36th PGIA ANNUAL CONGRESS

HANTHANA ESSENCE

PGIA CONGRESS IN BRIEF

Gearing Agricultural Research Towards Economic Development

University of Peradeniya
Sri Lanka

Message from the Director

It is with great pleasure that I, as the Director of the Postgraduate Institute of Agriculture (PGIA), share this message on the occasion of the fourth consecutive publication of Hanthana Essence, a journal dedicated to disseminating the research findings of the Institute to the wider public. Since its inception in 1975, PGIA has been at the forefront of postgraduate agricultural education in Sri Lanka, graduating over 5,000 students and offering a diverse range of programs, from Master's degrees to PhDs.

While much of our advanced research is published in specialized journals, it is vital that these findings also reach the wider public in an accessible and engaging format. The publication of Hanthana Essence fills this gap, effectively communicating key agricultural innovations to both the agribusiness sector and the general public.

It is gratifying to see Hanthana Essence evolve into such a vibrant and appealing journal for the fourth consecutive year, offering content that is both informative and enjoyable for readers. The articles, authored by our postgraduate students, offer them a unique platform to present their research in an engaging format, expanding their academic experience. I extend my heartfelt congratulations to everyone involved in this endeavor, including the Congress Coordinator, Chief Editor, Editorial Board, and especially our students, whose hard work has brought this journal to life.

As we prepare for the 36th Annual Congress of PGIA, I am confident that this new volume of Hanthana Essence will serve as a vibrant and eagerly anticipated bridge, connecting the postgraduate research community at PGIA in 2024 with the general public, and fostering greater understanding and appreciation of the vital contributions being made to the field of agriculture.

Prof. D.K.N.G. Pushpakumara
Director/PGIA

Message from the Coordinator

On behalf of the organizing committee, I am delighted to extend this message to the Hantana Essence magazine, which showcases the essence of the Annual Congress of the Postgraduate
Institute of Agriculture (PGIA), University of Peradeniya, Sri Lanka. Over the years, this congress has grown to become the flagship event of PGIA and a highlight of the institute's annual calendar.

The Annual Congress serves as a unique platform for postgraduate students to engage with local and international professionals and peers. It enables them to showcase their talents, expand their knowledge, build networks, and collaboratively explore both current and future research directions. The Hantana Essence magazine features Research Briefs—succinct summaries of students' postgraduate research aimed at translating complex findings into accessible language for the general public. These briefs undergo rigorous evaluation by an esteemed panel of judges, with the best submissions highlighted in the magazine.
As a leader in postgraduate agricultural education and research in Sri Lanka, the PGIA remains
deeply committed to bridging the gap between higher education and the nation's agricultural
needs. The Hantana Essence magazine plays a pivotal role in connecting postgraduate research
with the broader public, fostering awareness and understanding of these pressing issues.
I sincerely thank the editor, judging panel, authors, graphic designer, and the Congress Office of PGIA for their invaluable contributions to this publication. My best wishes go to all the authors whose work has enriched this year's edition of Hantana Essence.

Dr. Duminda N. Vidana Gamage
Coordinator of 36 th PGIA Annual Congress

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CURRENT STATUS OF WEED MANAGEMENT IN MAIZE CULTIVATIONS IN THE NORTH CENTRAL PROVINCE OF SRI LANKA

T.A.B.D. Sanjeewa

Maize Cultivation in NCP of Sri Lanka

- Maize is the second most widely cultivated cereal in Sri Lanka recording a gradual and significant increase in production from 2002 to 2021. Total national maize production in 2021 was 472,444 mt providing 79% of the total domestic requirement of 600,000 Mt/year. The North Central Province (NCP) produced 43% of the total requirement of the country.

Figure 1: Maize cultivations in the NCP

Significance of Weeds in Maize Production

- Weeds is the number one biotic constraint for Maize cultivation and severe weed competition result in 40% yield reduction as well as the weed control increases the cost of Maize production.

Prominent Weed Species in Maize fields of NCP

- The perennial grass *Megathyrsus maximus* is the dominant weed in maize cultivations in the NCP.
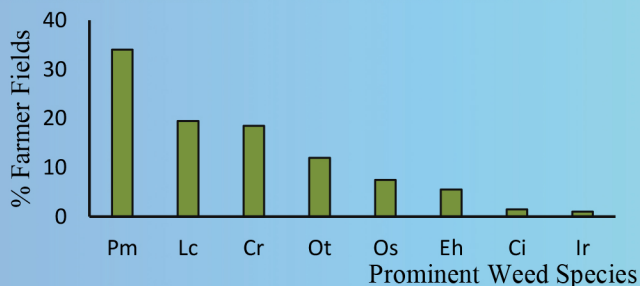

Figure 2: Relative abundance of troublesome weed species in maize cultivations; Pm = Megathyrsus maximus, Lc = Lantana camara, Cr = Cyperus rotundus, Ot = Others, Os = Ocimum sanctum, Eh = Euphorbia heterophylla, Ci = Cyperus iria and Ir = Ischaemum rugosum

Use of Herbicides for Weed Management in Maize

- Many of the maize farmers used machinery for land preparation, which also indirectly helps in pre-plant weed control in maize.
- Pre-plant herbicide Paraquat was banned in Sri Lanka since 2014, while an import ban was imposed on Glyphosate during the time of survey (May–Nov. 2021). However, both herbicides were used by maize farmers.
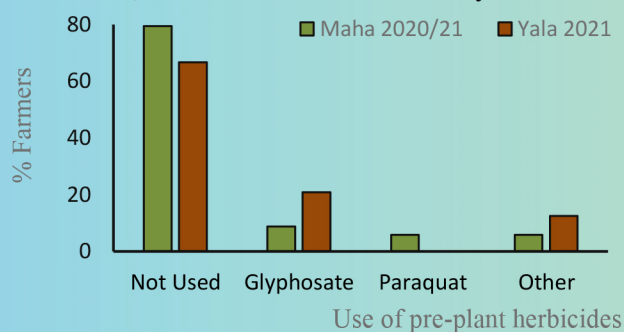

Figure 3: Use of Pre-plant Herbicides by Maize Farmers

- Use of herbicides is the most common post-plant weed control technique used in maize cultivation.
- Topramezone and Nicosulfuron were the most widely used post-plant herbicides in maize farming.
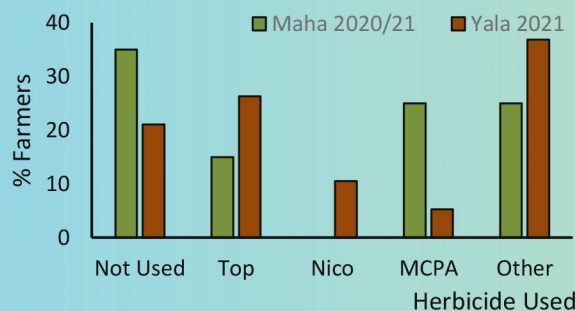

Figure 4: Use of Post-plant Herbicides by Maize; Note: Top = Topramezone (Clio®), Nico = Nicosulfuron (Topaz®)

Other Key Findings

- The main maize-based cropping systems in NCP are rainfed upland maize monocultures and Lowland paddy-based maize monocultures.
- Maize faming has gradually converted into a large-scale commercial enterprise with land consolidation and farm mechanization, thus reducing labour involvement.
- Though some farmers practiced tank mixing of herbicides, which is not recommended in Sri Lanka, about 52% of the respondents achieved successful weed control without tank-mixing herbicides.
- The majority of respondents adopted safety measures for personal protection during spraying.

Water pollution in lagoons

Water pollution in Sri Lanka's lagoon system is a serious environmental issue presently, as it diminishes the ecological services offered by the lagoons. The Sainthamaruthu coastal lagoon located in Ampara district in the dry zone seems to be polluted associated with the visual signs of proliferation of aquatic weeds and unpleasant odour, but it is not scientifically proven yet. Hence, the lagoon has found losing its potential uses over the time.

Figure 1: Condition of Sainthamaruthu lagoon at present and past

To ensure the services of the lagoon in long term, pollution has to be managed sustainably where assessment of pollution status is essential. This study scientifically documents the pollution status in Sainthamaruthu lagoon by assessing the degree of water pollution using Water Quality Index (WQI), Comprehensive Pollution Index (CPI) and by analyzing the spatiotemporal variation in water pollution and its sources.

Status of water quality

Based on the WQI, Sainthamaruthu lagoon was found unsuitable for drinking and fish culture as its WQIs were greater than 100 at all the monitoring regions across different rainfall seasons.

Table 1: Spatiotemporal variation of WQI

	Downstream	Midstream	Upstream
NEM	431.2	462.7	596.4
FIM	174.1	196.2	256.8
SWM	378.4	251.6	369.2
SIM	281.8	328.6	549.1

Degree of pollution

The pollution level in the lagoon varied spatially and temporally, whereas, upstream region was found severely polluted (CPI>2.01) during NEM rainfall season as a result of significantly higher concentrations of ammonium nitrogen (3.5-4.5 mg/L) and total phosphorus (2.9-3 mg/L). Meanwhile, the mid and down streams were moderately polluted (1.01<CPI<2.0) throughout the year.
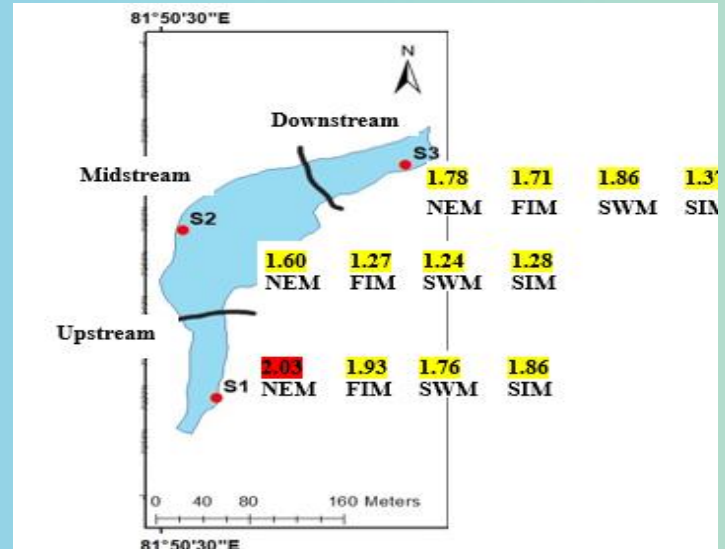

Figure 2: Overview of spatiotemporal variation of CPI in Sainthamaruthu lagoon

Sources of pollution

The pollution in Sainthamaruthu lagoon is primarily caused by a mixed sources including mineralization, sea water intrusion, effluent discharge and wastewater release during both the seasons. While, agricultural runoff and weather condition also caused pollution substantially in Sainthamaruthu lagoon.
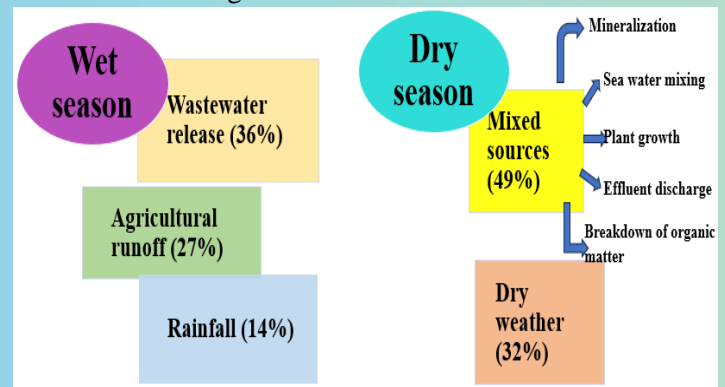

Figure 3: Pollution sources in Sainthamaruthu lagoon

The facts identified in this study provide a baseline information to remediate the lagoon in near future.

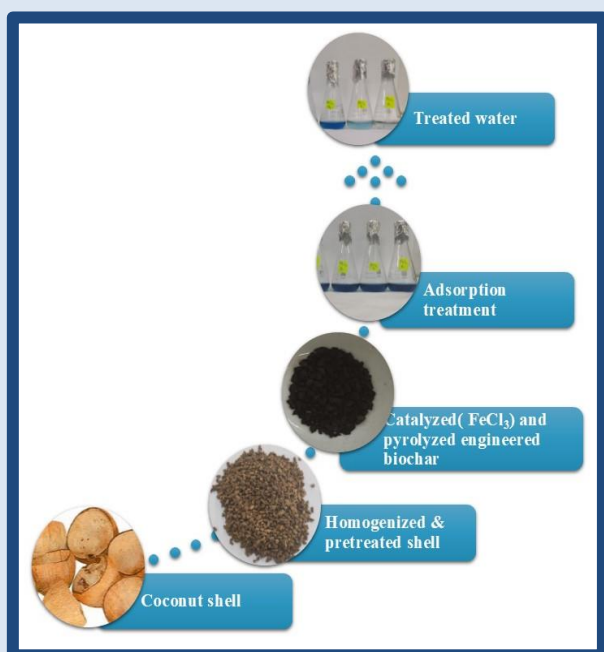# TWO – STAGE CATALYTIC ACTIVATION OF COCONUT SHELL BIOCHAR FOR EFFECTIVE MALACHITE GREEN REMOVAL FROM WATER

Bavithira Thavarajah

Introduction

Malachite Green is a dye which is widely used in various industries in Sri Lanka. But their removal from wastewater has been an expensive and complex challenge. In an attempt to find sustainable solutions, this study has focused on developing a novel engineered biochar derived from coconut shells through catalytic activation with iron chloride.

Experimental setup

Engineered biochar was produced using an iron catalyst ($FeCl_3$) and pyrolysed at 200, 300 and 400 °C. In order to compare the adsorptive performance (q_e in mg/g) of engineered biochar, their adsorptive performance was studied under well-defined experimental conditions including pH (6), initial dye concentration (100 mg/L), engineered biochar dosage (1 g/L) and temperature (27 °C). The engineered biochar with a high adsorptive performance (amount of adsorbate removed by unit weight of engineered biochar) was selected. A complete scientific study of best-engineered biochar was carried out using a number of methodologies such as isotherm, kinetics, rate-limiting, and thermodynamics.

Treated water

Adsorption treatment

Catalyzed ($FeCl_3$) and pyrolyzed engineered biochar

Homogenized & pretreated shell

Coconut shell

Results

Best adsorptive performance (q_e: 50.20 mg/g) observed for engineered biochar, which is Impregnated with 9% $FeCl_3$ and pyrolysed at 400 °C

Adsorption isotherm
- Well fixed with Freundlich model
- Multilayer adsorption

Rate liming factor analysis
- 1st phase: Rapid dye movement to biochar surface
- 2nd phase: Intraparticle diffusion

Engineered biochar from coconut shell via iron catalyst for Malachite Green removal

Adsorption thermodynamics
- Endothermic
- Spontaneous and feasible at all temperature

Adsorption kinetics
- Well fixed with psuedo second order model
- Chemisorption

Dye initial concentration: 300 mg/L

pH: 6

Engineered bichar dosage: 1g/L

High adsorption

Conclusion

This study creates a novel way for the effective design of a simple, low-cost filter to remove Malachite Green from industrial wastewater.

ASSOCIATION OF DIETARY PATTERNS AND SARCOPENIA IN THE AGEING POPULATION IN POLONNARUWA DISTRICT, SRI LANKA

Fazna Rafeek

Sarcopenia is a condition that many people experience as they get older, marked by the gradual weakening and loss of muscle. This decline in muscle strength makes it harder for older adults to stay active and can increase their chances of falling or facing other health issues. The word sarcopenia comes from Greek, with "sarx" meaning flesh and "penia" meaning loss, which together describe how muscles start to thin and weaken over time.
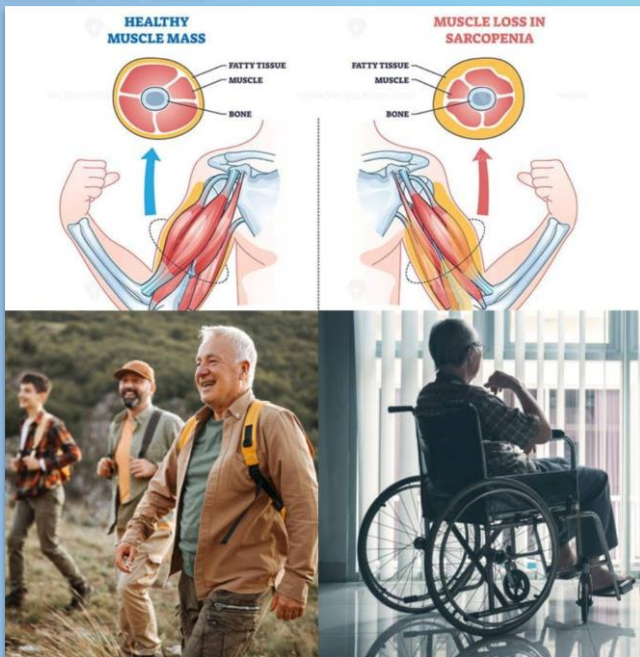

Eating enough protein and staying physically active, especially with exercises, that strengthen muscles can help slow this process. Around the world, sarcopenia is recognized as a serious health issue for aging populations, but research on it is still limited in Sri Lanka. Studying sarcopenia in Sri Lankan communities could provide valuable insights and help develop better support strategies for older adults to maintain their strength and independence as they age.

The study was conducted in the Polonnaruwa District with 150 participants aged 65 and above. Sarcopenia was assessed through measurements of muscle mass, handgrip strength, and gait speed. Interviewers administered questionnaires and physical assessments were conducted to gather data on associated risk factors.

The study revealed that nearly half (49.6%) of participants aged 65 and above in Polonnaruwa had sarcopenia, with slightly more women affected (52.9%) than men (44.6%). Findings showed that the risk of sarcopenia increased with age but risk is lower among individuals with a healthier BMI.
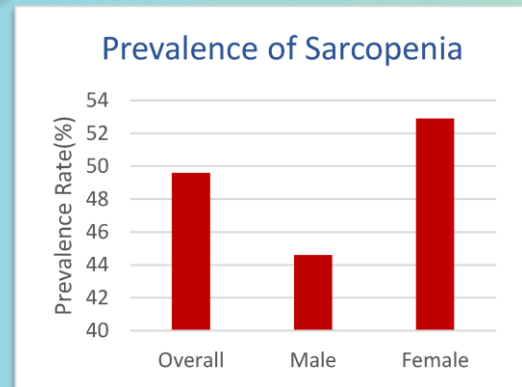
The study shows that consuming adequate protein, is essential for maintaining muscle mass. Proper nutritional status and regular physical activity showed a significant protective effect against sarcopenia.
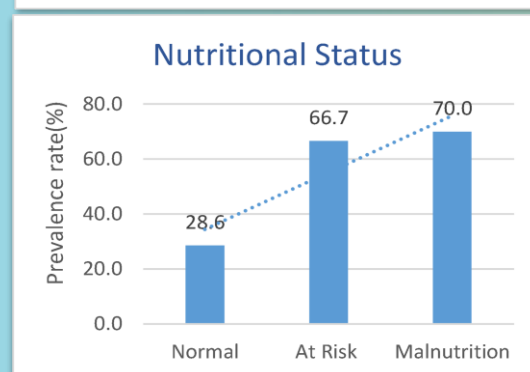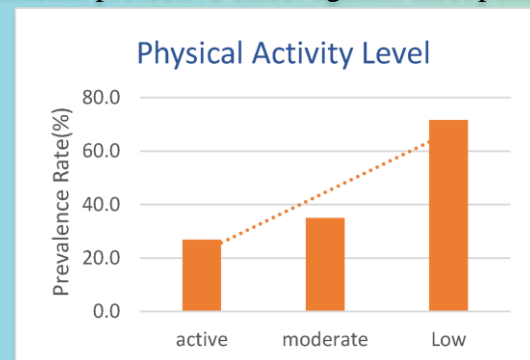
These findings emphasize that proper nutrition and physical activity are vital for maintaining muscle health in older adults. Encouraging healthy eating and regular exercise can enhance the quality of life for aging populations and lower the risk of sarcopenia-related health problems.

EXPLORING THE POTENTIAL OF UNDERUTILIZED TUBERS IN MEAT PROCESSING

Varthani Susruthan

Meatballs are made from minced meat combined with other non-meat ingredients to increase their nutritional and functional value. Binders are frequently used non-meat ingredients in the meat industry to significantly enhance the product's sensory qualities. They bind water and fat to maintain meat emulsion, particularly in ground meat products like meatballs. Many chemical binders are employed, which is not ideal for health reasons. Therefore, researchers and industries are interested in finding the best plant-based binder.

Palmyrah (*Borassus flabellifer* L.)

Palmyrah is an underutilised source readily available in the Northern Province of Sri Lanka. It offers several ecological, medical, economic, and sociological advantages. Many plant components, including the root, shoot, leaves, fruit, and seeds, have historically been used as food. The young shoot is an edible fleshy scale leaves bundle, which develops when seeds germinate. Two types of flour were produced from the young shoot: sun-dried and ground tuber flour called "*Odiyal*" and, boiled, dried and ground tuber flour called "*Plukodiyal*".

Study

This study aimed to reveal the impact of incorporating Palmyrah as a natural binding agent/ filler in meat products. Chicken meatballs were prepared as Control, T1- with 5% *Odiyal*, T2-10% *Odiyal*, T3-5% *Plukodiyal* and T4-10% *Plukodiyal* which were stored at 4±1 °C for five days until further analysis. Sensory properties, proximate composition, physical properties, and microbial properties of meatballs were determined.

Sensory attributes

The quantity of other ingredients was maintained during processing except the wheat flour, *Odiyal,* and *Plukodiyal*. Based on the sensory results, 10% of Odiyal and 10% of Plukodiyal were selected for subsequent studies.

Proximate (of uncooked) and physical properties (of cooked) analysis of chicken meatballs incorporated with different Palmyrah flour

Proximate composition of uncooked meatballs
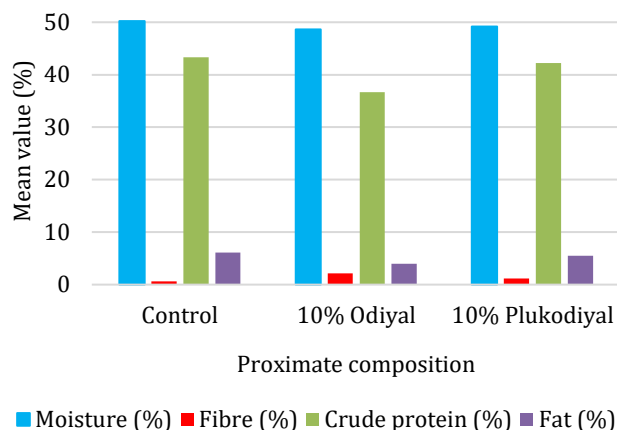
Physical properties of cooked meatballs
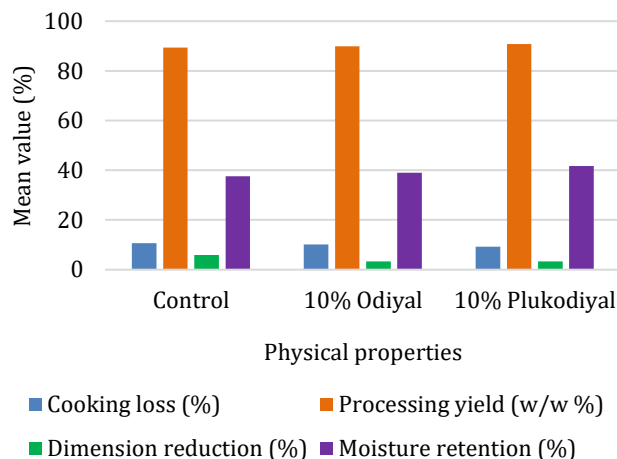
Food for thought

- The inclusion of 10% (w/w) of *Odiyal* flour or *Plukodiyal* flour can significantly improve the consumer preference for meatballs, particularly the taste.
- The incorporation of Palmyrah flour is positively associated with processing yield, moisture retention, diameter reduction, sensory properties, and nutrient contents.
- Both Palmyrah flour-incorporated hygienically prepared meatballs can be stored for up to three days under aerobic packaging and refrigeration (4±1 °C).
- The inclusion of 10% (w/w) of *Odiyal* flour is more suitable as a natural binder for meat-based products.

SMART STRATEGIES FOR MANAGING DAIRY CATTLE: GROUPING BY MILK PRODUCTION AND REPRODUCTIVE PERFORMANCES
## K.G.C.B. Wijebandara

Background

Economic return of commercial dairy farming depends on correct decision making in selection of animals. Absence of systematic assessment and lack of pedigree data deprive the opportunities in correct decision making for selection in many instances. In remedying this situation, we propose here non-genetic multivariate techniques such as principal component analysis (PCA) and cluster analysis in grouping animals according to productive and reproductive potential.

We applied these techniques on a random animal herd in a state-owned commercial dairy herd (NLDB - Ridiyagama farm), in order to assess their effectiveness in grouping animals according to their overall production and reproduction potentials.

Principal Component Analysis

Variation of milk production-(MP), lactation length-(LL) and calving interval-(CI) among animals during initial three parities could be quantified using three principal components (PCs). Accordingly, having captured over 70% of the overall variation, first two PCs were identified as parameters that could be used to investigate the production and reproduction variation of a herd instead of analyzing the individual traits separately in large scale dairy farming.
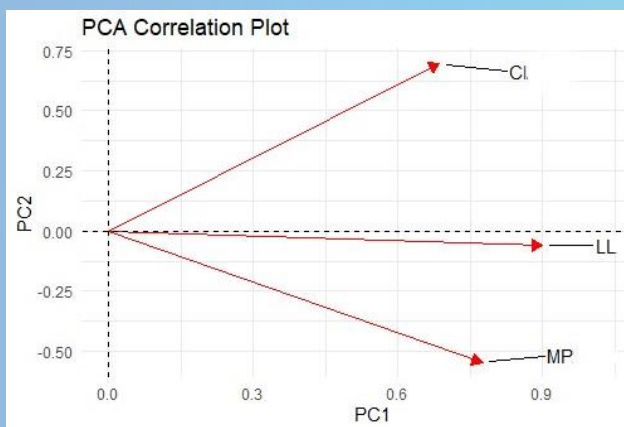
Trait	Correlations		Loading scores	
	PC1	PC2	PC1	PC2
Milk Production	0.77	−0.54	0.56	−0.61
Lactation Length	0.89	−0.05	0.65	−0.06
Calving Interval	0.68	0.69	0.50	0.78

K-means clustering

This technique allowed to categorize the individuals with similar production potential together according to the traits considered.
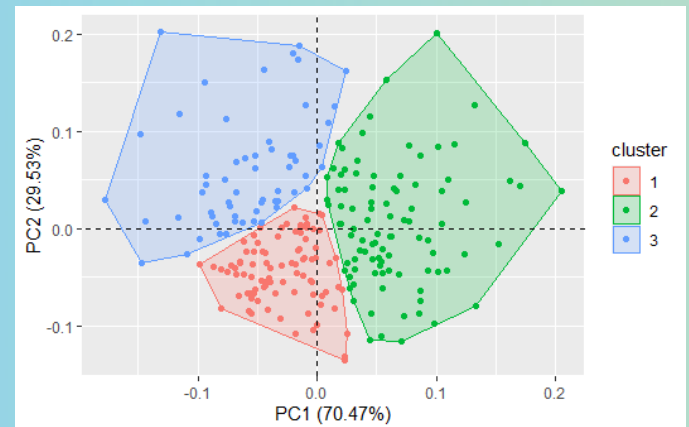
Variation among the clusters were identified with the use of ANOVA and it indicated a significant difference for the traits between the animals in different clusters.

Cluster	Milk Production (L)	Lactation Length (days)	Calving Interval (days)
	Average (± SE)	Average (± SE)	Average (± SE)
1	4291±106[a]	350±5[a]	425±6[a]
2	5595±132[b]	475±9[b]	585±8[b]
3	2230±106[c]	293±11[c]	508±12[c]

This study indicated the applicability of the K-means clustering method on the Sri Lankan commercial dairy herds to categorize the animals according to their production and reproduction potential for informed decision making in herd improvement programs.

NUTRITIONAL STATUS OF THE LIP, ORAL CAVITY AND PHARYNX CANCER PATIENTS IN DIFFERENT STAGES OF THE DISEASE IN SRI LANKA

Chanika Prasadini Jayasekara

The nutritional status of patients with lip, oral cavity, and pharynx cancer can be affected by the disease itself and the different treatment procedures. Reduced dietary intake can lead to malnutrition, which can affect treatment outcomes and patient's quality of life.

This cross-sectional study aims to determine whether there is an association between nutritional status and the stage of the disease in patients with lip, oral cavity, and pharynx cancer at different stages of the disease. Among adult attending the clinics of a leading cancer hospital, 282 patients were selected. The study population was aged over 18 years and were from both genders, histologically diagnosed with Lip, Oral cavity and Pharynx cancer. The subjects selected were conscious and rational to respond to the queries asked by the interviewer and were free of diagnosed diabetes mellitus or any other chronic disorders which needs modifications of the diet at the time of interviewing. The Patient-Generated Subjective Global Assessment (PG-SGA) was used to assess the nutritional status of the patients.
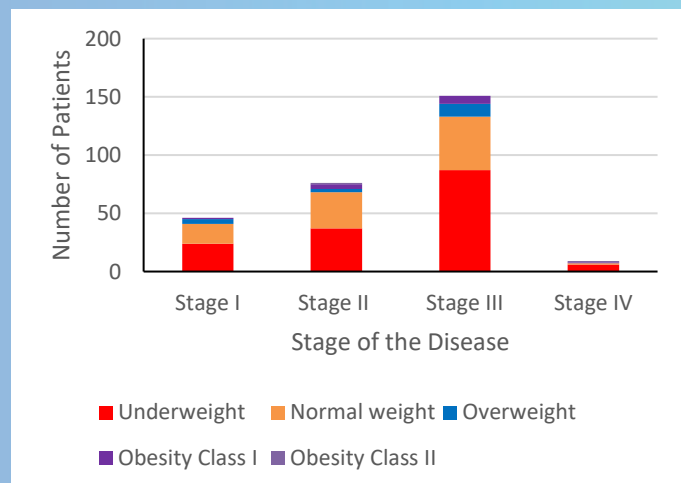
Participants belonging to all the stages of the disease according to the Body Mass Index category of Loss of body weight >5% within one to six months is known as cachexia. Nearly half of the study population was cachectic. It was prominent in stage III and stage IV of the disease.
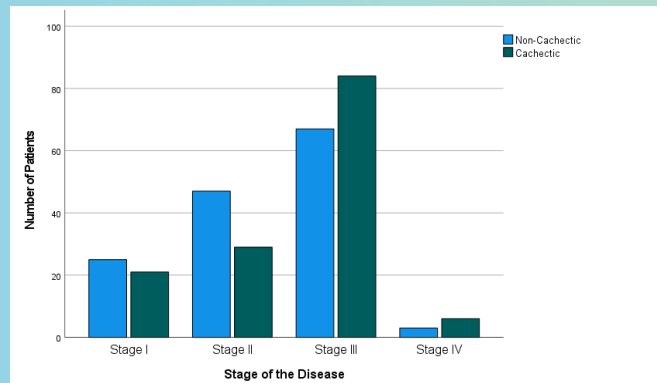
Presence of cachexia among four stages of the disease
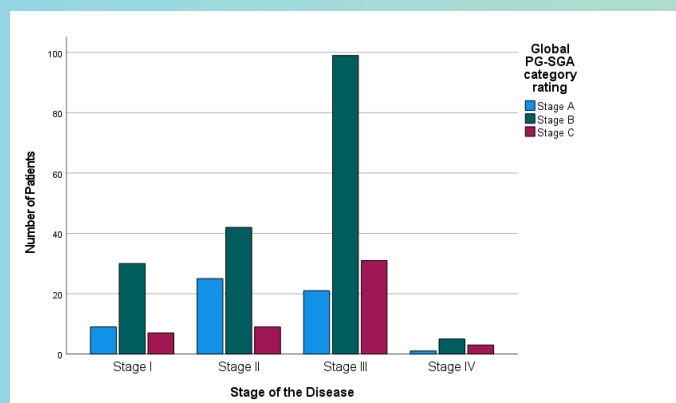
Distribution of Global PG-SGA category rating among four stages of the disease
Stage A: Well nourished, Stage B: Moderate/Suspected malnutrition, Stage C: Severely malnourished
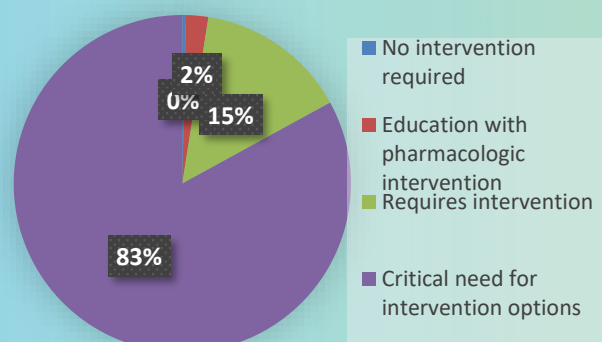
PG-SGA Nutrition intervention recommendation
According to the result, we conclude that there is enough evidence to suggest an association between Lip, Oral cavity and Pharynx cancer patients' nutritional status and their stage of the disease. Therefore, it is necessary to incorporate nutritional evaluation aligned with the cancer's stage, as a treatment strategy.

USE OF WILD SUGARCANE PLANTS TO CONTROL INTERNODE BORER (INB) (*Chilo sacchariphagus indicus*)

V.K.A.S.M. Wanasinghe

Sugarcane in Sri Lanka

Sugarcane is one of the major plantation crops in Sri Lanka used for sugar, jaggery and ethanol production. The extent of sugarcane cultivation in Sri Lanka is around 26,600 ha. Among the biotic stresses, internode borer (INB) (*Chilo sacchariphagus* indicus) is one of the major pest of sugarcane in Sri Lanka.

Mature larva of INB

Damage of INB to young plants and stalks

Internode Borer

- Sugarcane is susceptible for INB attack at any stage of growth.
- Young larvae feed on leaf tissue and older larvae move down through the leaf sheaths and bore into the stalk from side.
- Sugar content of millable stalks are seriously affected and decreased in normal extraction.
- After harvesting, bored cane deteriorates more quickly than clean cane.

Innovative Strategies for INB Control

-Wild sugarcane (*Erianthus* spp) is a strong candidate for INB management programs.

-It can be used as a trap crop to catch INB larvae without damage to commercial sugarcane plants.

- Also it is an excellent parent for developing resistant sugarcane varieties.

Screening of different types of wild sugarcane

Identification of more preferred type by INB → High damages on leaves and young plants → **IND 81 80** The excellent trap crop

Identification of less preferred type by INB → Zero damages on leaves and young plants → **MOL 4503** The excellent parent

2 Years Long Studies in Three Locations…….

- **IND 8180** was the highly preferred wild sugarcane type
- It can be used as a perimeter trap crop
- **MOL 4503** was the least preferred wild sugarcane type
- It can be used as a resistant parent
- The additional advantages of using wild sugarcane as a trap crop include its ability to rehabilitate the soil, serve as a live barrier against insect vector responsible for sugarcane white leaf disease, and its high biomass makes it a valuable source of livestock forage.

ASSESSING RICE CROP PERFORMANCE IN CONTROLLED AND COMMERCIAL FIELD THROUGH UAV MULTISPECTRAL IMAGERY

Piyumi Pamodani Dharmaratne

Background and Problem Identification

Traditionally, rice crop growth parameter estimation is based upon data collection techniques from ground-based field visits. Such techniques are often subjective, costly and is prone to large errors, leading to poor crop assessment and crop area estimation. Also, the obtained data may not become available on time for appropriate action. At the same time, no yield estimation tools unless developed or tested locally are suitable for local use.

Therefore, this study aims to evaluate the potential of monitoring rice crop growth parameter using a UAV based remote sensing protocol, so that the farmers and researchers can monitor the crop response during management activities in real-time before the harvest. In this study the generated relationship from the data of an initial experimental field was used to find the applicability of using UAV based technique to monitor the crop performance of an ongoing farmer field.

Experimental design

Rice variety Bg 300 was cultivated in the *Maha* season under four separate sampling plots of controlled levels of N-fertilizer dosages applied as (0% (0 kg/ha), 50% (112.5 kg/ha), 100% (225 kg/ha), and 150% (337.5 kg/ha)) to induce a variation in the field. Ground-truth measurements (Leaf-Chlorophyll: Leaf-Chl), Above-ground biomass: AGB), Plant height: PHt), Leaf moisture: LM) and Rice yield: RY) were taken from quadrants (1 m^2) laid randomly over each sub plot. Then it was extended to commercial farmer rice fields (Bg 374) during the *Maha* season in Sri Lanka. Aerial images were acquired at the booting stage (6 weeks after planting) of the crop at 25 m flying height by a DJI P4 Multispectral UAV. The raw images were then processed through the software (for image processing, segmentation, and to extract the average reflectance).

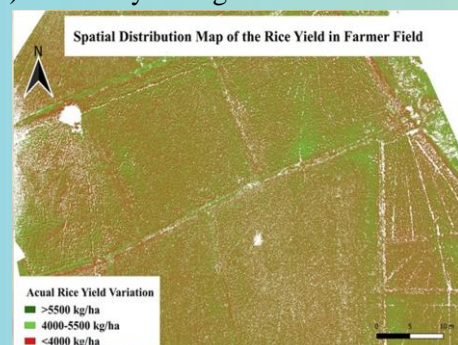Rice crop at booting — Image Processing — Orthomosaic RGB imagery
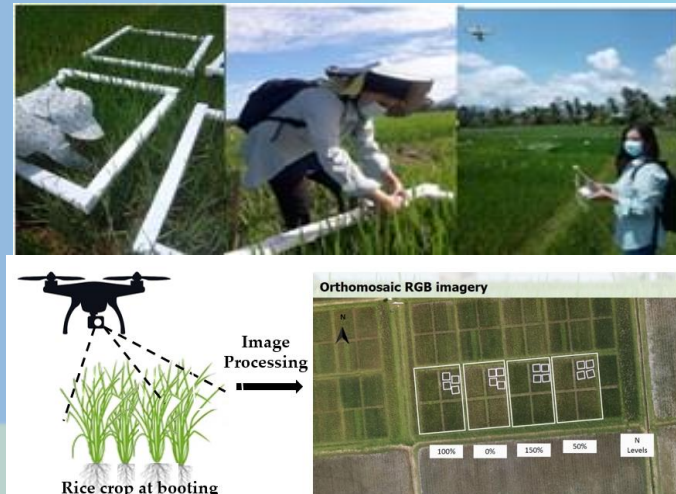
PLS-R analysis was used to extract the best fitted VIs from the rice field data to generate the field specific vegetation indices (VIs).

Findings

Derived VIs were then used to select the best combination of VIs explaining the respective growth parameters. The combination of selected VIs showed significant association with the growth parameters in the controlled rice field experiment.

Rice crop parameters	Optimum VIs selected at controlled rice field experiment	Accuracies obtained over controlled field		Accuracies obtained over farmer field	
		R^2	RMSE	R^2	RMSE
Leaf-Chl	CI $_{red\ edge}$, TCARI	0.84	0.28	0.57	1.35
AGB	TVI, SR	0.81	0.06 kg/m^2	0.60	1.23 kg/m^2
PHt	TVI, GRVI, SR	0.63	0.11 cm	0.41	9.95 cm
LM	TVI, NPCI	0.57	0.16%	0.36	34.4 %
RY	NDVI, SIPI, GRVI, NGRVI, TCARI, CI $_{red\ edge}$, OSAVI, NPCI	0.98	128.5 kg/ha	0.53	563.04 kg/ha

When the results were validated in the farmer field, Leaf-Chl, AGB, and RY showed an accuracy $> 50\%$, besides, PHt, and LM depicted $<50\%$ accuracy which performed a different association in different soils, rice varieties, weedy conditions, and agronomic practices. This result illustrates that in controlled fields we manipulate various factors, such as water availability, nutrient levels, and pest control. In contrast, farmer fields may exhibit greater variability due to differences in management practices, soil types, and local conditions. Furthermore, spatial maps can be generated to indicate the expected RY variability from the farmer rice field 1 ½ months before harvest giving the opportunity to allocate more inputs (more attention) into low yielding areas.

Spatial Distribution Map of the Rice Yield in Farmer Field

Acual Rice Yield Variation
- >5500 kg/ha
- 4000-5500 kg/ha
- <4000 kg/ha

Conclusion

Therefore, VIs selected at controlled rice field behaved differently in complex environments. Thus, UAV-based multispectral imagery was capable of estimating rice crop growth parameters and rice yield with a significant accuracy and can be used to estimate those parameters 1 ½ month before the harvest encouraging more environmentally sustainable agriculture.

OLD RICE BRAN SHOULD BE AVOIDED IN BROILER FEEDS

S.M.R. Samarakoon

In Sri Lanka, rice is the crop with largest cultivated extent, and its milling produces rice bran which is a nutritious and affordable by-product making up around 10% of the grain weight. Nutritionally, rice bran is comparable to other grains, offering an excellent source of animal feed that doesn't compete with human food supplies. However, improper storage can cause rice bran to spoil quickly, negatively impacting bird growth and meat quality.

In our study, we explored how storage duration affects the nutritional quality of rice bran and its influence on broiler chicken growth and meat quality. We fed broiler chicken with feed containing rice bran stored for different lengths of time as; less than a day, a week, and 30 days. Each week, we tracked chickens' weight, feed intake, and feeding efficiency. After 35 days, we checked their meat yields, and tested the quality of the breast meat.

Growth performance of broiler chicken fed with experimental diets for 35 days.

	CD	RP1	RP2	RP3
Final Body weight (g)	1805.4[a]	1795.9[a]	1689.2[a]	1305.9[b]
Weight gain (g/bird)	1758.5[a]	1748.7[a]	1642.4[a]	1258.9[b]
Feed intake (g/bird)	2576.2[a]	2911.3[a]	2830.1[a]	2461.5[b]
FCR (g/g^{-1})	1.5[a]	1.7[ab]	1.7[ab]	2.0[b]

Values in the same raw with different superscripts are significantly different at $P < 0.05$. CD: Control diet (Corn-soy-based control diet without rice bran). RP1: Diet containing rice bran stored for <24 hours, RP2: Diet containing rice bran stored for 1 week, RP3: Diet containing rice bran stored for 30 days.

The findings were clear: broilers fed rice bran stored for 30 days had lower weight gain and feed efficiency, meaning they needed more feed to achieve weight gain. Extended storage increased lipid oxidation, indicating rancidity in the feed, which reduced its taste appeal and lowered feed intake, ultimately stunting growth. In contrast, rice bran stored for less than a week had no adverse effects on growth or meat quality, preserving its nutritional advantages.

Meat quality parameters of broiler chicken fed experimental diets for 35 days

Meat quality parameter	CD	RP1	RP2	RP3
pH	5.9	6.0	6.1	6.0
Cooking loss (%)	37.2	38.2	37.3	37.4
Drip loss (%)	8.1	8.0	8.1	8.0
Water holding capacity (%)	37.2	29.6	32.7	32.8
TBARS	2.9[d]	3.1[c]	3.2[b]	3.3[a]

Values in the same raw with different superscripts are significantly different at P < 0.05. TBARS: 2-Thiobarbituric Acid-Reactive Substances. CD: Control diet (Corn-soy-based control diet without rice bran). RP1: Diet containing rice bran stored for <24 hours, RP2: Diet containing rice bran stored for 1 week, RP3: Diet containing rice bran stored for 30 days.

These results highlight the importance of using fresh rice bran in poultry feed to optimize birds' health and maximize economic value in the industry.

Maintaining proper storage practices is crucial to preserving rice bran's quality, ensuring its safety and effectiveness in broiler diets. This highlights the role of storage duration in retaining the nutritional value of rice bran for poultry.

CAN ANTIOXIDANTS BOOST BROILER GROWTH AND IMPROVE MEAT QUALITY IN RICE BRAN DIETS?

S. M.R. Samarakoon

Rice bran, a nutritious by-product of rice processing, is a cost-effective feed ingredient for broilers. However, when stored too long, rice bran can become rancid, losing its nutritional value and potentially impacting the growth and meat quality of chickens. In an earlier study, we found that rice bran stored for over 30 days reduced both growth and meat freshness. This led us to explore whether adding antioxidants to broiler diets containing older rice bran could counter these effects.

For this study, we fed groups of broiler chicken with different diets over 35 days. Groups received either fresh rice bran, 30-day-old rice bran, or 30-day-old rice bran combined with antioxidants (BHT or polyphenol-rich sugarcane extract, PRSE) added through feed or water.
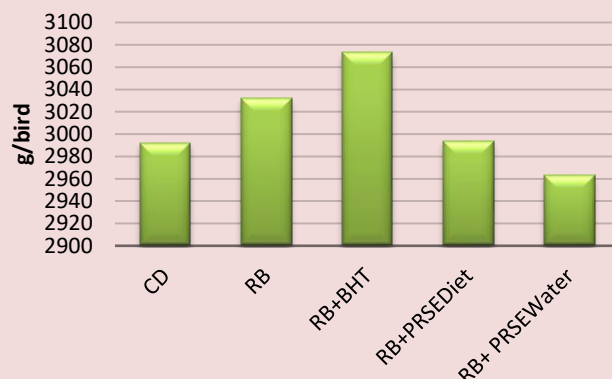
Final Body weight
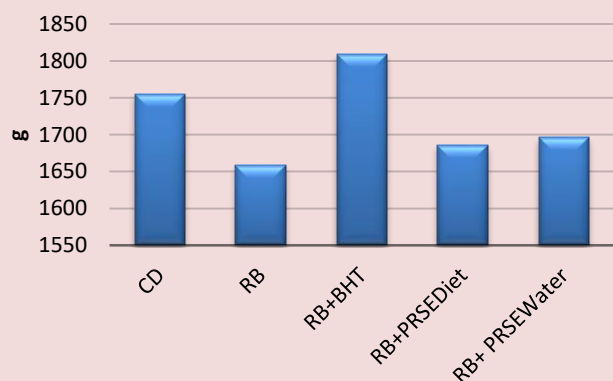
Weight gain

Feed intake

CD: Diet containing rice bran stored for <24 hours, RB: Diet containing rice bran stored for 30 days, RB+BHT: Diet containing rice bran stored for 30 days and 0.5% Bultylated Hydroxytoluene (BHT), RB+PRSE$_{Diet}$: Diet containing rice bran stored for 30 days and 0.1% polyphenol-rich sugarcane extract con centrations (PRSE), RB+PRSE$_{Water}$: Diet containing rice bran stored for 30 days + 0.05% PRSE in water.

Our results showed that while antioxidants didn't directly improve growth or nutritional composition, they did help reduce rancidity in the feed, especially by the fifth week. Remarkably, taste testers preferred the flavor of chicken from birds that received antioxidant supplements, suggesting that antioxidants may enhance meat palatability.

In conclusion, while antioxidants may not boost growth directly, they improve feed freshness and enhance the taste of broiler meat adding consumer appeal in poultry production.

Sri Lanka's Seaweed Potential: A Growing Industry

G.D.S.P. Rajapaksha

Seaweed, a marine plant often overlooked, holds immense potential for various industries. One type of seaweed, *Kappaphycus alvarezii*, is particularly valuable for its production of carrageenan, a natural thickener used in a wide range of products from food to pharmaceuticals.

A recent study conducted in Mannar, Sri Lanka, explored the cultivation of *Kappaphycus alvarezii* in two locations: Pesalai and Valaippadu. The research focused on comparing the growth rates and carrageenan yields of the green and brown morphotypes of this seaweed.

A mixed cultivation of green and brown morphotypes

Key Findings:

Rapid Growth Rate: Both locations demonstrated impressive growth rates, exceeding 3.5% per day within 45 days of cultivation. This rate aligns with international standards for commercial seaweed farming.

High-Quality Carrageenan: The seaweed produced carrageenan with excellent water-holding capacity and yields surpassing 25%, meeting global quality benchmarks.

No Difference Between Morphotypes: While the green and brown morphotypes of *Kappaphycus alvarezii* were often mixed by farmers, the study found no significant difference in their growth rates or carrageenan yields.

Potential for Pharmaceutical Applications: The green morphotype was shown to contain higher levels of bioactive compounds, making it more suitable for pharmaceutical uses such as extracting antioxidants and phenols.

Economic Opportunities: These findings highlight the potential for Sri Lanka to develop a thriving seaweed industry. By capitalizing on the rapid growth and high-quality carrageenan production, the country can enhance its economic growth and tap into the expanding global market for seaweed-based products.

Locations of the experiment: Mannar, Sri Lanka

Seaweed cultivated plots in the seawater

Seaweed at the beginning (100g weight seedlings)

Harvest after 45 days of cultivation (700-800g)

Carrageenan powder   *Set carrageenan gel*

Call to Action: Policymakers and investors should recognize the economic benefits of seaweed and provide the necessary support to develop this industry. This includes investing in research and development, promoting sustainable farming practices, and facilitating access to markets. By embracing seaweed as a valuable resource, Sri Lanka can position itself as a leader in the global seaweed industry.

ASSESSING THE CARBON FOOTPRINT OF SRI LANKAN BLACK TEA PRODUCTION

M.M.K.D. Manathunga

Sri Lanka, a leader in the global tea industry, contributes substantially to the nation's economy, but the environmental impact of tea production is an emerging concern. My research examined the carbon footprint of black tea production, specifically the Orthodox tea-making process—a traditional method widely used in Sri Lanka. This study, conducted at a medium-scale tea factory in Pilimathalawa, aims to understand where the emissions are highest and how they can be reduced, aligning with growing consumer demand for sustainable products.
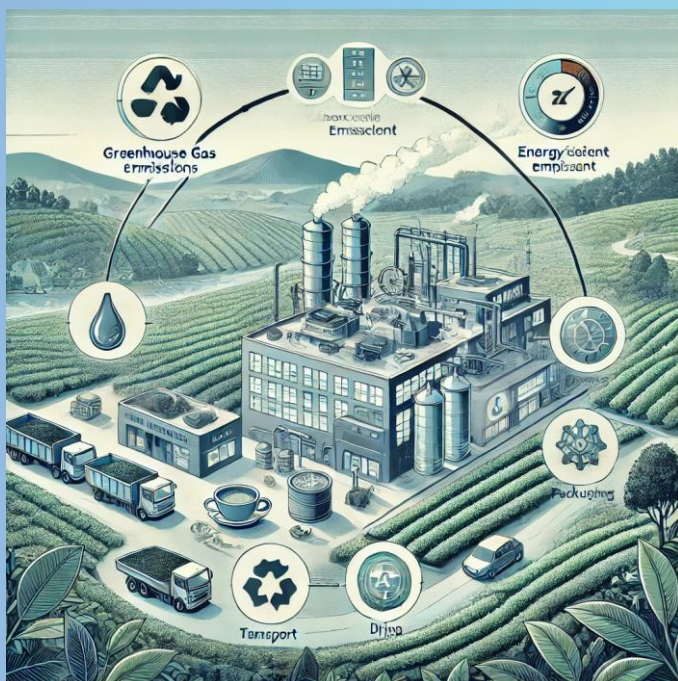

Through a Life Cycle Assessment (LCA), which tracks environmental impact from "cradle to gate," I evaluated each stage of tea production, from cultivation and processing to transportation.

Cradle ⟶ **Gate**

The results highlight that tea processing (50.49%) and cultivation (44.35%) are the primary sources of greenhouse gas emissions. Nitrogen fertilizer, used in cultivation, is the largest single contributor (44.3%) to the carbon footprint.

Processing steps like drying and withering are particularly energy-intensive. Despite the fact that 85% of energy is coming from renewable sources, poor fuel wood management greatly affects the carbon footprint.
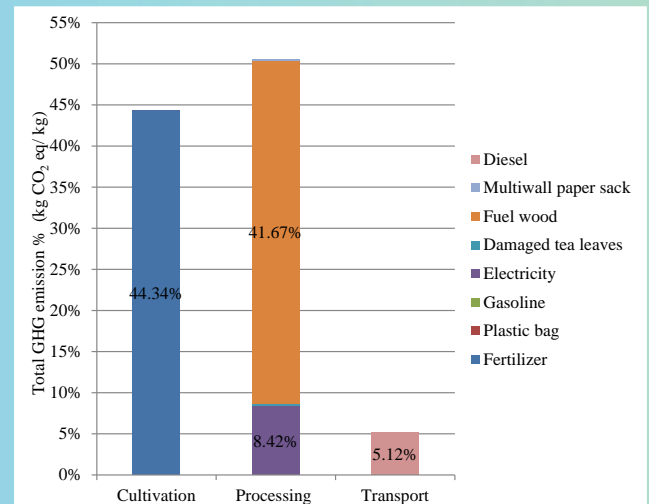
Total carbon emission at each phase with source of emission.

Regular energy audits can play a critical role here, helping factories identify opportunities to optimize fuel use and improve energy efficiency in processes like drying. Additionally, regulating the moisture content of fuel wood ensures more efficient combustion and reduces emissions. By managing fuel wood moisture, factories can lower their reliance on external sources, often unsustainably harvested, thus decreasing environmental impact.

Assessing the carbon footprint through LCA is beneficial as it provides a detailed map of emissions, allowing the industry to pinpoint hotspots and adopt targeted and effective mitigation strategies. The study found an average carbon footprint of 9.898 kg CO_2 eq per kilogram of tea.

Practical solutions include optimizing fertilizer use, employing energy-efficient equipment, and promoting sustainable forestry. By implementing these strategies, Sri Lanka's tea industry can enhance its sustainability, meeting the expectations of a more eco-conscious market while supporting the country's environmental goals.

ENVIRONMENTAL FACTORS INFLUENCING SEED GERMINATION AND SEEDLING EMERGENCE OF *Cyperus iria*

K.Nishanthan

Cyperus iria is a troublesome sedge weed in agricultural fields, particularly in lowland paddy cultivation. The weed causes 40-64 % yield loss in paddy. Understanding the ecology of the weeds, its response to environmental conditions and agronomic practices would provide insights into its adaptive capacity, help predicting its distribution and abundance, and this, assisting in developing control strategies.

Objectives

The study focused on elucidating the response of *C. iria* to changes in the environmental conditions. The study comprised three experiments to assess the impact of (1) day/night temperature and duration of light, (2) depth of flooding, and (3) seed burial depth on seed germination and seedling emergence.

Methodology:

The experiments were conducted sequentially at the Faculty of Agriculture, University of Jaffna at Kilinochchi, Sri Lanka. Twenty-five matured *C. iria* inflorescences were randomly collected from paddy fields heavily populated with this sedge weed from each of the five districts in the Northern Province.
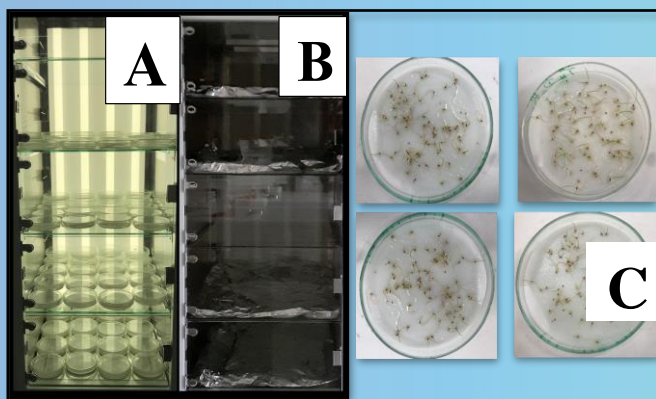
Treatment arrangement inside the incubator. A - Light treatment; B - Dark treatment and C- Germinated C. iria in petri dishes

Arrangements of Flooding treatments

*Germination pattern of C. iria in different seed burial depths*

Results:

Cyperus iria seeds from Vavuniya recorded the highest seed germination at all combinations of day/night temperature and light durations, while the lowest recorded from Jaffna. The temperature, light, flooding depth and duration, and soil-burial depth significantly influenced seed germination and seedling emergence of *C. iria*. The day/night temperatures of 25/20 °C, allowing the seeds in continuous darkness, maintaining a continuous flooding height at 2.5 - 5 cm at early stages of weed growth (from 5 day after sowing) at least for 28 days and burying *C. iria* seeds in soil at depths >1 cm significantly reduced the seed germination and seedling emergence of this troublesome sedge weed in paddy cultivation. Land preparation (e.g. deep ploughing) and water management (e.g. impounding standing water at early stages) would help managing *C. iria* effectively in paddy fields.

A management strategy for *C. iria* should be designed based on the ecology of the weed coupled with other available technologies.

# Root to Leaf: Tomato Plant's Environmental Response
I.N.S. Dewapriya

Changing environments can determine how plants grow, impacting their structure, ability to carry out photosynthesis, and how they handle stress. These changes play a crucial role in plant development, with important consequences for agriculture and food security. As climate change increasingly impacts the world, understanding how crops adapt to changes in environmental conditions is very important. Tomato is one of the world's most popular and valuable crops, known for their rich nutritional content and versatility for culinary purposes. This study looked at how different greenhouse micro environments influenced the anatomy of a hybrid tomato variety "Sylviana" in three greenhouse setups in the mid-country wet zone of Sri Lanka using simple method using light microscope.
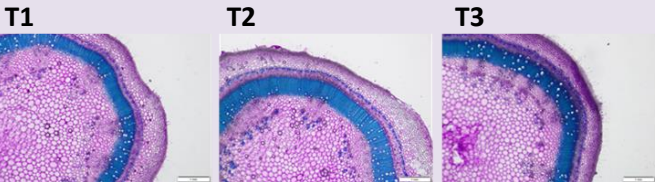
Experimental setup
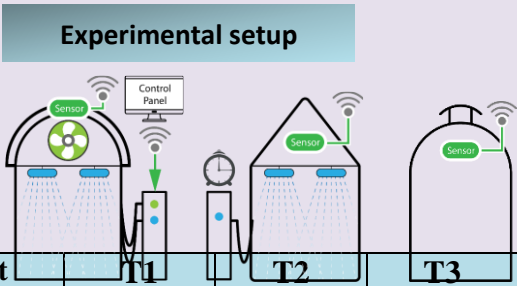
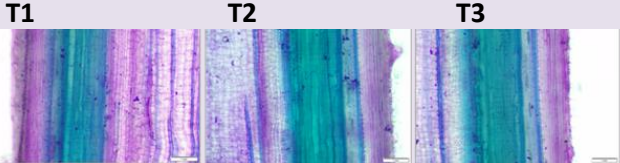| Treatment	T1	T2	T3
Temperature (°C)	< 35	< 37	< 39
Light Intensity (lx)	5500	11000	8000
RH (%)	60-80		

Light microscopic observations
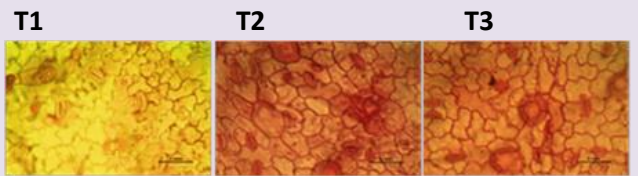
T1   T2   T3
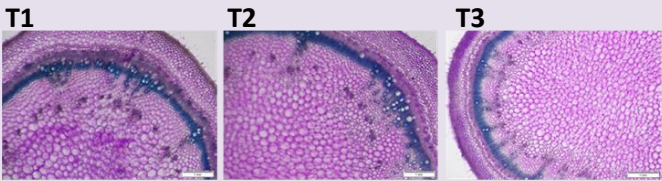
Cross-section of tomato stem at the reproductive stage

T1   T2   T3
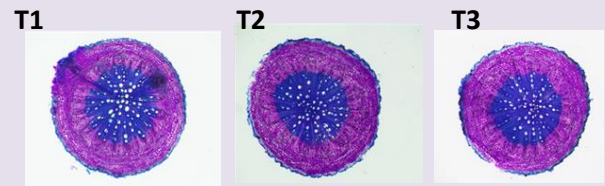

Cross-section of tomato stem at the vegetative stage

T1   T2   T3

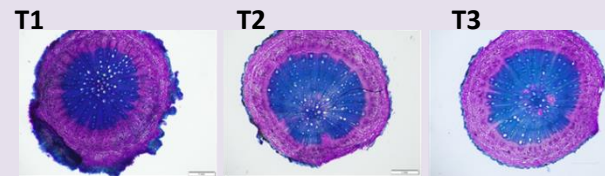Tangential-section of tomato stem at the vegetative stage

T1   T2   T3

Leaf upper layer

T1   T2   T3

Leaf lower layer

T1   T2   T3

Cross-section of tomato root at the reproductive stage

T1   T2   T3

Cross-section of tomato root at the vegetative stage

Key findings and conclusions

The leaf experienced higher temperatures forming many stomata on the lower leaf surface. The xylem vessel thickness of stems increased during plant development, with the highest temperature environment showing the higher xylem vessel thickness in the reproductive stage. Root diameter and the vascular area were increased with the plant growth. The study suggests that changes in tomato plant anatomy under different microclimatic conditions possibly improving water transport, plant cooling or structural defects. This knowledge can be applied to understand the need for careful plant management to optimize growth and yield, especially with unpredictable climate patterns and to the development of stress-resistant varieties. The simple laboratory method of anatomical detection used in this study could be applied in similar plant studies.

CEYLON CINNAMON SPENT BARK WASTE: A NEW SOURCE OF DIETARY FIBER WITH HEALTH BENEFITS

L.H.M.P.R. Lansakara

Cinnamon spent bark waste

The oil derived from Ceylon cinnamon or "true cinnamon" is highly valued in the world market for its purity with a variety of active compounds such as cinnamaldehyde and eugenol which contribute to its unique aroma and health effects. Cinnamon spent bark waste is the byproduct that accumulates in large quantities at cinnamon oil distillation facilities, creating disposal problems.

Cinnamon bark

Dietary fiber

Certain 'insoluble dietary fiber' is a group of indigestible carbohydrates in plant-based foods which protects humans against chronic diseases, supports a healthy gut, and plays a crucial role in weight management and blood sugar control.

✓ This research suggested a novel solution to turn cinnamon spent bark waste into a source of dietary fiber with valuable functional properties.

Chemical extraction of dietary fiber

What we did?

Cinnamon spent bark waste has very low levels of soluble dietary fiber but a high concentration of insoluble dietary fiber, which was focused on extracting. Three methods were investigated to extract insoluble dietary fiber as water-based, chemical, and enzymatic extraction.

Results of the study

Water-extraction resulted the highest yield of dietary fiber, but the fiber produced by chemical and enzymatic treatments showed superior hydration properties which indicate the ability to hold more water and swell to a greater degree. Additionally, all three methods produced fibers with improved oil-holding capacity compared to the original cinnamon spent bark waste. Chemically extracted insoluble fiber, especially, exhibited the highest oil-holding capacity, a property beneficial to improve texture of food products. Furthermore, chemically and enzymatically treated fibers showed increased glucose adsorption, which is important in controlling blood sugar levels when included in the diet.

Analysis of glucose adsorption capacity

Despite producing lower fiber yields than water-extraction, the chemically extracted insoluble fiber stood out for its enhanced functional properties, making it a suitable candidate for high-value applications in the food industry and nutritional supplements.

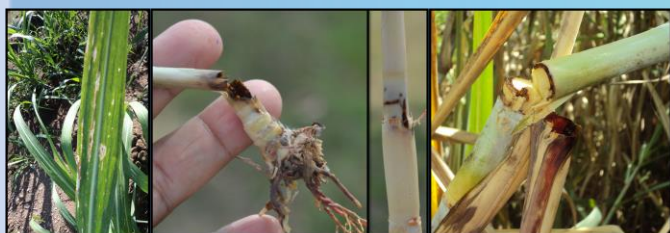# DO LEAF SHEATH CHARACTERS OF SUGARCANE HARM TO INTERNODE BORER?

V.K.A.S.M. Wanasinghe

Sugarcane Internode Borer (INB)

Internode borer (INB) (*Chilo sacchariphagus indicus*) is a major insect pest of sugarcane in Sri Lanka. Resistant sugarcane varieties is an approach for population management.

Adult moth of INB | Larva of INB

How do they damage?

- Feed inner tissues of sugarcane stalk and leaf
- Weak stem is liable for wind-breakages
- Death of young plants
- Form side shoots
- Poor germination
- Reduce the sugar content of stalks
- Borer tunnels open the way to infection by bacteria, fungi and yeast

Plant Characteristics for INB Resistance

- High fiber varieties are resistant for INB. However, when fiber content increases, the sugar content will decrease.
- Identification of effective resistant characters which have not affected to the sugar content is essential for future breeding programs.

- We studied two morphological characters of leaf sheath of commercial sugarcane and wild sugarcane varieties.
- Those characters were **Leaf sheath thickness** and **leaf insertion hairs (LI hairs)**.


How leaf sheath thickness affect to INB larvae?

If the thickness of leaf sheath increases, the damages of INB larvae to sugarcane plants will decrease. Because the larvae can't enter in to the stalk through thick leaf sheath.

How do leaf insertion hairs affect to INB larvae?

We found that **LI hairs** were only present on wild sugarcane. These hairs delay the entrance of larvae to stalk and because of that, they get destroyed by predators and sunlight.
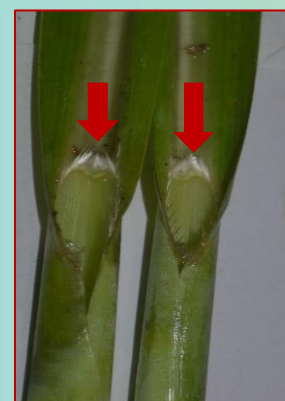
According to the study,

-Leaf sheath thickness and density of leaf insertion hairs significantly reduced the INB damage to cane.

- Those two morphological characters can be incorporated in to breeding program of sugarcane in Sri Lanka.

OPTIMIZATION OF AGRONOMIC PRACTISES FOR YIELD ENHANCEMENT OF SCOTCH BONNET PEPPER (*Capsicum chinense* Jacq.) UNDER CONTROLLED CULTIVATION

H.G.A.M. Wickramarathne

Scotch Bonnet (*Capsicum chinense* L.), commonly referred to as *"Nai Miris"*, in Sri Lanka, has recently emerged as a significant crop in the Protected Agriculture (PA) industry in the country. It holds considerable market value, often surpassing that of bell pepper, the top value vegetable grown in polytunnels in Sri Lanka. Pepper production is found from the humid tropics to dry deserts and cool temperate climates. Peppers can be grown as an annual or perennial crop in open fields or under protective cover. The ability of peppers to grow and produce a quality crop in such a wide range of climates has made them a common crop worldwide, and their annual production has increased substantially over the years (Bosland and Votava, 2012).

How this study matters?

The current practices of cultivating Scotch Bonnet in polytunnels vary among farmers. Some utilize soil beds or grow bags filled with soil and compost mixtures, while others adopt techniques similar to those used for bell pepper cultivation. Despite these efforts, achieving optimal yields remains challenging due to the complexities involved in transiting from open-field to polytunnel cultivation. Issues such as plant spacing, growing medium and crop maintenance, often rely on practices designed for open-field conditions. Therefore, the successful cultivation of Scotch Bonnet in polytunnels is hindered by the lack of specialized technologies and practices tailored specially for this system.

By systematically investigating factors such as plant spacing, fertilizer management, and crop maintenance, the study sought to enhance the productivity and profitability of the crop. While providing science-based recommendations and comprehensive guidelines, this research attempts to support the sustainable growth of the industry, ultimately benefiting both farmers and consumers.

What we did?

One-month-old seedlings were transplanted into 9 L polythene bags following split-plot design, with the spacing as the main plot factor and plant management and growth media as the subplots. Two different growth media: A: a coir dust and partially burned paddy husk mixture (1:1), and B: topsoil and compost blend (1:1) and, Two plant spacings (75 cm inter-row and 50 cm within the row, and 100 cm inter-row and 75 cm within the row) were tested in combination with two distinct plant management systems within the two-growth media: two-stem pruning (Dutch V2) and un-pruned (Spanish).
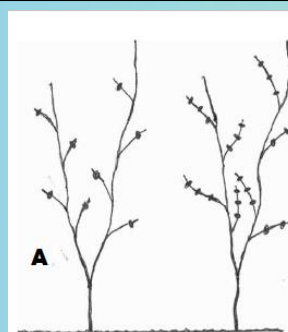

Figure 1:A – Dutch V pruning System

The bags were arranged in a double-row system within the polytunnel. Albert's fertilizer mixture (a commercially used complete plant nutrient mixture) was applied, supplemented with $Ca(NO_3)_2$, $MgSO_4$, and Krista K 44 (a commercially available K supplement with 44% K_2O) to meet the plants' nutritional requirements. Adjustments were made based on plant growth and observed deficiency symptoms. The number of fruits per plant and, weight of fruits harvested as fruit yield per plant were recorded and statistically analyzed using SAS software, with means separation conducted using the LSD mean separation method.
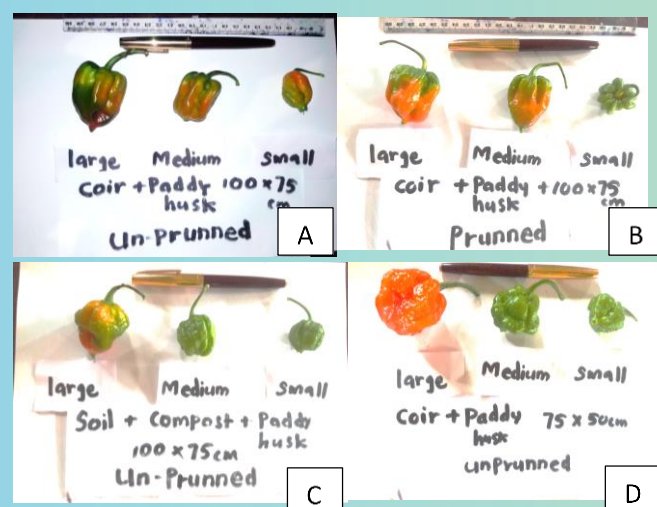

Figure 2 Pod size with different treatments

What we found?

Compositions of the growth media impacts significantly on fruit yield of Scotch Bonnet cultivated in polytunnels. The mixture of CD and PBPH performs better than the topsoil and compost blend in promoting yield without pruning. Pruning has mixed effects, emphasizing the need for tailored management practices. These findings also highlight the importance of selecting appropriate growth media and adopting suitable pruning techniques to optimize Scotch Bonnet production in polytunnels, contributing to a sustainable cultivation of this high-value crop in Sri Lanka.

IMPACT OF EXTERNAL FACTORS ON CHEMICAL PROPERTIES OF COCO PITH SUBSTRATE

R.K.R.M.Ajith Gunasena

Introduction

The use of soil-less grow media or substrates in advanced agricultural systems is a critical focal area in modern agriculture. Among the major substrates, coco pith stands out with increasing global demand due to its unique attributes. However, despite its functionality, coco pith has certain limitations in helping optimal crop growth, primarily due to specific physico-chemical properties that need corrections before use. In the grow media industry, especially for young plant propagation, chemically stabilized raw materials are essential. The chemical properties, electrical conductivity (EC), pH, and the ionic contents of sodium and potassium are the most critical for optimizing plant growth performance.

The study

We investigated the impact of external factors; soil suitability class (SS: S_1 to S_4), coconut variety (VAR: tall-TT and dwarf-DT), fiber processing method (MM: wet and dry milling) and, the aging status (Ag: aged and non-aged) on the chemical properties of coco pith.

## Interactions of factors on chemical properties

	EC	pH	Na_h	Na_Cl	K_h	K_Cl
VAR×MM×Ag		×	×			
SS×MM×Ag				×		
MM×Ag	×	×			×	×
VAR×Ag		×				
SS×MM			×	×		
SS×Ag			×	×		

The factors exhibited varying levels of interaction effects on the chemical composition of coco pith. Combined effect of milling method and ageing status influenced on EC, pH and K^+ levels of CP. The Na^+ level of coco pith is affected by the interaction of soil suitability class, milling method, and ageing status. Notably, ageing significantly reduces Na^+ levels, regardless of the soil suitability class or milling method practiced.

Combined effects of soil suitability class (SS), Dry and wet milling, with (Yes) and without (No) ageing on the sodium content of coco pith
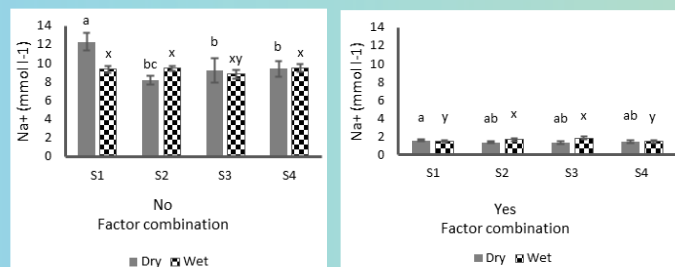
Combined effects of variety (DT & TT), wet and dry milling, with (Yes) and Without (No) ageing on the sodium content of coco pith
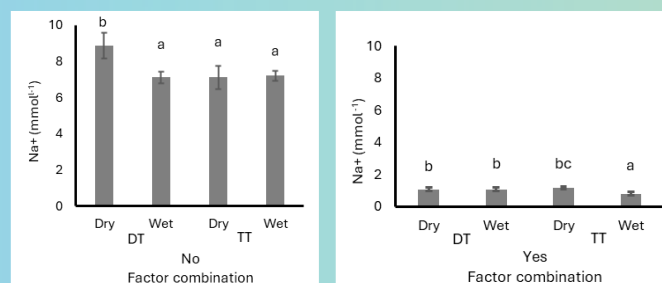
Key Takeaway

The milling method and aging process are important factors in determining the chemical quality of coco pith. Specifically, the combination of wet milling and aging yields the best results by lowering electrical conductivity, K^+ levels and optimizing pH levels. Aging also effectively reduces Na^+ levels in coco pith. Reduction of Na^+ is more effective for soil suitability classes S_1 and S_4 and also for the variety TT, under wet milling with aging.

Therefore, promoting the wet milling method for separating coco pith (through the fiber extraction process) and aging them before use will improve the chemical properties of value added coco pith products to be used as grow media or substrates in horticulture and other advanced agricultural systems.

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