sri Lanka continues to be driven by perception than evidence. This research study was conducted to examine how strongly radio medium delivers the media attributes linked to brand equity compared to television, press and social media in marketing and to identify differences between experts' perception and consumer based findings. Brand equity concept and its measures are important intangible assets in marketing communication, and they are instrumental in measuring marketing effectiveness. Telephone surveys were conducted using a structured questionnaire across the registered residents in the electoral registry of the Western province of Sri Lanka and among a sample of media experts of Sri Lankan media industry. Four hundred twenty five respondents (425) were randomly selected from an already recruited sample drawn by a reputed marketing research organization. Experts were selected as a representation of more than 50% of the media industry. Responses were analyzed using ordered logistic regression analysis, descriptive analysis, Wilcoxon rank sum test and Kruskal-Wallis H tests. Findings reveal that radio medium has more strength than press media but is less strong than television and social media in delivering media attributes. Results also indicate the differences of expert perception and consumer evidences on how strong radio media advertising strategies are and how strong radio medium is as a brand recall medium compared to other media. These research findings provide implications for the media industry in Sri Lanka by highlighting the need for re-evaluating the current industry practice in allocating budgets across media, giving the direction for media planners in deciding the role of media channel in delivering the campaign objectives and on the potential of the radio medium in delivering recall attribute.

Keywords: Radio marketing communication, Marketing effectiveness, Media attributes, Brand equity

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[1]Third Shift Media (Pvt) Ltd., Colombo 03

* sarathsk@agri.pdn.ac.lk

A Survey on Consumer Awareness on Proper Usage of Edible Oils in North-Western and Western Provinces in Sri Lanka

Gamage C.S., Samarakoon E.R.J.* and Pathirage K.P.D.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Lack of consumer awareness on edible oils is a concern that needs to be given higher attention as the awareness on preserving the quality of oil assists in preventing harmful health effects. The main objective of this study was to assess the consumer awareness on storage conditions and proper usage to preserve the oil quality. Moreover, the study was directed to evaluate the consumers' awareness on the health effects of edible oils, differentiate between coconut oil and palm oil usage and to evaluate the impact of demographic factors in purchasing edible oils. An online survey consisting of 40 questions was conducted using 295 participants from North-Western and Western provinces. Pearson correlation, chi-square and factor analysis was used to analyse the impact of demographic characteristics on the awareness of usage of edible oils. Descriptive statistics were used to assess the extent of consumer awareness on health effects, usage and storage of oil. The main findings of the study exhibited that a majority of respondents (96.6%) used coconut oil as the frying oil. A high prevalence of non-communicable diseases was reported among coconut oil users (10% - high blood pressure and 4% - high cholesterol and diabetes).The respondents did not possess adequate knowledge on proper storage: 12% did not practice any precautionary methods to preserve oil in storage and only 2% were aware of dark storage, while 53% of the respondents were particularly aware on common health effects, 71% on aflatoxin issue and 58% on proper usage of oil. The age of the respondents was significantly correlated with the awareness of health effects and proper usage ($P<0.05$).The results showed that consumers from North-Western and Western provinces were not sufficiently knowledgeable on proper storage of edible oils which can lead to adverse health effects.

Keywords: Edible oil, Consumer awareness, Proper storage, Frying, Health effects

[1]Lanka Spice (Pvt) Ltd., Makumbura, Kottawa, Sri Lanka

* rasanjalis@agri.pdn.ac.lk

A Survey on Management Practices, and Attitudes towards Animal Welfare of Broiler Buy-Back Farmers in Gampaha District, Sri Lanka

Senevirathna G.G.U.L.B., Samarakone T.S.* and Bandara R.M.A.S.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

This study assessed some key management practices and attitudes of the buy-back farmers towards broiler welfare. A total of forty poultry farmers engaged in the buy-back system in Gampaha District, Sri Lanka were interviewed via telephone conversations using an open structured questionnaire. Data were statistically analyzed using SPSS version 23.0. Relationships among variables were computed by Ordinal Logistic Regression. Among the 40 broiler buy-back farmers, majority (56%) were in-between age group 35-50 years old and 17.6% were female farmers. All the 40 farmers did not have a proper educational background related to poultry farming. The most popular flock sizes were 1000-5000 birds (64.1%). All the farmers were purposely checking the flock, for sick or injured birds. Moreover, 97.4% of farmers practiced isolation of sick birds from others. However, no one euthanized severely injured or sick birds. All farmers were practicing up-right position when catching and handling birds. Among the 40 farmers, 56.4% were not aware of concepts of farm animal welfare. Farmers' attitude on livestock welfare, attitude on transportation, and attitude on slaughtering were compared with gender, age, experience, and level of education and resulted in no significant difference. There was a trend to be significant (P = 0.051) of welfare awareness (Yes) with the attitude of the way of handling of birds is important. When flock size increased, farmers' awareness of pain of bird was decreased (P=0.0001). According to the results of this study, a considerable proportion of buy-back farmers had negative or neutral opinions regarding broiler chicken welfare, and their management techniques were mostly production-focused. We believe that poultry welfare awareness programs would be beneficial to improve farmers' positive attitudes to ensure the welfare of broiler chickens.

Keywords: Animal Welfare, Attitudes, Broilers, Buy-back Farmers

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[1]Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka

* thusiths@agri.pdn.ac.lk

An Analysis of Post-harvest Losses along Value Chains of Tomato produced in Badulla, Sri Lanka

Weerawanni D.W.M.T.M. and Weerahewa J.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Reduction in Post-harvest losses in vegetables and fruits, which are estimated at 30-40 percent in many developing countries, is one of the strategies adopted by large number of countries. Post-harvest losses in tomato are alleged to be very large due to its highly perishable nature. However, little work has been undertaken to quantify the volume and value of losses along tomato value chains in Sri Lanka. The objectives of this study are (i) to quantify post-harvest losses along selected tomato value chains starting from Badulla district, (ii) to estimate the average economic loss at each interface of the value chain and (iii) to examine the factors affecting the size of the losses by different value chain actors. A primary survey covering of 125 farmers, collectors, transporters, wholesalers and retailers was conducted to obtain information on demographic characteristics of value chain actors, characteristics of their enterprise, and their post-harvest handling practices and amount of post-harvest loss in each value chain actor. The results show that on average, 27% of the product is lost along the value chain and physical losses incurred by farmers, collectors, transporters, wholesalers, retailers are 1.43%, 7.15%, 8.34%, 6.60% and 3.53%, respectively. The average economic loss along the chain is LKR 19.91 per kg and losses incurred by farmers, collectors, transporters, wholesalers and retailers are LKR 0.83, 4.48, 5.84, 5.04 and 3.72 per kg, respectively. Experience in the business, selling price of tomato, transport distance and packaging medium have statistically significant effects on the size of the loss and losses associated with plastic or wooden crates found to be smaller than those of the net or polythene bags. Harvesting round and transport distance were principal causal factors contributing to tomato post-harvest losses along the value chain by farmers and traders respectively.

Keywords: Tomato value chain, post-harvest loss, Economic loss, Food handling technologies, Characteristics of value chain actors

* jeevika.weerahewa@agri.pdn.ac.lk

An Assessment of Marine Fisheries Supply Chain in the Western Province, Sri Lanka to Develop a Conceptual Model for a Mobile Application for Improved Market Participation

Gule Godage L.C., Dissanayake U.I.* and Korale-Gedara P.M.[1]
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The fisheries industry contributed 1.3% to the GDP of the country in 2019, where 1.1% is from marine fisheries. Due to the perishable nature of fish, the right information on the market and prices at the right time is critical for fishermen in marketing their products. However, there is an information asymmetry in the supply chain, and this has emerged as the main barrier for fishermen to engage effectively in marketing. ICT-based mobile applications can be used to alleviate this information asymmetry. This research intended to map the key actors in the fisheries supply chain, identify the determinants of intention to use ICT tools for market participation among fishermen in the Western Province, Sri Lanka, and thereby develop a conceptual model for a mobile application. The study community was fishermen from Negombo, Dikkowita and Beruwala fisheries harbors. The primary data were collected through a survey using a questionnaire (n=77), administered through telephone interviews. Participants for the survey were selected through the multistage cluster sampling method. Fifteen Key Informant Interviews were conducted to obtain qualitative data. Data were analyzed using descriptive statistics and a probit regression model. According to results, fishermen, auctioneers, suppliers, commission agents, wholesalers, retailers and consumers were the main actors of the fisheries supply chain. Sixty eight percent of the respondents were willing to use mobile applications for market participation. Fishermen who had other income sources ($p<0.05$), membership in a CBO ($p<0.05$), awareness of online business ($p<0.05$) and heavy users of ICT tools ($p<0.05$) had a higher intention to use ICT tools for market participation. Based on the results, a conceptual model for a mobile based trading platform was proposed. It was suggested to include functionalities such as a platform to meet potential buyers and sellers, display daily prices, transaction details and transport arrangements.

Keywords: Fishermen, Supply chain, Probit model, Market participation, Mobile application

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[1]Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Peradeniya

* uvasara@agri.pdn.ac.lk

An Inquiry into Propensity of Dwellers in the Udagaldebokka Isolated Forest-dependent Community to Resettle off the Forest: A Cultural Consensus Analysis

Wickramarathne N.A.D.L.* and Jayaweera A.
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

This ethnographic study investigates the culturally determined tendency of the dwellers in an isolated forest-dependent community in Sri Lanka to resettle away from the forest and closer to other human settlements. This community, residing in a small hamlet (Udagaldebokka) surrounded by the thick Knuckles forest, consists of 33 families belonging to four generations. Our observations revealed that most of the dominant cultural components, such as food habits, medicinal practices, livelihoods, and spiritual beliefs of the Udagaldebokka dwellers, are closely linked to the forest. Given heavy dependence of the Udagaldebokka dwellers on forest resources and their dire living conditions, a culturally sensitive program to relocate the entire community can have implications on both forest conservation goals and welfare standards of the community. Such a relocation program needs an in-depth insight into shared cultural models shaping dwellers' willingness or reluctance to migrate. To quantitatively determine whether tendency of the Udagaldebokka dwellers to leave their current hamlet and resettle elsewhere off the forest remains a coherent culture within their community, a cultural consensus analysis was conducted. An Informal Cultural Consensus Model was employed over a sample of 28 dwellers and the same analysis was repeated with different subgroups of the sample (i.e., clustered based on gender and generation). Findings revealed that there is a coherent cultural model on 'Resettlement propensity' among the Udagaldebokka dwellers regardless of their age and gender differences. The cultural model consists of four belief dimensions; (1) contentment with the current place of residence, (2) uncertainty in adaptive capacity, (3) perceived opportunities for development if resettled off the forest and (4) subjective norms on migration and resettlement.

Keywords: Forest-dependent communities, Resettlement propensity, Cultural Consensus Analysis, Coherent cultural model

* ag15106@agri.pdn.ac.lk

An Overview of Effects of Microplastics on Aquatic Species in Coastal and Marine Ecosystems

Rajapaksha R.A.K.G.C.D. and Athauda A.R.S.B.*
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Microplastics mean particles that are smaller than 5 mm. World attention on microplastics has drawn on current situation on this topic because of the increasing threat to ecosystems. There are two types of microplastics such as primary and secondary. Prominent microplastic verities are synthetic types such as polyethylene, polypropylene, polystyrene, etc. Not only in the terrestrial environment but also the aquatic environment affected by microplastics. This review is focused on effects of microplastics on aquatic species in coastal and marine ecosystems. Therefore, an extensive survey on reported work was carried and compiled the information on effect of microplastic on aquatic ecosystems. The studies have shown that the coral reef ecosystem was the most affected ecosystem from microplastics. When compared with the rest of the world, China is reported to be the pioneer in plastic production that accounted for the 25 % of total production. The Mediterranean Sea has been identified as the most polluted sea. A few types of microplastics abundant in the ocean and among them, fiber type has been reported to be the most prominent and the blue color was the prominent. It has been observed that the microplastics can affect the aquatic fauna after ingestion leading to reproduction disabilities, accumulation in tissues and negative energy balance, reducing growth rate, accumulating heavy metals through the food chain, overgrowing, bleaching, etc. Further, not only aquatic fauna, but also aquatic flora, such as seagrass ecosystem can be affected by microplastics. Anthropogenic activities have led to microplastic accumulation in all the part of the ocean. It has been reported that aquatic animals misidentify the microplastic as particle and ingest and then it led to abnormalities in those animals. Therefore, it is necessary to pay more attention on developing other harmless materials which can replace plastics and reduce environment impact.

Keywords: Microplastics, Aquatic species, Ecosystems, Biodiversity

* sbathauda@agri.pdn.ac.lk

Assessing the Financial Cost of Clinical Mastitis at Ridiyagama NLDB Farm in Sri Lanka

Kumarasiri S.M.G., Silva G.L.L.P.* and Korale-Gedara P.M.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Mastitis causes considerable economic losses on the dairy industry worldwide. The main objective of this study was to estimate the financial losses occurred by clinical mastitis at the herd-level in NLDB dairy farm, Ridiyagama, Sri Lanka. Mastitis economic frameworks already published were used to develop an economic model with the key cost components, namely milk production losses, drugs, discarded milk, veterinary services, labor, diagnostics, culling and death losses. A partial budget approach was used to estimate the cost. Milk yield reduction due to mastitis was estimated using panel regression model with 100 lactating animals. In estimating other costs, the study depends on the farm records and available literature. Accordingly, it was found that milk yield reduction per animal due to clinical mastitis was 2.33 liters per day. The total economic cost of clinical mastitis was estimated to be LKR. 22,700.00 per milking cow per 310-day lactation. The total economic cost included milk production loss (LKR. 27,280.00), culling cost (LKR. 15,787.00), discarded milk (LKR. 3,861.00), drug cost (LKR. 3,778.00), death losses (LKR. 3,308.00), and other related costs (labor cost, veterinary services cost and diagnostics cost; LKR. 260.00) per cow per 310-day lactation. However, the cost of culling (LKR. 15,787.00) was considered as an additional revenue earned by selling animals. The highest cost component is the production loss due to clinical mastitis. It accounts for 70% of the total cost. The total cost at the herd-level of 1333 lactating animals with the annual prevalence rate of 37% was LKR. 11.19 millions. The model developed in the current study can be used to compute mastitis costs at the herd and national level.

Keywords: Mastitis, Dairy farm, Cost of mastitis, Sri Lanka, Cost components

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[1]Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Peradeniya

* pradeepas@agri.pdn.ac.lk

Assessment of Brand Equity of Different Degree Programmes in Sri Lanka: with Special Reference to Medicine, Agriculture and Biological Science

Tennakoon T.M.G.H.B., Kodithuwakku K.A.S.S.* and Abhayarathna M.H.R.
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Brands are fundamentally about experiences and relationships, and therefore, they form the prime basis of an institution's connection with its stakeholders. However, there have been minimal studies that have assessed the brand equity of degree programmes offered by public universities in Sri Lanka. This study mainly focuses on brand awareness, perception and attitude and brand reputation dimensions of brand equity. Brand awareness is the ability of potential consumers to recognize the brand as an individual of a specific category. Brand Reputation refers to the overall value, esteem, and character of a brand that results from people's decisions. Perception and attitude refer to the decisions of students about a brand's overall excellence. Thus, the current study aims to assess the brand equity of selected degree programmes in the biological stream (Medicine, Agriculture and Science) offered by different public universities in Sri Lanka from the students' perspectives. The study adopted a quantitative methodology, where data were collected using a pre-tested self-administered questionnaire. The target population was A/L students in the biological stream living in Kandy, Badulla, Colombo and Galle districts. A sample of 157 students was drawn using a convenient sampling technique. The data were analysed by a Friedman test, Spearman's test and panel order logistic regression with random effect. In this study, the brand equity of different degree programmes was measured. The findings revealed that the brand equity of the same degree programme differs when offered by different universities for all three selected degree programmes. Further, results indicated a significant (p<0.05) effect of brand awareness, perception and attitude and brand reputation on selecting a degree programme. Therefore, findings suggest that brand equity plays a significant role in degree programme selection. This study would help universities to implement branding strategies to enhance the brand equity of degree programmes.

Keywords: Customer based brand equity, Public Universities, Brand Reputation, Perception and attitude, Brand awareness

* sarathsk@agri.pdn.ac.lk

Assessment of Occurrence and Types of Microplastics in Commercial Compost

Madhushani M.M.K., Karunarathna A.K.* and Ranasinghe A.S.Y.P.[1]
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Two types of compost are commercially available in Sri Lanka: agricultural compost (AC) made out of a mixture of green leaves, crop residues with manure, and municipal solid waste compost (MSWC) made from the organic fraction of municipal waste. Compost quality is generally assessed using conventional quality criteria such as nutrient availability, heavy metal content, and pathogens; however, emerging pollutants like microplastics have not been recognized. Thus, this research was conducted to assess the occurrence, distribution, and types of microplastics in compost samples taken from three MSWC manufacturing facilities, namely Jaffna municipal council, Kandy municipal council, Kerawalapitiya composting factory. Agricultural waste compost sample was taken from Sustainable Agriculture Research and Development Centre at Makandura. A 100 g representative sample of compost was first oven dried for 24 hours and then the sample was sieved through seven sieves from 4 mm to 0.075 mm mesh sizes. The sample retain on each sieve size was spread on a while paper and microplastic particles were manually picked up under a magnifier using forceps. Plastic particles smaller than 5 mm were counted, weighed and separated into soft/film plastics, and hard plastics. Results showed that MSWC samples contain 990 to 2110 particles/kg, which can be expressed as 934 ppm to 1656 ppm. Comparatively, AC contained 120 particles/kg (43 ppm). Particle size analysis showed that microplastic particles in MSWC were larger than compost particles (D_{50} 1.7 to 2.2 mm), indicating that the microplastics had originated from contaminated feedstock. The soft plastics accounted for 96-99% microplastics in MSWC while 100% of microplastics in AC. The study revealed that tested MSWC have contaminated by microplastics that can pose a threat to soil health; thus, further studies are recommended to establish quality control protocols for MSWC manufacturing process.

Keywords: Agricultural compost, Microplastics, Municipal solid waste compost

[1]Sustainable Agriculture Research and Development Centre, Makandura, Gonawila

* anujica@agri.pdn.ac.lk

Can Self-organized and Diverse Village Business Groups Remain Resilient? An Insight from the Case of Anthurium Growers' Group in Galkadapathana, Sri Lanka

Ariyarathne M.H.D.D.* and Jayaweera A.
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

There is a continuing debate in academic literature over the query of whether self-organized community groups are a reality unless either a representative of the government or a third-party agent involves in administrating and managing such groups. Many scholars support the view that even if self-organized groups can be formed, they may not remain resilient for longer in the face of various social, environmental, and economic stresses and adjourn before all their target goals are met. Diversity within self-organized groups are believed to add more uncertainty on longevity and performance of such groups. Amidst this intense debate, many agree upon the importance of such self-organized and diverse village groups in both regional development and welfare efforts. This case study was an attempt to address the above arguments by examining a self-organized and diverse village business group in Sri Lanka, which has been reportedly continuing as a success story. The study, through a qualitative approach, first investigated the structural and functional properties of the aforementioned group known as "*Saubhagya*" Anthurium Growers Society in the Galakadapathana GN division. Then, the study investigated the social factors underlying the strength of network bonds that had been building up and maintaining resilience within the collective. Laid on a combined grounded theory and structured framework approach, this study employed key informant and structured interviews to collect data. NVIVO software was used in organizing and analyzing data. The study could reveal the distinctive role of social preferences, social norms, leadership and power dynamics, network dynamics, and mental biases such as sunk-cost fallacy in motivating group members to continue their active membership within the group despite stresses.

Keywords: Self-organized and Diverse Community Business Groups, Resilience, Social factors, Qualitative approach

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* ag15120@agri.pdn.ac.lk

Consumers' Risk Perception of Chemical Contamination of Powdered Milk and its' Influence on Purchase Intention

Lakshantha Y.V.A.R.S. and Korale-Gedara P.M.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Powdered milk is one of the most convenient ways of consuming milk and it is a highly demanded form of dairy product in Sri Lanka. In the recent past, there were a few food-safety scandals in the dairy industry and this challenged the safety of powdered milk. Against this background, this study assessed the risk perception of consumers towards consuming powdered milk and the association between risk perception and trust of information sources, trust towards product, knowledge, subjective norm and, attitude. Finally, the study assessed the association between risk perception and the intention to purchase. A primary survey was conducted among students and the staff at the University of Peradeniya, Sri Lanka. A proportionately stratified random sampling technique was used as the sampling technique. The sample included 273 undergraduate students, 23 academic and 75 non-academic staff members. A pre-tested questionnaire was administered through a google form. The data were analyzed employing Descriptive statistics, Principal component analysis, and Structural Equation Modelling. As per the results, both attitudes and subjective norms influence risk perception. Family and peers' have a strong positive effect on forming risk perception while the media and advertisement have a weaker effect. Consumers' knowledge and trust towards the media news on powdered milk influence both attitude and purchase intention. Knowledgeable people tend to perceive a lower risk of consuming powdered milk as compared to others. Furthermore, their trust in information on media was relatively low. Higher the perceived risk lowers the intention to purchase. The study underscores the importance of enhancing the knowledge of the people on food safety. As people tend to trust the information on media and use modern communication media to obtain information, markets can use modern media sources to transfer information to consumers.

Keywords: knowledge, trut, risk, powdered milk, purchase intention

* pradeepakg@agri.pdn.ac.lk

Determinants of Household Dietary Diversity: A case with of Hunupola area in Western province, Sri Lanka

Dasanayake W.A.S.I. and Gunaratne L.H.P.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Household Dietary Diversity (HDD) is a measure of food consumption that reflects household access to a variety of foods, and also a proxy for nutrient adequacy of the diet. The main objective of the study was to estimate the HDD among semi-urban population and then identify the factors that affecting the HDD. The study was conceptualized with an understanding of food and nutritional security is related to household livelihood and the living environment. Sustainable Livelihood Framework (SDF) was used to identify the determinants of HDD. The SDF encompasses the HDD as a function of human capital, natural capital, physical capital, financial capital and social capital. The access to these capitals was modified by social relations, institutions and organizations and mainly influenced by trends, shocks and seasonality resulting in different livelihood strategy choices. The study was conducted in Hunupola Grama Niladari Division in Gampaha district, Western province. A systematic random sample of 30 households was drawn for data collection. The questionnaire contained demographic details and the questions on 12 groups of foods consumed during a 3-day period by using standard questionnaire. The analysis was done by using Chi-Square analysis and fitting multiple linear and ordinary logistic regression models. The overall HDD score of the study population was 0.72. According to the two-way relationships, prosperity, occupation of husband, having animal husbandry and home gardens were related to the HDD. The multiple regression models identified that wife education, household income, monthly expenditure are determinants of the HDD. The ordinal regression also produced consistent results. Therefore, it could be concluded that the HDD is the study area is in moderate level and determinants of the household dietary diversity wife's education, having home gardens, family income and monthly food expenditure. The study sheds important implications in improving dietary diversity.

Keywords: Household Dietary diversity, Sustainable Livelihood Framework, human capital, natural capital, physical capital

* lhpgunaratne@agri.pdn.ac.lk

Determinants of Online Buying Behavior of Food among Undergraduates through Food Delivery Apps

Herath H.M.N.G.H.P. and Weerasooriya S.A.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The development of Information Communication Technology fuels the internet penetration rate of the world and it brings the whole world to peoples' fingertips. In this milieu, consumers have shown a greater tendency to shift to online activities from their traditional offline activities. The growth of internet providers and increasing penetration of smartphones have promoted the growth of various food delivery apps (FDAs). This study looks into the determinants of online buying of food among undergraduates through food delivery apps by employing the theoretical foundations of the Technology Acceptance Model (TAM) and Uses and Gratification (U&G) theories. The study was quantitative in nature where data was collected using an online survey. The questionnaire was administered to 558 undergraduates of the University of Peradeniya, Sri Lanka. This questionnaire was developed using validated scales from previous literature, containing Likert scale responses. Data were analyzed using descriptive analyses and Structural Equation Modeling (SEM). Reliability was assured through construct reliability. Convergent validity and discriminant validity confirmed the validity of the constructs. Model fit was tested using absolute model fit, incremental model fit, and parsimonious model fit. Results indicate that a majority of the respondents were using FDAs and out of them a majority were hostel residents. The usage of FDAs increased with the increasing family monthly income and it was seen that COVID-19 decreased the usage of FDAs among respondents. SEM revealed that perceived usefulness and perceived ease of use significantly affected attitude ($p < 0.05$). Attitude, convenience, and quality control had a significant effect on purchase intention ($p < 0.05$), while purchase intention significantly affected the online buying behavior of food through FDAs ($p < 0.001$). The study enriches the existing literature while providing implications for future research on online buying through FDAs.

Keywords: Internet penetration rate, Food delivery apps, Perceived usefulness, Perceived ease of use, Purchase intention

* senalw@agri.pdn.ac.lk

Determinants of Translating Entrepreneurial Intention to Action: A Study of Final Year Undergraduate Students of the University of Peradeniya

de Alwis D.T., Kodithuwakku K.A.S.S.* and Hemachandra S.D.S.
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Entrepreneurs are the wealth creators of an economy, and hence business start-ups are encouraged. Although it is often suggested that entrepreneurial intentions are predictors of entrepreneurial action, all intentions do not necessarily translate into action. This situation creates the intention-action gap caused by those who fail to act on their intentions. Empirical evidence suggests that the intention explains only a 30% variance in entrepreneurial action. Undergraduate entrepreneurship has been focused on recent entrepreneurial studies as entrepreneurship is an attractive choice for the younger population. This study aimed to understand the relationship between entrepreneurial intention and entrepreneurial actions of the final year undergraduates of the University of Peradeniya, Sri Lanka, and the determinants of the intention to action translation. Primary data were collected using a pre-tested self-administered online questionnaire. The questionnaire was circulated among the final year student population of the university, and four hundred and fifty-three students (n=453) returned the completed questionnaires. Hierarchical OLS regression with a main effect model and an interactions model was used for data analysis. The research focused on the effects of individual characteristics such as gender, family entrepreneurial background, and environmental factors such as faculty entrepreneurial environment on the translation of entrepreneurial intention to action. Of the respondents who had entrepreneurial intentions, 32% showed some entrepreneurial activities. The results also revealed a significant ($P<0.01$) positive relationship between entrepreneurial intention and action. The analysis also found significant ($P<0.05$) positive effects of gender, perceived entrepreneurial skills, faculty entrepreneurial environment, and entrepreneurial education on entrepreneurial action. Furthermore, it was found that the translation of entrepreneurial intention to action was stronger for male undergraduates than female undergraduates.

Keywords: Entrepreneurial intention, entrepreneurial action, Hierarchical OLS regression

* sarathsk@agri.pdn.ac.lk

Dietary Diversity and Malnutrition Status of Children: Analysis across the Children in the Resettlement Areas in Jaffna District

Selvanayagam N.E., Weerasooriya S.A.* and Korale-Gedara P.M.
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Nutritional status is the most important indicator of the quality of life in children. Child under the age of five years is among the most vulnerable to nutritional deficiencies. The prevalence of child malnutrition is higher among the resettled, compared to the resident group in Jaffna. Thus, this study was conducted to explore whether dietary diversity is a determinant of child malnutrition in the resettlement areas. A cross-sectional survey was carried out in the *Valikamam* North region of Jaffna district involving 60 children (6-59 months) with their mothers or caregivers as respondents. A multistage random sampling procedure was used to select the Divisional Secretariat, *Grama Niladhari* division, households, and children with their respondents to the sample. Multinomial logit regression and Chi-square analyses were used to analyze the collected data. Descriptive analysis revealed that the children consumed 2 to 9 food groups out of 12 food groups over 24 hours. The consumption of animal products was low compared to plant-based products. The majority of the children (71.1%) consumed a diet that was in the medium dietary diversity category. Multinomial logit results showed that the sex of household head, maternal education, and caregiver's age have a negative, significant effect on low dietary diversity ($P<0.05$). The prevalence of stunting, underweight, and wasting in the study sample was respectively 38.34%, 25%, and 8.34%. As per the results of the Chi-square test, there was no association between dietary diversity and malnutrition status of children in this study area. Government invention, availability of safe water, and sanitation are associated with the malnutrition status of children. Thus, the study recommends having new policies or programs which target improving the knowledge of mothers and availability of safe water and sanitation in the area to improve the nutritional status of children.

Keywords: Dietary diversity, malnutrition status, resettlement area, stunting, wasting

* senalw@agri.pdn.ac.lk

Does Gender Matter in Farm Mechanization and Adoption of Micro Irrigation Technologies? : A Study in Thalawa, Mahaweli Irrigation Block in Sri Lanka

Dewasurendra D.A.R.N. and Wijerathna R.M.S.*
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Farmers use machinery to perform critical time-sensitive agricultural tasks and operations. Micro irrigation technology has proven to be higher in water use efficiency when compared to the traditional surface irrigation. However, there are different factors that affect on agricultural technology adoption. Those factors are needed to understand in order to facilitate the technology adoption process. The present study was aimed at finding whether there was a gender effect on adoption of machinery and micro irrigation technologies since there is a research gap in the literature. Simple random and snowball sampling techniques were used to select 30 male and 30 female farmers from a selected village in the Thalawa Irrigation block of the Mahaweli system H in Sri Lanka. Data were collected using a structured questionnaire, and through telephone interviews with the support of an enumerator. Data were analyzed using Mann-Whitney U test, Pearson Chi-Square test, Pearson and Spearman correlation analysis and descriptive statistics. Results revealed that, there was a significant difference ($P<0.01$) in adoption of machinery and micro irrigation technologies between men and women farmers. Gender stereotype factors had a significant association ($P<0.05$) with the adoption of technologies. Higher competition for the same machinery during the season was a major barrier for women compared to men when hiring machineries. Higher initial and maintenance cost, lack of incentives, lack of knowledge and skills to establish and maintain were the other major drawbacks for adoption. Therefore, giving subsidies, gender sensitive extension services and technology development, and introduction of cost effective machinery are essential to increase the technology adoption.

Keywords: Farm machineries, Micro irrigation technologies, Adoption, Gender

* madhavi@agri.pdn.ac.lk

Effect of Entrepreneurial Orientation on the Level of Success of Digital Entrepreneurs in Sri Lanka

Wijethunga H.K.T.M., Kodithuwakku K.A.S.S.* and Abhayarathna M.H.R.
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

With the recent developments in technology in the e-commerce sector, different business platforms are available for an individual to function as an online entrepreneur in Sri Lanka. Being a successful online entrepreneur in digital platforms can be complicated as it could depend on several factors. Entrepreneurial orientation (EO), which comprises; risk-taking, innovativeness, and proactiveness, is considered an important aspect that could influence an entrepreneur's business success. However, there is a lack of studies on the effect of EO on online entrepreneurs' business success. Therefore, the current study aimed to identify the influence of EO along with demographic factors, environmental factors, and business characteristics on the level of success of online entrepreneurs. The study was carried out among 207 online entrepreneurs who have registered at the official business groups on Facebook. Data were collected online using google forms through a pre-tested survey questionnaire. The sample was drawn from five different main E-platforms using a stratified sampling technique. The unit of analysis of the study was an individual online entrepreneur. Data were analyzed using ordinal logistic regression. The study discloses that EO ($p<0.05$) and work experience ($p<0.05$) positively influence the level of success. Further, gender also affects the level of success, where being a male shows a significant positive effect ($p<0.05$) on the level of success compared to that of a female. Under environmental factors, socio-economic conditions showed a significant positive influence ($p<0.05$), whereas business characteristics exhibited no significant effect on the level of success. The study's findings suggested that to achieve a higher level of success as an online entrepreneur, their entrepreneurial orientation (being more innovative, proactive, and risk-taking) plays a significant role. Further, the level of success positively relates to an individual's work experience and socio-economic condition, where males demonstrate a high level of success compared to females.

Keywords: Digital entrepreneur, Level of success, Entrepreneurial orientation, Demographic factors, Environmental factors

* sarathsk@agri.pdn.ac.lk

Effect of Non Tariff Measures on the Spice Exports of Sri Lanka: A Gravity Approach

Udagedara G.H. and Weerasooriya S.A.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Spices are a significant contributor to agricultural exports generating a considerable amount of foreign exchange in Sri Lanka. Even though Sri Lanka has a competitive edge in the international market through spice exports, trade literature revealed that non-tariff measures (NTMs) imposed by developed countries act as a considerable trade barrier. This study analyzes the significance and effects of NTMs on Sri Lanka's major spice exports (cinnamon, pepper, clove, nutmeg, mace, and cardamom) and attempts to quantify their impact and identify the impact of other key drivers. To achieve this objective, a gravity model was used. A panel data set was organized with 18 products at HS-6 digit level exported from Sri Lanka to 12 countries from 2001 to 2017. The Poisson pseudo maximum likelihood (PPML) technique was employed to investigate the effect of NTMs. The results suggested that the GDP of the importing country, tariffs, sanitary and phytosanitary (SPS) measures, and total NTMs have a negative effect and the population of the importing country, distance, technical barriers to trade (TBT), has a positive effect, at a significance level of 0.05. The ad-valorem tariff equivalent was calculated based on the elasticity values obtained from the gravity model. Results showed that SPS contributed to the increase in the price of spice exports by an equivalent tax of 4.30% and total NTMs contributed 1.98% respectively. Surprisingly, the TBT decreased the prices by an equivalent tax of 0.90%. This implies that the different types of NTMs have varying effects on the spice exports of Sri Lanka. Further, at the policy-makers level, it is best to tackle NTMs effectively by proper policies to meet the international demand and to increase awareness through further research initiatives in this area.

Keywords: Spice exports, Non-tariff measures, Poisson pseudo maximum likelihood estimator, Gravity model, Ad-valorem equivalent

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* senalw@agri.pdn.ac.lk

Effect of Socio-demographic Factors on Advertising Appeals Underpinning Food Choice Behavior of Young Adults in Sri Lanka

Serasinghe D.R.* and Jayaweera A.
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Advertising appeals are powerful nudge interventions influencing choices made by human beings who often rely on heuristics to make decisions. This study attempted to reveal the effect of socio-demographic factors on advertising appeals underpinning food choice behavior among young adults in Sri Lanka. An online quasi-experiment was conducted over a sample of 445 young Sri Lankans within the age category of 18-39 years. The quasi-experiment sought to find the association between 16 selected socio-demographic characteristics and food choices structured by six different sets of advertising appeals. Socio-demographic factors included biographical and structural demographics, household-related demographics, employment and career-related demographics and social learning-related demographics. First, with a 2-way chi-square test of independence, association between each demographic variable and choice corresponding to each advertising appeal was tested. Although there were statistically significant associations between many socio-demographics and choices structured by advertising appeals, the strengths of all the associations were deemed weak by the obtained Cramer's V values (<0.3). Then, a 3-way chi square test of independence was run to test the same associations while controlling for each socio-demographic factor concerned. Among the resulted significant relationships (p<0.05), there were moderately strong (Cramer's V>0.3) associations between the socio-demographics and the choices structured by the advertising appeals. Among all the socio-demographics, social-learning related demographics were found to be more pervasive and influential. Another 3-way chi square test of independence was run to find whether food preferences were associated with corresponding choices structured by advertising appeals when controlled for socio demographics. It was revealed that the strength of associations between food preferences and appeals distinctively rose once controlled for the socio-demographics.

Keywords: Food choice behavior, socio-demographic factors, advertising appeals, food preferences

* ag15183@agri.pdn.ac.lk

Effect of Socioeconomic Status of Dairy Farmers on Productivity of Dairy Farms in Three Veterinary Divisions in Gampaha District

Ekanayake E.M.D.M.L., Prasanna P.H.P.* and Weerasooriya S.A.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

A field survey was carried out to assess the effect of socioeconomic aspects of dairy cattle farmers on productivity in Gampaha, Minuwangoda, Marandagahamula veterinary divisions of the Gampaha district. Sixty farmers were randomly selected and interviewed using a pretested questionnaire on family characteristics, socioeconomic status, livestock information, labour distribution, monthly budget and income composition. The data were analyzed using Statistical Package for the Social Sciences (SPSS). The Ordinary Least Squares (OLS) regression analysis was used to study the relationship between dairy productivity and independent variables. According to the surveyed results, the majority of farmers (90%) in all three divisions were male. The majority of farmers (75%) practised a semi intensive farming system. The predominant breed in the surveyed area was Jersey (62.7%) which was followed by local breeds (31.3%). Household's members were involved either on a part-time (46.1%) or full time (28.7%) basis to perform the essential work in the dairy. Artificial insemination (AI) was the most widely used (71.6%) breeding method. The multiple linear regression results revealed that milking frequency, lactation length and feed consumption had a positive influence on milk productivity and that was statistically not significant at a 5% significance level. The Farming experience between 21-30 years had a positive impact on dairy productivity compared to less than 10 years' experience although it was not statistically significant at a 5% significance level. Primary, secondary and more than secondary education levels had a positive influence on dairy productivity compared to no formal education. Semi-intensive and intensive management systems had a positive influence compared to the extensive management system. Herd size and off-farm income and farming experience between 11-20 years had a negative influence.

Keywords: Dairy productivity, Socioeconomic status, Semi-intensive

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[1]Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Peradeniya

* phpprasanna@agri.pdn.ac.lk

Effect of Synchronous Online Education on Academic Self-Efficacy of Undergraduates of University of Peradeniya

Abeywardhana A.A.S.P. and Jayawardena L.N.A.C .*
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Online education has become a common phenomenon in Sri Lanka due to the health guidelines imposed during Covid-19 pandemic. Online education operates in synchronous and asynchronous modes. Overall objective of this study was to identify the factors affecting synchronous online education and analyze the effect of synchronous online education on academic self-efficacy of Undergraduates. Data were collected using stratified random sampling with the use of a questionnaire from the final year undergraduates of the Faculties of Agriculture, Allied Health Sciences, and Engineering of University of Peradeniya. Quantitative correlational research design was adopted. According to the analysis, system accessibility, systematic lecture content, classroom interaction, instructor characteristics, academic satisfaction, and digital competence indicated positive associations with academic self-efficacy ($p<0.05$). Among the factors contributing to synchronous online education, classroom interactions, instructor characteristics, system accessibility and systematic lecture content had significant effect on academic self-efficacy ($p<0.05$). Students' confidence in handling online learning applications had a positive effect on their academic self-efficacy during this period. Devices used, quality of network, academic satisfaction and digital competency had not shown significant effect on academic self-efficacy of undergraduates ($p>0.05$). Gender, faculty of study, residential area, parental educational level, and English language proficiency had not affected the academic self-efficacy of undergraduates. The study was limited to three faculties of the University offering science based syllabus due to the Covid-19 situation. It is recommended to conduct further studies across academic institutions offering online education.

Keywords: online learning, academic self-efficacy, impact of Covid-19, lecture content, classroom interaction

* chandanacj@agri.pdn.ac.lk

Effectiveness of Online Training Programs in Providing In-Service Training for Extension Staff: A Case Study in Coconut Development Training Centre, Sri Lanka

Weerathunga P.L.N.M., Dissanayake U.I.*, Wanigasundera W.A.D.P[1] and Dadigama K.A.[2]
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

In service training is important for the capacity building of the extension officers. Due to the COVID-19 outbreak and related travel restrictions, agricultural organizations have arranged online training for the extension staff. This study was conducted to evaluate the effectiveness of online training provided by the Coconut Development Training Centre (CDTC) to its 225 extension officers (EOs). Kirkpatrick's four-level evaluation model was used as the theoretical framework. Participant's *reaction* to the online training and *learning* were assessed. Three separate questionnaires were circulated with open invitations to the participants of the training programs to assess reaction (n=75), pre-test (n=124), and post-test (n=61). Key informant discussions and observations were made to collect qualitative data. Data were analyzed using Mann Whitney-U test, Ordinal Logistic Regression, Spearman's correlation and descriptive statistics. According to the findings training environment ($P<0.01$), training content ($P<0.01$) and trainer characteristics ($P<0.01$) were highly correlated with trainee satisfaction on online training. Results for pre-test and post-test show that the participants' learning had improved after the training ($P=0.000$). Internet skills of participants have affected the effectiveness of training ($P<0.001$). The study concludes that online training is effective in providing theoretical knowledge to the extension staff. However, there are limitations in delivering practical skills. Regular training can be arranged for the extension staff even after the pandemic situation to refresh knowledge. It is necessary to improve ICT skills among trainers and trainees to get benefits of online training.

Keywords: Coconut sector, Online Training, Kirkpatrick's Training Evaluation Model, Extension, Capacity Building

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[1]Sri Lanka Development of Journalists Forum, Swarna Place, Nawala Road, Rajagiriya
[2]Coconut Cultivation Board, Lunuwila

* uvasara@agri.pdn.ac.lk

Employment Status, Perceived Life Stress and Psychological Well-being among Graduates: The Case of Agriculture Graduates from the University of Peradeniya, Sri Lanka

Subodhani J.A.S. and Kumar S.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Every person is subjected to varying degrees of life stresses. This study examined how one's nature of employment influenced agriculture graduate's life stress and psychological well-being, as well as the relationship between perceived life stress and psychological well-being. The study adopted a cross-sectional survey design. A list of alumni and their contact details were obtained, with permission, from the faculty. The study employed an online pre-tested questionnaire which used questions in both open-ended and close-ended formats. Perceived life stress was measured using the perceived stress scale (PSS), and psychological well-being was measured using the Diener satisfaction with life scale, both demonstrated adequate internal reliability. A total of 129 agriculture graduates participated in the study. To accomplish the study's objectives, descriptive analyses, and multiple linear regressions were used. The majority of agriculture graduates were employed. It was determined that high level of perceived life stress had an impact on psychological well-being. A greater part of agriculture graduates had moderate life stress and a medium level of psychological well-being. The impact of demographic and employment characteristics on psychological well-being was strongly predicted by perceived life stress. Master's degree holders had a significant negative influence on psychological well-being when compared with other higher education levels ($p<0.05$). When compared to other work indicators, period of employment was closely related to psychological well-being. Employees with longer periods of employment reported favorable psychological wellbeing.

Keywords: Perceived life stress, Psychological well-being, Employment status

* skumar@agri.pdn.ac.lk

Environmental Damages and Diver Expectation of Returns in High Value Fisheries in Northern and Eastern Sri Lanka

Sayanthan T. and Prasada D.V.P.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Environmental damage can lead to stock losses in high value fisheries. Diver income can be negatively affected due to stock losses that environmental damages may cause. Water pollution, sea bed disturbance, coral reef degradation, tourism activities and species composition changes are major environmental factors. This study aimed to identify the changes of revenue, maximum economic yield due to environmental damages in high value fisheries. Revenue function estimated with and without environmental damages along with cost function. Northern and Eastern areas were selected to conduct the diver survey. The findings of the study indicate that there is a reduction in revenue when the environmental changes are considered. Bionomic equilibrium effort is lower after considering the environmental damage but the effort level of maximum economic yield increased after considering the environmental impacts. Therefore, higher effort levels are expected even when the revenue is declining due to environmental damage. Pollution and overcrowding contribute more to stock loss among various environmental damages. The higher fishing effort threatens the long-term viability of high value stocks. This result can be used for designing proper environmental management practices in high value fisheries.

Keywords: Environmental damage, High value fisheries, Effort, Bionomic equilibrium, Maximum economic yield

* prasada@agri.pdn.ac.lk

Estimation of the Living Wage for the Tea Plantation Workers

Bandara H.M.S.P., Gunaratne L.H.P.* and Weligamage S.P.
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The tea sector is a labour-intensive industry that accommodates about 0.4 million workers. There is a continuous struggle for higher wages in the tea sector. This study attempted to estimate the living wage that affords a basic but decent life using the Anker methodology, supplemented by computing the economic wage based on production theory. It is noted that the wage gap between current pay and the living wage is somewhat bridged by the provision of valued in-kind benefits like housing and health, education, and child care service. The required data for the analysis were obtained from published sources. The Anker methodology uses food cost, housing cost, and non-food-non housing cost, provision for unseen events in estimating the cost for basic but decent living standards, and then mandatory deduction and in-kind benefits are added to obtain the living wage. An opinion survey was also conducted with the plantation management to obtain a holistic view of the impact of wage hikes on the cost of production, and labour turnover. The study found that the minimum monthly living wage is LKR 24,168.95 for an estate worker; however, the average monthly wage of an estate worker is LKR 21,290.09. Therefore, there is a gap between the living wage and what they receive as their monthly wage. The value of the marginal product of labour is LKR 18,077.5 per month. The tea plantation management believes that with the wage incensement plantation workers can affords a basic but decent life but this could further increase the cost of production of tea and it will harm the future of the tea industry.

Keywords: Tea industry, Anker Methodology, Living wage, Economic wage, Wage gap

* lhpgunaratne@agri.pdn.ac.lk

Factors Affecting Investment Diversification Intentions of Young Adults: A Study of Recent Graduates of University of Peradeniya

Ranaweera K.K.D.P., Kodithuwakku K.A.S.S.* and Jayaweera V.W.
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Investments lead to the economic growth of any country. Therefore, how individuals make investment decisions is an important phenomenon to study. After economic liberalization, numerous investment alternatives have been available in the market. However, preferences and attitudes regarding investments vary from person to person. Recent studies have given a significant attention to the investment aspirations of young adults because they are potential future investors in an economy. However, there seems to be a dearth of studies on the intention to invest in different investment avenues concerning young adults in developing country contexts. This study aims to explore the common sources of information regarding investment for young adults, explore the most preferred investment avenues among young adults, and find out what factors could influence intention to invest on different investment avenues. The study adopted the theory of reasoned action (TRA) as the basic theoretical framework. The study was carried out using an online self-administered questionnaire survey. Data was collected from 153 recently passed out graduates of the University of Peradeniya representing young adults, and they were analysed using the multiple linear regression technique. The findings of the study revealed that most individuals use the internet to mobilise investment-related information, followed by electronic media, consulting with friends and peer investors. Further, the fixed deposit was the most preferred investment avenue while capital market instruments were the least preferred among the graduates. In addition, results indicated that the intention to invest in different investment avenues is influenced by attitudes, risk perception and education levels. However, subjective norms, financial literacy and other demographic variables, such as; gender, marital status, current occupation and monthly income did not significantly affect.

Keywords: Investment preference, sources of information, multiple investment avenues, young adults, intention to invest in different investment avenues

* sarathsk@agri.pdn.ac.lk

Family Business Succession Planning and its Determinants

Mimasha J.P.S., Kodithuwakku K.A.S.S.* and Jayaweera V.W.
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

In recent times, the family business has become an active study area among researchers. Family businesses contribute enormously to the economy and are of utmost importance. Succession is defined as the passing of business leadership from the owner to the successor. Since the previous research has shown that only 30% have survived the succession to the second generation and a mere 10% to the third, it is crucial for family businesses to engage in succession planning to continue through generations. The objectives of the current study were; to investigate whether the family business owners plan for succession and the determinants of family business succession planning. The population was family businesses located in the Gampaha Municipal Council area, Western Province, Sri Lanka. A list of fifty-two (52) members of the Gampaha United Trade Association who attended the two most recent meetings was initially considered as the sample, of which 45 members responded. The sample was further increased to 84 by adopting the snowball sampling technique. Primary data were collected through telephone surveys which were guided by a pre-tested structured questionnaire. In-depth interviews were also conducted with selected respondents to obtain qualitative data. Descriptive statistics and binary logistic regression were used to analyse data and achieve research objectives. The findings revealed that the majority (57%) of the sample had taken at least a single step towards succession planning. Results further showed that family business succession planning is more likely to occur when the owner's level of education increases, family commitment increases, family involvement in the business increases, business age increases and when the business size increases. Furthermore, the research found that family business succession planning is less likely to occur with increasing family cohesion. Quantitative research findings were supplemented by specific patterns identified through in-depth case studies.

Keywords: Family businesses, family business succession, family business succession planning, selecting successors

* sarathsk@agri.pdn.ac.lk

Farmer Attitude on Dry Cow Welfare in Selected Veterinary Divisions of Kandy District of Sri Lanka

Ranthethge R.G.D.P., Samarakone T.S.* and Bandara R.M.A.S.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Dry cow management practices influence on health, welfare and improved milk production in the next lactation. Poor farmer–cow relationships and negative attitudes of the farmer on humane practices could reduce cow welfare and overall productivity. In this study, farmers' attitudes on key dry cow management practices and dry cow welfare were studied via an open structured questionnaire. A total of forty dairy farmers in Kandy District, Sri Lanka were surveyed. Data were collected through face-to-face interviews with the farmers. The collected data were statistically analyzed using SPSS version 23.0. The majority of the farmers were men (77.5%) in small-scale farming (87.5%) with part-time involvement (72.5%). Most of the farmers belonged to 35 - 50 years of age (42.5%) with more than ten years of experience (62.5%). Farmers' attitudes on management practices were significantly affected by gender and part/full-time involvement. A significant effect of gender was observed for health management (P=0.033) and calving management attitudes (P=0.018). Male farmers were better than females in welfare-friendly attitudes for the health management of dry cows and calving management. Farmers in part-time involvement in dairy industry also had a significant impact on welfare positive attitudes towards calving (P=0.038) and health management practices (P=0.013). Farmer age and the experience of farming did not significantly affect their attitudes. A majority of farmers (90%) were unaware of key concepts of dairy cow welfare, and however, had positive attitudes on routine dry cow management practices (80%). However, considerable percentages of farmers (12.5%) were unaware of welfare-friendly routine management practices and had answered as "Neither agree nor disagree". We suggest that further improvement to positive welfare attitudes towards dry cow management should be targeted via proper knowledge dissemination and education programs.

Keywords: Attitudes, Dry cow, Management practices, Welfare

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[1]Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka

* thusiths@agri.pdn.ac.lk

Fire Occurrence and Damage to the Undergrowth of Forest Plantations in the Nawalapitiya Forest Range

Premathilaka R.C.P. and Hitinayake H.M.G.S.B.*
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The objective of the present study was to assess the fire occurrence, damage to undergrowth and to observe the vegetation recovery in the forest plantation in the Nawalapitiya Forest Range in order to identify guidelines to control them and facilitate regeneration. Information related to forest fires occurred during 2019-2021 were collected from the Range Forest Office, Nawalapitiya. They included fire locations, their timing, extent and severity of damage and monthly rainfall. Cause for the fires and vegetation recovery process were evaluated through field studies. Each parameter was given a weighted score according to the importance. Based on the data, Fire Risk Index was calculated for each location. The forest sites burnt during 2020-2021 at Pupuressa, Hunugala and Udawariyagala were selected to conduct vegetation study. The results showed that Udawariyagala, Haloya and Bhadrawathi areas in Nawalapitiya Forest Range are the most fire prone areas. This can be attributed to the very low rainfall in certain months of the year, high fuel availability and socio-economic reasons. A significant ($p<0.05$) correlation was observed between Fire Risk Index and extent of fire damage on a given site. Main causes for the fire initiation in the studied locations are accidental reasons and setting fire for cultivation and clearing roads. Estimated Shannon Index Values shows that the species diversity and evenness is higher in the sections of the sites that were not affected by fires in 2020-2021 when compared to sections burnt in 2020-2021. The study also identified the composition of the fire climax vegetation found as the undergrowth in the *Pinus* plantations establishment in the Nawalapitiya Forest Range.

Keywords: Fire Risk Index, Causes of Forest Fires, Vegetation Recovery, Nawalapitiya Forest Range

* gaminih@agri.pdn.ac.lk

Health Risks and Return in Dive Fisheries of Northern and Eastern Sri Lanka

Ragulan R. and Prasada D.V.P.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

There are significant health risks such as pressure-related risks (decompression sickness, barotrauma, nitrogen narcosis), equipment-related risks (regulator problems, hose blockage, hose rupture), risk of the aquatic and underwater environment, and gas poisoning in diving. Health costs are not considered by the divers in Sri Lanka due to the lack of awareness. However, ignorance of health risks can be costly to diver lifetime income and also fish stocks. This study aimed to evaluate the health cost of divers, optimum economic extraction point with the consideration of health cost. The cost of illness method was used to estimate the health cost. The revenue and cost function was estimated after the consideration of health costs. This study targeted the divers in the northern and eastern coastal areas of Sri Lanka. Data collection was done as a formal interview using a structured questionnaire. According to the results, after considering the health cost, both the optimum effort of divers at the profit-maximizing point and the optimum effort at bionomic equilibrium are predicted to be lower than the currently observed levels. Further, regression analysis showed that the health cost of divers, their daily revenue, and landing sites in Trincomalee and Batticaloa districts are related to the future intended income of the divers. The findings of this study will help to create awareness about managing fisheries while giving necessary emphasis on the health of divers.

Keywords: Health costs, Cost of illness approach, Future income, Bionomic equilibrium

* prasada@agri.pdn.ac.lk

Impact of Covid-19 Pandemic on Livelihood Capital of Fishing Households in Moratuwa Divisional Secretariat, Sri Lanka

Gunasekara M.W.U. and Wijerathna R.M.S.*
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The fisheries sector is one of the important socio-economic sectors that contributes to the local economy of Sri Lanka. However, this sector is vulnerable and sensitive to the natural hazards like Covid-19 pandemic. The purpose of this study was to assess the impact of Covid-19 pandemic on livelihood capital of fishing households belonging to the marine fisheries sector in the Moratuwa Divisional Secretariat (DS) of Sri Lanka. The data were collected from randomly selected 50 households from eight *grama niladhari* divisions in the Moratuwa DS. The data were analyzed using descriptive and inferential statistics. Among the considered variables (spread of the disease, economic crisis and socio-demographic factors) spread of the disease and factors related to the economic crisis were the significant predictors of the livelihood capital ($p<0.05$). The results confirmed that the socio-demographic factors, such as age, gender, and educational level, did not possess a significant effect on their livelihood capital. The descriptive statistics suggested that fishing households had to face difficulties in fulfilling basic household needs during the pandemic period. Furthermore, the results revealed that there was an association between disease infection and spending extra money on medication and other antiseptics. This study highlights the importance of providing necessary support to the fishing community considering their welfare needs and, socio-economic factors in a vulnerable situation like Covid-19 pandemic.

Keywords: Covid-19 pandemic, livelihood capital, fishing households, economic crisis, socio-economic wellbeing

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* madhavi@agri.pdn.ac.lk

Impact of Import Ban of Maize on Chicken Meat and Egg Prices.

Pathmasiri D.P.T.M., Korale-Gedara P.M.* and Perera W.N.U.[1]
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

To protect local maize farmers and ease the pressure on the exchange rate and balance of Payment, the Sri Lankan government has imposed an import ban on maize since January 2020. The poultry industry, one of the main consumers of imported maize, has been affected by this ban as the local production of maize, which is around 250,000 MT is not adequate to meet the industry demand. Since maize is one of the main feed ingredients in the poultry industry, this can have an impact on the cost of production of poultry products. The main research objective of this study is to assess the impact of this ban on the prices of chicken meat and egg. The study modeled the price transmission between maize and chicken meat and egg using ARDL bound test. The required monthly data on prices of chicken, egg, maize, and other feed ingredients were obtained from the Department of Animal Production and Health and a leading animal feed manufacturing company. As the results revealed, both chicken meat and egg price have a long-run relationship with maize prices. An increase in maize price by 1% leads to an increase in egg price by 0.69% and an increase in chicken price by 0.35%. The estimated Error Correction Model reveals that short-run deviations from the long-run equilibrium between maize-egg and maize-chicken are corrected within 1.5 months and around 22 days respectively. Considering the fact that both prices of egg and chicken are regulated, this indicates a considerable price transmission from maize to poultry products. This research recommends that until the local production reaches a level adequate to meet the local demand, the government needs to take measures to import the requirement of maize to avoid price increases of chicken meat and egg which are essential food commodities.

Keywords: Egg, Chicken, Maize, ARDL model, Error Correction Model

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[1]Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya

* pradeepakg@agri.pdn.ac.lk

Influences of Demographic Characteristics, Consumer Preferences and Misconceptions on Meat and Eggs Consumption in Sri Lanka

Kawvindi W.D.S., Perera W.N.U.* and Kumara S.M.S.P.[1]
Department of Animal Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The consumption of animal source food improves human nutrition and health by preventing protein and micronutrient deficiency-related problems. However, animal source food intake has been low in many developing countries, including Sri Lanka. Achieving food and nutritional security is a major challenge due to unhealthy eating patterns, misconceptions, beliefs, and myths. Therefore, the objective of this study was to study the influence of demographic characteristics, consumers' preferences and misconceptions on meat and eggs consumption in Sri Lanka. Data were collected from 1000 respondents through a primary survey using an online questionnaire. The collected data were analysed using descriptive statistics and Kruskal-Wallis nonparametric tests in Statistical Package for Social Science (SPSS) version 22. The analysed data indicated that the demographic information, nutrition knowledge related information and factors influenced the purchase decisions and consumption behaviour. Results showed that about 88.5% of respondents consumed eggs and meat. It was found that 46% of meat consumers consumed only chicken. On average, most respondents consume eggs and meat 2-3 times a week (38.8 and 24.9% of total respondents for eggs and meat, respectively). It was observed that when a blood droplet was spotted in the egg yolk, 19.6 % of respondents reject the egg for consumption. Moreover, 8% respondents reject the egg due to the chalazae. Kruskal-Wallis tests showed that ethnicity ($H(3)=13.605$, $p=0.003$), religion ($H(5)=26.949$, $p=0.000$), residential area ($H(2)=15.981$, $p=0.000$), education level ($H(9)=94.377$, $p=0.000$), occupation ($H(9)=30.449$, $p=0.000$) and household monthly income ($H(9)=37.739$, $p=0.000$) significantly influenced the misconception knowledge on meat and eggs. Overall, 32.4% of respondents were observed with higher level of misconceptions. Thus, the need of educating people with fact-based knowledge through awareness programs to improve nutrition-related knowledge and attitudes for dietary changes towards a healthier dietary pattern is highlighted.

Keywords: Demographic characteristic, Misconception, Consumer preference, Meat, Eggs

[1]Department of Agricultural Extension, Faculty of Agriculture, University of Peradeniya, Peradeniya

* nipunap@agri.pdn.ac.lk

Job Preferences of Agriculture graduates: A study of graduates of the University of Peradeniya

Bandara W.M.D.G. and Kumar S.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Graduates of Faculties of Agriculture find work in varied industries and sectors, partly due to the multidisciplinary nature of their programs and because of the theoretical and practical focuses that these programs adopt. Studying job preferences is beneficial for universities, employers and potential employees. The study used a cross sectional design, in which a sample of most recent Agriculture graduates, who constituted three batches of students of the University of Peradeniya, completed a questionnaire. Descriptive statistics and multiple linear regression statistical techniques were used for analysis. Results indicated that students' preferences fell into three broad categories: work context (working conditions, supervisors, coworkers), compensation attributes (job security, income, compensation package and advancement potential) and non- compensation attributes (location of the job, social responsibility and nature of work). Only civil status related to compensation attributes and non-compensation attributes ($P<0.05$). Gender and age were unrelated to job preference of Agricultural graduates. Investigative, social and artistic personality types have an influence on the non-compensation and work context job attributes ($P<0.05$). Participants reported a high level of job market knowledge but it was found to be unrelated to the job preference of Agriculture graduates. Implications are discussed.

Keywords: Job preferences, Agriculture graduates, personality type

* skumar@agri.pdn.ac.lk

Municipal Solid Waste (MSW) Composting and Potential Environmental Risk Associated with High Electrical Conductivity (EC) of MSW Compost in Sri Lanka

Dhanushka K.K., Karunarathna A.K.[1] **and Wimalasiri K.M.S.***
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Municipal Solid Waste (MSW) has become an increasingly recognized environmental issue faced by developing nations. MSW composting is an efficient and cost-effective waste disposal method executed in Sri Lanka. Waste generation in Sri Lanka is over 6400 tons/day, and the waste generating potential is 0.25 to 0.5 kg/capita/day. Major fraction (65-66%) of MSW consists of biodegradable organic materials, and 53.3% out of the total is primarily kitchen waste. Windrow and static pile composting are suitable and cost-effective waste disposal methods practiced in developing nations including Sri Lanka. With the increasing demand for organic crops, commercial MSW composting also gets increased. Compost made from MSW is slightly different from the compost produced using common organic waste. One of the quality issues faced by MSW compost in Sri Lanka is the Electrical Conductivity (EC) above 4 dS/m. Use of composts with high EC is believed to result in reduced plant growth and poor yield. High NaCl concentrations can inhibit growth by accumulating high levels of both Na^+ and Cl^- simultaneously, although the effects of the two ions may differ. EC provides the cumulative value of soluble salts present in compost which includes mineral nutrients supporting plant growth, indicating that EC cannot directly be correlated to the salt toxicity. Use of the analytical parameter, "Nutrient index (Ag index)" instead of EC provides a better measure of the relative amount of NaCl present in compost, indicating the salt toxicity level. Ag index above 10 refers to the best quality compost, while that below 4 refers to poor quality compost. Higher EC of MSW compost can be reduced by irrigating with high-quality water, adding gypsum, and introducing zeolite as a composting element.

Keywords: MSW, Composting, Food Waste, Electrical Conductivity, Ag index

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

* swarnaw@agri.pdn.ac.lk

Occupational Stress among the Private Sector Executive Level Employees

Senanayake W.A.S.M. and Jayawardena L.N.A.C .*
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Occupational stress is one of the most crucial problems faced by the employees of organizations all over the world. Occupational stress can cause emotional cost to employee well-being as well as economic cost to organization and its performance. The main objective of the study was to identify and asses the factors affecting occupational stress of the private sector executive level employees. Executive level employees of Lankem Ceylon PLC organization were selected as the study population. Quantitative correlational research design was adopted. Sample size was 42 executive employees working in six departments of the selected organization. Seven employees from each department were selected to the study using stratified random sampling method. A self-administered survey was conducted online. An online focus group discussion was conducted to explore and triangulate the findings. Majority of the respondents (69%) had indicated a high level of occupational stress among them. Employees work load, impact of Covid-19 to work arrangements, support of co-workers, employee competency, and the educational or professional qualification have shown a significant effect on the occupational stress ($P<0.1$) of executive level employees. Other factors such as the employees' gender, marital status, work experience, support of superiors, job autonomy, and physical work environment had no significant effect on the occupational stress of executive level employees. Due to the Covid-19 pandemic situation the study was conducted through online mode using a relatively sample size.Effective coping strategies can be formulated through the identification of major factors of occupational stress.

Keywords: Occupational Stress, Work Load, Employee competency, Executive level employees

* chandanacj@agri.pdn.ac.lk

Online Purchasing Behavior of Fast Moving Consumer Goods (FMCG): With Specific Reference to COVID-19 Post Lockdown Period of a Sample from Gampaha District

Shanika L.A.A. and Kumar S.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Traditionally, consumers should walk along the aisles of supermarkets to find their Fast Moving Consumer Goods (FMCG), whereas online, they can simply browse and click to fulfill their needs. Yet, online purchasing of FMCG in Sri Lanka remains low. COVID-19 pandemic drastically changed shopping behavior as many consumers transitioned to online FMCG purchasing. Yet, once traditional shopping was possible, online purchasing reduced, suggesting that consumers are ambivalent about the online purchasing of FMCG. This research investigates the changes that occurred in online purchasing of FMCG before and after COVID lockdown periods and investigates key determinants of consumers' online purchasing intention of FMCG in Sri Lanka. The study also examines the relationship between purchasing intention and the purchasing behavior of the online FMCG shopping. An online survey was conducted with a pre-tested questionnaire to collect data from the consumers who are living in the Gampaha district. A sample of 131 consumers, obtained using a snowballing sampling method, were analyzed using descriptive statistics, Wilcoxon Signed Ranked test, Spearman's correlation test and Order Logistic Regression. Results indicated a small positive change in online FMCG buying behavior before and after the COVID-19 lockdown. Younger consumers were more likely to report an online FMCG purchasing intention compared to older persons. Subjective norms, perceived financial and convenience risks significantly influenced ($p<0.05$) online purchasing intention suggesting that concerns over the riskiness of online purchases regarding financial losses and concerns of inconvenience are important considerations to consumers. There was a positive correlation between online FMCG purchasing intention and purchasing behavior. These results can be applied to supermarkets to improve the facility of online FMCG shopping by minimizing perceived risks factors affecting their intention. The study also suggests that addressing perceived norms regarding online shopping may result in more favorable perceptions regarding online FMCG shopping.

Keywords: Online, FMCG, Perceived risks, Purchasing intention, Purchasing behavior

* skumar@agri.pdn.ac.lk

Owner's Characteristics and Business Performance during COVID-19: A Study of Agriculture Based Small and Medium Enterprises in Three Grama Niladari Divisions in Chilaw

Jayaweera M.A.S.S. and Kumar S.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The COVID-19 pandemic has disrupted business activity, particularly for small and medium enterprises, some of which have been entirely lost to the economy. This unexpected crisis has required that businesses change quickly with few resources. Some enterprises respond to this situation by applying creativity and have responded to the change more successfully than others. Generally, business performance depends on the owner's characteristics and how they operate their businesses. Therefore the aim of this research was to examine the relationship between owner characteristics and small business performance during the pandemic. This research consisted of collecting primary data, using a questionnaire, from agriculture-based small and medium enterprises in three gramaniladari divisions, in Chilaw. Hypotheses were tested using descriptive techniques and multiple regression analyses. It was hypothesized that the owner's s characteristics would relate to business performance and also, business performance and owner satisfaction would be positively correlated. The results indicate that a substantial proportion of businesses have closed due to the pandemic. Business owners had used both financial and non-financial strategies to tackle the crisis (obtaining loans, utilizing business and social networks, pursuing new market channels), but a substantial number simply did not adopt special strategies. The personality characteristics adaptability, competitiveness, and emotional resilience significantly affected business performance ($p<0.05$). The owner's age, business type, business age, non-financial strategies also showed significant relationships with business performance ($p<0.05$). Additionally, owner satisfaction and business performance show a strong correlation ($p<0.01$). The research findings give insights into how the pandemic has taken a toll on SMEs in the agriculture sector. They also provide support for research evidence suggesting that owner's characteristics are related to business performance.

Keywords: Owner's characteristics, Business characteristics, Owner satisfaction, Business performance, COVID-19

* skumar@agri.pdn.ac.lk

Potential for Biodiversity Conservation and Agroforestry Based Development in Homegarden Systems in Asideniya Area of Kegalle District of Sri Lanka

Kasthuriarachchi K.A.M.D. and Pushpakumara D.K.N.G.*
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Homegarden agroforestry system is one of the major land use activity in Sri Lanka has a high potential for biodiversity conservation. Kandyan homegarden is the dominant homegarden system in Kegalle district which has a high structurally complexity but due to various reasons this system is somewhat degraded. Consequently, the objective of this study was to assess diversity of homegardens and their further improvement potential with agroforestry tree interventions in rural village of Asideniya village of Kegalle district located in the WL2b agroecological region. Twenty-five homegardens were sampled on size, diameter at breast height, tree height, species diversity and potential for agroforestry based tree interventions. All tree species were identified to the species level and revealed the presence of 79 species from 31 families and 65 genera. The average size of the homegarden is 0.066±0.01 ha and average tree density is 578±42 trees per ha. *Areca catechu* L. was the most abundant tree species, followed by *Cocos nucifera* L. and *Artocarpus heterophyllus* Lam in homegardens. The species area curve revealed the sample size to be adequate for estimation of species diversity of homegardens whereas Shannon Wiener Index ranged from 1.04 to 2.73 with a mean value of 2.17±0.38. The Relative Importance Values of species and used categories of species were found to be good approximates for importance of species for householders. Potential of agroforestry tree interventions such as substitution, replacement, expansion and management could be effectively used to improve homegardens to achieve biodiversity conservation through utilization while addressing issues related to food and nutritional security of householders. This study concludes the high potential of homegardens in Asideniya area for further biodiversity conservation through agroforestry based development with tree based interventions.

Keywords: Biodiversity Conservation, Agroforestry Development, Homegarden, Tree interventions

* ngpkumara@agri.pdn.ac.lk

Potential Use of Microorganisms for the Economic Sustainability of Food Industry: A Review

Vidyasekara E.V.R.T., Samarakoon E.R.J.* and Rajawardana D.U.[1]
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Economic sustainability is one of the major pillars of the sustainability concept which decides the long-term survival of a particular organization with the market competition. Among many ways to achieve economic sustainability in food industries, microorganisms play a vital role, as their applications have been spread throughout the food value chain. Positive impacts of microorganisms on social and environmental pillars of sustainability while exerting minimum negative influences are added advantages of using them. Raw material and operational cost reduction, support to increase the demand for food products rapidly and utilization of food waste to generate an income are some primary techniques to achieve economic sustainability. In this review, the integration of microbial technologies for the achievement of economic sustainability has been widely discussed covering areas such as nitrogen fixation and bioremediation in crop production, fermentation, nutrient enrichment and genetic modifications in food processing and bioethanol, compost production and anaerobic digestion in food waste management. The beneficial and destructive effects of using microorganisms for economic sustainability have been critically evaluated while providing strong shreds of evidence. The challenges encountered during microorganism-related researches in the food industry have been considered in future directions. Microorganisms are genetically engineered at present abundantly to customize their metabolic activities to make them suited for the food industry operations as it is more economically sustainable. Even though the research and development cost for biotechnological advancements and genetic engineering is high, considering the long-term advantages, scientists tend to use microorganism-related genetic engineering techniques which itself depicts their potential use in the economic sustainability of the food industry.

Keywords: Microorganisms, Economic Sustainability, Food Industry, Waste Management

[1]Industrial Technology Institute, Halbarawa Garden, Thalahena, Malabe

* rasanjalis@agri.pdn.ac.lk

Psycho-social Factors Predicting the Willingness of Rural Women to Engage in Profit-oriented Self-help Groups: A Study with Reference to Farm Households in the Mahakanumulla Tank Cascade System

Perera L.K.D.N.* and Jayaweera A.
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

This study is an attempt to investigate the psycho-social factors predicting the willingness of rural women in the Mahakanumulla Tank Cascade System (MTCS) to engage in profit-oriented self-help groups (POSHG). Data were collected from a sample of 95 randomly selected adult women from four villages of the MTCS through a pre-tested structured questionnaire. A structural model, theorizing the causal relationship between seven psycho-social factors and the willingness of rural women to engage in POSHG, was developed based on an extended Theory of Planned Behavior (TPB). Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to validate the measurement model and to test the hypotheses. The results confirmed the validity of the model. As depicted by the construct mean of the latent variable gauging the dependent variable, the respondents had expressed a high level of willingness to engage in POSHG. The findings, pertaining to the concerned population, indicated that (1) attitudes towards benefits of engaging in a group business, (2) perceived behavioral control in collective action and (3) perceived risk of being subject to jealousy, significantly predict willingness of rural women to engage in POSHG.

Keywords: Psycho-social factors, Rural women, Profit-oriented Self-help Groups, Theory of Planned Behavior, Structural Equation Modelling

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* ag15176@agri.pdn.ac.lk

Quality of Life of Women Garment Workers and its Variations Based on Residential Status: A Case of the Biyagama Export Processing Zone

Pitawala L.M.D.D.M. and Kumar S.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Garment factory workers, and particularly women workers, drive the success of the Sri Lankan apparel and textile industry. As many are migrant workers, their residential status is likely to affect their experiences and quality of life (QOL). This research aims at studying QOL and how it varies by residential status (own houses, boardings, and hostels). The World Health Organization Quality of Life BREF (WHOQOL-BREF) model was used to conceptualize QOL dimensions (physical, psychological, social, and environment). Mixed methods research was conducted using both quantitative and qualitative methods on a random sample of 120 women garment workers of the Biyagama Export Processing Zone belonging to the 3 residence types. Data were gathered through telephone surveys employing the Sinhala version of the WHOQOL-BREF scale, behavioral measures of QOL domains, and open-ended questions. Descriptive analyses revealed a majority of workers had favorable levels of QOL. Repeated measures-MANOVA analysis revealed a marginally significant interaction between QOL domains and residential status ($p = 0.054$). Social QOL was rated lower than other domains in all residence types. Environment QOL differed from the other domains, but only among hostel residents. Follow-up analyses of quantitative and qualitative data revealed common problems across residences, such as musculo-skeletal complaints, work related pressure, concerns over social standing, and positive elements such as improved living standards, a sense of independence, access to good healthcare. There were also variations among boarding and hostel residents with regards to their physical and psychological QOL. QOL was influenced by monthly income, marital status, education, presence of children, and prevailing illnesses of the workers, and by COVID-19 and working conditions. The findings of this study can be used to improve the QOL of workers and demonstrated that further research on the impact of COVID-19 on the QOL of the garment worker population is warranted.

Keywords: Quality of life, Women garment workers, Residential status, WHOQOL-BREF, Export Processing Zones

* skumar@agri.pdn.ac.lk

Recycling and Disposal of Agrochemical Waste: A Sustainable Model for an Agrarian Village

Fernando W.W.M.J.* and Weerasooriya S.A.
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Agrochemical waste disposal is one of the key issues faced by farmers. Improper disposal further causes a harmful and significant impact on the environment and living organisms. Given this backdrop, this study was conducted to introduce a sustainable reverse logistic model to an agrarian village to prevent improper agrochemical waste disposal and identifying factors that lead to farmer's decision to adapt to such a model. There are many factors influencing farmers' decision on following the reverse logistic model such as demographic factors, socio-economic factors, perceived value factors, geographical factors, and psychological factors. The study was conducted to identify perceived risk, perceived benefit, perceived value that ultimately influenced the farmer's behavior to adapt to a sustainable reverse logistic model. The most common materials found are plastic, glass, and polyethylene, and the most common disposal practices for these materials include dumping in fields and burning. A total of 71 farmers were randomly interviewed from *Mahakanumulla* village in the Anuradhapura district. The data was collected through a survey and a Structural Equation Model (SEM) was used to empirically estimate the impact of perceived benefit, perceived risk, and perceived value on green disposal behavior. The perceived benefits and perceived risk had a significant effect on green disposal behavior. Among them, perceived risk (0.615) had the greatest positive effects on green disposal behavior followed by perceived benefits (0.351). Also, perceived risk (0.580) and perceived benefits (0.320) had a significant impact on perceived value. The results of the study shows that awareness of the risk and benefits influences green disposal behavior. This study aids policymakers in implementing green disposal models that has potential for higher adaptability among farmers.

Keywords: Agrochemical waste, perceived risk, perceived benefit, perceived value , reverse logistic model

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* ag15023@agri.pdn.ac.lk

Regeneration of two Native Widespread Pioneer Tree Species using Seeds

Madushankha H.V.L.L. and Hitinayake H.M.G.S.B.*
Department of Crop Science,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Kenda (*Macaranga peltata*) and Gedumba (*Trema orientalis)* are two native widespread pioneer species found in Sri Lanka. Production of prolific number of seeds, rapid growth rate, high requirement of sunlight, and short life span are key ecological characteristics of the pioneer species. Even though there is a prolific production of seeds, both species shows low natural regeneration. No studies have been conducted in Sri Lanka to evaluate the germination of these two species. The objective of the present study was to identify methods to increase the germination rate of the selected two native pioneer species. Three different seed treatments, soaking seed in 150 ppm, Gibberellic acid for 15 minutes (T1), soaking seed in 50% Sulfuric acid for 10 minutes (T2), cold treatment that is refrigeration for 24 hours before planting in trays (T3) and a control (T4) were assessed in the experiment. The germination rates were measured just after harvesting and six weeks after harvesting. Each treatment was replicated five times and treatments were arranged in a completely randomized design. Seeds were planted in treys filled with top soil and each replicate consisted of 20 seeds. Low seed germination rates were reported for both species when tested just after harvesting and six weeks after harvesting. Cold treated Kenda seeds just after harvesting showed higher rate of germination ($p<0.05$) when compared to other treatments. Cold treatment improved germination percentages for both Kenda and Gedumba both just after harvesting (18% and 14%, respectively) and after six weeks from harvesting (16% and 14%, respectively). Lowest germination rates were reported in the control for both species when tested just after harvesting and six weeks after harvesting. Both species showeds very similar behavior against the treatments as well for the duration of storage.

Keywords: Pioneer species, *Macaranga peltata*, *Trema orientalis*, Seed germination

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* gaminih@agri.pdn.ac.lk

Social Capital, Gender and Information Exchange: A Case study in Rural Agriculture Village in Sri Lanka

Prabhavi B.U.I. and Wijerathna R.M.S.*
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The network of relationships among people who live and work in a particular society which helps in functioning the society well is known as the social capital. The objective of this study was to investigate whether there is an association between social capital, gender, and information exchange in a rural farming community. Contribution of social capital for the farmer to farmer information diffusion or the informal information exchange mechanism was the main focus. About 30 male and 30 female farmers from Hirgollagama village of the Thalawa Divisional Secretariat of Anuradhapura District of Sri Lanka were randomly selected for the study. A Structured questionnaire was used as the data collection instrument. In addition, field observations were also made. A linear regression model was used to analyze the effect of social capital on information exchange. Findings revealed that there is an impact on social capital indicators; volunteering action ($p=0.000$) and participation in social events ($p=0.021$). Those factors have a positive impact on information exchange ($p<0.05$). It was observed that the access to information by formal ways was higher by male farmers than that of females while access to information by informal ways and mass media was higher by the female farmers. Overall, there is an association between information exchange and gender ($p=0.055$). The findings of this study will be important in the field of agriculture information dissemination to improve accessibility to agriculture information by rural men and women.

Keywords: Social capital, Gender, Information Exchange, Access to agriculture information

* madhavi@agri.pdn.ac.lk

Students' Attitude, Knowledge and Experience on Sexual and Gender Based Violence and Harassment: A Study at the University of Peradeniya

Solomans A.G. and Wijerathna R.M.S.*
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Sexual and Gender Based Violence and Harassment (SGBVH) is the most extreme expression of unequal gender relations in society and one of the most widespread violations of human rights. The university is a cross section of the society. The main objective of this study was to investigate the present status of SGBVH in the University of Peradeniya. The specific objectives were to examine the university students' attitude, knowledge and experience on SGBVH. A Google survey was conducted inviting all the final year students of the University (2020/2021) to respond. Three hundred and sixty five students had responded to the survey. Descriptive and correlation statistics were used to analyze the data. Accordingly, majority of the students (81%) perceived that there was no presence of SGBVH at the university. However, the rest of the respondents (11%) perceived that it existed within the university to some extent. Moreover, very few (8%) remained neutral in their responses. Among the respondents, some students reported of having experience on digital violence (20%), partner violence (11%), emotional violence (12%) and verbal violence (17%). There was a positive relationship between students' attitude and students' knowledge on SGBVH. This study concludes that the university is not free from SGBVH. The study highlights the importance to develop awareness among students on SGBVH and taking measures to develop positive attitudes to eradicate SGBVH along with other measures.

Keywords: Sexual and gender based violence and harassment, Attitude, Experience , Knowlwdge

* madhavi@agri.pdn.ac.lk

The effect of Organizational Reward Systems on Employee Job Motivation

Kalpadeep B.P.T. and Jayawardena L.N.A.C .*
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The motivation of employees is one of the most influential factors for employees' work performance. Organizational reward systems play a vital role by improving employee satisfaction with the job role. The main purpose of this study was to identify and examine the effect of organizational reward systems on employee job motivation. Two organizations specialized in the apparel sector and manufacturing solid rubber tires were selected for the study. A self-administrated questionnaire was used to collect data. Eighty employees, 40 from each of the two organizations, were selected randomly for data collection through a questionnaire. Selected employees were in the middle and operational level management categories. Deductive correlational research design was adopted. Descriptive methods, correlation, and regression were used to analyze the data. The study showed that employee motivation was influenced by both financial and non-financial incentives. From the factors in the reward system, non-financial rewards, and financial benefits have shown a significant effect ($p<0.05$) on employees' job motivation. It was found that the job autonomy and support of the leaders (superiors) had significant effects ($p<0.05$) on employees' job motivation. The effect of employee autonomy on employees' motivation was noteworthy. From the study variables, gender, organizational climate, work-life balance, and the nature of basic/fixed pay had no significant effect ($p>0.05$) on the job motivation of employees. Further studies are suggested on the effect of diverse benefits packages offered to employees by Sri Lankan organizations.

Keywords: Employee job motivation, Organizational reward system, Financial rewards, Non-financial rewards, Job autonomy

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* chandanacj@agri.pdn.ac.lk

The Role of Gut Microbiome on Physical and Mental Health of Human: A Review

Wickramasinghe W.M.N.D. and Wijesinghe D.G.N.G.*
Department of Food Science & Technology,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The human gastrointestinal tract (GIT) has a rich microbial ecosystem that is both taxonomically and functionally diverse. The term "gut microbiome" refers to the vast array of symbiotic microbiota in the human gastrointestinal system as well as their collective interacting genomes. The colon contains around 10–100 trillion microbiota, and more than 90% of all phylogenetic varieties of colonic bacteria belong to the domain phyla Firmicutes and the Bacteroidetes. The composition of the microbial community is host-specific, evolving during an individual's lifespan and vulnerable to exogenous and endogenous alterations. The early colonization of the gut with microbes is crucial for developing the infant's immune system, metabolic function and future health. During childbirth, maternal microorganisms are transmitted to offspring, which is crucial in colonizing the infant's intestine. The gut microbiome's composition and homeostasis are highly variable due to microbiome intrinsic variables, host factors and environmental influences. The diet is one of the essential variables in developing one's gut microbiota. Extensive studies have been conducted on the human gut microbiome and its significance in both health and disease, establishing its participation in human metabolism, nutrition, physiology and immunological function. Dysbiosis in the gut microbiome is linked to various health problems, including inflammatory bowel disease (IBD), GIT malignancies, obesity, cardiovascular disease, rheumatoid arthritis, cholelithiasis, allergy and asthma. This review summarizes the evolving knowledge on composition, diversity and functionality of gut microbiota, how the microbial community is influenced in dysbiotic disease conditions and their impact on cognitive development.

Keywords: Gut microbiota, Health , Disease, Dysbiosis, Cognitive development

* wijeng@agri.pdn.ac.lk

The Work From Home effect on the Performance of Employees

Perera R.N. and Jayawardena L.N.A.C .*
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Organizations struggle to limit the impact of Coronavirus while maintaining job continuity. Many organizations have transitioned their employees from the traditional workplaces, especially offices, to Work From Home (WFH) as a strategy to manage organizational performance during COVID-19 pandemic. Employee performance influences an organization's success. The main objective of the study was to identify the effect of WFH on employee work performance in private sector organizations during the COVID-19 pandemic. Study examined how WFH, organizational-related factors, employee competency related factors, motivation, and job-related factors affect on employees' WFH performance. The target population of this research was middle-level WFH employees in private sector organizations. The study was conducted with three private sector organizations in Gampaha District, Western Province, Sri Lanka. Two of them were insurance companies, and one was a manufacturing company. Deductive correlational research design was adopted. The quasi-random sample (n=90) was used for data collection. Two questionnaires were created to collect data which included demographic factors, major factors affecting Employees' WFH performance, and an evaluation of Employees' WFH performance. Data were analyzed using correlation, regression analysis and descriptive statistics. There were significant ($P<0.05$) effects of WFH, work environment and organizational communication on employee WFH performance. Employee motivation, organizational culture, job autonomy, employee teamwork competency, and employee adaptability competency had no significant effect ($P>0.05$) on employee WFH performance. It is recommended to conduct further exploratory and longitudinal studies in Sri Lankan context.

Keywords: Work From Home, Employee Performance, COVID-19, Work Environment, Organizational Communication

* chandanacj@agri.pdn.ac.lk

Unhealthy Snacking Behavior amongst University Students during the COVID 19 Pandemic: A Study of Students of the University of Peradeniya, Sri Lanka

Sasanka U.B.E. and Kumar S.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Today, with the spread of the COVID 19 pandemic, almost all university students in Sri Lanka, continue their academic semesters at their residence, through online platforms. These students have been recognized as one of the most vulnerable groups for poor dietary behaviors including unhealthy snacking, particularly while involving online learning. The current study examined the nature of and factors affecting unhealthy snacking behavior amongst university students. It also examined the self reported changes in overall snacking behavior, due to the pandemic. The Theory of Planned Behavior was used as a foundation. An online survey was conducted with a pretested questionnaire, with students of the Faculty of Agriculture, University of Peradeniya. A sample of 207 students were surveyed and analyzed using descriptive statistics, one-way ANOVA and path analysis to address stated research objectives. The results revealed that biscuits (94.7%), buns and pastries (84.5%), confectioneries (81.2%) and deep fried snacks (80.2%) were the most common unhealthy snack types consumed. The majority consumed unhealthy snacks between lunch to dinner (83.1%), and while watching TV or movies (74.3%). Although 91.8% were aware of the traffic light color code systems available for labelling sugar sweetened bottled beverages, only 24.2% were aware of the availability of the same system for packaged snack foods. Further, findings revealed that unhealthy snacking behavior did not significantly vary by socio-demographic factors ($p>0.05$). Attitudes, family's norms, perceived behavioral control and intention were major factors significantly affecting unhealthy snacking behavior amongst university students ($p<0.05$), although friends' norms had no significant impact ($p>0.05$). Snack choices (60.7%) and the snacking occasions (58.2%) were the characteristics that mostly changed due to the COVID 19 pandemic. Theoretical and practical implications were discussed for altering the existing behavior.

Keywords: COVID 19, Theory of Planned Behavior, Unhealthy Snacking Behavior

* skumar@agri.pdn.ac.lk

Use of Facebook as a Source of Agricultural Information by Mushroom Growers in Munamaldeniye Agriculture Instructor Region

Edirisinghe E.M.N.H. and Dissanayake U.I.*
Department of Agricultural Extension,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Extension services in mushroom cultivation has been constrained by not enough agricultural extension officers to render services and prevailing Covid-19 situation. Thus, it is necessary to find out innovative extension approaches as alternatives. Therefore, this study was conducted to design, implement and evaluate a Facebook campaign to providing agricultural information for mushroom growers in Munamaldeniye Agriculture Instructor region. This participatory action research based on the Kolb action research model. Information for the requirement assessment was collected using ten key informant discussions. A Facebook https://www.facebook.com/groups/335158117967502/?ref=share link was created and initially 24 mushroom growers were recruited. Then, snowball sampling was used to recruit up to134 participants. Technical information related to mushroom cultivation were developed, with validation of subject experts, and shared with the participants. A pre-test and post-test analysis was conducted to test knowledge gain of the participants. An online survey (n=42) was conducted with conveniently selected respondents to assess effectiveness of the intervention. Accordingly, majority of the respondents were satisfied with the information shared on Facebook page (86%), agreed Facebook as a suitable platform to receive information during Covid-19 pandemic (88%), and suggested the Facebook pages as one of the highly suitable platform to distribute advisory services among mushroom growers (90%). Thus, this study concludes that Facebook social media platform can be used in networking and information delivery among mushroom farmer in the area.

Keywords: Facebook, mushroom growers, action research, Munamaldeniye, Extension Campaign

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* uvasara@agri.pdn.ac.lk

Valuing Ecosystem Services Provided by Minor Village Tanks in the Dry Zone of Sri Lanka

Dilhari W.A.D.S. and Weerahewa J.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

The minor irrigation tanks in many village cascade systems in Dry zone have degraded overtime and the governmental and non-governmental agencies have started allocating large sums of money, in the recent past, on rehabilitation. However, the selection of tanks for rehabilitation process is primarily based on irrigation potential and the attention paid on other ecosystem services are insufficient. This research study was undertaken to present ecosystem services namely provisioning, regulatory, supporting and cultural services provided by the minor village tanks in Dry zone and to assess their economic values. A review of literature was undertaken to identify the nature of ecosystem services and market prices and benefit transfer valuation based approaches were used to value selected ecosystem services of three tanks namely *Mahakanumulla, Mawathawewa and Galwaduwagama* that belong to the Mahakanumulla cascade in Anuradhapura district of Sri Lanka. The results of the study show that the tanks provide a wide range of ecosystem services and the communities depend heavily on provisioning services for their subsistence and wellbeing. The average economic value of the provisional services from tanks in Mahakanumulla was 467,121 LKR/ha/year. Fisheries, irrigation water and domestic water supply together accounted for more than 75% of the total estimated value of the provisioning services. The average value of regulatory services (water quality and flood control), supporting services (biodiversity), and cultural services (recreational bird watching) were 538,122 LKR/ha/year, 180,735 LKR/ha/year and 312 LKR/ha/year, respectively. The average aggregate value of three tanks in Mahakanumulla cascade was 1,186,290 LKR/ha/year. The value of regulatory and supporting services were observed to be considerably high which implies the importance of indirect benefits provided by tanks. It is recommended to provide due recognition to such indirect benefits in designing of future tank ecosystem management plans.

Keywords: Tank rehabilitation, Ecosystem services, Economic value, Market prices, Benefit transfer

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* jeevika.weerahewa@agri.pdn.ac.lk

Willingness to Pay for Improved Planting Materials of Mango by Smallholder Farmers in Dry Zone, Sri Lanka

Athapaththu A.M.P.A. and Weerahewa J.*
Department of Agricultural Economics and Business Management,
Faculty of Agriculture, University of Peradeniya, Peradeniya

Introduction of new agricultural technologies is at the center of development policy making in developing countries. A better understanding on the degree and determinants adoption of improved agricultural technology is hence required develop an appropriate policy framework. The objectives of this study are to assess: (a) average willingness to pay (WTP) for quality mango planting materials of *TomEJC* cultivar, and (b) the factors that determine the degree of adoption and WTP. An experimental auction namely; second price sealed-bid auction was conducted to reveal the adoption rate and WTP of households living in Thirappane Divisional Secretariat and Heckman model was used to determine the factors affecting degree of adoption and WTP. A pre-tested structured questionnaire was used to obtain information on characteristics of the household, land availability for cultivation, current state of mango cultivation and awareness of the new technology. A sample of 107 randomly selected households participated and 55 participants were provided information related to cultivation of *TomEJC* prior to the interview. The results indicated that mean bids for *TomEJC* planting materials for the pooled sample was LKR 287.03 per plant. A higher WTP of LKR 365.34 per plant was recorded for the group that received prior information. Heckman model first-stage results indicated that decision to adopt was positively & significantly influenced by household type, mango availability in the home garden, education level, and preference to initiate commercial mango cultivation. The second-stage results revealed that WTP was positively & significantly influenced by information provision and average monthly income. Preference to initiate commercial mango cultivation was negatively & significantly affected on WTP. These findings indicate that raising awareness on the new technology will be required as the first step in promoting the new technology.

Keywords: Improved planting materials, Experimental auction, Participation decision, *TomEJC*

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* jeevika.weerahewa@agri.pdn.ac.lk

Author Index

C

D

H

I

R

S

W

Y

Winners of FAuRS 2019

Oral Presentation Session

Theme I : **Agricultural Production and Productivity**

Senevirathne S.M.P.

Assessment of the Nitrogen Release Patterns of Different Controlled Released and Stabilized Urea-based N Fertilizers and Their Impact on the Productivity and Nitrogen Use Efficiency of Maize (*Zea mays* L.)

Co-authors: Nissanka S.P. and Gunawardena M.

Theme II : **Technological Interventions & Applications in Agriculture**

Edirisinghe S.A. (Gold Medalist)

Development of an Improved Food Packaging Material Using Graphene Oxide Nanocomposites to Substitute the Multilayer Co-extruded Food Packaging Material

Co-authors: Mendis B.E.P., Gunawardana M. and De Silva, R.T.

Theme III : **Food Quality & Product Development**

Herath H.N.M.N.

Effect of Roasting of Coriander Seeds on Total Phenolic Content and Anti- inflammatory and Free Radical Scavenging Activities of Aqueous Extracts

Co-authors: Illeperuma D.C.K., Jayasinghe C.V.L. and Gunathilake K.D.P.

Theme IV : **Community & Environment**

Welewanni W.W.M.S.M.

Impact of Urban Development on Spatiotemporal Trends of Urban Heat Island Effect of Three Cities of Central Hill, Sri Lanka and Potential Use of Lichens as Bio-indicators to Monitor Environmental Pollution

Co-authors: Nissanka S.P., Gunawardena A. and Weerakoon G.

Poster Presentation Session

Theme I : **Agricultural Production & Productivity**

Kodithuwakku V.N.

*Phenotypic Plastic Responses in Morphophysiological Traits of Three Plectranthus scutellarioides (*L.*) R. Br (coleus) Varieties in Response to a Light Gradient Continuum.*

Co-authors: Beneragama C.K. and Krishnaraja S. A.

Theme II : **Technological Interventions & Applications in Agriculture**

Chandrasekera E.D.C.T.

Hepatoprotective Effects of Curcumin against Chemically-Induced Liver Lesions in Rats

Co-authors: Kodithuwakku S.P., Wijesundara K., Bogahawaththa S. and Gunawardane M.

Theme III : **Food Quality & Product Development**

Karunadhipathi U.L.

Development of Cassava (*Manihot esculenta Crantz*) *Starch Based Biodegradable Food Packaging Material with Eggshell and Cellulose Fillers*

Co-author: Himali S.M.C.

Theme IV : **Community & Environment**

Hettiarachchi M.H.S.M.

S*creening Different Climate Control Intensities for Greenhouse Tomato Production*

Co-authors: Weerakkody W.A.P. and Bandaranayake P.C.G.

3MT® (Three Minute Thesis) Competition

Winner : **Rathnayaka R.M.M.P.**

Impact of Perceived Social Identity on Collective Efficacy Beliefs: An Insight from the Mahakanumulla Tank Cascade System

Co-author: Anuradha J.M.P.N.

1st Runner-up: Prabashwari T.I.G.

A Novel Technique of Phospholipase Application in Milk: Would Improve the Cheese Yield of Gouda

Co-authors: Vidanarachchi J.K., Prasanna P.H.P., Jayawaradene L.P.I.N.P. and Gunathilake W.L.C.M.

2nd Runner-up: Chandrasekera E.D.C.T.

Hepatoprotective Effects of Curcumin against Chemically-Induced Liver Lesions in Rats

Co-authors: Kodithuwakku S.P., Wijesundara K., Bogahawaththa S. and Gunawardane M.

Invention and Innovation Competition

Winner : Ishara W.A.K.S.

Development of Edible Dessert Cup Using Banana Blossom Powder

Co-author: Arampath P.C.

1st Runner-up: Karunadhipathi U.L.

Development of Cassava (Manihotesculenta Crantz) Starch Based Biodegradable Food Packaging Material with Eggshell and Cellulose Fillers

Co-author: Himali S.M.C.

2nd Runner-up: Karunanayake K.M.S.L.

Screening of an Effective Bacterial Consortium and Developing Formulations Using Rhizobacteria for Plant Growth Promotion and Management of Selected Soil Borne Pathogens

Co-author: De Costa D.M.

Research Brief Competition

English: Amarawansha R.M.K.P.

Therapeutic Effect of Allium sativum, Trigonella foenum-graecum and Momordica charantia for Bovine Mastitis

Co-authors: Jinadasa H.R.N., Rajapakse R.P.V.J., Jayasinghe U.L.B. and Wijayagunawardane M.P.B.

Sinhala: **Ranasinghe R.D.U.A.**
Variation of Wood Density in Different Tree Species Found in the Tropical Rainforests in Sri Lanka
Co-authors: Sanjeewani H.K.N., Wijetunga W.M.G.A.S.T.B., Samarasinghe D.P., Madhumali R.M.C. and De Costa W.A.J.M.

Tamil: **Ganasegaram K.**
Effect of Increased Day Length on Growth of Paddy in a Low Sunshine Zone in Kandy
Co-authors: Dharmasena D.A.N., Mowjood M.I.M. and Dassanayake K.

Research Video Competition

Winner: **Samarasinghe S.A.I.L.N.**
Impact of Different Wavelengths on the Growth, Leaf Anatomy and Yield of Rice (Oryza sativa L*)*
Co-author: Ariyaratne M.

1st Runner-up: Karunadhipathi U.L.
Development of Cassava (Manihot esculenta Crantz) Starch Based Biodegradable Food Packaging Material with Eggshell and Cellulose Fillers
Co-author: Himali S.M.C.

2nd Runner-up: Chandrasekera E.D.C.T.
Hepatoprotective Effects of Curcumin against Chemically-Induced Liver Lesions in Rats
Co-authors: Kodithuwakku S.P., Wijesundara K., Bogahawaththa S. and Gunawardane M.

Scientific-Eye Competition

Winner: **Fernando S.R.T.**
Comparative Study on Quality and Safety Aspects of Marine Fishery Chain of Selected Fishery Harbors in Sri Lanka
Co-authors: Rajapakse R.P.N.P. and Wickramasinghe W.S.

1st Runner-up: Wanniarachchi W.A.K.T.M.
Development of a Spice Infused Beverage Series Using Mature Coconut Water (Cocos nucifera)
Co-authors: Arampath P.C. and Dissanayake S.

2nd Runner-up: Rathnapala P.G.P.K.
Do Inoculation of Effective Microorganisms (EM-1® or Effective Microorganism®) and Nitrogen Supplementation Accelerate the Elephant Dung Decomposition?
Co-authors: Vidanarachchi J.K., Dandeniya W.S., Bandaranayake L., Nayanajith A. and Perera A.N.F.

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