NSATRS 2024

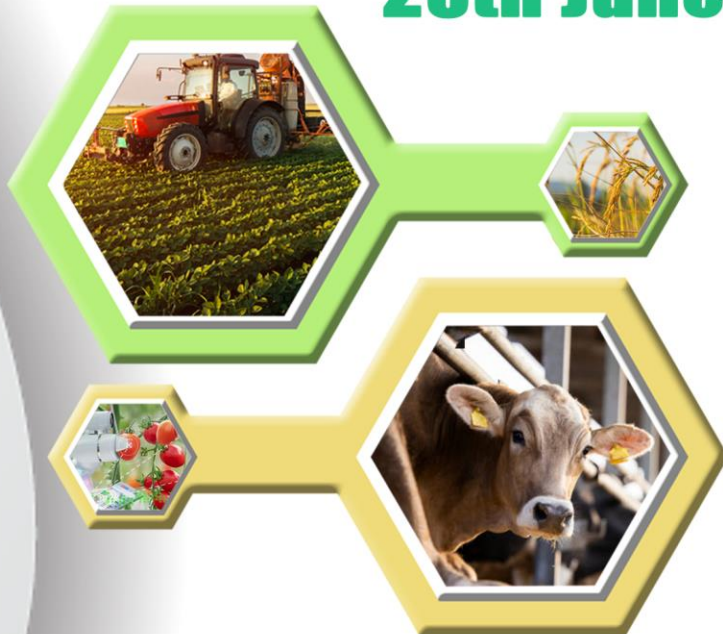**Sustainable Development through Innovative and Resilient Agriculture**

PROCEEDINGS OF THE
5th NATIONAL SYMPOSIUM ON
AGRO-TECHNOLOGY AND RURAL SCIENCES 2024

28th June 2024

**University of Colombo Institute for Agro-Technology and Rural Sciences
Hambantota, Sri Lanka**

PROCEEDINGS OF THE 5th NATIONAL SYMPOSIUM ON AGRO-TECHNOLOGY AND RURAL SCIENCES 2024

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MESSAGE FROM THE VICE CHANCELLOR

I am delighted to provide this message for the Fifth National Symposium on Agro-Technology and Rural Sciences (NSATRS 2024) as the Vice-Chancellor of the University of Colombo. I believe that your chosen theme "Sustainable Development through Innovative and Resilient Agriculture" which comes under two different keynote speeches in addressing landmark issues relevant to the main theme, enlightens the priorities of Sri Lankans in addressing food security and safety by practicing sustainable agricultural approaches. I firmly believe that this symposium provides a unique platform to bring researchers, entrepreneurs, innovative farmers, and the industry together to deliberate on the diverse areas of Agro-Technology while disseminating their knowledge and experience in research work.

I immensely appreciate the Director and all academic members of the organizing committee, administrators, and students of UCIARS for the excellent team effort in piloting the NSATRS for the 5th consecutive year amidst a lot of challenges prevailing within the country. NSATRS holds a prominent position in the annual university academic calendar, as it unveils appropriate and sustainable discoveries related to modern agriculture, embarking on the development of various communities in Sri Lanka.

Further, I am enthused with the contribution and commitment made by the UCIARS, a center of excellence in the field of Agro-Technology, in creating scientists together with entrepreneurs for the betterment of Sri Lanka's agricultural sector. It is noteworthy to say that the pivotal role played by UCIARS in developing agricultural graduates as well as their research engagement over the past few years is incredible and the University of Colombo is indeed proud of it.

Your collective effort to make the Fifth National Symposium on Agro Technology and Rural Sciences 2024 a success is highly appreciated, and I send my best wishes for this great event of UCIARS.

Senior Professor (Chair) H.D. Karunaratne
Vice Chancellor
University of Colombo
Sri Lanka

MESSAGE FROM THE DIRECTOR

As the Director of the University of Colombo Institute for Agro-Technology and Rural Sciences (UCIARS), I am delighted and honored to address the Virtual Fifth National Symposium on Agro-Technology and Rural Sciences 2024 (NSATRS 2024). This year's theme, "Sustainable development through innovative and resilient agriculture," is both timely and crucial.

Recent research indicates a concerning stagnation in agricultural production growth. Major grain crop yields are increasing by merely about 1 percent annually, which is insufficient compared to the global population growth rate. With the rising global population requiring more land for settlement, expanding the cultivated area to meet food demands is not feasible. Additionally, factors like climate change are contributing to reduced agricultural output. Therefore, enhancing agricultural productivity is essential to boost food production. This symposium aims to facilitate the exchange of expertise, experiences, and research findings, providing a forum for young researchers to discuss challenges and future directions in various agricultural research fields to improve Sri Lanka's agricultural productivity.

Furthermore, NSATRS 2024 offers a valuable platform for young academics, researchers, and students to share new discoveries, innovative ideas, and showcase their talents. UCIARS plays a pivotal role in knowledge dissemination, technology generation, product development, patenting, and fostering agro-entrepreneurs, all of which directly contribute to the advancement of Sri Lanka's agricultural sector. I extend my heartfelt appreciation and congratulations to the organizing committee, keynote speakers, paper presenters, and participants of this symposium. I wish everyone great success.

Professor D.M.C. Champathi Gunathilake
Director / UCIARS
Chairman / NSATRS 2024

MESSAGE FROM THE COORDINATOR

It is with great honor and pride to forward this message as the coordinator of the 5th National Symposium of Agro-Technology and Rural Sciences (NSATRS 2024) conducted by the University of Colombo Institute for Agro-Technology and Rural Sciences.

NSATRS 2024 provides a distinguished platform for researchers, scientists, academics, and students to exchange ideas and present recent research findings under the theme "Sustainable Development through Innovative and Resilient Agriculture." The symposium encompasses five thematic areas: Technical advancement for sustainable agriculture, Crop production and protection technologies, Food, nutrient and post-harvest technologies, Sustainable livestock farming and aquatic production, and Entrepreneureship & rural development. As a virtual symposium, this brings eminent scientists from a wide array of agricultural research disciplines to a common platform, marking a significant step by a leading university institution in providing a stepping stone for achieving career goals and advancing both Sri Lankan and global agriculture.

The seeds for NSATRS 2024 were sown several months ago with the blessings of UCIARS and a team of dedicated individuals. So, we could harvest the abundant fruits of their tireless effort and teamwork today. Therefore, I express my heartfelt gratitude to the Organizing and Technical Committees, all the academic/ non-academic staff members in UCIARS and everyone else who contributed to the success of the event in numerous ways.

I wish to express my sincere gratitude to the keynote speakers, guests of honor, and chief guests for their inspiring involvement and valuable support in making the event a great success. I wish to convey my sincere gratitude to our reviewers, session chairs, panel members and editorial board who have generously contributed their time and insights. Their critical evaluations and constructive feedback have been invaluable in shaping this symposium and maintaining the integrity and quality of our proceedings.

I sincerely appreciate our sponsors and partners for their support and confidence in the significance of this symposium, which has greatly enhanced the event's scope and impact.
I congratulate all authors and participants of NSATRS 2024 for their enthusiastic engagement and willingness to share their research ideas, which has enriched the symposium, creating a dynamic and engaging experience for all involved.

Ms. Nelka Sriwarnasinghe
Coordinator / NSATRS 2024

MESSAGE FROM THE SECRETARY

It is a great honor to me and I am privileged to compile research articles as the secretary of the 5th National Symposium on Agro-Technology and Rural Sciences 2024 (NSATRS 2024) which builds a congregation platform for the professionals in the field of agriculture. The University of Colombo Institute for Agro-Technology and Rural Sciences is now, for the 5th consecutive year, congregating NSATRS 2024 on a timely important theme 'Sustainable Development through Innovative and Resilient Agriculture'. The main objective of NSATRS 2024 is to bring academics, researchers, and professionals in diverse subject areas that help to face emerging challenges and promote new horizons that foster enhanced agricultural performances.

I take this opportunity to express my heartfelt gratitude to all my colleagues of the organizing committee of NSATRS 2024 who sacrificed their time and energy out of the clock to make this event a great success. I herewith welcome and thank all invitees, authors, participants and all well-wishers, on behalf of the UCIARS.

The organizing committee believes time at the symposium would be productive and more informative. I wish you all a very fruitful and pleasant stay at the NSATRS 2024. Hope and wish the NSATRS 2024 brings opportunities for all of us to gain new knowledge, reach new heights and look forward a sustainable future of the agriculture sector in Sri Lanka.

Mr. A.J.M.C.M. Siriwardana
Secretary / NSATRS 2024

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SYSTEMATIC LITERATURE REVIEW ON THE APPLICATION OF UNMANNED AERIAL VEHICLES (UAVS) TECHNOLOGY FOR PADDY CULTIVATION IN SRI LANKA

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Abstract

Rice is the staple food in Sri Lanka and the widely cultivated crop among farmers. The majority of the country relies on traditional methods with limited technologies for seasonal paddy area mapping, forecasting, and identification of cultivation issues. Recognizing the need for advanced agricultural surveillance, Unmanned Aerial Vehicles (UAVs) have emerged as a promising tool. UAVs offer valuable insights into crop growth, development, and the overall monitoring of agricultural landscapes. Therefore, our study aimed to delve into the insights of UAVs under the main themes of (1) applications of UAVs in paddy cultivation in Sri Lanka, (2) the challenges and implications of UAV integration in current paddy farming practices, and (3) future recommendations that will lead to the deployment of UAVs in sustainable paddy cultivation in the country. We screened 25 peer reviewed articles published in English language using Google Scholar platform from 2005 to 2024 period. We analyzed the selected papers using thematic analysis. The findings revealed the applications of UAVs, encompassing crop monitoring and mapping, weed detection, nutrient and chlorophyll analysis, soil salinity detection, as well as fertilizer and irrigation management, and yield estimation. Equipped with advanced sensors such as multispectral and thermal imaging cameras, UAVs enable high-resolution data acquisition, facilitating detailed assessments of crops. However, despite the enormous potential of this UAV technology for paddy cultivation, its application remains restricted to the research level. Also, some of the primary constraints observed in UAV applications are the capture and availability of images on time, a lack of high spatial resolution images, challenges with image interpretation, and data extraction and also harsh weather conditions. Regulatory constraints like airspace restrictions and licensing requirements pose legal challenges. Moreover, cost implications and the need for specialized training limit accessibility. To overcome these obstacles, it is imperative for government agencies, research institutions, industry stakeholders, and farmers to collaborate closely in order to promote innovation and facilitate the practical integration of UAVs into agricultural workflows. Investments in UAV technology, data analytics, and decision support systems are crucial for unlocking productivity gains and promoting environmental sustainability in agriculture.

Keywords: *Crop monitoring, Paddy farming, Precision agriculture, Remote sensing, Unmanned Aerial Vehicles (UAVs)*

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INTEGRATING REMOTE SENSING FOR CROP MANAGEMENT IN SRI LANKA: OPPORTUNITIES AND CHALLENGES

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Abstract

Sri Lanka's agricultural sector, once the backbone of its economy, has faced significant challenges due to climate change, infrastructure gaps, and limited technological access in recent years, leading to a decline in productivity and economic instability. The adoption of remote sensing technology in crop management shows promise for reviving agriculture and promoting economic growth in the face of these obstacles. This study aims to assess the potential of integrating remote sensing technologies in Sri Lanka's crop management by leveraging global outcomes, proposing strategies to overcome barriers, and maximizing the gains for sustainable agricultural development. In this review study, a comprehensive investigation was conducted to assess the impacts of incorporating remote sensing technology into crop management practices in Sri Lanka. The methodology involved analyzing 20 peer-reviewed publications globally, focusing on successful applications of remote sensing in crop management, extracting insights adaptable to Sri Lanka, and proposing strategies to overcome identified challenges. The findings present the combined information from the studies on remote sensing applications in crop management worldwide, highlighting their potential relevance for Sri Lanka. Various methods, such as UAV (Unmanned Aerial Vehicle)-based imaging and satellite data fusion, demonstrate precise crop monitoring, yield estimation, weed mapping, and disease detection capabilities, as evidenced in studies from diverse regions like Europe, Asia, Africa, and North America. Challenges in technology adoption in Sri Lanka, including cost, lack of technical expertise, and infrastructure limitations, are addressed with strategies like financial aid, infrastructure development, and technical training, drawing inspiration from successful initiatives in other countries. Policy guidelines are crucial for promoting technology in Sri Lanka's crop management, requiring regulations from pertinent authorities, with proposed frameworks addressing privacy concerns and encouraging technology uptake, drawing from global models. Challenges related to scalability and maintenance are addressed through collaborative partnerships and regional service centers, which are similar to the approaches adopted in other agricultural contexts. Therefore, implementing these strategies into practice would allow Sri Lanka to harness remote sensing technology, enhance crop management, and ensure agricultural advancement and sustainability.

Keywords: *Agricultural advancement, Crop management, Remote sensing, Technology uptake*

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AUTOMATED DETECTION OF POTATO LATE BLIGHT DISEASE SEVERITY USING CONVOLUTIONAL NEURAL NETWORKS

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Abstract

Potato late blight disease (PLBD) caused by the pathogen *Phytophthora infestans* is a highly catastrophic disease that possess a significant threat to the potato cultivation in Sri Lanka. Timely diagnosis and precise severity assessment of PLBD in the early stage is crucial to prevent quantitative and qualitative loss of potato yield. Assessing PLBD proves challenging task for potato farmers and researchers, who often rely on traditional methods such as visual observations. These methods are prone to errors, which can lead to inaccurate assessments of disease severity and contributed to the rapid spread of disease, increased use of fungicides and significant losses in potato yield. Using image data and machine learning algorithms to evaluate the severity of PLBD can be an effective approach. Convolutional neural network (CNN) based models are favored for their accuracy in object detection, making them increasingly popular for this purpose. Hence, this study aimed to develop a CNN model to detect and assess the severity of PLBD using images of potato leaves. The clear images of fully visible PLBD affected potato leaves were used as input for the model. By merging severity classes, the proposed model achieved an increased accuracy of 68%. After applying image augmentation techniques and necessary pre-processing steps, the dataset was trained on a CNN. The model achieved a classification accuracy of 94%. The final prediction was made using the testing dataset by loading the best model weight. The proposed model offers an efficient on-site assessment of PLBD severity, providing quick and easy evaluation.

Keywords: *Convolutional neural network, Disease severity, Machine learning, Phytophthora infestans, Potato*

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MOLECULAR DOCKING AND DYNAMICS SIMULATIONS OF OsBBX13-DNA (G-box) COMPLEX INTERACTIONS IN *Oryza sativa* L.

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Abstract

Understanding the DNA-protein interactions of regulatory protein complexes in crops, help to improve the crops for different agronomical traits. B-box (BBX) family of transcription factors play key roles in plant development and stress responses. Rice BBX13 (OsBBX13) has highly conserved two B-box domains in the N-terminus similar to *Arabidopsis* BBX21. It is demonstrated that the second B-box domain of *Arabidopsis* BBX21 binds to G-box and T/G-box cis regulatory regions of promoters regulating gene transcription. However, the crystal structures of rice BBX proteins as well as information on their interactions with DNA are not available. The focus of the present study was to predict the interactions and stability of OsBBX13-DNA (G-box) complex using molecular docking and dynamics simulations. The PDB structure of homeodomain transcription factor WUS-HD bound to G-Box DNA (6RYI) was redocked using HADDOCK server 2.4 to validate docking. The N-terminal region containing B-box domains of OsBBX13 was modeled using I-TASSER server. The docking of G-box with the conserved B-box2 domain of OsBBX13 was performed using HADDOCK 2.4. The stability of the docked structure was investigated using molecular dynamics simulations for 200 ns using Gromacs version 2020.6. The re-docked WUS-HD protein-G-box complex was superimposed on to the 6RYI reference structure from PDB and a low RMSD of 0.721 Å was observed confirming the validity of docking by HADDOCK 2.4 server. A set of five OsBBX13 structural models were predicted by I-TASSER and the model with lowest C-score was selected for further analysis. RMSD, Rg, and SASA analysis indicated that protein-DNA complex was stable after 10 ns in the MD simulation run. Analysis of B-box2 domain–DNA interaction showed that 9 hydrogen bonds formed by Ser53, Ser54, Ser55, Lys59 and Arg79 and hydrophobic interactions formed by Ser56, Leu51, Ala52, Ala57, Arg99 and Glu77 residues play an important role in stabilizing the protein-DNA complex. This study predicts that OsBBX13 can bind to G-box promoter sequence to form a stable complex. G-box regulates the transcriptional activity of light and abiotic stress-responsive genes. Thus, OsBBX13 could be a good candidate gene for improving crops for abiotic stress resistance in the future.

Keywords: B-box, DNA, HADDOCK, OsBBX13, Protein

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ROBOTICS AND ARTIFICIAL INTELLIGENCE FOR CROP PROTECTION: ADVANTAGES, BARRIERS AND RESEARCH NEEDS

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Abstract

As per the prediction of World Food and Agriculture Organization (WFO), global population will be increased by nearly two billion in 2050. Increasing of agricultural debts, unforeseeable climatic problems and biotic stress are the challenges on food security while 20-40 % of global crop loss is arisen by insect pest and diseases. Minimum knowledge and expertise on crop protection create dependency of farmers on pesticides with some negative impact on human health, biodiversity and the environment. The current technological advancements of agriculture are remarkable and Artificial Intelligence (AI) and Robotics evolved from other techniques generate cognitive solutions for crop protection. The author in this paper presents a substantial discussion on identification of the advantages, barriers and research needs in the application of robotics and AI in crop protection. The methodology adopted in the study is qualitative in nature with a content analysis of literature. Robotics and AI are very recent technologies comprised with safety, preciseness, efficiency, cost effectiveness and functioning with sensors, cameras and machine learning algorithms. Utility in the pest and disease diagnosis, detectability of severity levels of the damages and being an alternative solution for chemical crop protection by reducing negative effects on the environment are the potential advantages. Afflicting on climatic changes, imperfection at invasive pest and disease problems, requirement of high technological skills and low affordability of farmers describe the barriers on the technology. Robotics and AI are advantageous in crop protection and National policies should be strengthened with sustainable and economical concepts addressing the hurdles on the approach. Participation of organizational and strategy researchers with improved awareness direct to the promising research endeavors.

Keywords: *Artificial Intelligence, Barriers, Crop Protection, Research needs, Robotics*

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COMPUTER VISION IN LIVESTOCK DISEASE MANAGEMENT – A REVIEW

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Abstract

This review examines the role of computer vision technology in modern livestock management. As global demands for food production grow rapidly, precision agriculture, facilitated by advancements in computer vision, emerges as a crucial approach to meet these challenges sustainably. The computer vision system offers significant benefits, including automated health monitoring, precise measurement of morphological traits, and early disease detection using thermal imaging. By analyzing recent studies, this review highlights the effectiveness of various camera types from infrared to 3D cameras in diagnosing diseases. In cattle, computer vision has been used to detect mastitis, bovine respiratory disease and Foot-and-Mouth Disease, while in sheep; it has identified mastitis and blue tongue virus. In pig industry swine fevers have been detected using these technologies. Computer vision systems provide clear advantages over traditional methods in disease management including fast and early detection of disease, high throughput, non-invasion monitoring, high scalability, real-time monitoring, data-driven decision making, cost-effective and possible to integrate with other technologies. However, limitations such as species specificity, high initial cost, technical and infrastructure requirements, the need for expertise, environmental variability and the absence of standard confirmation methods must be addressed. Despite these challenges, computer vision is invaluable during disease outbreaks, allowing for rapid screening of large animal populations before laboratory confirmation. Future research should focus on automating processes and integrating artificial intelligence algorithms to enhance accuracy and efficiency. In conclusion, this review highlights the critical role of computer vision in advancing livestock management practices. By utilizing this technology, farmers can optimize operations, improve animal welfare, and contribute to sustainable food production. Moreover, it outlines avenues for future research and development to further enhance the capabilities of computer vision systems in the agricultural sector.

Keywords: *Computer vision, Disease detection, Livestock management, Precision agriculture, Sustainability*

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UAV-BASED MULTISPECTRAL IMAGING AND MACHINE LEARNING MODELLING FOR NON-DESTRUCTIVE PREDICTION OF SUGARCANE MATURITY

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Abstract

Commercial sugarcane farming encounters challenges in accurately identifying the correct maturity stage for harvesting which significantly impacts sugar yields and thereby profits. Thus, this study addressed the issue by developing prediction models for Brix, Pol, and CCS yield parameter values in sugarcane fields. The field experiment was conducted at the Lanka Sugar Company (Pvt) Ltd, Pelwatte, Sri Lanka, using two popular sugarcane varieties (SL 96 128 and SL 92 5588). UAV-based multispectral images were captured with a DJI Mavic 3 multispectral drone during the 10th, 11th, and 12th months of the sugarcane growth cycle. The RGB Ortho mosaic maps were generated using Agisoft Metashape software (Version: Professional 64 Bit) and ten vegetative indexes (NDVI, GNDVI, RVI, Clgreen, Clrededge, GCVI, DVI, LCI, GDVI, and NDRE) were calculated utilizing QGIS software (Version:3.34.2). After the flight mission, average values of Brix, Pol, and CCS were measured from five randomly selected sugarcane stalks for each variety within a $1m^2$ quadrant. The ten vegetation indices were compared averaged reference values for Brix, Pol, and CCS to determine the strongest correlation. Clrededge vegetative index showed the strongest correlation (r) with Brix, Pol, and CCS for SL 96128 variety (0.844, 0.823, 0.805) and SL 92 5588 variety (0.812, 0.794, 0.763). Therefore, Clrededge was selected as the predictive variable. After evaluating Simple Linear Regression, Support Vector Regression, and Random Forest (RF) models, the RF model emerged as the best-fitted model for both sugarcane varieties. For SL 96 128, the RF model yielded a high correlation with Brix (R^2 0.86, RMSE 0.67), Pol (R^2 0.79, RMSE 0.85), and CCS (R^2 0.78, RMSE 0.64). Similarly, for SL 92 5588, the RF model achieved strong correlation with Brix (R^2 0.85, RMSE 0.62), Pol (R^2 0.82, RMSE 0.78), and CCS (R^2 0.84, RMSE 0.52). The findings emphasize the RF Regression model's effectiveness in accurately predicting Brix, Pol, and CCS values for both varieties.

Keywords: *Machine Learning, Multispectral Imaging, Non-Destructive Prediction, Sugarcane Maturity, UAV*

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SPATIOTEMPORAL VARIABILITY OF SRI LANKAN RAINFALL FROM 1990 TO 2020

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Abstract

Rainfall serves as a cornerstone for numerous sectors, including rain-fed agriculture, hydropower generation, fisheries, tourism, and the stability of coastal ecosystems. Given its pivotal role, understanding rainfall patterns is crucial for informed decision-making and the effective management of these sectors. This study aims to scrutinize the spatiotemporal variation in Sri Lankan rainfall over the past three decades. Utilizing daily rainfall data from 52 stations across the country spanning from 1990 to 2020, this analysis computed monthly, annual, and monsoonal rainfall metrics, meticulously addressing missing data using established methodologies. Employing statistical tools such as Mann-Kendall and Sen's slope, temporal variations in rainfall were discerned. Inter-decadal comparisons were conducted, revealing shifts in mean annual rainfall across distinct periods (1991–2000, 2001–2010, and 2011–2020). Spatial distributions of mean decadal rainfall were visualized using ArcGIS, complemented by the Inverse Distance Weighting (IDW) method to interpolate annual values, enhancing spatial comprehension. Significantly increasing trends in rainfall were identified during specific monsoon seasons and inter-monsoon periods at various stations, while notable decreases were observed in others. Interestingly, a substantial increase in rainfall was noted in the dry zone during 2011–2020 compared to 1991–2000, indicative of dynamic shifts in precipitation patterns. These findings underscore the variability of rainfall across Sri Lanka's climatic zones over the past three decades, suggesting potential revisions to current demarcations. Such insights are invaluable for informing policies, strategies, and future research endeavors in climate science and related disciplines.

Keywords: *Agriculture, Climate Zone, Rainfall, Sri Lanka*

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CROP PRODUCTION AND PROTECTION TECHNOLOGIES

A CASE STUDY ON CONSUMPTION PATTERN AND AWARENESS OF UNDERUTILIZED FRUITS AMONG SELECTED UNDERGRADUATES OF FACULTY OF AGRICULTURE, UNIVERSITY OF JAFFNA, SRI LANKA

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Abstract

Underutilized fruits are those that are often overlooked or not commonly found in mainstream markets, despite their potential nutritional value and unique flavor. This study was carried out to find the consumption pattern, knowledge and attitudes over selected 40 underutilized fruits by randomly selected 50 undergraduate students of Faculty of Agriculture, University of Jaffna. Respondents were instructed to participate in a self-administered online survey. The results of this study conclude that, 66% of the undergraduates were aware about underutilized fruits. 46% of the respondents have average knowledge on nutritional profile of underutilized fruits. 50% of the respondents are consuming any one kind of underutilized fruit per week either mostly as fruit juice (44%) or as raw fruit (30%). Among 40 underutilized fruits, >50% of the studied population never consumed Nil veralu, Kirala, Heen karamba, Kalu mediriya and Mee. Non-availability (46%) is the biggest barrier for consumption of underutilized fruits. Introduction of underutilized fruits subsidy (50%) is the remedy that high number of respondents think may help to consume underutilized fruits on daily basis. Though majority of students consider price (42%) while purchasing food, introduction of low cost, cheaper means of underutilized fruit based products will enhance the fruit consumption by undergraduates.

Keywords: *Awareness, Consumption pattern, Undergraduates, Underutilized fruits*

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EFFECT OF METRIBUZIN, GLYPHOSATE APPLICATION AND MANUAL WEEDING ON GROWTH, YIELD AND COST FOR WEEDING IN PRODUCTION OF SOYBEAN (*Glycine max* L.)

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Abstract

Soybean (*Glycine max* L.) is mainly cultivated for oil and protein. Weeds are a major challenge in soybean cultivation and it requires two weeding cycles for the entire growing period. Due to low labor availability and high expenses, farmers move towards chemical weeding. Metribuzin and glyphosate are two common weedicides that are used in soybean cultivation. This study was conducted to evaluate the impact of metribuzin, glyphosate and manual weeding on the growth and yield of soybeans and to analyze the cost effectiveness of weedicide application and manual weeding of soybeans. This experiment was conducted inside a protected house at the Faculty of Agriculture, University of Ruhuna. The experiment was laid out in Completely Randomized Design (CRD) with four treatments and four replicates from each. The treatments were, T1/control (2 cycles of manual weeding at 14 days and 35 days after seed sowing (DASS), T2(metribuzin for 1st weeding & 2nd weeding-manually), T3(metribuzin for 1st weeding & 2nd weeding was done using glyphosate), and T4(glyphosate for both weeding cycles).The study collected data from 12 plants from each plot, analyzing the number of weeds, growth and yield parameters. The data was analyzed using ANOVA, with means separated using Dunnett's test at 5% probability level. Results revealed that, there was no significant difference for all the growth parameters (plant height, number of leaves/plant, number of shoots/plant) and yield parameters (time taken to 50% flowering, number of pods/plant, pod filling percentage (%) and seed weight (g m^{-2}) with compared to T1, while the number of weeds per plot at 14 DASS was significantly lower in T2 & T3. The least amount was spent on practicing T4(Rs.26,000.00 ha^{-1}) while T1(Rs. 120,000.00 ha^{-1}) was the highest. Results concluded that metribuzin and glyphosate had no significant impact on the growth and yield of soybean while glyphosate was more cost effective than manual weeding in both weeding cycles.

Keywords: Glyphosate, Growth and Yield, Manual Weeding, Metribuzin, Soybean

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STUDY THE IMPACT OF GIBBERELLIC ACID INHIBITION BY FOLIAR APPLICATION OF PACLOBUTRAZOL ON GROWTH AND YIELD OF CURRY CHILI CULTIVATED IN SHADED PROTECTED HOUSE

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Abstract

This study was conducted to study the impact of gibberellic acid inhibition using paclobutrazol (PBZ) on cultivation of curry chili in protected houses under shade. As per previous studies, 50% shading was implemented to alleviate high temperatures. This experiment was conducted at Faculty of Agriculture, University of Ruhuna arranging in a Randomized Complete Block Design with six treatments, T1 (0 ppm/control), T2 (30 ppm), T3 (60 ppm), T4 (90 ppm), T5 (120 ppm) & T6 (150 ppm) each replicating five times. Foliar spray was applied at 14 days' interval & data recorded at same interval were statistically analyzed using ANOVA & means were compared using Dunnett's test. The results revealed that PBZ significantly reduced plant height, internodal length, stem diameter and number of leaves/plant compared to the control. T1 exhibited the highest plant height (144.20 cm) while T6 exhibited the lowest (56.30 cm). T1 recorded the highest internodal length (5.76 cm & 4.14 cm) while T6 recorded 4.74 cm & 3.24 cm for 3-4 and 7-8 nodes respectively. T1 recorded the highest values (8.49 cm & 8.58 cm) and T6 recorded the lowest (7.88 cm & 7.90 cm) for stem diameter at 2.5 cm & 7.5 cm above base of the stem respectively. Number of leaves/plant was highest in T1 (45) while T6 recorded only 29 leaves/plant. Reproductive parameters were significantly influenced by T3, T4, T5 & T6 treatments. T1 had the highest fruit count/plant (6) & longest fruit (16.16 cm) whereas T6 had the lowest values (2 fruits/plant & 10.56 cm fruit length). Fruit diameter in T5 (14.40 mm) & T6 (13.44 mm) were significantly different from T1 (25.14 mm). Fruit weight was significantly lower in T3, T4, T5 and T6 than control (45.46 g). However, T2 was not significantly affected reproductive parameters but reduced the plant height by 33.70% compared to control. Results revealed that curry chili can be successfully cultivated with a foliar application of 30ppm PBZ at 14 days interval with minimal impact on yield.

Keywords: Curry chili, Gibberellic acid, Paclobutrazol, Protected house, Shade conditions

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IMPACTS OF SMART FERTILZERS AS A STRATEGY FOR BETTER CROP PRODUCTION IN TROPICAL AGRICULTURE

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Abstract

The global demand for food production is expected to rise significantly in the coming decades, necessitating innovative approaches to enhance agricultural productivity while minimizing environmental impact. The widely used chemical fertilizers have negative impacts on the soil, the environment, and even human health, despite the fact that they may boost plant growth and output. Therefore, smart fertilizers are one of the most promising solutions or substitutes for conventional fertilizers. The objective of this study has been aimed to review on utilization of smart fertilizers for better crop production in tropical agriculture. The study was carried out as a non-systematic review study using online databases ResearchGate and Google Scholar. Combinations of following keywords were used to guide the search: smart fertilizers, tropical agriculture, impacts of smart fertilizers and nutrient management. As per findings, the smart fertilizers utilize advanced technologies such as nano-fertilizers, slow or controlled-release fertilizers and bioformulation of fertilizers etc. to deliver nutrients precisely to crops based on their requirements, soil conditions, and environmental factors. By enhancing nutrient use efficiency and minimizing nutrient losses through leaching and runoff, smart fertilizers contribute to tropical agriculture practices by reducing environmental pollution and conserving natural resources. Smart fertilizers actively engage in the enhancement of soil health, fostering a symbiotic relationship between agricultural inputs and the intricate microbial communities within the soil matrix, fostering crop resilience to climate variability, and reducing the carbon footprint of agriculture. While smart fertilizers offer promising avenues for agriculture, their implementation faces intricate challenges and limitations. High initial costs associated with technology acquisition and deployment, ongoing maintenance and calibration requirements, regulatory barriers, pose additional hurdles to commercialization and market uptake, research gaps regarding the long-term environmental impacts, interactions with soil microorganisms, and effects on ecosystem dynamics necessitate further research and risk assessment are major challenges and limitations. Overall, it underscores the potential of smart fertilizers as a transformative strategy for advancing tropical agricultural practices and calls for concerted efforts to harness their full benefits for global food security and environmental sustainability. Moving forward, concerted efforts are needed to address barriers to adoption, promote interdisciplinary research, and foster inclusive approaches to ensure the equitable and sustainable deployment of smart fertilizers for global food security and environmental stewardship.

Keywords: *Bioformulation, Controlled-release fertilizers, Nanotechnology, Smart fertilizers, Tropical agriculture*

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STUDY ON SUITABILITY OF DIFFERENT TECHNIQUES FOR THE PRODUCTION OFORGANIC LIQUID FERTILIZER FROM GIANT WATER FERN (*Salvinia molesta*) AND MOSQUITO FERN (*Azolla pinnata*)

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Abstract

Excessive usage of chemical fertilizers could lead to harmful impact on environmental sustainability and human health. Organic agricultural practices are considered as a way to mitigate such negative effects. In this context the present study was developed to identify a suitable technique to produce organic liquid fertilizer from giant water fern (*Salvinia molesta*) and mosquito fern (*Azolla pinnata*). The experiment was designed with five treatments such as oven dry method, grinding, anaerobic digestion, aerobic digestion using aerator and *Trichoderma* digestion each with three replicates. Further, the nutrient contents like N, P, K, Ca, Mg, and Zn of solutions prepared from both plant species under different methods were measured following standard procedures. Then the recorded data was analyzed using Statistical Analysis System software. Results of this study revealed that there was no special nutrition extraction done under any method studied. However, the grinding method performed well in nutrient extraction for both *Salvinia* (N- 0.02 mg L^{-1}, K- 0.08 mg $L^{-1}$and Mg- 0.215 mg L^{-1}) and *Azolla* (P- 0.59 mg L^{-1}, K- 0.09 mg L^{-1}, Ca- 0.31 mg L^{-1} and Zn- 0.13 mg L^{-1}). In addition, overall comparison of nutrient content of extracts obtained from both species revealed that*Azolla* has higher nutrient content than *Salvinia* excluding magnesium.

Keywords: *Extraction, Grinding, Liquid fertilizer, Nutrient content, Sustainability*

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THE EFFECT OF FOLIAR APPLICATION OF FISH AMINO ACID ON GROWTH AND YIELD OF TOMATO CULTIVAR 'PADMA'

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Abstract

This research was conducted to evaluate the effect of fish amino acid (FAA) as an organic alternative fertilizer on growth and yield of tomato variety Padma. FAA was produced by fish waste and over ripen banana. A pot experiment was followed as a randomized complete block design in an open field. The treatments included the control without fertilizer, 100% inorganic fertilizer (IF), 0.5% , 1%, 2.5%, 5%, 10% FAA rates as sole foliar applications. The same FAA application rates were applied with 50% IF recommendation as integrated applications. Application of FAA was carried out at 7th, 14th, 21st, 28th, and 35th days after transplanting. The N, P, K and pH, EC contents in prepared FAA were 1.16%, 2.59% and 2.50% and 4.36, 24µs cm^{-1} respectively. The results revealed that foliar spray of FAA 1% with 50% recommended dose of IF gave the significantly highest ($p<0.05$) plant height (84.36 cm±1.49), chlorophyll content (820.33±14.30), Leaf Area Index (1.66 cm±0.163), number of flowers/plant (26±1.870), Number of fruits/plant (44±1.414) and total yield/plant (2800 g±2.828) among all the tested treatments. The foliar spray of FAA 1% with 50% recommended dose of IF did not have any significant difference ($p<0.05$) in soil pH (6.53±0.090[a]) compared to inorganic fertilizer application (6.18±0.037[a]). FAA contains various nutrients, and types of amino acids which help to both plants and rhizosphere growth. Therefore, this study concluded that the integrated application of foliar spray of FAA 1% with 50% recommended dose of IF has appreciable effects on the growth and yield of tomato variety Padma.

Keywords: *Foliar Application, Fish Amino Acid, Integrated application, Organic Fertilizer, Yield*

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EFFECT OF FERROUS FOR THE ACCLIMATIZATION OF TISSUE CULTURED *Cryptocoryne wendtii* PLANTS IN HYDROPONIC SYSTEM

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Abstract

In the aquaculture industry of Sri Lanka, Cryptocoryne species are important aquatic plants. Inthe absence indiscriminately harvested from the wild to supply to the export market. Out of theten endemic Cryptocoryne species that occur in Sri Lanka, nine are classified as "Highly Threatened" species in the Red List of the International Union for the Conservation of Nature.This research was conducted to evaluate of a regular supply due to a lack of effective propagation methods, Cryptocoryne species are the effect of ferrous (Fe^{3+}) in a hydroponic system for acclimatization of tissue-cultured *Cryptocoryne wendtii* plants to enhance the qualityof the plant. The plants were arranged in glass tanks (4L), containing 0.25mg/L (T1), 0.5mg/L(T2), 0.75mg/L (T3), 1.2mg/L (T4) and 1.5mg/L (T5) of ferrous EDTA with 0.5g/L of Albert solution. In control 0.5g/L Albert solution was used. Each treatment consists three replicates and each replicate has ten plants. pH of replicate 1 had been maintained at 6.5 - 7.0 and 2 and3 at 5.5 to 6.0 respectively. The plant growth parameters, the number of leaves, maximum root and leaf length were recorded before and after the experiment. One-Way ANOVA and multiplecomparison test were performed to analyze the data using SPSS (25). According to the analysis of data, all the treatments were significantly different from each other, ($p<0.05$). According to the findings, T1 was proved the exclusive treatment than others, with the best growth performance giving numerically the highest number of leaves, maximum leaf length and area as (5.82±1.23), (9.84±0.45), (125.65±10.48cm) respectively. The results conclude that 0.25mg/L ferrous EDTA added to 0.5g/L Albert solution is the most appropriate fertilization concentration for the acclimatization of tissue-cultured *Cryptocoryne wendtii*. Hydroponics is ideal for acclimating tissue cultured *C. wendtii*. The study should continue long-term and be applied to an aquaponics system.

Keywords: *Acclimatization, Albert's solution, Cryptocoryne wendtii, Ferrous, Hydroponic system*

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EFFECTS OF *Moringa Oleifera* LEAF EXTRACTS ON GERMINATION AND SEEDLING PERFORMANCE OF *MA WEE* AND *MAHA MA WEE* (*Oryza Sativa* L.) VARIETIES IN SRI LANKA

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Abstract

Rice (*Oryza sativa* L.) serves as a staple food across many Asian nations, accounting for over 80% of the global rice consumption within the region. *Ma wee* and *Maha Ma wee* are two of the most important traditional rice varieties in Sri Lanka. The primary objective of this study is to enhance the germination performance and early seedling growth of the *Ma wee* and *Maha Ma wee* rice varieties. This will be achieved by identifying the optimal priming times and the most effective concentrations of Moringa aqueous extract. A Moringa leaf aqueous extract (MLE) (1:10, w/v) was made by blending 30g of leaf material with 300mL of distilled water, then filtered. In this study, the effects of two factors, priming time (18 hours and 24 hours) and concentrations (10%, 20%, 30%, 40%), were tested using ten replications. Unprimed seeds were kept as the control. The germination test was conducted employing a completely randomized design. Germination Percentage (GP), Hypocotyl Length (HL), Radical Length (RL), Seed Vigor Index (SVI), Mean Germination Time (MGT) and Germination Index (GI) were evaluated. Subsequently, pot cultivation was undertaken utilizing a randomized complete block design (RCBD) over a period of four weeks to evaluate the early seedling growth performance. Data were analyzed following analysis of variance, IBM SPSS 23 version. In germination studies, it was observed that a significant improvement in the germination performance and early seedling growth of the *Ma wee* variety when seeds were primed with MLE for 24 hours. In the *Ma wee* variety, the highest GP, HL, RL, SVI, and GI were achieved at 85%, 8.6 mm, 19.5 mm, 23.9, and 10.8, respectively, with seeds primed for 24 hours at 30%. Similarly, the highest shoot height (24.5 cm) and total fresh weight (0.23g) were observed with the same priming treatment. For the *Maha Ma wee* variety, the highest GP, HL, RL, SVI, and GI were recorded at 80%, 8.1 mm, 18.5 mm, 21.28, and 11.2, respectively, also with seeds primed for 24 hours at 40%. Additionally, the highest shoot height (26.1 cm) and total fresh weight (0.29g) were reported with the same priming duration and concentration. These finding suggest that MLE had a significant positive impact on the initial stages of plant development, suggesting the potential utilization of MLE as a stimulant for improved germination and seedling growth of the selected *Ma wee* varieties in Sri Lanka.

Keywords: Germination Percentage, Moringa oleifera leaf extract, Priming, Rice

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EFFECT OF DIFFERENT LEVELS OF INORGANIC FERTILIZER COMBINED WITH ORGANIC POTTING MEDIA ON VEGETATIVE PERFORMANCES OF CHILI, BRINJAL AND CAPSICUM

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Abstract

Increased chemical fertilizer prices made an impact on farmers on the application rates. Reduced chemical fertilizer application rates may positively impact the soil environment and its biology. However, there were complaints from farmers on yield decline in cultivations with improved varieties. The sole use of organic amendments has not always proved promising yield. However, integrated nutrient management with both chemical fertilizers and organic amendments is beneficial because it reduces the need of the chemical fertilizers, the cost of production and impact on soil environment. Therefore, the present study was carried out to evaluate and compare the vegetative performances of improved varieties of brinjal, chili and capsicum when treated with Department of Agriculture (DOA) recommended chemical fertilizer, and its adjusted rates along with potting media containing general waste compost, topsoil, sand, decomposed refused tea and poultry litter in 2:1:1:1:2 ratio respectively. The assessments for three crops were conducted as three separate experiments arranged in Complete Randomized Design. There were four treatments including control (no inorganic fertilizer), T1-DOA recommended chemical fertilizer rate, T2-Double rate of the DOA recommendation and T3-Half rate of the DOA recommendation. Vegetative assessments (plant height and number of leaves) were conducted for 10 weeks period. Data were analyzed using one-way ANOVA. At 3rd, 8th, 9th and 10th week, the control plants showed the highest brinjal plant height compared to T1 with no significant difference to T3 (except in week 03). Control and T3 brinjal plants had the highest number of leaves compared to T1 plants. T2 resulted the lowest plant height and lowest number of leaves in chili. Neither plant height nor number of leaves were significantly different between treatments for capsicum. In summary, reduced rates of inorganic fertilizer resulted better vegetative performances in brinjal, chili and capsicum with rich organic amendments, however, deficiencies should be monitored with the growth stage.

Keywords: *Chemical fertilizer, Integrated nutrient management, Organic amendments, Vegetables vegetative growth*

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EVALUATION OF DIFFERENT SOIL AMENDMENTS TO MANAGE CLUBROOT DISEASE OF CABBAGE

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Abstract

Clubroot disease poses a significant threat to the cabbage cultivation in Sri Lanka. The development of this disease is influenced by various factors, with soil pH being one of the significant ones. As of right now, there are no guidelines for controlling this infection, however, increasing soil pH is effective. To raise the soil pH levels, farmers currently use a variety of soil amendments such as lime, paddy husk ash, and poultry manure. This study was done to find the effectiveness of farmer practice soil amendments to manage this disease. A pot trial and field trial were conducted using different soil amendments including Lime (1.5 t/ha), Lime (2 t/ha), Poultry manure (5t/ha), Poultry manure (10t/ha), paddy husk ash (20t/ha), Lime (1.5t/ha) + poultry manure (5t/ha), Lime (1.5t/ha) +paddy husk ash 20t/ha. Those were compared with the fungicide Amisulbrom and an untreated control. pH was measured before soil amendment, at planting, and before the first, second, and third top dressings. Rainfall and soil temperature were recorded weekly throughout the growing periods. At three months after planting disease severity of the cabbage roots of both experiments were evaluated using a standard severity scale. The results revealed that the disease severity followed a similar pattern in both experiments. The significantly lowest disease severity (at pot trial 0.0% and field trial 20%) was recorded in the fungicide-applied treatment. Out of all the soil amendments that were employed in this experiment, the treatments that applied lime alone showed the lowest disease severity (around 50%) when compared to the other treatments in both trials. Further, those treatments showed higher pH values throughout the growing season. However, lime with poultry manure as well as lime with paddy husk ash applied treatments did not show significant disease reduction, even though the pH was recorded above 7.0 until the second top dressing. A partial control of cabbage clubroot disease can be achieved by adding 1.5 or 2.0 t/ha of lime to the soil.

Keywords: Cabbage clubroot, Lime, Soil amendment, Soil pH

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AGRONOMIC METHOD TO IMPROVE NITROGEN USE EFFICIENCY IN RICE

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Abstract

High amounts of Nitrogen fertilizer waste through de-nitrification, volatilization and leaching processes and cause to reduce nitrogen use efficiency (NUE). One of the methods that can be used to improve NUE is the use of nitrogen inhibitors. Nitrogen inhibitors are products that help to slow down the conversion of nitrogen to forms that are susceptible to losses. The experiment was carried out at the CIC seed farm, Pelwehera, Sri Lanka from July 2023 to October 2023. The objective of this research is to improve NUE agronomically in rice. The experiment was designed as randomized complete block design with nine treatments each with three replicates. The treatments were as follows; T1 - 100% urea, T2 - 75% urea, T3 - 50% urea, T4 - 100% urea with chemical inhibitor 1L Mt^{-1}, T5 -75% urea with chemical inhibitor 1L Mt^{-1}, T6 - 50% urea with chemical inhibitor 1L Mt^{-1}, T7 - 75% urea with chemical inhibitor 1.5L Mt^{-1}, T8 -50% urea with chemical inhibitor 1.5L Mt^{-1} and T9 - no nitrogen. Analysis was performed to evaluate the effect of yield on yield components and yield with NUE for each treatment. The results showed that, there was no significant differences in actual yield of treatments with 100% urea (5.41 t ha^{-1}), 75% urea (5.02 t ha^{-1}), 100% urea with chemical inhibitor 1L Mt^{-1} (5.22 t ha^{-1}), 75% urea with chemical inhibitor 1L Mt-1 (5.48 t ha-1), 50% urea with chemical inhibitor 1L Mt^{-1} (5.07 t ha^{-1}) and 75% urea with chemical inhibitor 1.5 L Mt^{-1} (5.38 t ha^{-1}). However, results indicate that application of 50% urea with chemical inhibitor 1L Mt^{-1} helps to achieve the non-significant grain yield (5.07 t ha^{-1}) for application of 100% urea (5.41 t ha^{-1}) and it indicates that combination 50% urea with chemical inhibitor 1L Mt^{-1} has ability to enhance the NUE and increase the grain yield.

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ENHANCING GERMINATION AND EARLY GROWTH OF *Passiflora foetida* THROUGH SEED TREATMENT AND MEDIA OPTIMIZATION

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Abstract

Passiflora foetida is an underutilized medicinal plant species in Sri Lanka rich in important phytochemicals. Their limited propagation techniques, the importance and use of underutilized crop species have significantly decreased and led to a critical genetic loss of their gene pools, making this crop "lost" or "neglected". Therefore, to establish a rapid propagation technique and identify the most effective germination-inducing agent and medium for seed propagation of *Passiflora foetida,* an experiment was carried out in a two-factor factorial manner at the University of Colombo Institute for Agro-Technology and Rural Sciences, Hambantota, Sri Lanka. Different types of seed treatments: Gibberellic Acid, hot water, and no any treatment (control) were tested in different potting media of sand, topsoil, sand and topsoil at the ratio of 1:1. There were nine treatment combinations and four replications each containing 10 seeds and those were arranged in a Factorial Complete Randomized Design. Germination percentage, days taken for germination, survival percentage, and number of leaves were recorded and statistical analysis was done using SAS 9.1.3 software. A significant interaction ($P< 0.05$) of seed germinating agents and media types was observed in the survival of *P. foetida* seeds. However, there is no significant interaction ($P> 0.05$) between the tested factors in germination percentage, days taken for germination, and number of leaves. The results revealed a significant effect of germination-inducing agents and media types on germination percentage, while Gibberellic acid showing the highest percentage of 79% at 8th day. Days required for 50% germination showed a notable reduction with Gibberellic acid treatment (8 days) compared to the control (10 days), highlighting its efficiency in accelerating germination. The number of leaves during the second week varied significantly, with Gibberellic acid treatment leading to a higher leaf count of four, and topsoil and sand + topsoil media promoting superior leaf development. Survival percentage affected by a significant interaction between seed germinating agents and media types, with hot water treatment combined with topsoil media resulting in the highest survival rate of 92%. This study shows that seeds treated with gibberellic acid and hot water along with the top soil media seem to be suitable for enhancing the *Passiflora foetida* L. seed germination and survival.

Keywords: *Germination, Gibberellic acid, Hot water, Sand, Topsoil*

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EFFECTS OF DIFFERENT ORGANIC FERTILIZERS APPLICATIONS ON GROWTH AND YIELD OF TOMATO (*Solanum lycopersicum*)

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Abstract

Organic fertilizer contributes greatly to improving soil fertility. A field experiment was carried out at the District Agriculture Training center, Thirunelvely, Jaffna from February to May 2023 to evaluate the effect of application of different organic fertilizers on growth and yield of tomato (*Solanum lycopersicum).* The experiment was laid out as a Randomized Complete Block Design with five replicates. Experiment included four treatments such as T1-jeevamirutha, T2- panchagavya, T3- Amirthakaraisal and T4- Control (No fertilizers are used). The soil and compost mixture (1:1) were filled in to the potting bags. The selected organic fertilizers were sprayed as foliar application from two weeks after transplanting and continued until fruit formation. The organic fertilizers were applied once a week. Plant height, number of leaves per plant, number of branches per plant, number of flowers per plant, number of fruits and fruit yield per plant were measured. The plant growth parameters were measured at weekly interval. The collected data was entered and compiled by using the Ms-excel program. The data was analyzed by using ANOVA. Results of the growth parameters were indicated that T1 (jeevamirutha) was showed better performance with plant height (76 cm), Number of leaves per plant (26.00), Number of branches per plant (4.857), Number of flowers per plant (17.86), Number of fruits (15.83) and weight (552.7kg) of yield. Significant level p-5%. The study was concluded that application of jeevamirutha foliar spray increases the growth and yield of tomato. So, it is recommended to apply the jeevamirutha as a plant booster which is low cost and eco-friendly practice.

Keywords: *Amirthakaraisal, Jeevamirutha, Liquid fertilizer, Panchagavya, Tomato*

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DETERMINATION OF ARSENIC LEVELS IN IRRIGATION WATER AND AGRICULTURAL SOIL OF EXPORT-ORIENTED LEAFY VEGETABLE CULTIVATIONS (*Centella asiatica*), (*Alternanthera sessilis*)

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Abstract

Arsenic contamination in agricultural perishables poses a significant health risk, particularly in leafy vegetables consumed worldwide. Vegetable consumption has been identified as a consequential route of heavy metal exposure. Therefore, Food & Agricultural Organization, World Health Organization and Codex Alimentarius have imposed stringent limits for heavy metals contents in leafy vegetables. Export-oriented green vegetable cultivations are mainly located in Puttlam and Kalutara districts in Sri Lanka. It was reported that arsenic was detected in some 'Gotukola' (*Centella asiatica*) and 'Mukunuwenna' (*Alternanthera sessilis*) cultivated in Puttlam and Kalutara districts for the purpose of exporting to the European Union. This study aimed to assess arsenic levels in irrigation water and agricultural soil of European Union-Targeted *Centella asiatica* and *Alternanthera sessilis* cultivations in Kalutara and Puttalam districts. Irrigation water and soil samples were collected from registered cultivation sites located in Puttlam and Kalutara Districts of Sri Lanka and their arsenic concentrations were determined using the Inductive Coupled Plasma – Mass Spectrometry (ICP-MS) technique. In any irrigation water sample collected from the Kalutara district, arsenic was not detected above the maximum permissible level (0.1ppm) stipulated by the Word Health Organization but in 5.29% of irrigation water sample collected from Puttlam district, arsenic was detected above the maximum permissible level. Nevertheless, in agricultural soil collected from both the districts, arsenic was not detected above the maximum permissible level (4.5ppm) stipulated by the Word Health Organization. According to the results of this study, it can be concluded that irrigation water is the main source of contamination of green leafy vegetables with arsenic. Source of Arsenic contamination should be identified and measures should be taken to minimize Arsenic content in 'Gotukola' and 'Mukunuwenna'. Further studies are required to assess the suitability of irrigation water sources of green leafy vegetable cultivations of these two districts.

***Keywords:** Arsenic, Agricultural Soil, Irrigation Water, ICP-MS, MPLs*

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A COMPREHENSIVE REVIEW ON AYURVEDA PERSPECTIVE OF PEST AND DISEASE MANAGEMENT

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Abstract

Vrikshayurveda is the branch of Ayurveda that addresses all facets of plant life. Agricultural development is a potent tool to end extreme poverty, boost prosperity, and feed 10 billion people by 2050. It is two to four times more effective in raising income among the poorest and is crucial to economic growth, accounting for 4% of the global Gross Domestic Product (GDP). The objective of this study was to review on Ayurveda perspective on pest and disease management. The study utilized the Systematic Literature Review (SLR) approach and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria to select 64 articles, by using Scopus, Web of Science, PubMed, and Lens.Org databases by using the search terms "Pest", "Disease", "Ayurveda"," Control" and "Management". The findings indicate that Ayurveda categorizes plant diseases as exogenous or endogenous, caused by external factors and imbalances in doshas, with treatment methods varying based on affected parts and causative agents. Treatment methods vary based on the plant part and the causative agent. The treatment methods vary based on the affected part of the plant and the causative agent. To treat worm infestations, water the plant with cold water for seven days and fertilize it with cow dung, milk, and *Kunapa jala*. For heat sickness, mist the plant with milk and *Kunapa jala*. For falls, apply honey and ghee paste. For soil issues, replace unhealthy dirt with healthy soil and water and milk the plant. For burns, use lotus paste and mud. Treatment depends on *Dosha* vitiation for endogenous causes. Ayurveda offers natural weed control methods like crop rotation, combination planting, hand weeding, herbal sprays, soil health management, herbicides, and crop diversity. These promote sustainable agriculture and environmental friendliness but may vary depending on climate, soil type, and weed species. Further Ayurveda promotes preventive measures like healthy planting, tree spacing, and soil fertility, uses medicinal plants, and herbs for infection control, and advocating natural pest control methods. This comprehensive review emphasizes the potential of Ayurveda in pest and disease management, highlighting its relevance for sustainable agricultural practices, and suggests future research on its practical application.

Keywords: *Ayurveda Perspective, Comprehensive review, Disease Management, Pest*

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EVALUATION OF DIFFERENT SOIL AMENDMENTS AND FOLIAR SPRAYS ON GROWTH AND YIELD PERFORMANCE OF BLACK GRAM (*Vigna mungo* L.)

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Abstract

A field experiment was conducted at the Integrated Farm and Training Center, Faculty of Agriculture, University of Jaffna, Sri Lanka, during the period from April to August 2023, to evaluate the effectiveness of different soil amendments and foliar sprays on growth and yield performance of black gram (*Vigna mungo* L.) variety Anuradha. The treatments consisted of three soil treatment levels (A0- Control; Only cow dung was mixed with the soil (100%), A1 – Cow dung (50%) + Poultry manure (50%), A2 – Cow dung (50%) + Poultry manure (25%) + *Prosopis juliflora* leaves (25%)) and five foliar spray treatment levels (F0 – Control, F1 – Pancha-kavya – 4% concentration, F2 – Sea Weed Extract – 15% concentration, F3 – Vermi Wash – 50 % of concentration, F4 – Aloe Vera Extract – 50 % of concentration). The experiment was conducted in a split plot design with three replicates. Data collected on growth, yield and other parameters such as root length and nodulation were subjected to analysis of variance (ANOVA) to determine the effects and their interactions using SAS 9.1. Mean separation was done by using the Duncan method. Application of soil amendments has significantly ($p<0.05$) affected the number of nodules per plant and which led to the maximization of vegetative, reproductive and yield parameters. Different foliar spray treatments have significantly ($p<0.05$) affected and influenced the growth, reproductive and yield parameters of black gram. Considering all growth, reproductive and yield parameters A2 (Cow dung (50%) + Poultry manure (25%) + *Prosopis juliflora* leaves (25%)) soil amendment was significantly ($p<0.05$) performed well among all three soil amendments; plant height (61.35 cm), number of leaves (53.6), number of flowers (4.35), number of pods (29.08), number of nodules (50.82), root length (16.24), yield (2.5 t/ha) and seaweed (*Kappaphycus alvarezii*) foliar spray treatment was performed well among all five foliar sprays; plant height (62.46 cm), number of leaves (53.81), number of flowers (3.83), number of pods (32.39), number of nodules (50.41), root length(16.32), yield (2.79 t/ha). This experiment results revealed that combination of A2 and F2 improved the yield (3.04 t/ha) of black gram.

Keywords: Black gram, Foliar sprays, Prosopis juliflora, Soil amendments, Seaweed

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INFLUENCE OF NITROGEN FERTILIZER REGIME ON TEA YIELD – A META-ANALYSIS

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Abstract

Tea cultivation faces increasing global demand necessitating optimized practices for yield and sustainability. Nitrogen fertilizer profoundly influences tea productivity, yet influences of fertilizer type and level on yield are unclear. Therefore, a comprehensive meta-analysis was conducted to investigate relationships between nitrogen management (fertilizer types and levels) and tea yield. Nitrogen (N) fertilizer types were inorganic, organic and both types of fertilizers whereas fertilizer levels were no N (control), low ($\leq$300) and high (>300) kg N ha^{-1}. This study provided insights from 32 studies and 421 observations. The findings reveal that nitrogen levels insignificantly impacted tea yield. The yield ranged between 6750 -7000, 8000 - 8250 and 6000 - 6250 kg ha^{-1}, for inorganic, organic and both fertilizers, respectively. Organic fertilizers outperformed (P<0.05) than other two fertilizer types, underscoring the critical role of fertilizer selection. However, fertilizer levels had no significant impact on the tea yield which shows the influences of other soil and climatic factors in yield attributes. Nitrogen utilization efficiency remains consistent across fertilizer levels and types, with organic options showing potential for higher efficiency. Subgroup analysis revealed substantial heterogeneity within subsets, suggesting multifaceted influences beyond studied parameters. Acknowledging limitations including potential publication bias and data heterogeneity, our research provides valuable insights for optimizing tea cultivation practices and guiding future research.

Keywords: *Fertilizer levels, Fertilizer types, Nitrogen fertilizer, Nitrogen utilization efficiency, Tea yield*

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EFFECTIVE WEED CONTROL METHOD FOR *Cyperus rotundus* (*KALANDURU*) IN IRRIGATED LAND OF LOW COUNTRY DRY ZONE, SRI LANKA

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Abstract

Cyperus rotundus, commonly known as *Kalanduru* is a troublesome and economically damaging weed, widely naturalized in the tropical and subtropical regions of the world. An experiment was conducted to identify an effective weed control method for *C. rotundus* in the irrigated farmland in UCIARS, Weligatta, Hambantota, Sri Lanka. A Split Plot Design with three replicates was used for the field experiment with three main plot factor levels (primary tillage – disc plough, primary with secondary tillage - disc plough + rotavator and zero tillage) and five subplot factor levels (chemical weedicide – Glyphosate 36% SL), organic mulch - paddy straw, inorganic mulch - black polythene, herbaceous cover crop - *Cleome viscosa* L. and no weed control). Fifteen treatment combinations were used. The weed parameters such as weed density and biomass of *C. rotundus* were measured monthly in three randomly selected places using a 20 cm × 20 cm quadrant. Analysis of variance (ANOVA) was performed for all the data at the 5% probability level using SAS software and DMRT was used for mean separation. There was a significant interaction between different tillage and management methods on weed density of *C. rotundus* after the 1st and 2nd months. Also, significantly higher values of weed density were observed in the treatments where received primary and secondary tillage with Wal aba cover crop (633.3 plants/ m^2 in 1st and 2nd month), primary and secondary tillage with no weed control (600 plants/ m^2 in 1st month and 591.6 plants/m^2 in 2nd month), zero tillage with Wal aba cover crop (566.67 plants/m^2 in 1st month and 533.3 plants/m^2 in 2nd month), and Zero tillage with no weed control (583.33 plants/m^2 in 1st month and 666.67 plants/m^2 in 2nd month). Moreover, all other treatments showed significantly lower weed density after the 1st month. According to the results primary tillage with glyphosate, primary tillage with paddy straw, and primary tillage with black polythene were recorded as highly effective for control of *C. rotundus* than other treatments. The lowest performance was recorded in primary and secondary tillage with Wal aba cover crop. The primary tillage with paddy straw (organic mulch) recorded the highest performance in controlling *C. rotundus*. Hence, it can be concluded that the tillage with mulching had a significant impact on management of *C. rotundus*. Furthermore, primary tillage is highly effective in suppressing *C. rotundus*.

Keywords: *Cleome viscosa, Cyperus rotundus, Glyphosate, Herbaceous cover crop, Paddy straw*

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INFLUENCES ON YIELD PERFORMANCES OF CHILI (*Capsicum annuum*) THROUGH INTERCROPPING WITH FEW GRAIN LEGUMES

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Abstract

Adoption of intercropping may increase crop production despite of declining trend of agricultural lands in Sri Lanka. Thus, a field experiment on influences of yield performances of chili through intercropping with few grain legumes was executed at Agriculture Research Station, Thirunelvely, Sri Lanka during August to November 2023 to find out an appropriate intercrop combination for higher productivity. The experiment was consisted of chili variety MICH HY 1 with five treatments viz., sole chili, chili + black gram, chili+ green gram, chili + cowpea and Chili + DOA recommended chemical fertilizer and the experiment was laid out in Randomized Complete Block Design (RCBD) arrangement. Growth parameters, such as plant height, canopy width, Number of pods and Leaf area index were recorded at two weeks intervals. Crop yield was measured at each harvest and cumulative yield was used for statistical analysis. Data were analyzed by SAS 9.1.3 software. Result revealed that canopy width, no. of branches were significantly increased by intercropping with legumes. Intercropping with legumes was significantly influenced to double the yield of Chili with compare to the control. Considering the findings, there was positively prompted the growth and yield of chili by intercropping with few grain legumes.

Key words: *Chili, Intercropping, Legumes, Yield*

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EFFECTS OF SELECTED HERBAL AND MICROBIAL EXTRACTS ON SEVERITY OF CRYSANTHEMUM WHITE RUST DISEASE

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Abstract

Chrysanthemums are perennial flowering plants mainly used as cut flowers and pot plants, having growing demand in floriculture industry. It is an expensive flower species that belongs to family Asteraceae. Chrysanthemum White Rust (CWR) is one of the main diseases affecting the quality of flowers caused by *Puccinia horiana*. Inorganic fungicides are used to control the disease, but there is a demand for non-chemical methods due to hazardous effects and low market value of flowers which containing chemical residues. The present experiment was conducted to examine the effects of chemical (Mancozeb 75% wp-Manganese ethylenebis) and non-chemical substances such as rhizome extracts of turmeric and kaluwa ala (*Alpinia nigra*), mustard leaves extract, yoghurt extract and fermented fruit juice (FFJ) while no substances were applied in the control treatment. Complete Randomized Design was used to set up the experiment with three replicates. The disease severity was measured by using grid method and significantly reduced by the treatments used in the experiment when compared to control. According to the results all non-chemical herbal and microbial extracts controlled CWR disease as same as Mancozeb. Plants received FFJ were shorter than others. Flower diameter showed a significant difference among treatments where largest flowers were observed in control treatment and plants received Mancozeb. The number of leaves per plant and number of flower buds per plant were significantly different among treatments where FFJ treated plants had the lowest values. Therefore, it can be concluded that non-chemical substances used in the present study might be used as alternative to Mancozeb to control CWR disease without affecting the plant growth. However, burning spots on leaves were observed when applied FFJ, hence affected the quality of flower. It may be prevented by using low concentrations.

Keywords: Chrysanthemum white rust disease, Fungicides, Puccinia horiana

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ASSESSING POTENTIAL OF SUGARCANE BAGASSE BIOCHAR FOR INCREASING WATER HOLDING CAPACITY OF SUGARCANE (*Saccharum* hybrid spp.) GROWING SOILS IN SRI LANKA

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Abstract

In the context of sustainable agriculture, it is more important than ever to look for novel ways to improve water management and soil production. This research investigates the efficacy of biochar as a soil amendment to enhance water holding capacity (WHC) in sugarcane cultivation, focusing on three distinct soil types prevalent in Sri Lanka, (Reddish brown earth, Alluvial, and Non-calcic brown soils). The study explores the potential of sugarcane bagasse biochar, a carbon-rich material derived from biomass pyrolysis, in mitigating water scarcity challenges faced by sugarcane crops in the region. A series of laboratory experiments were conducted to assess the impact of varying biochar application rates from weight basis on soil water retention. Keen Rackowski box method was employed in experiments, utilizing sugarcane biochar rates of 0%, 0.5%, 1%, 1.5%, 2%, 3%, 4%, and 5%, for each experiment used 100 g of soil and 3 replications. Results reveal a significant enhancement in WHC for each soil type following the application of biochar. The soil samples are saturated in the box, allowed to drain, and then weight to determine the amount of water retained. Among the tested soils, the reddish-brown earth soil exhibited the maximum improvement in WHC. Specifically, the application of 5% biochar led to a notable reduction in moisture evaporation, directly impacting irrigation intervals. While the current findings are derived from laboratory-level studies, there is a compelling need for field trials to provide recommendations for practical applications at the farmer level. Furthermore, future research should focus on optimizing the mass production of biochar to reduce production costs before introducing this technology to farmers or the sugar industry. This study underscores the potential of sugarcane biochar as a sustainable soil amendment to enhance water retention, thereby contributing to more efficient irrigation practices. The findings lay the groundwork for practical applications in agriculture, but further research and field testing are essential for widespread adoption and successful integration into existing farming practices.

Keywords: *Biochar, Soil amendment, Sugarcane, Water holding capacity*

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DEVELOPMENT OF NITROGEN FERTILIZER RECOMMENDATION FOR HYBRID TOMATO (*Solanum lycopersicum* L.)

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Abstract

Solanum lycopersicum L. is a widely cultivated vegetable crop in Sri Lanka. The usage of recommended fertilizer level is important to obtain high yield of hybrid tomatoes. However, lack of studies has been conducted on developing a fertilizer recommendation for hybrid tomato varieties in Sri Lanka. The present study aimed on the development of nitrogen fertilizer recommendation for hybrid Tomato. The experiment was conducted in the greenhouse at the Horticultural Crop Research and Development Institute, Gannoruwa, Sri Lanka. The two factor (fertilizer levels and tomato varieties) factorial completely randomized design was used for the study. There were 12 treatment combinations with two tomato varieties (Bhatiya, Maheshi) and 6 fertilizer mixtures by changing the urea amount of department fertilizer recommendation (0 Urea (F1), 30kg/ha Urea (F2), 60kg/ha Urea (F3), 90kg/ha Urea (F4), 120kg/ha Urea (F5),150kg/ha Urea (F6)). Growth and yield parameters were tested after the application of treatments. The significantly highest number of fruits and shoot weights was recorded from F4 (90kg/ha Urea + DOA recommended TSP and MOP fertilizer). Compared to F1 and F2 the yield was significantly higher in F4. Further, the significantly highest root weight was recorded from Maheshi variety while significantly highest shoot weight was recorded from Bhathiya variety. It can be concluded that, the 90kg/ha Urea + DOA recommended TSP and MOP fertilizer (F4) could be verified for development of nitrogen fertilizer recommendation for hybrid tomato. Further studies are needed to confirm the findings and give a finalized fertilizer recommendation.

Keywords: *Hybrid tomato, Nitrogen fertilizer, Solanum lycopersicum L.*

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EFFECT OF GAMMA IRRADIATION ON SEED GERMINATION OF *Catharanthus roseus* (MADAGASCAR PERIWINKLE)

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Abstract

Physical mutagenesis is an effective mutational breeding method for improving various morphological characteristics of ornamental plants. The experiment was undertaken to investigate the effect of various dosages of gamma irradiation on seed germination of *Catharanthus roseus* (Madagascar periwinkle). The experiment was conducted at UCIARS, Weligatta to find out the appropriate gamma dosages for selecting planting materials for *C. roseus* with the purpose of crop improvement under gamma irradiation. Healthy matured dry seeds were exposed to ^{60}CO Gamma irradiation source at Horticultural Crops Research and Development Institute (HORDI), Gannoruwa, Sri Lanka. Treatments included six different gamma dosages such as (T0 - control) 0 Gy, (T1) 100 Gy, (T2) 200 Gy, (T3) 300 Gy, (T4) 400 Gy and (T5) 500 Gy. A Completely Randomized Design with four replicates and twelve samples per replicate was employed under shade house conditions. Data on germination were collected daily until constant germination was observed for up to 10 days, while other management practices were maintained. Data were analyzed using Minitab 17 statistical software with one-way ANOVA and Tukey's test to identify significant differences among treatments at a 0.05 significance level. The results revealed that the higher dosages of ^{60}CO Gamma irradiation significantly decreased the germination ability of *C. roseus* seeds (P<0.05). Specifically, 400 Gy and 500 Gy treatments resulted in significant reductions in germination, whereas lower dosages less than 400 Gy did not exhibit such effects. Seed germination started on day 3 after planting for all treatments except for T5 (500 Gy). Indicating a delayed germination initiation, seeds subjected to the T5 treatment began germination on day 5 after planting and exhibited a significantly lower overall germination percentage when compared to other treatments. The highest germination rate (84%) was observed in the control seeds, which were not subjected to gamma irradiation, whereas the lowest germination rate (8%) occurred in seeds treated with 500 Gy of gamma irradiation. High doses of gamma irradiation negatively impact germination by potentially inducing oxidative stress, which leads to cellular damage and reduced germination efficiency. At higher doses, such as 400 Gy and 500 Gy (as in T4 and T5 treatments respectively) radiation can cause significant damage to the DNA and cellular membranes, leading to delayed germination initiation and reduced overall germination percentages. These findings have practical implications for the use of gamma irradiation in plant breeding and seed preservation, emphasizing the need to carefully optimize irradiation doses to avoid adverse effects on seed germination of *C. roseus*.

Keywords: *Catharanthus roseus, Dosage, Gamma irradiation, Germination, Treatment*

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FOOD, NUTRITION AND POST-HARVEST TECHNOLOGIES

EVALUATION OF BIODEGRADABLE RICE STARCH COMPOSITE COATING FOR SHELF-LIFE EXTENSION OF FRUITS AND VEGETABLES

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Abstract

Rice starch-based edible film coatings are an efficient and cheaper packing method as an alternative to preservation and plastic packaging. The present study was conducted to investigate the possibility of soybean oil and glycerol to improve the efficiency of film coatings. Starch was extracted from rice, and modification was done with Carboxyl Methyl Cellulose (CMC) by the dry heat treatment method. Glycerol and CMC were mixed in different formulations as 1:1, 2:1, and 3:1 mass ratios and combined with a modified starch. Citric acid was used as a cross-linking agent. To prepare the samples with soybean oil, the same ratios were used, and 2 mL of soybean oil was added to the mixture. Without any plasticizer, modified starch was used as a control film. Altogether seven treatments, each with three replicates, were studied. Banana was used to apply coating, and weight loss were calculated after three days. The film ingredients and properties of stand-alone films moisture content, solubility, swelling power and ratio, transparency, and microstructure were examined. Fourier transform infrared spectroscopy (FT-IR) data was used to examine the interactions. Among all formulations, Glycerol: CMC, 2:1 with soybean oil has shown the average minimum weight loss (7. 27%) while banana, which is without coating, has shown the maximum (15.42%). Among all ratios, soybean oil has shown relatively lower solubility than oil without it, although it has low moisture content. All treatments with soybean oils showed a lower number of swelling capacities. (With oil, 1:1 = 1.17, 2:1 = 1.46, and 3:1 = 1.91) All the treated samples, except the control, have recorded 0.49 - 0.94 rage transparency at 550 nm wavelength. There was a significant difference ($p<0.05$) within the all-measured parameters. All the samples have been recorded at above 90% biodegradability within five days. These findings provide evidence that soy bean oil increases film efficiency, which will extend food shelf life.

Keywords: Coating, Glycerol, Plasticizer, Rice starch, Soybean oil

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DEVELOPMENT OF JAM USING THREE DIFFERENT BANANA VARIETIES (*Musa acuminata*) AVAILABLE IN SRI LANKA AND EVALUATE THEIR SENSORY, PHYSIOCHEMICAL, NUTRITIONAL AND FUNCTIONAL PROPERTIES

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Abstract

Banana (*Musa acuminata*) is popular tropical fruit rich in nutrients. However, post-harvest loss of ripened banana is high in Sri Lanka and value addition provides an opportunity to reduce wastage as well as generate income. Therefore, this research was conducted to assess the possibility of development of jam using three types of banana varieties (*Ambul, Seeni,* Cavendish). Product optimization was done by developing jam with changing amount of banana pulp, pumpkin puree, sugar and water. The sensory evaluations were done separately for each banana type using 30 semi-trained panelists with 5-point hedonic scale and data were analyzed using Kruskal-Wallis non-parametric method. The physiochemical, nutritional, functional properties and shelf-life evaluation of three selected samples stored in glass jar under both refrigerated (4 °C) and room temperature (30 °C) conditions were performed using standard AOAC methods. The most preferred formulations for *Ambul*, *Seeni* and Cavendish jams were 45:32:13:10, 45:25:20:10 and 40:35:15:10, respectively in a ratio of banana pulp (g): pumpkin puree (g): sugar (g): water (mL). Cavendish banana jam showed significantly higher ($p<0.05$) crude fiber (4.19 ± 0.27) and ascorbic acid (55.28 ± 0.58) contents as well as highest flavonoid content (0.102 ± 0.025 mg QE/100 g) and total phenolic content (176.19 ± 8.1 mg GAE/100 g) compared to other jam types. During the two months of storage period, the selected jam samples showed zero presence of total plate count and yeast and mold count while showing consistently elevated levels of total soluble solids from 68.23 to 68.95 in both refrigerated and room temperature conditions. It can be concluded that the developed banana jam using three different banana varieties can be stored under refrigerated conditions (4 °C) for two months of period without adding any preservatives.

Keywords: *Banana, Functional properties, Jam, Physiochemical properties, Sensory evaluation, Shelf-life*

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ASSESSMENT OF THE ORGANOLEPTIC PROPERTIES AND ANTIOXIDANT ACTIVITY OF BLUE BUTTERFLY PEA (*Clitoria ternatea*) TEA BLEND COMBINED WITH FRUIT FLAVOURINGS

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Abstract

Herbal tea, a caffeine-free alternative to the tea plant (*Camelia sinensis*), is gaining popularity due to its health benefits. The study aimed to develop value-added tea from blue butterfly pea flowers, evaluate its organoleptic properties and antioxidant activity, and incorporate fruit flavourings. This study utilized dehydrated blue butterfly pea flowers and fruits (Lime, Mango and Pineapple) to create a tea with improved health and taste, popularizing locally produced fruits and increasing demand for herbal tea. Flavours changed as 0.7%, 1.3%, 1.9% and 2.3% and dehydrated blue butterfly pea flowers remained constant (0.5%) in each blend. Individual sensory evaluations were carried out for the flavours and from that 0.7% concentrated sample of each flavour (lime/S1L1, pineapple/S1P1 and mango/S1M1) were selected as best flavour level, evaluated their antioxidant properties by Total Polyphenol content (TPC), Total Flavonoid Content (TFC), Total Anthocyanin Content (TAC), and Total Antioxidant Activity (DPPH Assay). According to the result, S1L1 performed the highest TPC(9.7367[a]±0.53), while other treatments performed similarly. There were not significant differences between the control sample (1.700[a]±0.05) and S1M1 (1.6700[a]±0.062), both recorded high TFC, S1L1 (0.5400[c]±0.026) and S1P1 (1.3466[b]±0.055) were significantly different, performing low values respectively. S1P1 (85.113[a]±6.01) presented the highest radical scavenging activity that was significantly different from other samples (P<0.05), control sample (69.187[b]±2.95), S1M1 (66.223[b]±8.11) and S1L1 (70.667[b]±4.07) performed low radical scavenging activity, and they were not significantly different from each other. TAC of all the samples was not significantly different and was performed similar way. The sample's primary source of anthocyanin is blue butterflies, and its content can be influenced by both external and internal factors. Ultimately, this study indicates that value-added tea performed better than the control sample.

Keywords: *Antioxidant activity, Blue pea, Sensory analysis, Tea blend, Tropical fruits*

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DEVELOPMENT OF DRINKING YOGHURT INCORPORATING DRAGON FRUIT PEEL AND EVALUATION OF PHYSICOCHEMICAL, PROXIMATE AND FUNCTIONAL PROPERTIES

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Abstract

Dragon fruit (*Hylocereus* spp) peel (DFP) which is frequently discarded has gained attention lately because of its reported health benefits such as anti-aging, anti-inflammatory, and anti-diabetic properties. Present study was focused on developing a drinking yoghurt incorporating DFP extract as a natural colorant and evaluating its physiochemical, nutritional, and functional properties. Preliminary studies were conducted to select the best ratio of DFP juice that can be incorporated with milk to prepare drinking yoghurt. The product optimization was done by changing the sugar levels (4%, 6%, 8% w/w) and incubation time (4hrs, 6hrs, 8hrs). Sensory evaluation was conducted by 30 semi-trained panelists using a 5-point hedonic scale and data were analyzed using Kruskal-Wallis test. The physicochemical, proximate, and functional properties and shelf-life of the developed product and the control drinking yoghurt (6% sugar, 8 hour incubation period, 0% DFP, 10% starter culture) were analyzed using standard methods and compared using student's *t*-test. The sensory results showed that drinking yoghurt samples containing 6% w/w sugar level and 8 hours incubation time had the highest sensory acceptance. Moreover, compared to the control, DFP yoghurt had highest crude fat (2.87 ± 0.002%), crude fiber (0.72 ± 0.002%), ash content (0.66 ± 0.05%), moisture content (84.08 ± 0.12%), total flavonoids (0.22 ± 0.001 mg QE/mL), total polyphenol (12.98 ± 0.51 mg GAE/100 mL), total antioxidants (824.3 ± 38.2 mg TE/ 100 g) and betalain content (0.0064 ± 0.001 mg/mL). The decrease of pH value of the DFP yoghurt was observed during the storage period while showing minimum change in betalain content. Overall, it can be concluded that the developed DFP drinking yoghurt can be stored under refrigerated conditions (4 °C) for 3 weeks period without adding any preservatives.

Keywords: *Dragon fruit peel, drinking yoghurt, physicochemical properties, functional properties, proximate composition*

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DEVELOPMENT AND QUALITY EVALUATION OF A SPICY-FLAVOURED TROPICAL SEED-BASED SNACK

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Abstract

The main objective of this research was to develop a snack which flavoured with natural spices and incorporated with tropical edible seeds to enhance the health benefits. The new product was a confectionary snack ball consisting of a core and coat. The core was comprised of a blend of sesame and pumpkin seed powder in a 2:1 ratio, with different levels of three different binding agents (T1, T2 and T3) glucose syrup 25%, coconut honey 40% and corn flour 17% respectively. The texture (hardness) of the core of the snack balls was determined by using the TX 700 texture profile analyser to select the best proportion. T1 was selected (T1=glucose syrup 25% + sesame seed 50%+pumpkin seed powder 25%). The coat of snack balls was changed by using different coating mixtures, which were formulated with three different natural spices, such as cinnamon, ginger and fennel. The formulas (CCM, CCG, CCF and CM) cinnamon-3%, ginger-2%, fennel-0.6% and 0% of natural spices, respectively were developed by changing the percentage of three different spices with dark cooking chocolate. S2 (S2=T1+CCM) was selected as the most acceptable snack ball with the desired sensory attributes. S2 was further analysed and followed by three replicates for proximate analysis, physicochemical analysis and shelf-life with its control sample (S1) (S1=T1+CM), and a commercially available artificially flavoured snack ball (CAS). Fibre content (31.07%) was increased and fat, calories and total sugar were not significant differences (P>0.05) between the control (S1) and new product (S2) with the addition of natural spices. The new product showed higher protein (13.48%), ash (9.71%) and fibre (31.07%) and lower levels of fat (20.63%), total sugar (22.08%), carbohydrate (51.40%) and calories (445.23%) than a CAS. According to the results, the new product (S2) (S2 = T1+CCM (cinnamon 3%+dark cooking chocolate 97%)) can be used as an alternative to artificially flavoured products in the market.

Keywords: Binding agent, Chocolate, Spicy flavour, Snack ball, Tropical seed

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BIOACTIVE POTENTIAL OF MICROENCAPSULATED COUNTRY BORAGE (*Coleus aromaticus L.*) LEAF EXTRACT DURING *IN VITRO* DIGESTION

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Abstract

Country borage (*Coleus aromaticus* L.) leaves, a rich source of various phenolic compounds with potent antioxidant and anti-inflammatory properties, are capable of combatting reactive oxygen species produced in the human body and offer immense potential for functional food development. Nevertheless, these compounds are sensitive to gastrointestinal conditions, which results in their low bioavailability and hinders their utilization. The present study aims to enhance the bioactivity of these phenolic compounds through encapsulation for functional food incorporation. The ethanolic extract of freeze-dried *C. aromaticus* leaf was encapsulated in chitosan, a natural biopolymer using the technique of ionic gelation with sodium tripolyphosphate (TPP) as the cross-linking agent, and the retention of bioactivity was evaluated under simulated gastrointestinal and dialysis conditions. The encapsulated particles were characterized by their chemical properties using Fourier-transform infrared (FT-IR) spectroscopy, and the morphological properties using scanning electron microscopy (SEM). Encapsulation efficiency and loading capacity of encapsulated particles were $76.38 \pm 2.00\%$ and $34.09 \pm 1.70\%$ respectively. *In vitro* digestion studies revealed a significantly higher release of polyphenols ($p < 0.05$) in simulated intestinal fluid and dialyzed fractions of encapsulated extract compared to non-encapsulated extract. FT-IR and SEM confirmed the presence of extract within the chitosan wall matrix with particles in microscale range. This successful encapsulation suggests targeted delivery of the bioactive compounds, maximizing their potential in functional food applications.

Keywords: *Bioactive compounds, Chitosan, Encapsulation, In-vitro digestion, Ionotropic gelation*

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PRODUCTION OF LOW-FAT YOGHURT BY SUBSTITUTING DAIRY MILK WITH RICE MILK (*Oryza sativa*)

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Abstract

Plant–based milk is used as a substitute for animal milk due to similarities in nutritional, functional and sensory properties. As well it will also be a solution for the people who have lactose intolerance. The study was conducted with the aim of replacing cow milk in yoghurt production with rice-based milk and the product was value added by adding some other plant-based ingredients making it a vegan diet. Four treatment combinations with three replicates were evaluated in this study as rice milk 100%, rice milk 50%: pumpkin puree 50%, rice milk 50%: banana puree 50% and rice milk 50%: pumpkin puree 25%: banana puree 25%. A sensory evaluation on appearance, smell, texture, taste and overall acceptability of the product and shelf-life evaluations were done and statistically analyzed using the Friedman test. According to the sensory evaluation, T4 was reported to be the best with the highest overall acceptability. pH, titratable acidity and fat contents were determined in triplicate, and statistically analyzed using ANOVA procedures at a 5% significance level. pH and titratable acidity tests were done within 3 days intervals and, the pH values and titratable acidity of the plant-based yoghurt have exceeded optimal values of 4.66 – 6.3 for pH and 4.2 – 4.6 for titratable acidity after 12 days deciding that the newly produced plant-based yoghurt is best to be consumed within 12 days. This study reveals that the percentage of fat is lower than cow's milk and confirmed this as a low-fat yoghurt product which can be recommended for people with obesity.

Keywords: *Banana puree, Lactose intolerance, Plant-based yoghurt, Pumpkin puree, Rice milk*

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COMMON ADULTERANTS AND METHODS TO THE IDENTIFICATION OF ADULTERATION IN GREEN TEA: A MINI REVIEW

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Abstract

Green tea is a non-fermented tea that is well-known for its health and therapeutic benefits. Unfortunately, the quality and effectiveness of green tea are often compromised due to the practice of adulteration. Hence, to maintain consumer trust and promote transparency within the tea market, it is important to understand the adulterants found in green tea and the techniques used to identify them. Therefore, this literature review aimed to explore the different types of green tea adulterants and various techniques used in the identification of these adulterants. We conducted a comprehensive search of scientific databases, Google Scholar, and PubMed for academic journals to gather information on green tea adulteration and identification techniques. Adulterants that are commonly found in green tea include chicory, acetamiprid, cashew, sibutramine, sugar, and glucose syrup. Acetamiprid, a neonicotinoid insecticide, is added during tea cultivation, while chicory, cashew nut husks, sibutramine, sugar, and glucose syrup are included in the manufacturing process. This can have a negative impact on the quality, safety, and authenticity of green tea products, causing significant challenges for consumers and the tea industry. Various techniques are used to detect adulterants in green tea, such as chromatography, spectroscopy, and DNA barcoding. For example, a biosensor that uses the Surface-enhanced Raman Scattering (SERS) spectroscopic method with gold nanoparticles is used to detect acetamiprid in green tea. Near Infrared Spectroscopy (NIRS) can detect sugar and glucose syrup in roasted green tea, while Attenuated Total Reflection in Fourier Transformation Near Infrared (ATR-FTNIR) spectroscopy can detect sibutramine in green tea with a level of adulteration ranging from 0.375 to 12 mg in 1.75 g of green tea. High-Performance Liquid Chromatography-Ultraviolet (HPLC-UV) and HPLC-Fluorescence Detection (HPLC-FLD) techniques can detect chicory in green tea, with fingerprints acquired at 280 nm and 280 nm/ 350 nm, respectively. High-resolution melting (Bar-HRM) analysis with a plant DNA barcoding marker is used to detect cashews in adulterated green tea with a sensitivity of 1% v/v. In conclusion, the advanced detection methods offer robust solutions to combat adulteration in green tea and ensure the consumers safety and integrity of the tea industry.

Keywords: Adulteration, Camellia sinensis, Green tea, Identification techniques, Tea

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MICROBIAL DECONTAMINATION OF CEYLON CINNAMON (*Cinnamomum zeylanicum*) POWDER BY GAMMA IRRADIATION

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Abstract

Ceylon cinnamon has high demand due to its unique culinary and functional properties. Cinnamon powder is value-added product mainly produced from quills, left-over trimmings, and chips. Due to the different origins of the raw materials and high surface area to the volume, risk of microbial contamination is high. Therefore, this study aimed to evaluate the impact of gamma irradiation on the microbial load of the cinnamon powder. A 30 numbers of cinnamon powder samples were randomly obtained from 25 kg commercial Ceylon cinnamon packages ready for exports. Samples were weighed (100 g) and packed in sterilized plastic bags. 10 samples were used as control and gamma irradiation at 3 kGy and 6 kGy doses were conducted for 10 samples at each dose point at Sri Lanka Gamma Centre using an industrial Cobalt-60 gamma irradiator. Total plate count test, yeast and mold count, and coliform test were conducted using ISO methods. The initial microbial load ($1.39 \times 10^5 \pm 0.533 \times 10^3$ CFU g^{-1}) was reduced drastically ($p<0.05$) in 3 kGy sample ($1.49 \times 10^3 \pm 0.015 \times 10^3$ CFU g^{-1}), which was compatible with export standards, and the 6 kGy treated sample was almost at sterile condition (0.00 ± 0.00 CFU g^{-1}). Few colonies of yeast and mold were observed in the control sample (below 30). Further, irradiated samples were in almost sterile condition at both dose points ($p<0.05$). Three irradiated samples showed negative results for the coliform test. Hence, both doses showed exceptional results. However, when considering the cost-effectiveness and time taken for gamma irradiation, 3 kGy was recommended as the most suitable dose for the microbial decontamination of cinnamon powder. Therefore, these results revealed that the gamma irradiation has the potential in decontamination of commercial Ceylon cinnamon powder preferred by major importing countries instead of sulfur treatment.

Keywords: Ceylon cinnamon, Decontamination, Gamma irradiation, Microbial reduction

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DEVELOPMENT OF VEGAN CURD BY USING LOCALLY AVAILABLE WHITE RICE (*Oryza sativa*), PEANUTS (*Arachis hypogaea*) AND CASHEW NUTS (*Anacardium occidentale*)

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Abstract

Vegan curd refers to a dairy-free alternative to traditional curd or yogurt, typically made from plant-based ingredients. It mimics the texture and taste of dairy curd while offering benefits such as being lactose-free, cholesterol-free, and lower in saturated fats. Vegan curd is rich in nutrients like protein, and calcium (if fortified), and often contains live cultures for probiotic benefits. This study focuses on developing a vegan curd using a composition of white rice (*Oryza sativa*), peanut (*Arachis hypogaea*), and cashew nuts (*Anacardium occidentale*). The study aims to create a plant-based alternative to traditional dairy curd with desirable sensory and nutritional attributes. Five different formulations consisting of white rice (WR): nuts (Cashew nut & peanut) in the proportions of 100:0%, 75%:25%, 50%:50%, 25%:75%, and 0%:100%, were used to make vegan curd and they were subjected to sensory evaluation. Sensory evaluation was conducted by 30 untrained panelists using a 5-point hedonic scale. The vegan curd was made of 50% WR & 50% nuts; treatment 3 (T3) attained higher scores for sensory attributes of appearance, color, flavor, aroma, texture, and overall acceptability. The selected vegan curd, T3 was subject to proximate and physiochemical analysis using standard protocols. Compared to a control (T1) sample, newly developed vegan curd (T3) had high crude protein (4.4%), crude fiber (3.3%), crude fat (7.2%), crude moisture (82.5%), crude ash (0.98%), carbohydrate content (19.85%) and sugar content (8.7%). The initial pH, total soluble solid (TSS) and titratable acid (TA) values of the freshly produced vegan curd sample (T3) were 4.8, 19%, and 0.98 respectively. pH and titratable acidity tests were done within 3 days intervals and, the pH values and titratable acidity of the vegan curd exceeded optimal values after 12 days, concluding that the newly produced product is best to be consumed within 12 days under refrigerated conditions (4 ^{O}C). Further, this study reveals that vegan curd can be produced with acceptable sensory and physiochemical attributes by incorporating locally available cereal varieties.

Keywords: Cereals, Proximate analysis, Sensory evaluation, Vegan curd, White rice

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IMPROVEMENT OF THE NUTRITIONAL VALUE OF YOGHURT USING PEANUT (*Arachis hypogaea*) MILK AND AMBUL BANANA (*Musa spp.*)

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Abstract

Dairy-based products such as milk and yogurt are known to have health promoting properties and provide important nutrients to the diet, including proteins, calcium, energy, and other macro and micronutrients. Some people are unable to digest lactose due to a deficiency in lactase, the enzyme that breaks down the lactose. This study aims to ascertain this by contrasting plant-based milk with cow's milk in varying proportions. The plant-based sauce was prepared by mixing peanuts and ambul banana in 1:4 ratio, respectively. Treatment samples were prepared by incorporating cow's milk and plant-based milk at different ratios, respectively. T1 (3:1), T2 (1:1), T3 (1:3), and T4 (only plant-based milk), whereas the control sample (T0) was prepared without adding a plant-based milk sample. The best sample was selected through a sensory evaluation of 9-point Hedonic scale with 30 untrained human objects. Parametric data were analyzed using the one-way ANOVA Tukey method with a 95 confidence level and non-parametric data were analyzed Friedman test using Minitab (version 19 (2019)). The sensory evaluation shows that T2 was successful throughout the sensory evaluation process. Physiochemical and biological properties analyses were carried out to determine the quality of plant-based yoghurt samples. According to the experiment, all yoghurt samples concluded that the moisture content was between 60-80% values. The pH value of all the yoghurt sample after the 14 days of storage ranged between 4 - 4.8 while titratable acidity value is significantly higher in plant-based milk yoghurt ($1.22\pm0.0252\%$) than in cow's milk yoghurt ($0.85\pm0.0265\%$). The ash content of yoghurt is significantly lower in plant-based milk yoghurt ($0.0189\pm0.001682\%$) than in cow's milk yoghurt ($0.03467\pm0.00466\%$). Cow's milk naturally contains more minerals like calcium and phosphorus, which contributes to a higher ash content compared to plant based alternatives. The fat content of cow's milk fat was lower (3.71%) than plant-based milk (5.34%). The water activity value is higher in T3 sample (0.84 ± 0.000529 %) than T0 sample (0.835 ± 0.000577 %). The assessment of biological properties showed negligible colony formation in yoghurt with peanut and ambul banana. During storage indicating microbiological safety for up to 10 days of shelf life analysis. In conclusion, plant-based milk can be effectively incorporated into yoghurt formula by improving physiochemical, biological properties, acceptable sensory properties and shelf life.

Keywords: Lactose intolerance, Peanut, Plant-based milk, Sensory, Yoghurt

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SUSTAINABLE LIVESTOCK FARMING
AND AQUATIC PRODUCTION
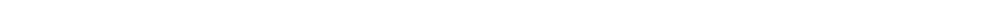
CANISTEL (*Pouteria campechiana*) AS AN ALTERNATIVE ENERGY SOURCE IN BROILER DIETS

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Abstract

Poultry feed prices have surged due to soaring energy and protein feed ingredient costs globally, intensifying competition between humans and animals for grains used in bioenergy. This necessitates the exploration of alternative dietary energy sources. Maize, a pricey imported ingredient, is a primary energy source in poultry feed production. To address this, this study examined Canistel (*Pouteria campechiana*) Baehni, an underutilized fruit found in tropical regions. The study aimed to assess Canistel's nutritional value and formulate poultry rations using Canistel meal as a cost-effective alternative to cereals. Canistel meal was oven dried and assessed for proximate composition. A sample of broiler day old chicks (of Lohman platinum) was selected and they were allotted to the dietary treatments, with thirty birds per treatment and three replicates. Four diets were formulated using combinations of maize meal. The control diet had 28 % maize, which was sequentially replaced with 25%, 50% and 75% of Canistel in treatments 1, 2 and 3 respectively. All the diets were Isoproteic and isoenergetic. Birds were weighed at the beginning of the experiment and subsequently at weekly intervals up to 6 weeks. Canistel contains 34.5% dry matter in the fresh pulp. Proximate composition of canistel meal was mostly comparable to maize in energy, high in fiber and ash contents but low in protein and fat content. Fully matured ripen fruit has the highest gross energy level. Dried canistel meal below 2mm particle size has high palatability and over 45 days' shelf life of compound feed after pelleting and packing according to preliminary trial. ANOVA showed that the four different treatments had no significant difference in weight gain, Feed Conversion Ratio (FCR) and Broiler Performance Index (BPI) of broilers at 42 days ($P<0.05$). Carcass analysis revealed that averages of carcass recovery were 72.6 % (±1.36) weight of carcass, giblet, and abdominal fat level, expensive edible meat (thighs and breast) were not significantly different in three treatments compared to control. Canistel has very high maize replacing ability with no deleterious side effects on growth. Cost for feed has reduced by 7.74% at the highest inclusion rate compared to the controlled diet with maize as the main energy supplement.

Keywords: *Canistel, Energy, Carcass recovery, Proximate composition, Weight gain*

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INFLUENCE OF DIFFERENT MICROALGAE ON GREEN MUSSEL (*Perna viridis*) GROWTH AND GONADAL DEVELOPMENT

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Abstract

The green mussel (*Perna viridis)*, is commercially significant species and has higher demand in local and international market.Understanding their growth and gonadal development with various microalgae is essential. This study addresses the existing knowledge gap concerning the influence of various microalgal species on the growth and gonadal development of the green mussel, *Perna viridis.* Theexperiment was conducted in nine tanks, each containing 12 green mussels.. Treatment one utilized *Chlorella*, while treatment two utilized *Thalassiosira* and *Chaetoceros* Brown microalgae. Treatment three employed both green and brown microalgae.All treatment had three replicate and continued for 24 days. Water quality characteristics and salinity tolerance were tested alongside growth parameters.Salinity stress levels of 0ppt, 15ppt, and 25ppt were employed. Results revealed that treatment three exhibited better growth performance, with numerically higher width (30.76 ± 2.21) and length (69.91 ± 7.30) compared to the other treatments. Additionally, treatment three recorded a higher Gonadosomatic Index (GHI) of 0.0922 ± 0.0484. .The highest survival percentage was observed in treatment three under salinity stress conditions. . Furthermore, the condition index and edibility showed numerically higher values in treatment three, which utilized both green and brown microalgae. This data was analyzed by SAS software. This study provides valuable insights into the selective use of microalgae to optimize green mussel aquaculture and enhance their reproductive potential. Future investigations may explore additional microalgal species to further enhance the growth and reproductive systems of green mussels beyond Thalassiosira, Chlorella, and Chaetoceros.

Keywords: *Chaetoceros, Chlorella, Green mussel, filter feeders, Thalassiosira, Perna viridis*

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STUDY ON THE EFFECT OF ROTIFER CULTURE WITH PROBIOTIC ON GUPPY FRY GROWTH AND DEVELOPMENT

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Abstract

Embarking on an innovative exploration, this study pioneers the integration of probiotics within rotifer culture (*Brachionus plicatillis*), unravelling a transformative narrative in the journey of nurturing guppy fry (*Poecilia reticulata*). To address this issue, probiotic-treated rotifers were fed to guppy fry. For the enhancement rotifer, three different concentrations of probiotics (T1: 2 ppm, T2: 5 ppm and T3: 10 ppm) were used, while the control group was fed by only using Chaetoceros. Each treatment with three replicates were randomly allocated into twelve beakers (4x3) containing 200 ml of rotifer culture. For this growth trial, one-day-old fries were stocked in nine plastic bottles each with eight individuals per experimental unit. These fries were fed either by 5 ppm treated, 10 ppm treated or untreated rotifers According to the findings of the first experiment, population of rotifers 12.75 ± 3.75 in day 10. All three treatments indicate a significant difference from the control. There is no statistically significant difference in biomass between treatments and controls, however, treatment 2 revealed numerically higher mean value of 175.77. In the second experiment, guppy reared in the TR3 (10 ppm) showed the highest length (10.00 ± 1.70W) than others. The treatment 2 and 3 both displayed better growth in width by giving 1.96 ± 0.18 and 1.96 ± 0.19 respectively. The highest body weight (5.7 ± 1.79) was also found in fries kept in TR3. Better weight of the guppy fry was revealed in the treatment 3 by giving numerically highest weight. This research demonstrates that supplementing rotifer culture with probiotics significantly enhances guppy fry early growth and development, in terms of length. Future investigations may explore alternative microalgae or live feed sources, seeking to further optimize guppy rearing. The results support the use of probiotic- supplemented rotifer culture as a promising strategy for enhancing guppy fry rearing, with potential applications in the aquaculture industry.

Keywords: Brachionus plicatillis, Chaetoceros, Poecilia reticulata, Probiotics, Rotifer

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ASSESSMENT OF TILAPIA FISH SCALE POWDER AS A LOW-COST AND ECO-FRIENDLY BIOSORBENT FOR THE REMOVAL OF REACTIVE RED 123 DYE IN WASTEWATER

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Abstract

Biosorption has been found to be an effective and eco-friendly technique to remove dye from textile wastewater. A considerable amount of *Oreochromis niloticus* Fish scales which result from the fish processing industry is discarded annually without utilization, which causes serious concerns in terms of environmental pollution. In this study, the potential of using Tilapia (*Oreochromis niloticus*) fish scales as a biosorbent to remove Reactive Red 123 dye (RR123) from wastewater was studied. Fish scales were dried and powdered and the effect of pH, dosage of fish scale and contact time on RR123 dye removal from wastewater was investigated. Dye removal parameters ie: final dye concentration, percentage of dye removal (%DR), Dye uptake capacity (q_e) and Removal rate (Rr) were examined. The effect of pH was tested for the 4 - 10 pH range and pH 4 was observed as the optimum level. The significantly highest %DR (57.698±0.371%), q_e (3.606±0.023mg/g) and Rr (0.481±0.003mg/L/min) were obtained for pH 4 treatment whilst these significantly lower in others. The effect of dosage was analysed in 4, 8, 12 and 16 mg/mL whilst the significantly higher %DR, Rr were observed in both 12 and 16 mg/mL treatments than the other two treatments. The optimum dosage was selected as 12mg/mL due to low operational cost. The effect of contact time was examined in 30, 60, 90 and 120 minutes and the optimum contact time was observed as 60 minutes with a significantly highest %DR (57.671±0.148%) and q_e (1.802±0.005mg/g) compared to other treatments. The extent of dye removal decreased with increasing pH, decreasing of adsorbent dosage and increasing of contact time. The maximum RR123 dye removal was obtained in the solution pH 4 using 12mg/mL FSP dosage, during 60 minutes of contact time. The surface functional groups of FSP are characterized by the FTIR as Phosphate, carbonate, carboxylic and amide groups. This study highlighted that the *O. niloticus* fish scale can be employed as a low-cost, effective biosorbent for the removal of Reactive red 123 dye in textile wastewater.

Keywords: *Biosorbent, Fish scales, Oreochromis niloticus, Reactive red 123 dye, Wastewater*

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GENETIC POLYMORPHISM AMONG BREEDING SIRES IN A MAIN CATTLE MANAGING CENTER, SRI LANKA

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Abstract

Sri Lanka spends approximately US$ 221 million annually to import 60% of its dairy requirements, highlighting the need for enhanced local production. Improving the genetic capacity of domestic cattle is essential for higher performance. Effective breeding programs depend significantly on sires' genetic quality. Traditional phenotypic methods for sire selection have limitations prompting the need for more informative DNA-based techniques, which are currently underutilized. This study aimed to introduce a molecular method to evaluate genetic polymorphism among breeding sires. Eleven semen donor bulls from a main Cattle Management Center in the Central Province, comprising Girolando (n=2), Jersey (n=5), Friesian (n=2) and Sahiwal (n=2) breeds were analyzed by randomly amplified polymorphic DNA (RAPD) PCR. DNA was extracted from whole blood using a commercial kit (Promega, USA) and amplified with RAPD primers OPA18 (5'AGGTGACCGT3') and OPA16 (5'AGCCAGCGAA3'). The resulting bands, visualized via agarose gel electrophoresis, were analyzed using NTSYS-PC program (2.10). Genetic relationships were measured using Jaccard's similarity coefficient and UPGMA analysis. The two RAPD primers generated 16 bands ranging from 1450bp to 450bp, with 56.25% polymorphic and 43.75% monomorphic loci. Primer OPA-18 produced 11 loci (54.5% monomorphic and 45.5% polymorphic), while OPA-16 produced 5 loci (20% monomorphic and 80% polymorphic). Similarity indexes among bulls ranged from 0.50 to 1.00 cumulatively, with individual ranges of 0.54-1.00 for OPA 18 and 0.20-1.00 for OPA 16. Dendrogram analysis revealed two major clusters: one containing both Sahiwal bulls and the second comprising the remaining bulls with sub-clusters. The findings demonstrated the effectiveness of RAPD PCR in detecting the genetic heterogeneity among sires. Similarity indexes can guide more balanced breeding schemes. Further studies with larger groups are recommended for wider applications in breeding programs.

***Keywords:** Breeding, Cattle, RAPD PCR, Sri Lanka*

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EVALUATION OF ANTIBACTERIAL EFFECTS OF AQUATIC AND TERRESTRIAL PLANT EXTRACTS AGAINST FISH AND SHRIMP PATHOGENS

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Abstract

The extensive use of antibiotics in aquaculture has led to the development of antibiotic-resistant bacteria, posing risks to both aquatic organisms and human health through the food chain. To address these issues, the aquaculture industry is exploring alternative disease management strategies.. Plant derivatives have emerged as viable alternative to the commercial chemotherapeutics used in aquaculture. This study investigated the antibacterial properties of 95% ethanol extracts from four aquatic plants and two terrestrial plants against bacterial pathogens isolated from fish and shrimp.The aquatic plants studied were Red Water Lily (*Nymphaea rubra*), Water Cabbage (*Pistia stratiotes*), Money Plant (*Hydrocotyle vulgaris*), and Duckweed (*Lemna minor*). The terrestrial plants were Candle Bush (*Senna alata*) and Neeramulli (*Hygrophila auriculata*). Ethanol extracts of each plant were prepared at concentrations of 100, 50, 25, 12.5, 6.25, and 3.125 ppm. The antibacterial activity against *Aeromonas caviae*, *Aeromonas hydrophila*, and *Edwardsiella tarda* was tested using the disk diffusion method, with distilled water as a control. Data were analyzed using Minitab (version 20) at a 95% confidence level for one-way interactions involving plant, bacteria, and concentration. All six plant extracts demonstrated antibacterial activity, with *Nymphaea rubra* showing the most significant effect ($P<0.05$). At 100 ppm, *Nymphaea rubra* exhibited the highest inhibition zones against *A. hydrophila* (1.133 ± 0.577 mm), *A. caviae* (1.316 ± 0.052 mm), and *E. tarda* (1.150 ± 0.086 mm). These results suggest that *N. rubra* is a promising natural chemotherapeutic agent, offering a viable alternative to commercially available treatments in aquaculture.

Keywords: Antibiotic, Aquaculture, Chemotherapeutic, Inhibition,, Virulent

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EFFECTS OF STOCKING DENSITY AND FEED TYPE ON GROWTH PERFORMANCE AND BODY COLOR OF SWORDTAIL FISH, (*Xiphophorus hellerii)* IN INDOOR RECIRCULATING AQUACULTURE SYSTEM

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Abstract

Growth performance and body color of the fish are important factors in the ornamental fish industry. The present study was conducted to evaluate the effects of stocking density and feed type on growth performance, feed utilization efficiency, percentage survival rate and body coloration of swordtail fish (*Xiphophorus hellerii*) in an indoor-recirculating aquaculture system (RAS) for 56 days. The experiment used a 2×2 factorial design with two distinct stocking densities (low :15 fish per 60 L and high :30 fish per 60 L) and two types of commercial fish feeds; normal commercial feed (NF) and commercial color enhancing feed (CF). Crude protein%, crude lipid% and carotenoid content of NF was 45.81 ± 0.92, 5.21 ± 0.20 and 26.94 ± 0.31 ($\mu g\ g^{-1}$) respectively while it was 36.42 ± 0.61, 6.25 ± 0.12 and 68.25 ± 0.23 ($\mu g\ g^{-1}$) in CF. Twelve fish groups (0.0640 ± 0.0001g initial mean weight; 10.40 ± 0.01mm initial mean total length) were established at two stocking densities and within each group, two types of feed were allotted. At the end of the study, final body weight, final body length, % Specific Growth Rate (%SGR), % Average Daily Gain (%ADG), Feed Conversion Ratio (FCR), mean feed intake, survival rate and carotenoid content were compared in F-test (Factorial ANOVA). According to the results, the significantly higher final body weight, total body length, %SGR and %ADG were observed in fish reared under low stocking density and fed with normal commercial feed (NF15). The best feed utilization efficiency with a low FCR value was observed in fish at low stocking density and fed with normal feed. However, percentage survival rate and carotenoid content in swordtail fish were not significantly affected by stocking density or feed type ($P>0.05$). The interaction between feed type and stocking density did not significantly impact any measured parameters. Results of this study revealed that both feed type and stocking density effect growth performance and feed utilization efficiency of swordtail fish.

Keywords: Carotenoid, Coloration, Feed type, Stocking density, Xiphophorus hellerii

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EFFECT OF STOCKING DENSITY OF NILE TILAPIA (*Oreochromis niloticus*) ON PRODUCTIVITY OF AQUAPONIC SYSTEM WITH GREEN CHILI (*Capsicum annuum L.*)

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Abstract

Aquaponics is an integration of aquaculture and hydroponics in which nutrients released or accumulated in the fish culture system are utilized by the plants grown in soilless culture media. This experiment was conducted to evaluate the effects of the stocking density of monosex Nile tilapia (*Oreochromis niloticus*) with green chili (*Capsicum annuum L.*) on the productivity of the aquaponic system. The productivity of the system is measured in terms of the growth performance of fish and plants. The study investigated three stocking densities of tilapia, specifically 12, 16, and 20 fish per 60 liters of water, in triplicate over a six-week duration. Each experimental unit consists of a fish tank and three pots having nine chili plants (three plants per pot) and a water-recirculating unit. Water circulation was three times per day and each circulation cycle lasted two hours (0800hr to 1000hr, 1200hr to 1400hr, and 1600hr to 1800hr). Fish in each treatment were fed two times a day (0900h and 1600h) to near satiety. The average daily gain (%ADG), specific growth rate (SGR), feed conversion ratio (FCR), survival rate, and whole-body proximate composition of fish were used to assess the performances of fish. The chlorophyll content of plant leaves was estimated by the Arnon method at the end of the experiment while the mean height, mean stem dry weight, and mean root dry weight of plants were used to assess the growth performance of the plants. At the end of six weeks, the growth performance of fish and plants in each treatment were compared in one-way analysis of variance (ANOVA). Results revealed that survival rate, %ADG, SGR, FCR and whole-body proximate composition of fish were unaffected by the treatments. Similarly, Chlorophyll-a, Chlorophyll-b, mean height, mean stem dry weight, and mean root dry weight of plants were not affected by the stocking density of fish. Therefore, this study concluded that the productivity of the aquaponic system in terms of growth performance of fish and chili plant is not affected by the tested three stocking densities of tilapia and therefore the stocking density of 20 fish/60L tank is recommended for this system.

Keywords: Chili Plant, Growth, Nile Tilapia, Stocking Density

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EXPLORING STRATEGIES FOR DEVELOPING AND EXPANDING INTEGRATED RICE-FISH FARMING TO ENHANCE FOOD SECURITY IN SRI LANKA

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Abstract

Integrated Rice-fish farming (IRFF) represents a symbiotic farming system where fish are cultivated in rice fields. This review aimed to assess the relevance and role of IRFF as a strategic approach to ensure food security in Sri Lanka. In this attempt available information on Integrated Rice Fish farming have been compiled with the support of scientific data bases of Google Scholar, PubMed, Scopus, and Science Direct. According to the literature, the IRFF significantly increased both rice and fish yields compared to their monocultures, and the productions vary with the geographic regions. For instance, IRFF in Indonesia exhibited an increase of their rice production by 22-32% than that of monocultures and similar trends were also observed in West Bengal, India, and Thailand. Considering the Sri Lankan context, as Sri Lankan adults and children especially under five years are prevalent several forms of malnutrition including underweight, stunting and wasting, micronutrient inadequacies. Thus, the development and expansion of rice-fish farming among the rural farming communities is vital as a system that increase both protein, carbohydrate and other micronutrient requirement demand exist specially among rural communities. However, well-planned strategies to develop and expand this system among in Sri Lankan rural paddy farmers are required. The robust political commitment and support from governmental and non-governmental entities are vital for facilitating accessible credits for initial infrastructure, implementing training and awareness programs tailored for small-scale farmers, establishing effective market linkages, conducting adaptive research initiatives, and ensuring the provision of essential inputs such as quality fingerlings. The success of these strategies depends on the active involvement of financial institutions and donor organizations, aimed at empowering farmers and ensuring equitable compensation. In conclusion, this review unveils the significance of IRFF in enhancing food security and outline pathways for its development and expansion in Sri Lanka. Further, rice-fish integration is one of the best options to mitigate the malnutrition issues in rural communities, and particularly important to meet the Sustainable Development Goals (No Poverty (SDG 1), Zero Hunger (SDG 2), Good Health and Well-being (SDG 3)).

Keywords: *Agricultural sustainability, Development strategies, Food security, Rice-fish farming, Sri Lanka*

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ENTREPRENEURSHIP AND RURAL DEVELOPMENT

IDENTIFICATION OF EXTENSION SERVICE PROVIDERS OF LOW COUNTRY TEA SMALLHOLDERS: A CASE STUDY IN MATARA DISTRICT

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Abstract

Tea smallholders are the largest contributors to the annual tea production in Sri Lanka. The contribution of smallholders to the total production 299.338 mn.kg is 223.38 mn.kg (74.56 %) in 2021. The optimal performance of smallholders is highly determined by the factors affecting to their performance. This study attempts to identify the advisory and extension service providers to tea smallholders in Matara district of low country tea sector. The study selected 250 smallholders in Matara district using random sampling method proportionately to Tea Inspector / Instructor ranges. A pretested questionnaire was used as the data-gathering tool and the field survey was conducted during January - June 2019. Further, checklists and informal discussions were also incorporated. The study revealed that tea smallholders in the low-country receive advisory and extension services mainly from Tea Smallholdings Development Authority (63 %), Tea Smallholdings Development Societies (57 %), and also from agro inputs supply companies (46.5 %). Tea Research Institute and the Sri Lanka Tea Board (SLTB) were recorded by 24.5 % and 23 % of the growers. Further, this sub sector is served by tea processors and green leaf dealers eager to secure their green leaf supply. These findings can conclude that both public and private sector agencies provide advisory and extension needs of smallholders and essential to establish an integrated tea extension approach to train a majority of smallholders in low country tea sector.

Keywords: *Extension services, Production, Smallholders, Tea processors, Leaf dealers, Tea processors*

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ASSESSING PERFORMANCE FACTORS OF AGRICULTURAL SME'S: A CASE STUDY IN KANTALE DS DIVISION, TRINCOMALEE DISTRICT

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Abstract

Agricultural small and medium-sized enterprises (SMEs) have an important role in changing societal dynamics and driving a country's economic progress. However, in Sri Lanka, the lack of performance monitoring tools has made it more difficult for SMEs to sustain and grow their businesses. The purpose of this study is to evaluate the factors that influence the performance of SMEs in the agriculture sector. Study area was the Kantale DS Division, Trincomalee district in Sri Lanka. Data were collected using a standardized questionnaire using Likert scale measurement ranging from strongly agree to strongly disagree and interviews to assess a variety of factors, including risk management, innovation, market and societal concerns, financial and operational performance, and staff performance. The survey addressed the entire population consisting of 88 agriculture SMEs selected from firm registration records between 2018 and July 2023. The findings show that financial (73.00%), operational (89.00%), and market (96.00%) performance are affecting positively for performance of SME's. Also, 98% of the participants agreed that environmental and social concerns have an influence on performance. Considering that of employee performance to the performance of SMEs, a significant number of respondents (68.00%) indicated indifference. Notably, 65% of SMEs strongly disagreed that their success were influenced by innovation. Risk management demonstrated a significant gap, with 49.0% strongly agreeing and 27.0% strongly disagreeing that risk management affects SMEs' performance. The outcomes of this study are significant for SME expansion, job generation, regional development, and general economic growth.

Keywords: *Agricultural sector, Economic growth, Performance monitoring, SMEs, Sri Lanka*

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EFFECT OF SELECTED CROP MANAGEMENT PRACTICES ON CROP YIELDS, USED IN THE HOME GARDEN: STUDY BASED ON HOME GARDENS IN MONERAGALA DIVISIONAL SECRETARIAT DIVISIONS IN MONERAGALA DISTRICT, SRI LANKA

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Abstract

Home gardening helps to bring food security and nutrition to rural households of developing nations. Therefore, this study assesses specific crop management practices used in home gardens and their impact on the crop's yield. There are a total of 78 home gardens, with three home gardens selected from each of the 26 villages in Moneragala DS division, Moneragala district of Sri Lanka from June to August of 2017. Data were obtained on the types of crop management practices used and the yield of crops in the home gardens. Data were analysed using SPSS statistical package, version 22 and t-test used as the statistical test. The descriptive findings showed that 61.53% of them did home gardening as a partial occupation. 29 of them had more than 4 plots. The average land size of home garden was 1.43 acres. 43 of them had own seed nursery. Mean experience in home gardening was 12 years. They use both retail and wholesale for marketing of their produce. Based on the independent sample's t-test, there were significant differences ($p < 0.05$ or $p < 0.1$) in crop yields or more yields were observed by specific management practices: mixed cropping resulted in higher yield in ground nut. Crop rotation positively affected the brinjal and pumpkin cultivations. The practices of shading, earthing up and loosening of soil increased the yield of pepper. Chemical control of insects increased yield in pumpkin. Drainage system for irrigation in brinjal, lemon and chillie have increased their yields. It seems that the adoption of above practices in home gardening affected or increased the specific crop yields. However, the validity of the results should be further checked by increasing the sample size of the practitioners of each practice of that specific crop.

Keywords: Home garden, Crop management practice, Crop yield

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ENHANCING ENTREPRENEURIAL EDUCATION THROUGH BLENDED LEARNING: CHALLENGES AND STRATEGIES FOR UNDERGRADUATE ENTREPRENEURS IN AGRICULTURAL FIELDS

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Abstract

Blended learning, a dynamic educational paradigm that integrates several instructional modalities such as lectures, discussions, group activities, assignments, and evaluations across both traditional and digital platforms, has enormous potential for educational enrichment. However, its application among undergraduate entrepreneurs provides a distinct set of obstacles that require careful consideration and resolution. As a result, the primary goal of this research is to identify the major challenges that student entrepreneurs experience and provide concrete strategies to effectively overcome these obstacles. The research was conducted at the University of Colombo Institute for Agro-Technology and Rural Sciences in Weligatta, Hambantota, Sri Lanka. Participants included every undergraduate entrepreneur currently enrolled in the institution's blended learning degree programme. Data was collected using a combination of interviews and group discussions guided by a pre-tested questionnaire available in English, Tamil, and Sinhala languages. Descriptive approaches, such as bar charts, were used, and demographic analysis was performed using the Statistical Package for the Social Sciences (SPSS) software version 26. Undergraduate entrepreneurs identified challenges with the blended learning framework, including difficulties in facilitating practical experiences, evaluating entrepreneurial competencies, technological and resource constraints, limited networking opportunities, and concerns about increased dropout rates. In response, the undergraduates proposed a variety of solutions, including the addition of more practical modules and specialized technologies, the incorporation of small group activities and project-based assessments, improvements in technology accessibility, the facilitation of networking avenues, and the expansion of student engagement strategies. By improving these aspects, we can increase the effectiveness of the blended learning programme and the quality of blended learning encounters for undergraduate entrepreneurs at the institute, thereby contributing significantly to the ongoing evolution of entrepreneurship education in Sri Lanka. By addressing these difficulties and applying the recommended solutions, stakeholders can improve the efficacy and impact of blended learning efforts, creating an environment suitable to entrepreneurial development and innovation in the agriculture sector.

Keywords: *Blended learning, Constraints, Educational enrichment, Entrepreneurship education, Undergraduate entrepreneurs*

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