



ISAE 2022
Faculty of Agriculture
University of Ruhuna
Sri Lanka



**Proceedings of the International Symposium on
Agriculture and Environment 2022**

ISAE 2022

***“Advanced Technologies, Training and Research for
Optimizing Agricultural Production”***

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Faculty of Agriculture
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Sri Lanka

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Preface

The Editorial Board unveils the Proceedings of the International Symposium on Agriculture and Environment with immense pleasure and delight (ISAE 2022). The ISAE 2022 International Symposium will be hosted as a virtual event on May 13, 2022, with the theme of "**Advanced Technologies, Training, and Research for Optimizing Agricultural Production**," which is well aligned with modern agriculture's current global interest.

One of the world's most pressing challenges is how to ensure food security for the world's rapidly growing population while also ensuring long-term development. According to the Food and Agriculture Organization, agricultural and food production will need to increase in order to feed the world's growing population, which is expected to reach 10 billion by 2050. The issue of food security, sustainability, productivity, and profitability is becoming increasingly essential as the world's population grows and market demand for higher product quantities and quality standards rises. Furthermore, economic pressure on the agricultural industry, as well as labor, environmental, and climate change challenges, are intensifying. As a result, in recent years, the use of efficient integrated smart technologies and techniques to improve the efficiency of Advanced Technologies, Training, and Research for Optimizing Agricultural Production has attracted a lot of attention. In this perspective, digital agriculture (also known as smart farming or smart agriculture) techniques can aid in a greater understanding of the interlinkages within the agricultural production system and their effects on farm production efficiency, all while balancing human health and well-being, social and environmental aspects, and agricultural system sustainability. Digital farming has advanced in recent years as a result of developments in data generation, data processing, and human-computer interactions. The adoption of modern Information and Communication Technology (ICT), Internet of Things (IoT), big data analytics and interpretation techniques, machine learning, and Artificial Intelligence has become one of the primary elements of digitalization in agriculture (AI). Digital farming techniques can help with (I) fertilizer, chemical, seed, and irrigation management procedures, (II) environmental protection, (III) pest, climate, and crop monitoring management solutions, and (IV) market demands and business conditions. Agricultural production systems, on the other hand, are complex, dynamic, and necessitate expert management. Additional monitoring, data analysis, and optimization capabilities, as well as more decision-making support, are predicted to be provided by digitalization approaches. As a result, prudent use of Advanced Technologies, Training, and Research for Optimizing Agricultural Production will aid in overcoming food security concerns posed by the ongoing COVID-19 pandemic as well as the current global economic crisis.

The Editorial Board believes that the ISAE 2022 Proceedings contribute as a rich collection of knowledge compiled by renowned scientists, policymakers, planners, technologists, and thinkers on the conference's main theme of "**Advanced Technologies, Training, and Research for Optimizing Agricultural Production**." Ensuring a high-quality conference requires accepting papers that pass a rigorous review process. This year, a large number of papers were submitted to the conference. Each paper was subject to review by 2–5 reviewers of the program committee members. We would like to express our heartfelt gratitude to the authors whose technical contributions are featured in these proceedings. We have been able to produce these proceedings owing of their exceptional contributions and hard work.

There will be 95 papers presented at 10 parallel technical sessions under Six sub-themes namely (1) Plant, Soil, Water and Environment (2) Crop Production and Productivity (3) Food

Technology and Nutritional Sciences (4) Agricultural Economics and Agribusiness (5) Livestock, Poultry, and Aquaculture, and (6) Innovative Agricultural Technologies.

We would like to thank all our keynote speakers for investing in the time and effort to synthesize the materials, as well as for their diverse and rich experiences in delivering remarkable presentations. We would also want to congratulate all our oral and poster presenters for their outstanding efforts in giving dynamic and exceptional presentations that fulfill the learning goals of students of all levels, including undergraduates, graduates, policy makers, and professionals. We are grateful to our track chairs for their outstanding work in reviewing papers in their tracks and managing the assignment of other volunteer reviewers, conference technical program committee members, and designated reviewers.

On behalf of the Editorial Board and the Publication Committee, I would like to extend our deepest thankfulness to the chief guest, keynote speakers and all authors for their scholarly contribution and splendid collaboration in the process of compiling this proceeding. Proceedings of the ISAE 2022 are a substantial outcome of a much-devoted team effort of many including the coordinator (Professor Dulcy Senarathne) of ISAE 2022 and, the members of the publication committee and the Editorial Board. Their untiring effort is tremendously admired and acknowledged. On behalf of the Editorial Board, as the editor-in chief of ISAE for 5th consecutive time, I would like to extend my best wishes to all participants for a productive and satisfying experience in the ISAE 2022 virtual conference.

Stay safe

Professor Guttilla Yugantha Jayasinghe

Editor-in-Chief

Proceedings-ISAE 2022

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Message from the Chief Guest
His Excellency Mr. Naor Gilon
Israeli Ambassador to Sri Lanka

International Symposium on Agriculture and Environment (ISAE) 2022
Faculty of Agriculture
University of Ruhuna
Sri Lanka

Dear Members,

On the annual flagship event, International Symposium on Agriculture and Environment (ISAE) 2022 by the Faculty of Agriculture, University of Ruhuna, on the theme "Advanced Technologies: Training and Research for Optimizing Agricultural Production", I would like to extend my good wishes and support to this special endeavor. I wish to congratulate all the participants and audience on this interesting lecture program and hope for a continuous interchange between Israel and Sri Lanka towards our growing bilateral cooperation. Once again, please accept my warm regards and heartiest greetings.

Yours Sincerely,
Naor Gilon
Ambassador of Israel
Embassy of Israel
New Delhi

Message from the Vice Chancellor
University of Ruhuna

Currently, our country is in a serious socioeconomic and a political crisis. The food crisis and shortage of essential goods are unprecedented. This is in the midst of perhaps a similar crisis globally. The shortage in fuel, gas and other commodities have affected almost all aspects of daily life. There is a war in Europe that could escalate into WW III at any given time. This situation in Sri Lanka could become worse in the months to come before getting better.

Hence, it is appropriate to state that, our country today, is at crossroads. We have to decide which way to walk and that will determine the destiny of our nation in the future. In this context, the ISAE 2022 conference organized on a virtual platform under the theme “Advanced technologies, Training and Research for Optimizing Agricultural Production” is relevant and timely.

Our country has produced thousands of professional experts in agriculture and invested in development of agriculture-based economy for decades. Despite this the country has not been able to be self- sufficient in basic food requirements such as rice and vegetables. Now a segment of our population is at risk of starvation. The past policies, frameworks and implemented activities and programme have not worked for the benefit of the masses. It is being interpreted as a political failure which in my opinion is a misinterpretation. There were agricultural professionals under every government who advised to follow these policies. Hence, the misinterpretation will lead to development of inappropriate policy frameworks further and these will be proven wrong one day.

Return on investments (ROI) in agriculture are small unless modern technology is adopted, and mass scale production is achieved. This is ill understood in our country. The past agricultural development models have failed in Sri Lanka despite expertise and investments. There are no short-term solutions for this problem. In my opinion this is due to lack of use of available research evidence based advanced technologies and lack of investments in adequate scale with mismanagement leading to losses. Our own farm is a good example for the entire country to learn as a failure of a nation.

Therefore, we should set an example for the rest of the country by deviating from current approach to our own farm based on the theme in the ISAE 2022 conference. Let me thank the Dean and the organizing committee of the ISAE conference of 2022 for organizing this even under immense difficulties with the country in a turmoil.

Prof Sujeewa Amarasena
Vice Chancellor

Message from the Dean
Faculty of Agriculture, University of Ruhuna

It is indeed a great pleasure to send this message as the Dean on behalf of all my colleagues who worked tirelessly to organize this symposium amidst many obstacles and challenges with the prevailing situation in the country. The Faculty of Agriculture, University of Ruhuna has very successfully organized two national and eleven international symposia in the past and the first edition of ISAE was hosted in 2011. We are committed to raise the standard of this event and live up to the expectations of researchers who selected our symposium to present their research findings.

Our vision is to make ISAE an annual meeting place for scientists and professionals in agricultural, environmental, and allied sciences to share their research findings, innovative ideas and forge new collaborations. Agriculture is considered as one of the main polluters of environment and our biggest challenge is to raise the agricultural production to feed the ever-increasing human population while protecting the environment and conserving natural resources.

The broad theme of this year's symposium is "*Advanced Technologies, Training and Research for Optimizing Agricultural Production*", highlighting the need of new technologies for increasing the agricultural production while safeguarding the environment for future generations. Modern agriculture fulfils multiple roles and purposes, including producing more food for a growing population, supplying raw materials for expanding industrial and bioenergy sectors, conserving the natural resources, environment, and biodiversity. In Sri Lanka, agriculture contributes significantly in providing rural employment, livelihoods and economic development. Development of new technologies through research and regular training programs for farmer communities are needed to enhance agricultural production in the country. The global demand for food is projected to increase several folds in the coming decades and there will be greater consumption of processed foods, animal proteins, fruits, and vegetables with higher demand for food quality and safety. At the same time, there will be increasing efforts to address some of the negative impacts on environment caused by agriculture. Our country is in need of a solid approach in natural resource management to position Sri Lanka's agriculture sector towards effective and efficient fulfillment of its multi-functional roles.

Collaborative research and networking among scientists are pivotal for the advancement of science and technology. Hopefully, the presentations done, and discussions followed at this symposium would lead to further research and development of new technologies to enhance agricultural production and achieve goals in national development. I take this opportunity to express my sincere gratitude to all my colleagues of the organizing committee who devoted their time and energy to make this event a success. Finally, I sincerely wish all authors, invited speakers, special guests and participants a productive and pleasant virtual stay at the ISAE 2022.

Prof. Sudas D. Wanniarachchi

Dean/Faculty of Agriculture

University of Ruhuna

Message from the Coordinator of the Symposium



It is a privilege for me to forward this message as the Coordinator of International Symposium on Agriculture and Environment (ISAE), which has evolved as a well-recognized platform organized by the Faculty of Agriculture, University of Ruhuna, Sri Lanka for the professionals in the fields of agriculture and environment to present and discuss various challenging issues in agriculture and environment.

Technological change has been the major driving force for increasing agricultural productivity and promoting agriculture development in all countries. In the past, the choice of technologies and their adoption were to increase production, productivity, and farm incomes. Over many decades, policies for agriculture, trade, research, education, and training have been strongly influenced the choice of correct technology, the level of agricultural production and farm practices. Agriculture is becoming more integrated in the agro-food chain and the global market, while environmental, food safety and quality, and animal welfare regulations are also increasingly impacting on the sector. Today, farmers, advisors and policy makers are faced with complex choices. They are faced with a wide range of technologies that are either available or under development; they must deal with the uncertainties of both the effects these new technologies will have throughout the farming operations. Therefore, having recognized the issue, this symposium is organized on the theme of “Advanced Technologies, Training and Research for Optimizing Agricultural Production”.

First and foremost, I welcome all invitees, authors of the abstracts submitted to the symposium, all the distinguish guests and participants who join us at ISAE 2022. As a virtual symposium it brings eminent scientists from a wide array of countries to a common platform. This provides a stage for discussing the recent developments and innovations in a wide variety of topics; (1) Plant, Soil, Water and Environment (2) Livestock, Poultry and Aquaculture (3) Innovative Agricultural Technologies (4) Food Technology and Nutritional Sciences (5) Agribusiness and Agricultural Economics and (6). Crop Production and Productivity. Over 100 research communications were accepted to be presented after a double-blind review process by experts in multi-disciplinary subject areas. The selected abstracts were scrutinized by an Editorial Board for their novelty, plagiarism, and language those were to be published in the proceedings of ISAE 2022.

I extend my profound gratitude to Senior Prof. Sujeewa Amarasena, the Vice Chancellor of University of Ruhuna and Senior Prof. Sudas Wanniarachchi, the Dean of the Faculty of Agriculture for giving me necessary administrative support in organizing this event. All the reviewers are acknowledged for taking time for reviewing together with the members of the Publication and Editorial committee, for their hard work. I have been fortunate enough to have a

motivated group to work with me. Therefore, I express my deepest appreciation to all the academic/ non-academic staff members who supported me in numerous ways. I wish a productive time to all the contributors to the ISAE 2022. Also, I do hope that you all will continue to be connected to ISAE in the future.

Prof. (Mrs.) Dulcy Senaratna

Coordinator, ISAE 2022

Keynote Speech of the Inaugural Session

Advanced Technologies, Training and Research for Optimizing Agricultural Production: Lessons from Israel

Joseph Shevel

President, Galilee International Management Institute, Israel

Abstract

National Cohesion is based primarily on equality of the population. If a government wishes to create cohesion, which will avoid societal violence, it must first reduce inequality. The "Arab Spring" is the most recent example of violence and upheaval caused by economic and social Inequality. Agricultural populations are well-known to be among the poorest and most vulnerable parts of the population. It is necessary, therefore, for central governments to strengthen these segments through the following: Upgrade the education for local students (schools and higher education); upgrade the agricultural infrastructure and improve production; provide subsidies; provide know-how (digital agriculture) and prevent immigration of populations from villages to major urban centres. Most of the population in Sri Lanka will be farmers. In order to assist them to stay in their farms and continue to cultivate the same, governments (national and regional) must prepare a plan for an efficient educational system as well as subsidies and transferring advanced know-how. Riots might erupt if the government is not preparing programme to upgrade education and level of agricultural production. Future of Sri Lanka lies in the level of cohesion of populations, especially farmers and their families.

Keywords: Agricultural infrastructure, Economic empowerment, Education, National cohesion and integration.

Introduction

Israel, officially **State of Israel**, is a country situated in the Middle East, located at the eastern end of the Mediterranean Sea. It is bordered by Lebanon to the north, Syria to the northeast, Jordan to the east and southeast, Egypt to the southwest, and the Mediterranean Sea to the west (Figure 1). The state of Israel is one country that St. Jerome touring in the fourth century described it as a land that has long drawn believers like a spiritual compass to the source of the religion. Christian zeal during the Middle Ages gave rise to a successful and thriving pilgrimage industry. A critical link between East and West, the Holy Land has endured an eternity of conflict among the Jews, Christians and Muslims leaving this venerated region stricken with sorrow and rage. But despite this, it has rich historical and religious significance and has contributed to liberating its people to the best of quality life.

Globally, there is a drive towards liberating people from abject states of penury to livelihoods worth of humane face. There is however a widening gap on the levels of economic ability which is likely to lower socio-economic growth of a country and subsequent the essence of a quality life (Galor and Moav, 2004; Aghion, Caroli; Garcia-Penalosa,1999) and even underinvestment in education to the less privileged members of society thus aggravating the widening gaps of social equality (Stiglitz, 2012).



Figure 1. Administrative Map of Israel showing the surrounding countries with international borders, district (mahoz) boundaries, district capitals, major cities, main roads, railroads, and major airports.

Source: UN Cartographic Section

Evidence suggests that modern society is on the verge of creating a crisis of inequality (Rajan, 2010) amid the other catastrophe that are facing humanity like the global economic crisis, impacts of climate change and the COVID-19 pandemic. Inequality as it will damage the long-cherished trust among people, and this becomes a precursor of conflict (Bardhan, 2005). These crises are on course to exacerbate disintegration and disharmony in society.

Interventions for this dilemma are replicated in modern economies. Marshall (2009) provides an argument that the distribution of resources is in fact a critical dimension of citizenship with a promise of access to social services, including education, that allow for full participation in society. This is about a country making a deliberate effort to ensure comfort of its people and recognizing the needs and ability of the people (Gutmann, 2003). It has been readily practiced in Israel, one of the cherished countries in terms of economic empowerment and looked at with glee due to social political histories of conflict especially trans-border.

The State of Israel is a country that stands on a thick line of economic, cultural and geopolitical matters that centrally affect its existence. This paper, therefore, explore how economic empowerment has been used as a tool for economic transformation of Israel. It dissects the historical development of the nation, geopolitical aspects, and the trans-border situation and how

all these have contributed to the drive, zeal and growth of this nation. Finally, the paper proposes the lessons that countries especially in the developing economies can learn for harmonious co-existences.

Israel: A Typology

The state of Israel was founded on 14 May 1948, following a decision by the United Nations to partition Palestine at the end of the British mandate. Israel is an outcome of a revolutionary movement, the Zionist movement, aiming at the return of the Jews to the land promised to them by God and from which they were exiled by the Romans (Aharoni, 1998). The region of the Mediterranean Sea to the banks of Jordan River derives its name from the Philistines, who occupied the southern coastal plain during the 12th Century B.C. Part of the Ottoman Empire before the World War I, was placed under the British Administration in 1920 by a League of Nations mandate. A monarchy was established in eastern Palestine or Transjordan. Jewish migration from Europe was heavy by 1947 when the UN drew up a proposed Arab and Jewish States west of Jordan, but Arab opposition thwarted the UN plan. When the British mandate ended in 1948, the State of Israel was proclaimed; fighting between the Jewish and Arab forces continued. In 1949 Armistice agreements between Israel and each of its neighbours partitioned the land- and Palestine ceased to be an official entity (National Geographic Magazine, 1989).

The rise, therefore, of the modern Israel had genesis from both religious and political sources with reverence of the Temple in Jerusalem that gave the Jewish identity of a promised land. Zionism which was a Jewish movement emerged due to conflicts from the neighbours of Israel, predominantly the Arab world and its nationalism. This rivalry demanded the land occupied by the Jewish state and other former Ottoman territories to the Palestine lands. From 1948 when the British Government declared independence to Israel, there was convergence of conflicts especially from the Muslim world, which has not ceased even today (*Sergio, 2015*). *Various peace efforts and peace building initiatives have been in place: from the 1979 Egypt- Israel Treaty, the Oslo Accord signed with the Palestine Liberation Movement and the Jordan –Israel Agreement of 1994. Last peace agreement was signed in 2021 between Israel and the Emirates, Morocco and Sudan*

Israel's Growth: The Multiplicity of Lessons

Israeli's economy has been unique having evolved from a less developed agricultural driven country to a high developed and technological driven country. Simhon (2016) has traced this economic development and achievements and document the high-level tech-industries that have emerged due to coalescing of skills. The country has fused and transformed itself to a capitalist economy with private enterprises that produces state of art technologies for the world.

Among heterogeneity of factors, cultural influences have played a significant role due to the flourishing of general ideologies from the western and eastern world. Bernstein & Swirski (1982) have a seminal discussion of the role of immigrant Jewish community in 1948 and other North American immigrants which is also in play bringing in a rich diversity of peoples with high skills and knowledge. This dispersal brought in high level demographic characteristics to this nation. Another factor is the geographical location, the inter play of neighboring countries and non-Jewish minorities being the Muslims and Christian Arabs all playing a leading role in economic development of this nation (Shavit et al., 2016). The country also received grants and capital from other European countries to support these people including reparations from the Federal Republic of Germany on the Nazi war crimes and atrocities committed to the Jewish people.

The economy of Israel has seen rapid growth of an integrated population that has overshoot itself into the world's economy. The country also has vast natural resources which have enabled it to have high living standards for its people. Other sectors such as tourism have grown rapidly and especially religious tourism. The country also has high level technologies and science-based industries ready for global export market.

The expansion of agricultural sector due to modern farming technologies such as irrigation and green house technologies has contributed to economic expansion. Israel produces horticulture and dairy products for readily available global market. However, the scarcity of water is a problem, but the country continues to use technologies for water catchment from Rivers Jordan and Yarqon and even Lake Tiberias. Further, technologies on desalinization of sea water have been used for domestic and agricultural consumption. These technologies are exported all over the world bringing in the much-needed foreign currency. Plate 1 shows agricultural products arising from the greenhouse technologies and ready for export market.



Plate 1. A net greenhouse in Los Pinos, Mexico, the largest greenhouse tomato project in the country, developed with Israel's Netafim drip irrigation and greenhouse technology (Courtesy Netafim)

Israel is a technology powerhouse especially in the military warfare. The conflicts abound from its neighbours including the perpetual wars in the West Bank and militants of the Hamas have seen the country evolve in efforts to protect its citizens. Another major expansion boost for the country has been the knowledge economy. This is driven more so by the country's information communication and technology (ICT) platforms made possible by the government's major investments. The high-quality human capital has been core in the innovation and economic growth of the country. Governments across the world, therefore, need to do investments on their people and this will create interventions in other sectors to make the country as vibrant as possible.

Israel's tech ecosystem is well anchored in the philosophy of encouraging innovations especially in the higher education sub-sector where research and development strategies (R&D) are high in place. It is for this reason that multinational companies have established hubs in Israel and thereby attracting high skilled workers, scientists and engineers. The unending conflict with Palestine has had a heavy toll on Israel's economic progression. This has hurt the tourism sector among other important sectors. The associated economic effects are drastic, and it seem that the country has to cease ground on a political front to grant territorial concessions to the Palestinians so as to avert the terror on the Israel people (Ben et al.,2012). While the Arab Israeli conflict is not over, as recent events have shown, it is clearly in the twilight of its existence (Bar-On, 1996).

About Galilee International Management Institute (GIMI)

Since its establishment in 1987, Galilee International Management Institute (GIMI) has reemerged as a globally reputable and leading management institute. Its goal is to provide accessible education, enhance human connections and cooperation, provide knowledge and assist in its implementation.

This is the key for creating sustainable development, social change and a more equal world. The Institute empower people and enable them to create positive change in their communities, by encouraging them to think differently, take risks, cooperate, lead changes – ***we create leaders***. Its story is the story of Israel, a technological pioneer renowned for its rapid economic and infrastructural development, despite lack of natural resources and regional strategic challenges.

Taking advantage of the position of Israel as an innovative world leader in various fields, based on knowledge development and investment in education, GIMI has a team of experts that deliver comprehensive and varied programs. In addition to its annual offerings, GIMI has long-term training agreements with many countries, including China, India, Latin American countries as well as many African countries. The Institute is granting tuition scholarships. This is in line with GIMI's mission to increase its commitment to share the Israeli know-how in an effort to improve sustainable development and especially agriculture. Among its Alumni are Government Ministers, University Vice Chancellors, State Governors and high-ranking officials, both Governmental and from the NGO sector. GIMI views this pro-active investment, especially in regional cooperation, as key in the path to peace and endeavors that promote Israeli-Palestinian endeavors towards coexistence.

Conclusion

This paper has provided a discussion on the state of Israel as a developed country. It has traced its historical and biblical development and referenced that the rapid development of the country has been due to a multiplicity of factors, and which contribute to a cohesive state. One of the key factors is investment in higher education which is critical for rapid economic development, especially in agriculture, and empowerment of the citizens, hence reducing conflict. These are the lessons that countries around the world need to employ to make them more cohesive and well bonded to avoid conflicts.

Recommendations

This paper makes the following recommendations

- 1) There is tremendous value in people moving places or working in the various parts of the world. This works towards enhancing cohesion among the people.
- 2) Governments of the world need to invest in promoting security and engage the youth fully so as to ensure proper cohesion.
- 3) Infrastructural development is an enabler of socio-economic transformation. Israel has developed due to massive investment in this area.
- 4) Cultural diversity is a way that people react and live with people of diverse cultures; unfortunately, in India and Sri Lanka, it is associated with ethnic and religious conflicts. In Israel, there is harmony among the Jews, Arabs and other immigrants of diverse origins.
- 5) Unity through transformative leadership is a precursor of national harmony. Nations of the world need to get lessons from Israel's leadership from Ben -Gurion who steered the country from 1948 to the current leadership of Prime Minister Naftalli Bennet who has been in power since 13th June 2021. Democratic ideals have ruled the space of Israel.
- 6) Investment in higher education is paramount for economic development and Israel has invested heavily in higher education.
- 7) More peace-building efforts should be linked to economic empowerment as is happening with the Palestine people.

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Plant, Soil, Water, and Environment



Keynote Speech

Carbon Farming: Experiences from Finland

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Finland is aiming high in climate action, with the goal set to be carbon neutral and the world's first fossil-free welfare society in next 13 years, already by 2035. The Finnish business sector prepared 14 sector-specific low-carbon roadmaps to achieve the goal, the initiative and solutions were proposed from the bottom-up for maximum engagement. The plan is exceptional as the roadmaps from all sectors are integrated and core roadmaps can be summed up – showcasing how the transition towards carbon-neutrality can be executed together in practice. These sectorial roadmaps include an overview of the current and target situation, a scenario analysis and means to achieve the target. The low-carbon roadmap for Finnish agriculture suggests that the emission from agriculture were 16 Mt CO₂ in 2018 or around 28% of total GHG emissions from Finland. 75% of the agricultural GHG emissions come from soil and field use. As a result, it is apparent that climate-smart farming on Finnish soils is the cornerstone for achieving national C neutrality. In general, significant emission reductions are possible without compromising food productivity.

Firstly, we should aim to keep the carbon where it is already: peatlands that currently produce 60% of agricultural GHG emissions in Finland. The scenario suggests flexible approach to reduce GHG from peat soils by around 50% by reduced tillage, increased long-term grasslands with high water table through regulatable subsurface drainage and restoring wetlands to least productive fields. There is also increasing interest in paludiculture, but the practical application is still in its infancy for boreal conditions.

The second main tool is to increase C sequestration to mineral soils that currently hold only few percent of C. Emission reductions include increased cultivation of leguminous plants and oilseeds, green manures and catch crops. Further, C farming practices tested currently in Finland include increased use of organic fertilizers (manures, composts, biogas digestates). Most of these organic amendments, however, are quite short-lived in the soil compared to biochar.

Biochars are defined as a carbonaceous porous solid material, produced by thermochemical conversion of biomass in anoxic atmosphere (pyrolysis) under controlled conditions with clean technology and is used for any purpose that does not involve its rapid mineralization to CO₂. The pyrolysis process additionally produces bio-oil, syngas, and heat energy; the relative yields of the different product components depend on the raw materials and the pyrolysis conditions. During pyrolysis, the aromatic compounds in biochar condense, making it resistant against chemical and biological degradation. Thus, the addition of such stable carbon to the soils is considered one of the most promising methods for long-term storage of carbon from the atmosphere (Woolf et al. 2016). The raw material, the pyrolysis conditions and possible after-treatment for activation significantly affect the properties of biochars, making it possible to tailor those targeting specific needs.

Some biochars can bring along co-benefits to C sequestration, for instance, reduce nutrient losses from the fields. According to recent meta-analysis, biochars reduce N₂O emissions from the soil by 38% and NO₃- leaching by 13%, on average. But is the method safe? We have been studying biochar with all main crops of Finland in our long-term field experiments since 2010 and have looked at the whole picture, from soil micro-organisms to nutrient losses and plant yield

formation. Our results so far assure that wood-based biochars are safe tools to sequester C to soils. We also found that biochars work as long-term fertilizers, they increased the concentration of P, K and Cu and Fe for crops increasingly over the first eight year-period.

Finally, it is worth to touch upon recent initiatives for C farming in Finland. Carbon Action network is one of the most influential ones and includes all stakeholders, from 100+ pilot farmers testing different C farming practices on their fields to businesses and politicians. They are contributing actively also to education with sharing latest C-sequestering knowledge to farmers via free online courses. There are also several voluntary C -fixing platforms (Puro.earth and compensate) that allow biochar producers or farmers using biochars in their fields to get C fixing credits bought by big companies like Microsoft or Shopify. The huge interest in C farming schemes in financial sector is illustrated well by the fact of all high-quality biochar producers have pre-sold their production in advance and several additional farmer-company-based collaboration C farming schemes are initialized.

Keywords: Biochar, Carbon, Carbon farming

Oral Presentations

ID 54

***In vitro* efficiency of solubilizing of different types of phosphate by bacteria isolated from a paddy grown Alfisol in the dry zone of Sri Lanka**

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Abstract

This study evaluated the *in vitro* efficiency of solubilizing different types of phosphate by bacteria isolated from the rhizosphere of rice at harvesting stage and cultivated in an Alfisol in Maha Illuppallama, dry zone of Sri Lanka. Soil suspensions were initially plated on Pikovskaya's (PVK) medium to screen phosphorous solubilizing bacteria (PSB). Thirty-two morphologically different bacterial colonies developed on PVK medium were inoculated to PVK, National Botanical Research Institute's phosphate (NBRIP-Ca₃(PO₄)₂) growth medium and Soy Lecithin media to quantify their phosphate solubilizing indices (SI). Among the 32 isolates, 10, 16 and 9 developed halos on PVK, NBRIP-Ca₃(PO₄)₂ and Soy Lecithin media, respectively. The SI values of the 10 isolates on PVK medium ranged from 2.37-4.14 and it ranged from 0.05-3.35 on NBRIP medium for the 16 isolates. SI values of the 9 isolates on Soy Lecithin medium ranged between 7.97-21. All the isolates that solubilized soy lecithin produced clear zones on PVK and NBRIP-Ca₃(PO₄)₂ media, indicating the broad-spectrum ability of those isolates to solubilize both inorganic and organic phosphorous. Cultures of LL, JJ, P, Y, A, M, U, X, D, L, O and N solubilized Eppawala rock phosphate (ERP) by increasing the phosphorous concentration in the growth medium from 0.19 to 0.33 mg/L compared to 0.01 mg/L in un-inoculated control. The isolate M, O, N, U, Y, X, A solubilized both organic and inorganic phosphorous forms including ERP. Compatibility of potential phosphorous solubilizers was tested to select candidates to be used in a consortium. Results of the incompatibility test revealed that the isolate A and LL and I are incompatible as well as the isolate M and X. Findings of the present study demonstrated the possibility of combining a large number of bacterial isolates for solubilizing organic and inorganic phosphorous and ERP. Isolate X and A can be excluded from the group of potential candidates as they showed incompatibility at *in vitro* with the isolates M and LL, respectively which are high performers in solubilizing organic, inorganic phosphorus and ERP. Therefore, isolates LL, M, N, O, U and Y could be included to form a consortium.

Keywords: Bacterial consortia, ERP, Organic phosphorus, PSB, Phosphate solubilizing index

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ID 72

Actinomycetes from the Kekanadura forest soil: Candidates for biofertilizer formulations

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Abstract

Actinomycetes synthesize a wide range of secondary metabolites with agronomical, industrial, and pharmaceutical importance. Actinomycetes were isolated from a tropical forest soil in order to identify strains with plant growth promotion traits for the selection of candidates for biofertilizer formulations. Actinomycetes were isolated from 10-20 cm depth soil in starch casein agar (SCA) and glycerol asparagine agar (GAA) with 7.8×10^4 CFU/g. Twenty-seven morphologically distinct strains were identified by evaluating their aerial and substrate mycelial characteristics in SCA. Twenty-one of those were provisionally identified to the genus level by their spore chain morphology of the aerial mycelia, which is a widely used criterion in actinomycetes identification. Among the identified strains, there were eleven *Streptomyces*, five *Nocardiosis*, two *Nocardia* and one each of *Actinomadura*, *Rhodococcus*, and *Kineococcus*. However, their identity needs to be confirmed by DNA sequencing. All 27 strains were found N-fixing at aerobic or microaerophilic conditions in the N-free-malate medium (semi-solid). Ammonia productions by those strains were confirmed using the peptone water *in vitro* assay. Fifteen strains were also found capable of solubilizing phosphate in the Pikovskaya's agar medium which contained calcium phosphate as the insoluble phosphate source. Except one strain, all other strains were able to produce indole acetic acid (IAA) at varying concentrations in broth cultures when tryptophan was provided as the precursor molecule. Their IAA production ranged 4.61-429.03 mg/L. Sixteen strains exceeded 100 mg/L IAA production. Therefore, plant growth promotion potential of such strains should be investigated further before incorporating into formulations as high IAA tend to inhibit plant growth in some instances. We tested antagonistic property of actinomycetes strains against *Sclerotium rolfsii*, which has a broad host range among the horticultural crops in Solanaceae and Cucurbitaceae families. They showed varying degrees of antagonistic potential. Twelve strains showed moderate to strong antagonistic activity against *S. rolfsii*. Overall results highlighted strain ACM 31, ACM 35, and ACM 45 were the best performing in terms of tested agronomic traits. We recommend testing isolated actinomycetes strains in different combinations with different host plants and soil types to evaluate their plant growth promotion potential.

Keywords: Antagonism, IAA, Nitrogen fixation, Plant growth promotion, Phosphate solubilization

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ID 73

Diazotrophic bacteria from a tropical forest soil with additional plant growth promoting traits: Prospective bioinoculants

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Abstract

Soil microbes play a key role in ecosystem functioning by being part of numerous biogeochemical cycles and organic matter decomposition. For this reason, microbial inoculants could contribute immensely to the sustainable agriculture as natural nutrient mobilizers. In this study, we isolated and characterized nitrogen-fixing bacteria extracted from soil to investigate their potential to be used as bioinoculants to improve crop growth and development. Fifteen isolates of bacteria were isolated from the Kekanadura Forest Reserve in Matara, Sri Lanka (5°98'51.79"N-80°59'12.90"E). Their N-fixing potential was confirmed by the widely used peptone water qualitative assay. Agriculturally important traits such as phosphate solubilization, synthesis of indole-3-acetic acid (IAA) and antagonisms against plant pathogen, *Sclerotium rolfsii* were also tested. Phosphate solubilization was tested by growing the bacteria in Pikovskayas agar medium, which contains calcium phosphate as the insoluble phosphate source. Strain DzpC, DzpE, DzpF, DzpQ and Azp1 showed clear zone surrounding bacterial growth indicating solubilization of phosphate in the medium. The IAA production was tested spectrophotometrically in broth cultures supplemented with tryptophan as the precursor molecule. Five strains, DzpC, DzpE, DzpF, DzpI and DzpQ produced IAA in the range of 9.9-64.1 mg/mL. The antagonistic potential of strains was tested in dual culture plate assay. Thirteen strains showed growth inhibition of *S. rolfsii* at varying degrees. Strain DzpC, DzpP and Azp1 showed the strongest antagonistic activity. When overall results were considered, DzpC, DzpE, DzpF, DzpI and DzpQ were the best performing strains. Bacteria were identified by their colony morphology and sequencing of 16S rRNA gene. Seven out of fifteen strains were morphologically similar to actinomycetes. Four strains were identified as *Bacillus toyonensis*, *Lysinibacillus macroides*, *Rhizobium tropici* and *Rhizobium* sp. by DNA sequencing. Since actinomycetes and endospore-forming bacteria such as *Bacillus* and *Lysinibacillus* are generally resistant to adverse environmental conditions, potential application of majority of the strains isolated in this study for commercial formulation in crop cultivation is high. Furthermore, since bacterial strains were isolated from the native soil, they are expected to have better adaptability to Sri Lankan soil compared to exotic strains.

Keywords: Biofertilizer, Diazotrophs, Nitrogen-fixation, Plant growth promotion

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ID 95

A GIS approach to assess the distribution patterns of nephrotoxic constituents in a CKDu prevalent area, Badulla district, Sri Lanka

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Abstract

Chronic Kidney Disease of unknown etiology (CKDu) has been a major public health concern in Sri Lanka for two to three decades. Consumption of water with nephrotoxic constituents is one of the major risk factors for CKDu. Hence, this study was carried out to investigate the distribution of nephrotoxic elements; Cadmium (Cd), Lead (Pb), Chromium (Cr), Arsenic (As), Zinc (Zn), Manganese (Mn), and Aluminum (Al) in Rideemaliyadda-South Grama Niladhari Division (GND), Badulla District, Sri Lanka using Geographical Information System (GIS) techniques. A total of thirty drinking water samples were collected according to the Random Stratified Design method and the concentrations of selected nephrotoxic elements were analyzed by using Inductively Coupled Plasma Mass Spectrometry (ICP_MS_Agilent_7800). Each analysis was performed in triplicates. The spatial distribution patterns of Cd, Pb, Cr, As, Zn, Mn, and Al were interpolated by the Inverse Distance Weighted (IDW) tool and Moran's Index (MI) tools in ArcMap software. The mean concentrations of Cd, Pb, Cr, As, Zn, Mn, and Al were 0.158 ± 0.032 , 1.722 ± 0.29 , 3.312 ± 0.185 , 2.401 ± 0.248 , 165.429 ± 22.015 , 55.458 ± 8.460 , and 45.995 ± 6.026 in $\mu\text{g/L}$, respectively. According to the spatial distribution results interpolated using the IDW tool, the concentrations of Cd, Pb, Cr, As, Zn, Mn, and Al were ranged from 0.010-1.788, 0.412-7.949, 0.481-7.809, 0.030-11.637, 13.670-1032.963, 10.258-204.615, 7.179-129.896, respectively in $\mu\text{g/L}$. According to the Moran's Index values resulting from the spatial autocorrelation, Cd (0.1803), Pb (0.2504), As (0.5611), and Mn (0.3806) distributions showed the clustered pattern while the Cr (-0.1505), Zn (-0.0012), and Al (-0.2833) showed a random distribution pattern. The spatial distribution maps of nephrotoxic element concentration revealed that most contaminated waters existed close to agricultural areas. Further, the results concluded that the health of the residents is at risk due to the long-term exposure to the contaminated drinking water with nephrotoxic elements, although the mean concentrations of analyzed nephrotoxic elements were not exceeded the drinking water quality standards recommended by the WHO. The study results can be utilized to monitor and plan to reduce water pollution by assessing the polluted sources and sites efficiently. The study recommends using innovative agricultural practices with the minimum use of synthetic agrochemicals to minimize the health impacts of excessive and long-term exposure to nephrotoxicants.

Keywords: CKDu, IDW, Moran's index, Nephrotoxic elements, Spatial distribution

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ID 102

A novel approach to determine the unknown concentration of a soil solution using UV spectrophotometer

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Abstract

Concentration is one of the primitive aspects in chemistry, which describes the extent of abundance of a solute in a given solution. Determining the concentration of a solution that does not has a chemical formula and with unknown molecular weight is one amongst the difficult topics. In this study, we have analyzed the concentration of such solutions using a comprehensive mathematics along with Beer – Lambert law for the UV spectrophotometer results. Experimental studies were conducted using the standard solutions of Biochar, Coir, Wood bark and Sawdust which were extracted from same *Coccus nucifera* species to verify the equality of concentrations. Solutions were prepared by mixing the raw materials with water at 1:2 (w/w) ratio. The hypothetical concentrations of solutions were in same range since each of the specimens contains similar type of organic content and all the solutions were prepared in same organic content: water empirical ratios. The objective of the study was achieved by proving that the concentration found using this novel approach for each specimen are almost equal since the specimens are from same origin, which simultaneously verified the hypothetical concentrations are same through mathematical computations. A comprehensive understanding in finite integrals is compulsory to get proficiency with this method. Furthermore, this approach is applicable to find the concentration of any soil solutions. The benefit of this model has vast scopes in future at resolving several queries related to medical, commercial, scientific, and industrial issues related to the concentration of solutions.

Keywords: Concentration, Beer-Lambert law, UV spectrophotometer, Finite integral

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ID 133

Soil organic carbon in mixed mangroves and monospecific stands; A case study from Rekawa and Kalametiya lagoons in Southern, Sri Lanka

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Abstract

The carbon sequestered and stored in mangrove ecosystems is a major component of “Blue Carbon” which is referred to carbon stored naturally in marine and coastal habitats, and it attracted a higher attention as it is more stable than other carbon pools. Therefore, this study investigated the influence of soil physicochemical properties i.e., pH, soil salinity, conductivity, soil moisture content (%), soil bulk density, soil porosity, phosphate content and nitrate content, on the stability of soil organic carbon (SOC) in mixed mangroves and monospecific stands. The study was carried out in Rekawa (mixed) and Kalametiya (monospecific) mangrove forests on the southern coast of Sri Lanka. The effect of soil properties on SOC along randomly selected line transects was measured and the influence was assessed by correlation analysis. According to the results, SOC contents of mixed mangroves and monospecific stands were significantly different, ranging from 0.026 to 0.722 gm⁻² in mixed mangroves while it differed from 0.034 to 0.454 gm⁻² in monospecific stands. The SOC was positively correlated with soil porosity and soil moisture content and negatively correlated with soil bulk density. Although salinity and conductivity were positively correlated with SOC in mixed mangroves, it turned to negative correlations in monospecific stands. Nitrate content was negatively correlated with SOC in mixed mangroves whereas it shows a positive correlation in monospecific stand. The pH and phosphate content showed no correlation with SOC in mixed mangroves, while pH was negatively, and phosphate content was positively correlated with SOC in monospecific stand. The finalized model which had the lowest Akaike Information Criterion (AIC) value in GLM analysis explained SOC, as a function of soil salinity, soil porosity and bulk density in mixed mangroves, in addition to those properties, pH, soil moisture content, soil phosphate content and nitrate content were significant properties for SOC in the monospecific stand. Further, it is recommended to investigate, SOC content/stability under different mangrove species densities and influence of other soil physico-chemical factors which are not discussed in this study in the future. The outcomes will be highly beneficial for mangrove replanting practitioners.

Keywords: Kalametiya, Mangroves, Physico- chemical, Rekawa, Soil organic carbon

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ID 15

Comparative account on chemical compositions and antioxidant potential of essential oils isolated from the leaves of two garcinia varieties grown in Sri Lanka

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Abstract

Sri Lankan flora *Garcinia quaesita* (Rath-Goraka) and *Garcinia zeylanica* (Kaha-Goraka) are indigenous to the country. Nonetheless, there are no adequate reports on chemical compositions (CCs) of essential oils (EOs) of both plants' leaves. The CCs and antioxidative capacity (AC) of isolated EOs from the leaves of both *Garcinia* varieties were investigated in the present study. The hydro-distilling technique with Clevenger type apparatus (plant: water; 1:5 w/v, 3 hours, 100 °C) was used to isolate the EOs, and CCs of the EOs were investigated by GC-MS analysis. The GC-MS data were compared with NIST 08 MS database to identify the CCs of the isolated EOs with a matching value of greater than 90%. AC of isolated EOs was determined by using the FRAP assay following literature protocols with Trolox as the standard. The hydro-distillation process yielded EOs of *G. quaesita* and *G. zeylanica* in the same quantity; 0.12% (v/w) on a fresh leaves weight basis. Based on the GC-MS analysis 33 different CCs have been discovered along with sesquiterpenes which are prominent in EOs. Out of twenty CCs identified in *G. quaesita*, fourteen of which are sesquiterpenes, with Copaene (19.39%) and Alloaromadendrene (12.12%) found in high concentration only in *G. quaesita*, whereas nineteen CCs were identified in *G. zeylanica*, seven of which are sesquiterpenes, with α -Cubebene (9.38%) found to be high only in *G. zeylanica*. Sesquiterpene such as Caryophyllene, and α -Humullene were identified in both *Garcinia* varieties, however, *G. zeylanica* had a greater concentration (12.94% and 11.24%, respectively) than the other. It is apparent that the EO of *G. quaesita* has the highest AC (274.74 \pm 1.32 μ L Trolox Eq/L) at the 5% significant level. In conclusion, even though many CCs were identified, based on the matching value (above 90%) and the NIST database, thirty-three CCs were discovered for the first time from the isolated EOs of *G. quaesita* and *G. zeylanica* leaves. *G. quaesita* EO appears to have more AC than *G. zeylanica* EO. The findings of both isolated EOs revealed that each type has its own character in terms of CCs.

Keywords: Antioxidants, Essential oil, *G. quaesita*, *G. zeylanica*, Hydro-distillation,

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Development of disease assessment key for bacterial rot disease and identification of high performing growth media for selected commercially grown *phalaenopsis* cultivars

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Abstract

Phalaenopsis is one of the major high value orchids with increasing demand and are cultivated as cut flower and pot plants in Sri Lanka. Production of quality planting material is significant to compete in global and local market. These plants are highly susceptible to bacterial rot and the growth media support the spread of the disease. The objectives of this study were, (a) to develop an assessment index for estimating bacterial rot disease severity of *Phalaenopsis* and (b) to estimate the growth performance of *Phalaenopsis* cultivars in different growth media in order to establish a suitable low-cost growth medium. The experiments were carried out in a selected plant nursery and the growth performance was assessed using number of leaves per plant, length, and width of the leaves as growth parameters. A disease severity scale was developed, by assessing the intensity of bacterial rot considering the colour change of the leaf due to the infection. Colour change indicates the breakdown of photosynthesis pigments leading the development of pale green colour on the leaf surface. Growth performances of two stages of two *Phalaenopsis* cultivars; *Phalaenopsis amabilis* and *Phalaenopsis* Antonio Caruana ("Roma") grown in four growth media; T₁- charcoal with coconut husk pieces (1:1), T₂ - pine bark with mosses (1:1), T₃ cemented regifoam boards and T₄- metal chips with coir dust (1:1) were evaluated. Among the four-growth media, T₄ has shown the highest growth performance. Based on the observations made using the developed disease severity index, it can be recommended that, the application of control measures at or early stage of 50% of disease severity is needed for the successful control of the bacterial rot in *Phalaenopsis*.

Keywords: Disease severity, Growth media, Growth parameters, *Phalaenopsis*

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ID 51

Evaluation of *in vitro* antibacterial activity of two blue flower forms of *Clitoria ternatea* L. against selected strains of human pathogenic bacteria

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Abstract

In recent years, infectious diseases have risen dramatically in prevalence, becoming a major worldwide health concern. The advent of antibiotic-resistant bacterial strains, as well as the associated side effects and toxicities, has challenged the efficiency of many antibiotics, resulting in inefficient therapy. Thus, discovering alternative antimicrobial agents with higher efficacy and lesser toxicity is of utmost importance. In this context, the utilization of natural herbs used in traditional medicine for identifying potential antimicrobial agents has attracted the interest of many researchers and practitioners. Despite the wide variety of therapeutic capabilities, *Clitoria ternatea* L. is an underutilized medicinal plant. In this study, the antibacterial potential of *C. ternatea* L. blue paired flowers (corolla with standard five petals) and blue solitary (corolla with one large standard petal, two wrinkled wings, and two white keels) flowers were evaluated against the selected control strains of human pathogenic bacteria, *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. The Soxhlet extraction technique was used to prepare the solvent extracts (ethanol, ethyl acetate, dichloromethane, chloroform, petroleum ether, and hexane) of each flower form. The minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were determined using a broth microdilution assay in Mueller-Hinton broth in 96-well microtiter plates. The highest extraction yield percentages (W/V) were obtained from the ethanol extracts of blue paired (21.02%) and blue solitary (10.06%) flowers. The results of broth microdilution assay revealed that all the *C. ternatea* blue paired and blue solitary solvent extracts were effective against strains of *S. aureus* and *E. coli*, whereas *P. aeruginosa* was resistant to all the tested petroleum ether and hexane extracts. The dichloromethane and chloroform (MIC and MBC values ranged from 0.13 mg/mL to 2 mg/mL) extracted blue paired and blue solitary flower forms have shown significant antibacterial activity ($p < 0.05$). Further, the study showed that different solvent extracts from the same plant flowers had varying degrees of inhibition when tested against different bacteria. Thus, the current investigation verifies the therapeutic use of *C. ternatea* blue flowers in traditional medicine and demonstrates their potential to be exploited in the discovery of novel antimicrobial agents, which is an important step forward.

Keywords: Antibacterial activity, Antibiotic resistance, Antimicrobial agents, *Clitoria ternatea* L., Solvent extraction

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ID 89

Effect of the Leaf Trichome Types, Density and Length on Selected Behavioural and Physiological Characteristics of *Deltocephalus menoni* (Hemiptera: Cicadellidae); Vector of Sugarcane White Leaf Disease

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Abstract

Trichome act as physical deterrents to insects on the plants and it is important for the resistance against insect herbivores. This study was conducted at the Sugarcane Research Institute (SRI), Uda Walawe with the objective of determining the effect of trichome type, density, and length on selected behavioural and physiological characteristics of *Deltocephalus menoni*, the vector of sugarcane White Leaf Disease (WLD) in Sri Lanka. Trichome types, density and morphology on leaf blade and midrib of ten sugarcane varieties/ accessions were studied with the behavioural characteristics of *D. Menoni*: aggregation, amount of feeding, and physiological characteristics namely, fecundity, nymphal development, and adult longevity on the same varieties/ accessions. Morphologically different four trichome types were recorded on test sugarcane varieties/ accessions and trichome density and lengths were significantly varied with the sugarcane variety on both leaf blade and the mid rib. Behavioural and physiological characters were also varied with the variety. Significantly positive correlations were observed between trichome density and length with study characteristics at 5% probability. Significant and positive correlations observed for nymphal period with trichome density on leaf lamina ($r = 0.47$, $n = 90$) and the mid rib ($r = 0.45$, $n = 90$) showing retarded development of nymphs on varieties with high trichome densities. Trichome length on leaf lamina showed positive and significant correlations with amount of feeding ($r = 0.62$, $n = 90$), adult conversion rate ($r = 0.54$, $n = 90$) and adult longevity ($r = 0.66$, $n = 90$). Trichome length on mid rib also showed similar type of relationship with amount of feeding ($r = 0.55$, $n = 90$), adult conversion rate ($r = 0.55$, $n = 90$) and adult longevity ($r = 0.64$, $n = 90$) illustrating that sugarcane varieties consist with higher trichome lengths enhances the studied characteristics of the vector on the leaf. The results imply that the feeding, survival, and longevity of *D. menoni* increases on sugarcane varieties with higher trichome lengths and densities providing higher opportunities for the vector to transmit the disease.

Keywords: *Deltocephalus menoni*, Leaf trichome, Sugarcane white leaf disease, Vector

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ID 92

Effect of ZnSO₄ on Cane Quality of the Variety SL 96 128, under Alfisols at Uda Walawe, Sri Lanka

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Abstract

Low sugar recovery experienced during the last few years has become a challenging issue for the Sri Lankan sugarcane industry. Enhancement of cane quality is one of the solutions to overcome this problem. The application of Zinc sulphate (ZnSO₄) as a soil amendment is practiced in some countries to enhance the quality of the cane. Therefore, this study was conducted to evaluate the effect of ZnSO₄ application on cane quality of commercial sugarcane variety SL 96 128 which is widely grown in Alfisols in Sri Lanka. A field experiment was conducted at the research farm of the Sugarcane Research Institute, Uda Walawe under irrigated conditions using RCBD with Five replicates. In addition to the recommended amounts of fertilizers (Urea-325 kg/ha, Triple Super Phosphate-50 kg/ha, Muriate of Potash-225 kg/ha), 7.5 kg/ha of ZnSO₄ (Zn - 22%) was applied to treated plots (T1) at 3 months of the crop age and untreated plots (T2) were maintained without ZnSO₄. The cane quality parameters: *i.e.*, Brix%, Pol% (Sucrose content), Purity%, Fiber% and POCS% (Pure obtainable cane sugar) were measured at 10, 11 and 12 months of crop ages and cane and sugar yields (t/ha) were estimated after harvesting the crop at 12 months. ANOVA was performed by using SAS statistical software to identify the effect of ZnSO₄ on cane quality. The temporal variation of quality parameters was assessed by carrying out two separate regression analyses for T1 and T2. The untreated plots (T2) showed a significant (P<0.001) declining trend for Brix%, Pol%, Purity%, and POCS% during 10 to 12 months period. At harvest, T1 recorded significantly high Pol % (14.73, 13.04), Purity % (91.60, 85.97), POCS % (11.35, 9.68) and sugar yields (10.60, 8.73) compared to T2 (at P<0.05). However, cane yields of T1 (93.67) and T2 (90.42) were not significantly different. This preliminary study revealed that there is a significant positive effect from soil micronutrient, Zn on cane quality parameters of the variety SL 96 128.

Keywords: Cane quality, Recovery, Sugarcane, Zinc sulphate

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ID 125

Effect of soil physicochemical factors on the growth of algae as a mat on soils in paddy fields; A case study in Hambantota district, Sri Lanka

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Abstract

The growth of algae as a mat on paddy soil in some fields of the Southern part of Sri Lanka, especially in Hambantota district is a challenge for rice cultivation. Rice seedlings entangled in algal mats result empty patches in the field. Determination of the effect of soil properties on luxuriant growth of algae is significant for planning controlling strategies as soil properties are highly influential on the biodiversity and the ecological cycle of life on soil in the paddy field ecosystem. The study aimed to determine the effect of major soil physicochemical factors on the development of algae as a mat on the paddy soil in Hambantota district. The results of the preliminary study conducted in the selected fields from five different locations (Godigamuwa, Netolpitiya, Thissamaharamaya, Weeravila, and Bandagiriya) in Hambantota district showed the presence of significantly ($p < 0.05$) higher biomass ($105.06 \pm 26.68 \text{ g m}^{-2}$) of algae in Godigamuwa at the early seedling stage (7 days old) compared to all other tested fields. Therefore, Godigamuwa was selected for further studies and algal and soil samples ($n=3$) were collected randomly from the fields at the tillering phase. Soil salinity, pH, conductivity, organic matter content (OM), gravimetric water content (GWC), available PO_4^{3-} , NO_3^- , and algal biomass were determined using the standard methods. Principal Component Analysis (PCA) and correlation analysis (CA) revealed the inter-correlation between analyzed soil physicochemical properties and algal biomass. Algal biomasses range from 142 g m^{-2} to 411 g m^{-2} and *Oscillatoria* sp. was identified as the dominant algal species inhabited in the algae mat. All the pH values were slightly acidic and the available soil PO_4^{3-} and NO_3^- concentrations were ranged between $0.5\text{-}0.18 \text{ mg kg}^{-1}$ and $2.36\text{-}6.39 \text{ mg kg}^{-1}$, respectively. Algal biomass showed a significant positive correlation with NO_3^- ($r=0.518$, $p < 0.05$) which significantly correlated with the salinity ($r=0.477$, $p < 0.05$) and conductivity ($r=0.433$, $p < 0.05$). Soil pH, OM, GWC, and available PO_4^{3-} have no significant relationship with the algal biomass. The present study concludes that the development of algae as a mat depends mainly on available NO_3^- content, salinity, and conductivity in paddy soil.

Keywords: Algae mat, Algal biomass, Paddy soil, Physicochemical properties

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ID 131

Comparison of paddy straw and paddy husk as mulching materials in Turmeric (*Curcuma longa* L.)

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Abstract

Soil and water management is equally important as same as quality of planting material for getting high yield of turmeric (*Curcuma longa* L.). Among management practices, mulching plays a critical role in conserving soil moisture, enhancing soil temperature for proper germination of rhizome, improving soil physical properties, suppressing weed growth, enriching soil fertility after decomposing mulching materials and preventing leaching from soil nutrients. Therefore, present study was carried out to compare the effect of two abundant mulching materials, paddy straw and paddy husk on the growth and yield of turmeric at the Faculty of Technology, University of Ruhuna, Sri Lanka from January 2021 to December 2021. The treatments used in this study were paddy straw (T₁), paddy husk (T₂) and control (T₀) without any mulching material. The experiment was laid out in a Randomized Complete Block Design with three replicates and twenty-four plants were used for one replicate in four rows with 30×30 cm spacing. After 11 months, plant height (cm), number of leaves, number of tillers/plants, leaf length (cm), leaf width (cm), fresh rhizomes weight (g), number of mother rhizomes/plant, number of primary fingers/plant and number of secondary fingers/plants were measured. Analysis of Variance was performed to determine the significant differences among T₁, T₂, and T₀. Plant height (162.45 ± 16.27 cm), number of tillers (6.07 ± 1.68), leaf width (15.5 ± 2.96 cm), fresh rhizomes weight (1560.9 ± 775.68 cm), number of mother rhizomes (6.4 ± 1.94), number of primary rhizomes (32 ± 14.19) and number of secondary rhizomes (93.5 ± 36.06) were significantly higher in T₂ than control treatment (P<0.05). There were no significant differences between the parameters of T₁ and T₂ or T₁ and T₀. Significant correlations were found between number of leaves with the fresh rhizome weight (r=0.678, α=0.01), number of tillers (r=0.874, α=0.01) and with the fresh rhizome weight (r=0.653, α=0.01) in control treatment. In treatment T₁, significant correlations were found between the same parameters, the number of leaves and the fresh rhizome weight (r=0.795, α=0.01), and number of tillers with the fresh rhizome weight (r=0.738, α=0.01). In treatment 2, number of leaves (r=0.795, α=0.01), number of tillers (r=0.738, α=0.01) and leaf length were (r=0.408, α=0.05) significantly correlated with the fresh rhizome weight. Paddy husk and paddy straw had similar impact on the growth and yield of turmeric except that paddy husk significantly increased the leaf length of turmeric. Increasing leaf length directly increases the sink capacity and consequently, it contributes to the yield increment of turmeric.

Keywords: Growth, Mulching, Paddy husk, Paddy straw, Turmeric, Yield

ID 109

Disease transmission proficiency of *Deltocephalus menoni* (Hemiptera: Cicadellidae); vector of sugarcane white leaf disease

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Abstract

Sugarcane White Leaf Disease (WLD) is one of the most devastating phytoplasma disease which cause heavy losses to the sugar cane industry in Sri Lanka. Leaf hopper, *Deltocephalus menoni* (Hemiptera: Cicadellidae) is the locally identified vector of WLD. Disease transmission proficiency of the vector is a key factor to consider in disease management. Therefore, this study was conducted to (a) find out the ability of males, females, and nymphs of *D. menoni* in transmitting the WLD and (b) determine the level of persistency of *D. menoni* in WLD phytoplasma (WLDP) transmission. To determine the percentage WLD transmission by virulified *D. menoni* males, females, and nymphs were introduced to one-month-old healthy potted plants in insect proof field cages for a one-week period. Test plants were maintained until WLD symptom development. In estimating the WLD transmission pattern of *D. menoni*, virulified one-day-old adult females were introduced to the healthy sugarcane plants allowing them to feed on healthy plant for 24h period. Then they were recollected and introduced to another set of healthy sugarcane plants. Above procedure was repeated in 24h frequency for 13 days. Test plants were maintained in insect proof field cages for three-month period. Presence of WLDP in the tested plants was confirmed by PCR with phytoplasma specific SPP1/SPP2 primers. Under local conditions, female and male adults, 2nd and 4th instar nymphs were capable of transmitting the WLDP to the healthy plants in a rate of 55.5, 44.5, 22.2 and 33.3%, respectively. Transmission efficiency of females is comparatively high. Adult female of *D. menoni* was capable to transmit the disease from just after acquisition of the WLDP up to maximum of 11 days. Results imply that *D. menoni* is incapable to propagate the WLDP within its body and circulative transmission dose not occurred within the insect. *D. menoni* is an efficient vector in secondary transmission of the WLD and it is a semi-persistent vector. Due to semi-persistent nature of the vector, the management practices are vital to prevent rapid spread of this disease in sugarcane plantations.

Keywords: *Deltocephalus menoni*, Leaf disease, Sugarcane white transmission, Vector

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ID 111

Fungal community associated with different stages of pathogenesis of Rough Bark Disease of cinnamon in major cultivation regions of Sri Lanka

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Abstract

Rough bark disease (RBD) is an economically important disease in cinnamon grown in Sri Lanka. The aim of the present study was to determine the fungal genera/species consistently associated with the RBD-infected stems and their relative abundance at different stages of the pathogenesis. Cinnamon stems showing typical RBD symptoms of initial, moderate, and severe stages of the disease development were collected from a total of 41 fields in Galle, Matara, Ratnapura, Kalutara and Matale districts. Fungi were isolated using PDA medium and identified based on their colony and spore morphology. Morphologically different fungal isolates which were consistent to different locations of a selected district and different disease developmental stages were proved for pathogenicity by standard Koch's rules under field conditions. Data collected was used to calculate colony forming unit (CFU) richness, fungal colony abundance, relative abundance of morphologically identified fungi and Shannon-Wiener diversity index. A total of 2407 different fungal isolates were obtained as pure cultures and based on the colony and spore morphology, they were grouped as Pestalotia-like (1909), Colletotrichum-like (150), Botryodiplodia-like (213), Phomopsis spp.-like (110), Trichoderma spp. (2) and unidentified fungi (23). A representative set of fungi of the above categories were identified by molecular methods as Pestalotia spp., Colletotrichum spp., Botryodiplodia spp., Phomopsis spp. and Trichoderma spp. Fungal CFU richness did not differ significantly among the districts but differed among the disease developmental stages. Fungal abundance significantly varied among the districts from where the samples were collected ($P < 0.05$). Fungal diversity index differed significantly among disease developmental stages ($P < 0.05$) having the highest at the severe stage. Relative abundance of Botryodiplodia, Colletotrichum and Pestalotia spp. differ significantly ($P < 0.05$) among the disease developmental stages. No significant difference for the relative abundance of Botryodiplodia spp., Colletotrichum spp., Pestalotia spp., Phomopsis spp. and Trichoderma spp. among the districts ($P > 0.05$). Findings confirmed that consistent association of Pestalotiopsis, Colletotrichum, Botryodiplodia and Phomopsis spp. (which were proven to be pathogenic) with RBD infected stems with a shift of their relative abundance among the disease developmental stages.

Keywords: Abundance, Fungal diversity index, Molecular identification, Morphological, Richness

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ID 119

A simple method for the preparation of permanent mounts of freshwater cyanobacteria for light microscopy

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Abstract

Taxonomic studies of microalgae in many laboratories use drawings, photographs, and type-specimens because, continuous maintenance of live specimens is mostly impractical. The most common and easy-to-handle type-specimens for microalgae are permanent slide preparations. Although there are established methods for preparing permanent slides for diatoms and green algae, no such methods have been developed specifically for cyanobacteria. Therefore, the objective of the present study was to develop a simple method for the preparation of permanent microscopic slides for freshwater cyanobacteria. Six species were selected to represent three forms of cyanobacteria, filamentous, unicellular colony-forming and unicellular non-colony-forming for the preparation of slides. Two acidic dyes, Fast Green and Brilliant Blue were used along with Mayer's egg albumin adhesive agent, fixative, dehydration and clearing agents. In the procedure with Fast Green, we used acetic acid: 96% ethanol (1:3) as the fixative in combination with gentle heat fixation. The specimens were dehydrated using a series of acetic acid and 96% ethanol solutions with different retention times. Finally, cleared with Xylene and mount on a drop of Canada balsam. This method successfully stained filamentous cyanobacteria. However, it poorly stained colony forming *Microcystis*. Apparently, the mucilage of the colony does not allow penetration of the dye to reach cells that are embedded within the mucilage. When this procedure was used for *Synechococcus*, which consists of single cells, those cells were loosely adhered to the glass slide and easily washed out. Therefore, a modified method was developed with Brilliant Blue including steps to overcome poor staining of colony forming cyanobacteria and loose adherence of unicellular non-colony forming cyanobacteria. Specimens were fixed to the glass slide using gentle heat and dehydrated using a series of 30-70% ethanol with various retention times. This modified method was able to stain *Microcystis*, *Synechococcus* and filamentous cyanobacteria. Slide preparations were found well preserved in terms of color and cellular structures when observed after 10 months of storage at room temperature. We recommend the method developed with Fast Green particularly for filamentous cyanobacteria while the method developed with Brilliant Blue for all three forms of filamentous, unicellular, and colony-forming cyanobacterial species for the preparation of permanent slides.

Keywords: Brilliant Blue, Cyanobacteria, Fast Green, Permanent slides

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ID 120

Evaluation of volatile antifungal properties of cinnamon leaf and bark oils for managing banana anthracnose disease caused by *Colletotrichum musae* at post-harvest stage

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Abstract

High postharvest losses occur in bananas due to the banana anthracnose disease. Application of cinnamon oil against the banana anthracnose pathogen is an effective solution for the postharvest losses. The volatile antifungal properties of cinnamon oil were evaluated against *Colletotrichum musae*, the causal agent of banana anthracnose disease under *in vitro* and *in vivo* conditions. The pathogen was isolated from infected banana fruits and cultured on potato dextrose agar (PDA). The antifungal efficacy of cinnamon oils on *C. musae* was evaluated *in vitro* using a series of volumes of the oils (0.1 – 4.4 µl/cm³), using a culture chamber method. The *in vitro* test revealed that 0.1 µl/cm³ level was sufficient to suppress the mycelia growth and spore germination of *C. musae*. For the *in vivo* evaluation, artificially inoculated banana fruits at the ripening stage were exposed to 25%, 50% and 100% concentrations of cinnamon leaf oil and bark oil (0.1 µl/cm³) at room temperature (27 °C) under ambient light to evaluate the anthracnose lesion development on the fruit surfaces. Average diameters of the lesions were recorded in 12 and 14 days after treatments. The minimum level to achieve significant lesion inhibition ($p < 0.005$) without damaging the fruit peel was the 50% concentration of cinnamon bark oil. Physical, chemical properties and organoleptic properties of the treated banana were evaluated along with the untreated fruits to assess their eating quality. The oil treatments did not significantly change the organoleptic properties of Cavendish banana except the taste, in which the leaf oil treated sample received less score. Fruit firmness of cinnamon bark oil and leaf oil treated banana samples were 3.44 N and 1.46 N, respectively compared to the control (3.2 N) ($p < 0.005$). The pH and titratable acidity of bark oil and leaf oil were 6.08, 5.72 and 1.50%, 0.99%, respectively ($p < 0.005$). The total soluble solid content of leaf oil treated sample was 22.90 % of Brix while that of bark oil was 26.40% of Brix. It was concluded that, among the treatments used Cavendish banana exposed to 50% cinnamon bark oil is the most effective for the control of banana disease without compromising fruit quality parameters under the tested conditions.

Keywords: Banana, Cinnamon leaf and bark oil, *Colletotrichum musae*

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ID 134

Evaluation of potential toxicity of wastewater from automobile service stations by using *Lemna minor* L

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Abstract

Automobile service industry is one of the leading producers of wastewater with different types of potential toxicants such as oil, grease, detergent and etc. Therefore, wastewater may affect negatively on different ecological receptors in receiving environments. Hence, it is important to characterize potential toxicity of wastewater before being discharged from automobile service stations in order to ensure environmental wellbeing. The study aimed to evaluate the potential toxicity of wastewater generated from automobile service centers by using *Lemna minor* which is widely used indicator plant in ecological risk assessments. Apparently, healthy *Lemna minor* plants were exposed to series of treatments containing 0%, 10%, 20%, 30%, 40%, 50% and 100% wastewater for 7 days. Sterilized distilled water was used as the control. The experiment was designed according to the randomized block (CRBD) by using three replicates for each treatment and control. The analyzed endpoints were relative growth rate (RGR), root number, root elongation and chlorophyll contents (chlorophyll a, chlorophyll b and total chlorophyll). The data were analyzed by employing one-way ANOVA followed by Tukey's post hoc test. All the end points measured from the treatments showed contamination level dependent significant ($P < 0.05$) decrease among the treatments and between each treatment and control. The recorded contamination level dependent significant ($P < 0.05$) negative RGR from the treatments with 30-100% wastewater (respectively $-0.0079 \pm 0.00079 \text{ gg}^{-1}\text{day}^{-1}$, $-0.0247 \pm 0.00247 \text{ gg}^{-1}\text{day}^{-1}$, $-0.0435 \pm 0.00529 \text{ gg}^{-1}\text{day}^{-1}$, $-0.1481 \pm 0.01938 \text{ gg}^{-1}\text{day}^{-1}$) inferred the growth inhibition. The calculated IC_{50} values based on the recorded inhibition in root number, root elongation, chlorophyll a, chlorophyll b and total chlorophyll contents from the treatments were 23.11%, 23.11%, 40.76%, 38.97%, and 38.977%, respectively. The recorded inhibitions in RGR and in the measured end points inferred the potential toxicity of wastewater generated in the service station highlighting the suitability of *Lemna minor* for the evaluation of toxicity.

Keywords: Automobile service centers, End points, *Lemna minor*, Toxicity, Wastewater

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Poster Presentations

ID 24

Organic agriculture as a means of reducing ecological footprint: A review

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Abstract

Farming intensification has been regarded as the most viable method to feed the world's rapidly rising population, owing to its greatly increased food production capability within changing environmental conditions. However, due to adverse management practices, application of high rates of agrochemicals and many other unsuited farming activities, intensified farms cause lots of environmental consequences. The emission of greenhouse gases mainly leads to global warming and the degradation of farmlands by converting them into unsustainable lands that could have otherwise been used effectively as agricultural production systems for a longer period. The Ecological Footprint (EF) is one of the best indicators for evaluating biologically productive land and water areas that are required for an individual or activity to meet all current consumption levels while using prevalent common technologies and resource management procedures, according to the sustainable development concept. This EF is widely used around the world for sustainability assessments. This review paper attempts to identify the potential of organic agriculture as a sustainable solution for reducing EF. In Agriculture, EF can be used to assess the ecological impacts of various agricultural production systems. People are now concerned about reducing the harmful effects of unsustainable farming practices on the environment and societal health. In comparison to unsustainable intense commercial farming methods, organic agriculture (OA) is better adapted to achieve targeted production levels in agriculture. Many agronomical practices, such as crop diversification, crop rotation, increasing the efficiency of nitrogen fertilizer usage, activities that increase soil carbon sequestration, and reduced or zero tillage practices combined with crop residue retention and nitrogen fixation using pulses, can reduce EF in OA.

Keywords: Ecological footprint, Greenhouse gases, Organic agriculture, Soil carbon sequestration, Sustainability assessments

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ID 43

Selecting efficient treatments to phytoremediate nitrate contamination in well water, ex-situ, using *Ipomoea aquatica*

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Abstract

Ipomoea aquatica has been identified as a potential plant to phytoremediate nitrate contamination of water. This study was conducted to select efficient treatments using *Ipomoea aquatica* to reduce nitrates in groundwater ex-situ and to get adequate nitrate-safe leafy vegetables. Groundwater samples were collected from a nitrate-contaminated well in the Chunnakam aquifer and analyzed for nitrate content. The experiment was conducted in plastic containers having 3.7 liters of groundwater in three-factor factorial design with three replicates, in. The factors were numbers of plants (5/10), water refilling (without a refill/refill up to the initial mark weekly), and foliar fertilizer application (without/with foliar fertilizer-FF). An organic formulation containing banana pseudostem liquid and Panchagavya was used as a foliar fertilizer. Treatments were, T1- 5 plants alone (PA), T2- 5 plants + FF, T3-10 PA, T4- 10 plants + FF, T5- 5 PA + refill, T6- 5 PA + refill + FF, T7- 10 PA + refill, T8- 10 plants + refill + FF. The pre-germinated two weeks old seedlings of *Ipomoea aquatica* were placed in plastic net trays above the containers having water in such a way that the roots were immersed in water. Nitrate in water was analyzed initially and at weekly intervals. Fresh weight, dry weight and $\text{NO}_3^- - \text{N}$ (Nitrate Nitrogen) of plants were measured after harvesting, at the end of three weeks after treatment. Initial nitrate in water was 138 mg/L. The treatments with 10 plants removed significantly higher nitrate reaching the safe level (below 50 mg/L). However, the available volume of water at the end was the lowest in T3 and T4, while T7 and T8 had the initial volume, indicating the efficiency of refilling. The lowest NO_3^- in treated water (23.46 mg/L) and the highest $\text{NO}_3^- - \text{N}$ in plants (55.84 mg/kg) were recorded in T8. According to the acceptable daily intake (ADI) limit of $\text{NO}_3^- - \text{N}$ as 3.7mg/kg body weight/per day, this phyto-remediated *Ipomoea aquatica* could be used as a vegetable without any harmful effect. It can be concluded that T7 (10 PA + refill) and T8 (10 plants + refill + FF) could be used by households to treat nitrate polluted well water while getting fresh leafy vegetables.

Keywords: Groundwater, *Ipomoea aquatica*, Nitrate, Phytoremediation

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ID 67

Silicon requirement for growth and yield of *indica* rice (*Oryza sativa*. cv 'Bw 367')

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Abstract

It has been estimated that a 50% increase in the major food crop yields, including rice, is needed to feed the projected population by 2050. In this regard, Silicon fertilization, has been identified as an effective approach to increase the growth and yield of rice. Continuous cultivation of high-yielding rice genotypes removes silicon from the soil. Therefore, soil available silicon must be replenished to ensure sustainable production. As a scanty of information is available on the silicon requirement of the *indica* rice, a pot experiment was carried out to identify the silicon requirement of an *indica* rice using Bw 367, a high yielding, silicon responsive, and popular genotype. Each experimental unit contained four uniformly grown seedlings. The experiment was arranged in RCBD with three replicates. Silicon was applied to the soil at the rates of 0, 50, 75, 100, 125, and 150 kg SiO₂/ha as a basal dressing. At harvesting, plant height (PH), shoot dry weight (SDW) and yield attributes such as number of tillers per plant (TP), total number of grains per panicle (TG), total number of filled grains per panicle (TFG), total unfilled grains per panicle (TUG), 1000-grain weight (TGW) and grain yield (GY) were recorded. Data were analyzed using SAS. Both PH and SDW were significantly increased with added silicon, and a 52% increment in SDW was observed at 100 kg SiO₂/ha rate, while TP and TGW were not significantly affected by silicon. The TFG was increased with the application of Si at 100 kg SiO₂/ha over the control by about 51%. With the application rate of 100 kg SiO₂/ha, a 30% reduction in TUG was found, which was statistically equal to 125 kg SiO₂/ha. Plants fertilized with 100 kg SiO₂/ha produced the highest TG (392 grains). According to the quadratic function, the optimum grain yield was found at a rate of 115 kg SiO₂/ha. It could be concluded that addition of silicon improved the growth and yield of rice. Basal application at the rate of 115 kg SiO₂/ha was identified as the best rate to achieve the optimum yield.

Keywords: Optimum yield, Silicon rates, Silicon uptake, Yield attributes

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ID 126

Quality profiles of commonly available compost brands in the markets of Southern province, Sri Lanka

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Abstract

Compost is humus like stable product generated by an aerobic biological decomposition of organic matter. In agriculture, compost is widely used as a soil conditioner in-order to improve soil properties. But it is important to standardize compost as similar to the inorganic fertilizers. Different compost brands without proper quality assurance have been introduced to the market with the decision by the Government of Sri Lanka to shift agriculture completely from inorganic to organic inputs. The study aimed to identify the quality profile of commonly available compost brands in the market of Southern Province, Sri Lanka in order to examine their compliance with the standards of Sri Lanka Standards Institution (SLSI) for municipal solid waste compost, under schedule number SLS 1634:2019. Eight commonly available compost brands were sampled from the market in the Southern province. The laboratory analyses were performed in triplicates according to the standard methods available in SLSI standards manual and in other literature to determine physico-chemical and biological parameters including colour, odour, particle size, pH, electrical conductivity, percentages of sand, moisture, total carbon, nitrogen, phosphorus, and potassium, selected heavy metal contents (Cd, Pb), fecal coliforms and viable weed seed content. Data were analyzed by employing one sample t-test. According to the results, none of the samples was compatible in 100% with the considered quality standards. The major nutrient contents: Nitrogen ($0.45 \pm 0.01\%$ - $1.29 \pm 0.01\%$), Phosphorus ($0.79 \pm 0.01\%$ - $3.62 \pm 0.04\%$) and Potassium ($1.03 \pm 0.00\%$ - $1.38 \pm 0.01\%$) were found to be low in 62.5% of the tested brands being unsuitable to be used as fertilizers while the rest (37.5%) had all the major nutrients adequately as recommended by SLSI. The C:N ratios ranged from 17.33 to 39.46. The resulted higher C:N ratios than the prescribed upper limit of the SLSI in 62.5% of the tested brands inferred insufficient maturity of the composts or use of low-quality organic matter with high carbon content for the compost production. Therefore, the overall results of the study highlight the need of the proper assessment and standardization of the quality profile of the compost prior to being released to the market.

Keywords: Compliance, Compost, Quality, Standard

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ID 16

Comparative study of different extraction techniques on phytochemical extraction of *Eryngium foetidum* leaves

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Abstract

The isolation of desired active compounds from plant-based materials is largely dependent on the extraction method performed. As a result, the purpose of this work was to evaluate the different extraction techniques based on the phytochemicals and antioxidant capacity of *Eryngium foetidum* leaves. During the analysis, water was utilized as the solvent, four extraction approaches were used: sonication (E1, one hour, RT, 40 kHz), Soxhlet (E2, six hours, 105 °C), maceration with agitation (E3, six hours, RT, 1000 rpm), and maceration with agitation upon heating (E4, six hours, 60 °C, 1000 rpm). The extracts were concentrated using a freeze dryer, and the obtained crude powder was used for further analysis. Standard methods were used for phytochemical screenings and quantification of total phenolics content (TPC), total flavonoids content (TFC), total tannins content (TTC), terpenoids content (TC), saponins content (SC), and alkaloids content (AC), while FRAP and DPPH assays were used to evaluate antioxidant capacity. The results showed that *E. foetidum* contains a diverse array of phytochemicals, with the TPC, TTC, TC, and SC account presenting to be higher in the extraction process E4 (37.37 ± 0.65 mg GAE/g, 36.99 ± 0.64 mg TAE/g, 0.89 ± 0.01 mM LE/g and 185.84 ± 0.54 mg SE/g, respectively) and lower in the technique E1. TFC levels were high in E2 (11.84 ± 0.14 mg QE/g), but TFC levels were low in E3. Further, AC was determined to be greater in E3 (1.67 ± 0.01 mg AE/g) and lower in E2. Total antioxidant capacity by FRAP assay was higher in E4 (47.17 ± 0.20 mg Trolox Eq/g) and lower in E1. The DPPH radical scavenging assay IC50 value in E3 was low (12.91 ± 0.02 mg/ml), indicating significant scavenging activity than others. In conclusion, the extraction technique E4 is a suitable method to extract antioxidants and polyphenolics from *E. foetidum* leaves. Because the amount of phytochemicals and antioxidant capacity vary according on the extraction procedure, an extraction method that is appropriate for the application should be chosen.

Keywords: Antioxidants, Extraction methods, *Eryngium foetidum*, phytochemicals

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ID 32

Knowledge, attitude, and perception (KAP) of university students towards mangrove ecosystems conservation in Sri Lanka

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Abstract

Mangrove ecosystems are identified as one of the most productive ecosystems and provide a range of ecosystem services, yet they have been heavily subjected to the decline over past years. Therefore, enhancing the knowledge, attitude, and perception (KAP) on mangroves conservation among stakeholders, especially, youth is one of possible strategies for the long-term mangrove conservation and management. In addition, this practice also can incorporate in national planning while fulfilling some research gaps in the field of mangrove ecosystems conservation. The present study was conducted to quantify the KAP and to assess the suitability of using university students towards sustainable mangrove ecosystems. This research was carried out as a questionnaire survey among students (n=527) representing 30 universities studying in the 2020-2021 academic period adopting a random sampling technique. Through the questionnaire, the level of KAP towards mangrove forest conservation among students was evaluated and quantified. Cronbach's alpha reliability test (Cronbach's alpha = 0.823) was followed to test the reliability of data. The study findings asserted that the range of Likert scaled score (5-highest and 1-lowest) for the knowledge assessment criteria was 3.5 to 4.5 scale. Further, attitude assessment criteria were in between 3.0 to 4.6 distributions whereas the perception criteria showed a score level from 4.0 to 4.7. Furthermore, it was noted that there exists a positive relationship between KAP components, as per the linear regression models of attitude and knowledge, perception and knowledge, and perception and attitude were significant. According to the linear regression models we tested for each component, the complete model designed to evaluate the effect of attitude ($p < 0.001$) and perception ($p < 0.001$) on the knowledge component received 98% of the weight when selecting the best model with Akaike Information Criterion to determine the relationships between components. Hence, the model asserts the significance and synergy of attitude and perception components for knowledge as the results were significant and positively correlated. The study findings suggest that as the students are aware of the importance of mangroves and conservation value and there exists a higher potential to employ their contribution to mangrove conservation projects research activities and community awareness.

Keywords: Conservation strategies, Knowledge-attitude-perception, Mangrove ecosystems, Sustainable management, University students

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ID 58

Effect of seed priming with polyamines on seed germination under stress conditions

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Abstract

Seed germination is one of the critical and sensitive stages of plant development and is affected by stresses. Polyamines (PAs) are aliphatic amine growth regulators playing key roles in plant development and defense. Diamine putrescine (Put), triamine spermidine (Spd), and tetramine spermine (Spm) are the most common free PAs in plants. The study was conducted to explore the benefits of seed priming with PAs on seed germination under stress conditions; for tomato (*Solanum lycopersicum* L.) under water stress and for rice (*Oryza sativa* L.) under Aluminium (Al^{3+}) stress. Tomato and rice seeds were surface sterilized and primed with 50 μ M and 1mM PAs solutions respectively or with sterile distilled water (controls). Pre-soaked 10-15 seeds were placed on filter papers and water stress for tomato seeds was enforced with 0.5% and 1% polyethylene glycol-6000 (PEG) and control (PEG free) solution while Al^{3+} stress for rice was induced by 250 μ M and 750 μ M of $AlCl_3$ solutions (pH 4.2) and control (Al free). Germination percentage, mean germination time and α -amylase activity of germinating seeds was assessed. After 04 days of sowing, percentage of tomato seed germination was reduced in 0.5% and 1% PEG in comparison to control. Percentages of germination of control, Put, Spd and Spm-primed tomato seeds were 43%, 53%, 62% and 63%, respectively in 0.5% PEG and in 1% PEG the percentages of germination were 37%, 52%, 60% and 62%, respectively. PA-untreated control rice seeds showed significantly reduced germination ($p < 0.05$) at 250 μ M Al^{3+} (14%) and 750 μ M Al^{3+} (4%) compared to germination at Al-free growth conditions (26%) after 03 days of sowing. Put, Spd and Spm-primed seeds showed enhanced germination both under Al-stressed and control conditions. Under 750 μ M of Al^{3+} , Put (28%), Spd (38%) and Spm (32%) primed seeds showed significantly higher percent germination in comparison to control (4%). Relatively higher α -amylase activities in Spd and Spm-primed tomato seeds were observed than that of control at 04 days of tomato seed germination in 1% PEG. Germinating PA-primed rice seeds indicated increased α -amylase activity compared to the PA-untreated controls under Al stress. These results exhibited that PA priming enhances germination of tomato seeds under water stress and rice seeds under Al stress suggesting positive effects of exogenous PA treatment in seed germination under these stress situations.

Keywords: Aluminium, Amylase, Germination, Polyamines, Water stress

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ID 99

Determination of quality and the geochemistry of soil in a chronic kidney disease of unknown etiology (CKDu) hotspot, Rideemaliyadda, Sri Lanka

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Abstract

CKDu appeared mainly in North Central province in Sri Lanka, and recently, it materialized in Uva province. Soil can be gripped as a main environmental source for the phenomenon of this kidney failure, as it is a material that is frequently used by people in the areas with CKDu generality, and soil has a direct correlation between food crops and water sources. Therefore, the present study explores the potentially toxic levels and soil quality in Rideemaliyadda-South Grama Niladari Division (a CKDu hotspot), Badulla district, Uva province, Sri Lanka, to explore the risk factors associated with the phenomenon of CKDu. Triplicated thirty soil samples were collected using the random stratified sampling method (Thirteen home gardens, nine cultivated areas, five forested areas, and three tank sediment samples) under the land use patterns in this area and evaluated using ArcMap 10.2.2 software. Cation concentrations including Cr, Mn, Cu, Zn, Cd, Pb, and As in collected soil and sediment samples were analyzed using inductively coupled plasma-mass spectrometry (ICP-MS) followed by Microwave digestion using concentrated nitric acid. The average concentration of selected heavy metals including Chromium (Cr), Manganese (Mn), Copper (Cu), Zinc (Zn), Cadmium (Cd), Lead (Pb), and Arsenic (As) in soil (in mg/kg) were 43.62 ± 6.19 , 411.60 ± 35.60 , 15.74 ± 1.76 , 52.30 ± 11.00 , 0.01 ± 0.01 , 8.85 ± 0.71 and 0.04 ± 0.04 , respectively. According to the toxicological studies, all existing concentrations were below the permissible levels considering the nephrotoxic heavy metal contents in soil (Cd, Pb, Cr, and As are proven as nephrotoxic heavy metals according to the toxicological studies), instead of that, Mn ($p = 0.020$), Cu ($p = 0.036$), and Zn ($p = 0.042$) were significantly higher in the CKDu hotspot than the reference levels of Mn, Cu, and Zn in soil (in mg/kg) were 476.00, 36.00, and 50.00, respectively. The average content of Zinc in soil exceeded the permissible levels given by WHO. Hypothesizing the Phosphates as an interactive anion to the availability of cations in soil, the phosphate concentrations in soil and sediment samples were measured using Ion Chromatography (IC). The average concentration of phosphate in soil was 7.08 ± 1.29 mg/kg. Pearson correlation coefficients indicated a negative correlation between the existing cadmium (Cd) concentrations and the phosphate (PO_4^{3-}) concentrations (-0.093) in soil and sediments. The mean soil pH in the CKDu hotspot showed a slightly acidic condition which was 6.78 ± 0.15 , and it was within permissible soil pH limits. The mean conductivity was compiled with the acceptable conductivity range, which was 118.20 ± 25.20 $\mu\text{S cm}^{-1}$. Lead, Chromium, Arsenic, and Cadmium were nephrotoxic heavy metals and were proved by toxicology chemistry. According to the results, the spatial distribution of Pb and Cr within the CKDu hotspot showed a clustered pattern, and those clustered appeared especially related to the agricultural lands in the area. Whether those heavy metal concentrations were below the permissible levels, lower concentrations can cause nephrotoxicity with long-term exposure.

Keywords: CKDu, Long-term exposure, Satisfied random sampling, Soil, Toxic heavy metals

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ID 121

Bioaccumulation of toxic metals in *Oryza sativa* grown in North Central province in Sri Lanka

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Abstract

This study was carried out to assess the levels of heavy metals such as Arsenic (As), Cadmium (Cd), and Lead (Pb) in domestically grown rice sold in North Central Province (NCP) which is identified as a high CKDu prevalent area in Sri Lanka. Based on eight paddy areas, thirty *Oryza sativa* composite samples were collected in each selected Divisional Secretariat (DS) area in NCP. Samples were subjected to microwave digestion process and As, Cd and Pb analysis were carried out by the ICP-MS. The mean Pb levels in domestically grown rice were significantly higher than the FAO/WHO allowable limits (Pb- 200 µg/kg) in most of the DS areas. Among selected DS areas, the Padaviya DS area has highlighted reporting 2815 µg/kg mean Pb content in the rice samples. However, none of the mean values of As and Cd in rice samples in selected areas have exceeded the FAO/WHO allowable limits (As- 200 µg/kg, Cd-400 µg/kg). The Highest Cd contamination was reported in Higurakgoda and Padaviya DS areas and the values were 106.69 µg/kg, 105.69 µg/kg, respectively. The highest mean value of as was reported in the Kebithigollewa DS area and it was 49.75 µg/kg. The values of estimated daily intake (EDI) of the analyzed metals were also very far below than the Tolerable Daily Intake (TDI) (Pb - 250 µg/day, Cd - 62 µg/day, As - 3 µg/day). Owing to high Pb content in domestically grown rice samples in selected areas, long term consumption of rice causes to accumulate the Pb in body tissues and generates a health risk of residents in selected CKDu affected areas in NCP.

Keywords: CKDu, Contamination, Rice, Toxic metals

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ID 132

Exogenous factors on adventitious root formation in *Vitex negundo* and *Flueggea leucopyrus*

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Abstract

Vitex negundo and *Flueggea leucopyrus* are invaluable medicinal plants used in herbal preparations. These species find difficulties in propagation through seeds due to many reasons. Therefore, it is important to develop appropriate vegetative propagation techniques for the successful rooting of these species. The present study was carried out to explore the effect of different rooting media, vegetative cutting types and hormone applications on the rooting of these species. Twelve different treatment combinations were arranged in Three Factor Factorial Completely Randomized Design with five replications for each species separately. Data were analyzed using SPSS (Version 25) and Minitab (Version 17). Means were separated using Duncan's multiple range test at 5% level of probability. Results showed that in *V. negundo*, the highest number of leaves (17.3) and buds (3.2) were recorded in hardwoods treated with IBA planted in sand: coir dust 1:1. *F. leucopyrus* had shown the highest number of leaves (6.2), the highest number of roots (3.8) and the highest root length (23.7cm) in softwoods treated with IBA hormone in sand: coir dust 1:1. In conclusion, hardwoods treated with IBA planted in sand: coir dust 1:1 could be recommended for successful rooting of *V. negundo*. Softwoods treated with IBA hormone in sand: coir dust 1:1 appeared as the most promising treatment combination for root formation as well as root growth and development in *F. leucopyrus*. These findings will be useful in the successful mass propagation of *Vitex negundo* and *Flueggea leucopyrus*.

Keywords: Hormone application, Rooting success, Rooting media, Vegetative cuttings

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Crop Production and Productivity



Keynote Speech

How phone-based AI can transform subsistence agriculture

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Abstract

Artificial Intelligence (AI) has progressed to the point that it can now compete with, and sometimes outperform, human experts in a variety of diagnostic tasks. With a large number of subsistence farmers now having access to mobile phones, high-powered agronomic diagnostic capability can be placed in their hands. We discuss about how this will have a global impact on small-scale farming.

Introduction

Agriculture revolves with assessment. Choosing the correct seeds, soil, water, mineral inputs, plucking time, and, of course, getting the best price for what is produced are all important considerations. All of this will be transformed by the deployment of artificial intelligence.

Rapid advances in artificial intelligence and the widespread use of smartphones equipped with high-quality cameras have opened many possibilities in agriculture. Millions of dollars have been invested on modernizing agriculture in countries like India and China, where the mainstay of production is still in the hands of small-holder farmers who practice age-old methods. Most of these investments are aimed at lowering bank risk and efficiently getting food from farmers, with the promise of high profits for investors based on efficiency benefits and the use of information technology. They frequently employ satellite imaging to estimate production, fertilizer use, and water shortages, using well-established procedures that have been used in industrial agriculture for decades. Many Global Agriculture Research organizations and non-governmental organizations (NGOs) working on subsistence farming issues conduct good research, but many lack the resources to turn it into effective tools that will reach their target. Agriculture Start-ups can fill this gap, but they are rarely utilized by institutions with a primary objective of research.

Development of technologies for substance farming

While there are a lot of subsistence farmers, their lifetime worth is very low. As a result, investment in technology development that would benefit subsistence farmers is undesirable. Only a few start-ups are focused on developing or implementing solutions specifically designed for this industry. In situations where less than 2% of farmers have access to agronomy advice, the impact of these start-ups could be greater than the combined efforts of NGOs and Departments of Agriculture, primarily because they must not only develop solutions, but also deliver those solutions to farmers in a way that is financially sustainable – in a way that benefits farmers: This is not a simple task.

Typology of AgTech Start-ups in developing economies

A broad categorization based on business models has been laid out, dividing enterprises into those that focus on inputs, outputs, or both.

1. Input based Ag Ventures-enterprises that sell inputs such as seeds, fertilizers, pesticides, and farm equipment
2. Output based Ag Ventures-enterprises that procure from farmers
3. Input and Output based Ag Ventures-that provide a suite of input and output services, including funding

With millions of dollars in funding and hundreds of start-ups vying for attention, we're seeing some innovative business models emerge. The majority of these start-ups, founded by IT graduates, see agriculture as an input-output business with AI as a tool for profit optimization. Almost every one of them considers themselves to be AI firms. A handful stand out among the enormous number of AgTech start-ups in terms of their potential to provide new types of agricultural services that help small-scale farmers, allowing them to increase production and profitability.

Farmers in the industrial world have enjoyed agricultural advisory services provided by profession agronomist – something that subsistence farmers do not have access to. Therefore, the business models that have emerged in Agriculture serving small holder famers invariably rely on commissions form input providers, buyers, and banks to support and sustain their ventures. This may translate in (1) & (2) to increase in the sale of farm inputs and efficiency gains in produce sale. In (3), there is gain in reducing input costs and maximizing produce value (such as in contract farming). The profitability of such ventures is more aligned with farmers-as they are based on achieving farming efficiencies- often with good use of new technologies. This is also the case in industrial farming activities with a good understanding of input-output cost management.

AI Technologies that benefit small holder farmers

- Crop Health Assessment - (Satellite & Phone Imagery)
- Soil Assessment - (Chemical technologies + AI)
- Seed and fertilizer quality assessment - (Image recognition + AI)
- Pests and Plant diseases identification - (Image recognition + AI)
- Produce Quality and spoilage assessment - (Image recognition + AI)
- Online Sales Platforms - using predictive AI

All these technologies are beginning to benefit small holder famers but often delivered through (1) & (2), primarily because farmers are unable to pay for them. More sophisticated business models will likely emerge that see small holder farmers as their primary beneficiary.

Technological barriers in AI Assessment

The majority of phones are now built with AI applications in mind. AI models can be put in the device or through cloud-hosted services, so even the most basic phones can benefit from it. Visual AI has progressed to the point where it can currently outperform human experts. The cost of AI assessment is decreasing by the day; in fact, if the AI model is implemented on a phone, it costs almost nothing. The actual fact is that there are no technology barriers to fully utilizing AI's capacity to address the concerns of smallholder farmers. The limitations are to do with socio economic context and the very slow phase of technology adoption by institutions in charge of servicing small holder farmers – most of which were setup during colonial rule and operate the

way they used to operate. Universities too are slow in the uptake of AI technologies – in areas other than computer science.

What is holding the application of AI back?

Funding. To build AI engines is important to have data tests of sample images. These are hard to acquire. Only agricultural institutions have access to such data and the expertise to validate it. In our experience (we have approached many of them), they tend to be research funding and publication focused. They certainly publish papers on the use of AI in agriculture. But this AI rarely levels the lab-because when it does its accuracy drops to miserable levels due to the variations in lighting conditions. But all these papers get reviewed published (by fellow researchers) often with a small foot note that further research is needed-setting the stage for the next paper and grant application. Many of them avoid the embarrassment of field testing. Working AI solutions are rarely of interest to them – because no research is now needed. The solutions are already there.

Most ministries of agriculture and NGOs are yet to come to terms with AI. In this context, it is virtually impossible to build accurate AI applications for pests and plant diseases with the millions of dollars to build infrastructure just to get access to images. But this is a temporary phase. Building AI applications is becoming so easy; soon, kids will be able to build them. They can also be built with a small number of images. In this context of academic disinterest in developing real usable solutions. Crowd-sourcing approaches may work. Interested individual scientist can work together as a global team to provide images and validate the accuracy of the AI applications-making it possible to build trustworthy AI applications.

What will the AI powered future of small holder farming look like?

In the future, smallholder farmers will be able to plan the season using technologies such as generative design to decide what to plant where and how to maximize the value of the land they own based on market demand for the various produce types that can be grown in that plot.

Forward contracts will then be made with lenders, insurance companies, Agri input companies, and companies that wish to purchase the farm produce. Phone based AI will assess the seed quality, pests, and plant diseases. AI Agronomy apps will be able to advice farmers on remedial measure that need to be taken throughout the growing season using a combination of satellite and phone imagery.

Farmers will be able to sort and quality-control their food at harvest using AI powered phone applications that will enable auction their produce to online buyers at the nest price based on AI-based quality standards.

AI apps will deliver agronomy knowledge at an unprecedented scale and efficiently

They will be help famers make intelligent decisions enabling to match the right chemical remedies and apply agrochemicals judiciously. They will help them to grade their produce according to the requirements of buyers optimizing what they get for their produce. The ability to verify quality of produce through the Agri value chain will significantly reduce waste and eliminate quality related disputes.

Overall, it will reduce input costs, optimize what the famer can get for what they produce, and significantly improve productivity – all through the application of information tailored to each famer's specific needs, just in time when they need it at next to no cost. This is the promise that artificial intelligence brings to subsistence agriculture.

Oral Presentations

ID 50

Management of powdery scab pathogen infection caused by *Spongospora subterranea* f. sp. *subterranea* in the potting mediums used for G1 seed potato production under poly tunnels

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Abstract

Using high-quality initial planting materials ensures the production of high-quality seed potatoes. Under polytunnels, the Department of Agriculture maintains a program for producing high-quality seed potatoes. Very recently it was reported that infection of powdery scab pathogen caused by *Spongospora subterranea* f. sp. *subterranea* in the soilless potting media used for that program. It is a quarantine pathogen, and there are currently no effective management techniques in place for it. As a result, this study was designed to investigate fumigants and fungicides for managing this infection. Powdery scab infected soilless media were collected from the G1 seed potato production polytunnel. Those were treated with fumigants; methamsodium (40 mL/L), formalin (100 mL/L), hydrogen peroxide (0.25 mL/L), and fungicides; mancozeb (2g/L), amisulbrom (0.5 mL/L, 1.0 mL/L, 1.5 mL/L) and kept for two weeks by covering a black polythene. The treated media were filled into grow bags and sprouted seed potato (var. Redlasoda) were planted one tuber per bag. For control untreated media was used. Three replicates for each treatment were kept according to the completely randomized design. Plants were maintained following the DOA recommended agronomic practices. Number of root galls per plant was recorded in weekly intervals from the age of two months to three months. At the end of the experimental period, no of infected tubers per plant and total yield per plant were recorded. The lowest mean number of root galls per plant (1.93 ± 0.02 , $p \leq 0.05$) was observed in amisulbrom (1.5mL/L) treatment followed by methamsodium and amisulbrom (1.0mL/L) while untreated growing medium showed the highest (7.49 ± 0.02). The lowest percentage of infected tubers per plant was also recorded in amisulbrom 1.5 mL/L treatment. But it was not significantly different from that of methamsodium, mancozeb and other two amisulbrom treatments. The highest yield per plant was observed in methamsodium treatment, but it was not significantly different with other treatments and the control. Our results highlighted that fumigation of soilless medium with 1.5 mL/L amisulbrom and 40 mL/L methamsodium has the potential to reduce powdery scab infection. However, further investigations are required by monitoring pathogen inoculum level, medium condition and environmental factors.

Keywords: Fumigants, Fungicide, Powdery scab, Seed potato

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ID 84

Potential of using *Chlorella* sp. grown in parboiled effluent in combination with organic or inorganic fertilizers: Effects on growth and yield of brinjal (*Solanum melongina*)

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Abstract

Present study was conducted to assess the potential use of *Chlorella* sp. grown in parboiled effluent as an organic nutrient source. *Chlorella* sp. was cultivated using parboiled effluent in a raceway reactor for 14 days continuously with constant light intensity ($200 \mu\text{mol photons m}^{-2} \text{s}^{-1}$) and constant mixing. The algal biomass was washed in distilled water and the nutrient content (N, P, and K) was determined. A pot experiment was conducted to find the response of brinjal (*Solanum melongina*) for different inorganic or organic fertilizer combinations with *Chlorella*, balancing the total nitrogen in each treatment except control (T1). The design was CRD with eight treatments and three replicates. The treatments were T1 - Control, T2 - 100% Inorganic Fertilizer (IF), T3 - 100% Cattle Manure (CM), T4 - 30 g *Chlorella* + 100% Inorganic Fertilizer except N (IFEN), T5 - 15 g *Chlorella* + 50 % IFEN, T6 - 15 g *Chlorella* + 50% CM, T7 - 20% *Chlorella* Foliar Spray (FS)+ 50% IFEN, T8 - 20 % *Chlorella* FS + 50% CM. Plant height, leaf number, flowers per plant, and the yield of brinjal were recorded and statistically analyzed. The *Chlorella* had 25% of nitrogen, 7.5% phosphorus, and 0.74% potassium. Significant variations were observed in height, leaf number and flower numbers among different treatments. All the treatments gave either a statistically similar or higher yield than T2 (100% IF), except the control. T6 (*Chlorella* 15 g + 50% CM) gave a significantly higher yield than all other treatments except T4 (30 g *Chlorella* + 100% IFEN). Considering the yield, T6 (15 g *Chlorella* + 50% CM) is the best option in organic combinations while T4 (30 g *Chlorella* + 100 % IFEN) is the best option in inorganic combinations. This study, therefore, highlights the potential of using *Chlorella* sp. grown in parboiled effluent as a nitrogen source for crop production. Further studies are required to optimize the nutrient supply including phosphorus.

Keywords: Algae, Brinjal, Foliar spray, Organic nutrient source

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ID 80

Effect of using different mulching materials on bulb yield of big onion in dry zone of Sri Lanka

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Abstract

Big onion (*Allium cepa L*) is utilized as a main condiment in Sri Lankan dishes, where it is considered as an important cash crop grown in dry zone of Sri Lanka. Success of onion cultivation is largely depending on the optimum cultural and management practices such as application of organic manure and chemical fertilizers, optimum irrigation schedule, proper weed management and time of planting. Mulching is a smart management practice, in which has been reported to be influence on soil moisture conservation, control of soil erosion and compaction and regulating soil temperature. Since application of mulching has not been extensively studied in big onion cultivation under Sri Lankan conditions; a study was carried out to find out a suitable mulching material which can increase the bulb yield. An experiment was conducted at the Agriculture Research Station, Weerawila, which belongs to DL₅ agro ecological zone and the experiment was laid out in randomized complete block design (RCBD) with three replications in three consecutive seasons (2015 Yala, 2017 Yala, 2018 Yala). Treatments were comprised of seven mulching materials (black polythene, White polythene, paddy straw, saw dust, paddy husk, wood creeper and partially burned paddy husk (PBPH). Results indicated that the bulb yield has shown significant difference ($P=0.05$) between each mulching treatment, in which the PBPH has shown 25% increase in bulb yield in comparison to the control. In addition, all the mulching materials have shown yield advantage during the tested seasons. Further, soil temperature with the application of artificial and natural mulching materials have shown a variation although not statistically tested. Interestingly, paddy husk mulch has recorded the lowest soil temperature while the highest was recorded in the white polythene mulch. Analysis of the economic returns of the mulching suggests that the partially burn paddy husk and black polythene mulching is superior and thus dominant over other mulching materials. Considering the availability of paddy husk in Hambantota district and considering the environment issues, the partially burned paddy husk can be recommended for the big onion cultivation.

Keywords: Big onion, Bulb yield, Mulch, Partially Burn Paddy Husk (PBPH)

ID 85

Morphological and biochemical indices for selecting sugarcane varieties resistant to smut disease

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Abstract

The qualitative and quantitative yield of Sugarcane (*Saccharum* spp. Hybrids) is significantly decreased by smut disease. The use of resistant varieties is the most cost-effective method of controlling the disease. The association between disease resistance and the underlying resistance mechanisms of the crop is not well-explained by the existing field-testing methods and not allowed the early selection of resistant varieties. Therefore, this research was carried out to identify morphological and biochemical characters as indices to select smut-resistant varieties and incorporate these indices into the existing screening methods to strengthen the varietal selection program for smut resistance. Fifty sugarcane accessions were selected from the available germplasm collection in Sri Lanka and evaluated for their resistance to smut disease by using artificial inoculation method. The inoculated sugarcane setts were established in the fields at Sugarcane Research farm, Udawalawa according to a randomized complete block design with three replicates and maintained from 2017- 2019. Three morphological characters and six biochemical characters were evaluated according to the standard protocols. The disease incidence and Area under Disease Progress Curve (AUDPC) were quantified in both plant and the first ratoon crops over a total period of 24 months. Pearson correlation coefficient test was performed to identify the relationship between AUDPC and tested morphological and biochemical characters. Principal Component Analysis was used to identify the responsible characters to be used as indices for sugarcane smut resistance and thereby to select the superior varieties with smut resistance. A significant variation was observed in AUDPC ($P \leq 0.05$) among the tested accessions. Significant negative correlations were observed in total phenols in the leaves, hardness of the bud, foliage inclination angle and number of scale leaves in the buds with AUDPC. The tested morphological and biochemical characters were grouped into four major components and the cumulative contribution rate was 66 %, revealing that total phenols in leaves, hardness of the bud, foliage inclination angle and the number of scale leaves in buds are useful, simple and non-laborious indices for early identification of sugarcane smut resistance varieties in large scale selection programs.

Keywords: Biochemical indices, Morphological indices, Principal component analysis, Sugarcane, Smut

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ID 100

Conventional PCR based semi-quantitative method for quantification of sugarcane white leaf disease phytoplasma

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Abstract

Semi-quantitative PCR technique is applying to indirectly quantify the level of nucleic acid. It is becoming more popular due to the limitation real-time quantitative PCR technology. The present study was done to optimization of a semi-quantitative PCR (semi-qPCR) protocol to quantification of sugarcane white leaf (SCWL) phytoplasma presence in the sugarcane tissues based on the conventional PCR technology. Genomic DNA was extracted from SCWL infected leaves and disease-free seedlings by CTAB protocol. A PCR program was performed with the DNA concentration gradient to find the optimum template DNA concentration for subsequent optimization of other parameters of the program. Well optimized primer pair SPP1/SPP2 and DnhF/DnhR newly designed primer pair were used to molecular detection of SCWL phytoplasma by conventional PCR instead of nested PCR. A PCR cycle gradient 25, 27, 29, 31, 33 and 35 was performed to determine the peak of the linear phase of the amplification for each primer pair. The PCR program was performed at 95°C for 3 min initial denaturation followed by 25-35 cycles: denaturation at 95 °C for 45, annealing at 53 °C for SPP1/SPP2 and 56 °C for DnhF/DnhR for 1 min and extension at 72 °C for 45 seconds for SPP1/SPP2 and 30 sec for DnhF/DnhR primers. The endpoint analysis was determined by quantification and analysis of DNA band intensities by ImageJ software of the resolved DNA bands in 1.5% agarose gels. The template DNA concentration 250 ng/μL was given consistent and significant band intensity. The primer pair SPP1/SPP2 had been amplified the target band for all replicates in all PCR cycles and band intensity was gradually increased with the cycle number. Statistical analysis confirmed that cycle number 31 started the plateau of the PCR program of SPP1/SPP2 primer pair. The primer pair DnhF/DnhR was capable of producing the target band, however, poorly amplified the negative control also in the later stage of the program. Hence, this primer pair cannot be used for the semi-qPCR. The SPP1/SPP2 primer pair, 250 ng/μl template DNA with 31 cycles PCR program can be successfully used to quantify the level of SCWL phytoplasma by conventional PCR instrument.

Keywords: Conventional PCR, Semi-quantitative PCR, Sugarcane, White leaf phytoplasma, 16S rRNA gene

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ID 123

Morphological characterization of a germplasm collection of cultivated cinnamon at mid-country research station, Dalpitiya

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Abstract

Sri Lankan cinnamon (*Cinnamomum verum* J. Presl) germplasm is diverse in morphology and chemical composition due to the cross-pollinating behavior of the crop. Most cinnamon cultivations are seed-derived, resulting in a mixture of chemical properties in the product. Products with specific chemical compositions are advantageous for niche markets of high price. Morphological characterization of germplasm provides representative accessions for chemical characterization for the above purpose. The germplasm collection, which is established at the Mid-Country Research Station, Dalpitiya, consists of 71 accessions of diverse morphology. Identification of accessions with distinct chemical compositions from the above collection is important to provide material for breeding purposes. Morphological characters of leaf length (LL), leaf width (LW), petiole length (PI), leaf arrangement (LA), leaf shape (LS), leaf apex (LAP), leaf base (LB), leaf venation (LV) and leaf margin (LM) were recorded in five mature leaves from 5th to 6th leaf of the tip of the branch using the Descriptors for Cinnamon (*Cinnamomum verum*) developed by Team of TURIS 2013 Project. The LL, LW and PI varied from 10.54-17.64 cm, 4.3-7.4 cm, 0.9-1.94 cm, respectively. LA of all accessions was either opposite or sub-opposite. The most common LS types were elliptic, narrowly elliptic, ovate, oval, and lanceolate, while only accessions 53 and 66 were of ovate-lanceolate and oblong-lanceolate, respectively. LS of broadly ovate was only recorded in *Sri Gemunu*. Variations of LAP and LB were acute, obtuse, acuminate, long-acuminate, narrowly acuminate, acuminate with broad acumen and acute, subacute, cuneate, rounded, subcordate, obtuse and obtuse, contracted into petiole, then shortly cuneate, respectively. LV of three-veined and three or five-veined was recorded from all accessions. Only accession 26 and *Sri Gemunu* were of entire LM, while all others were of undulate. The Principal Component Analysis followed by Cluster Analysis produced 6 clusters at a rescaled distance of 0.6. Accession 53 belonged to a unique cluster and *Sri Gemunu* clustered with accessions 22 and 57 in a separate cluster. *Sri Wijaya* is clustered with 36 accessions. Based on the above morphological diversity, it is suggested that the tested collection may be useful in future breeding programmes.

Keywords: *Cinnamomum verum* collection at Dalpitiya, Leaf morphology

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ID 128

Influences of different growing media on growth and development of *Piper longum*

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Abstract

Piper longum (family Piperaceae) is an imperative medicinal herb used in indigenous medicine. Lack of proper cultivation protocols exist as a major bottleneck for the commercial production of this invaluable species. Therefore, systematic cultivations with developed cultivation packages should be available to overcome the problems associated with this species. Further, *P. longum* cultivated without chemical inputs possess high quality, efficacy, and reliability. Therefore, a pot experiment was conducted to find out appropriate growth media for better growth and development of *P. longum*. Rooted cuttings were established in six different growth media with triplicates under Completely Randomized Design (CRD). Data on plant height (cm), number of leaves, number of branches, shoot and roots dry weights (g), and root volume (ml) were collected at 3 months after planting. All potting media were studied for available Nitrogen, Phosphorous, Potassium, Organic Matter %, pH and electrical conductivity. Data were analysed with analysis of variance (SAS 9.1 version) and means were separated using Duncan's multiple range test. According to the results, the highest number of leaves (43.3 ± 4.2), number of branches (7 ± 1), shoot dry weight (15.7 ± 1.1 g), root dry weight (2.86 ± 0.6 g) and root volume (19.7 ± 5.6 ml) were recorded from topsoil: sand: compost 1:1:1 medium. Different growth media showed significant difference ($P \leq 0.05$) for pH, electrical conductivity, nitrate nitrogen, ammonium nitrogen, phosphorus, potassium, and organic matter contents. Topsoil: sand: compost 1:1:1 showed pH and electrical conductivity 7.7 and 1.2 mS/cm, respectively. The same growth media reported 1.6 ppm of nitrate nitrogen, 0.76 ppm of ammonium nitrogen, 126.5 ppm of phosphorus, 193 ppm of potassium and 4.6% of organic matter. Topsoil with compost help to retain water as well as provide nutrients. Sand facilitates drainage and improves aeration. The lowest values for all the growth and yield parameters were recorded in topsoil: compost 1:2 indicating that excess compost may also negatively impact on growth and development of *P. longum*. Therefore, Topsoil: sand: compost 1:1:1 appeared to be the most promising growing media for *P. Longum* to grow under organic cultivations.

Keywords: Growth, Irrigation, Medicinal herb, Potting media, Yield

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ID 22

Flower production and flowering pattern of four groundnut varieties in Sri Lanka.

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Abstract

Groundnut (*Arachis hypogaea* L.) has an indeterminate flowering habit, which means that flowering can occur for an extended length of time during the life cycle. It leads to indeterminate fruiting habit with pods with various maturity classes at the point of harvest. These factors can influence the quality of the final harvest of groundnut seeds. Therefore, understanding the genetical behavior of flowering pattern in existing groundnut varieties in Sri Lanka would be the basis for improving such traits through breeding or by altering agronomic practices. In order to understand the flowering pattern of groundnut varieties, four peanut varieties (Tissa, ANKG1, Lanka Jumbo and ANKGN3) were planted as a pot experiment in a Completely Randomized Design (CRD) with five replicates from January to April 2021. After the first flowering of each individual plant, daily flowering count was recorded for nine weeks. According to the observations, all four varieties had their first flowering within 20-24 days after seedling emergence, and there was no relationship between the first flowering to the maturity duration of each variety. Total flower production during the examined period was significantly different among tested varieties. However, there was a positive relationship between maturity duration and peak flowering period, with short duration (90-100 days) varieties reaching the peak two weeks earlier than medium duration (105-110 days) varieties. According to the flowering pattern of tested varieties, Tissa showed uniform flowering during 3rd week to 5th week. Since the number of mature pods at harvest can directly influenced by the flower production at early flowering period, future studies should focus on determining the correlation between flowering pattern and maturing classes of pods in each genotype. It will provide useful information for the crop improvement of groundnut with high degree of mature pods.

Keywords: *Arachis*, Flowering pattern, Genotypes, Groundnut, Indeterminate, Maturity

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ID 77

Submergence tolerance of some *Heenati* type traditional rice accessions and modern rice varieties at the seedling stage

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Abstract

Among natural disasters, floods cause a 39% annual rice yield loss in Sri Lanka. The development of submergence tolerant rice cultivars using locally adapted rice accessions is the best solution to utilize the flood-prone lowlands of Sri Lanka. In the present study, sixteen modern rice cultivars and sixteen traditional rice accessions were screened at the seedling stage to evaluate their level of submergence tolerance. The traditional rice accessions used in the study belonged to *Heenati*, *Suduheenati*, *Rathuheenati*, and *Kaluheenati* groups. *Swarna Sub 1* cultivar was used as the standard check variety. Two weeks old seedlings were separately subjected to complete submergence stress for a continuous 9-day period and 14-day followed by two-week recovery in a randomized complete block design (RCBD). The survival rate of the submerged seedlings and the mode of seedling elongation during the submergence compared to the control plants. *Heenati-3707*, *Kaluheenati-4991*, and *Rathuheenati-4992* from the traditional rice accessions and *At-354*, and *Ld-371* from the modern rice cultivars scored 100% survival rates along with the standard positive control, *Swarna Sub-1* at 9-day submergence stress. *Swarna sub-1* had a 100% survival rate after 14 days of submergence, while *Heenati-4935*, *Kaluheenati-4621*, and *Kaluheenati-4991* had survival rates of 75%, 71%, and 60%, respectively. Traditional rice accessions scored more than 50% of survival rates. In modern rice cultivars, *Bw-400*, *At-405*, *Ld-371*, *At-354*, and *Bw-372* scored survival rates of 83.33%, 71%, 66.67%, 50%, and 50% respectively. Modern cultivars also secured more than 50% of survival rates. According to IRRI standard submergence scoring criteria, traditional rice accession *Heenati-4935* (75%) is moderately submergence tolerant, and *Kaluheenati* accessions (*4621*, *4991*) are moderately submergence susceptible. Among modern rice cultivars, *Bw-400* is moderately tolerant and *At-405*, *Ld-371*, *At-354*, and *Bw-372* accessions are moderately susceptible to submergence stress. Data analysis revealed the absence of a significant correlation between tolerant or susceptible rice cultivars and height gain or reduction under the submergence stress at 9-day or 14-day stresses of the studied rice accessions/cultivars. This emphasizes the functioning of diverse survival mechanisms in different rice accessions/cultivars under submergence stress. The identified moderately tolerant and moderately susceptible rice accessions/cultivars can be further studied at the field conditions for future breeding purposes.

Keywords: *Heenati* rice, Modern rice, Submergence tolerance

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ID 81

Adaptability assessment of newly developed cluster onion variety: ANKCLO 1

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Abstract

The development of high yielding cluster onion varieties is required to increase annual production while saving foreign exchange by minimizing importation. The experiment was conducted at Grain Legume and Oil Crop Research and Development Centre, Angunakolapelessa. Nine germplasm were employed with the recurrent parent selection procedure in a crossbreeding program. Selection was based on adaptation, self-pollination, and purification. Station trials were conducted in 2017 *Yala* and 2017/18 *Maha* seasons. Significantly high yields as 12.1t/ha (2017 *Yala*), 17.5t/ha (2017/18 *Maha*) were recorded in CLO-2015/1 and 11.4t/ha (2017 *Yala*), 18.3t/ha (2017/18 *Maha*) in CLO-2015/2. National Coordinated Varietal Test (NCVT) was conducted during 2018/19 *Maha* and 2019 *Yala* seasons. In 2018/19 *Maha* CLO-2015/1 line showed adaptability rank 1, according to the ranking and variance component methods. In 2019 *Yala* the CLO-2015/2 line showed adaptability rank 1 according to the above both analysis methods. Variety Adaptability Trials (VAT) was conducted 2019/20 *Maha* and 2020 *Yala* two seasons. According to the variance component method CLO-2015/2 showed adaptability rank 1 while CLO-2015/1 showed adaptability rank 2. Quality evaluation was done for two promising lines with three check varieties. Significantly higher pungency was recorded in CLO-2015/2 (17.7 μmol pyruvate/ ml) with TSS 20.8%. Significantly lower pH value (4.89) was recorded in promising line CLO-2015/2. Considering the above results promising line CLO-2015/2 was released with the name of "ANKCLO 1" at the variety releasing committee meeting held at the Department of Agriculture in 2021.

Keywords: Adaptability, CLO-2015/1, CLO-2015/2, Cluster onion, Out crossing

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ID 98

National assessment of the impacts of COVID-19 pandemic on the vegetable crop production in Sri Lanka

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Abstract

Vegetable production subsector plays an important role in food and nutritional security, employment, and reduction of rural poverty in Sri Lanka. Successful cultivation of vegetable crops usually requires intensive management because of the requirement of special management practices, fertilization, irrigation, and frequent crop scouting to manage pests, diseases, and weeds. However, the measures taken to curtail the spread of the ongoing COVID-19 pandemic such as travel restrictions, import controls, policy alterations, associated supply chain disruptions and economic crisis are discussed to impact the production of vegetable crops in the public domain. To assess the validity of this general perception, we used the national scale data on the extent of cultivation and total production of 13 vegetable crops namely, Tomato, Brinjal, Okra, Snake gourd, Bitter gourd, Red pumpkin, Ash pumpkin, Beans, Cabbage, Capsicum, Carrot, Beetroot and Raddish for both *Yala* (2020) and *Maha* (2020/21) seasons. The data were obtained from the Department of Census and Statistics, Sri Lanka and statistically compared to the pre-pandemic national scale, long-term average (2001-2019) of the extent of cultivation and production of the same crops during both seasons. Results showed that, most of the vegetable crops were resilient to the shocks created by COVID-19 pandemic during *Yala* 2020 and *Maha* 2020/21. Although the extent of cultivation decreased for Ash pumpkin, Beet root, Snake gourd and Radish, the production has increased, highlighting the increased productivity. Travel restrictions, closure of local markets and work from home lifestyle during the pandemic may have motivated local growers to produce vegetables at home gardens. Furthermore, several promotional programs to produce vegetables aiming the food and nutritional security may have supported for the resilience demonstrated by the vegetable sector despite of market closures and supply chain disruptions. Future studies should focus on holistically evaluating the effects of this pandemic on the vegetable production, marketing, and supply chain across the country.

Keywords: Agriculture, COVID-19, Home gardens, Resilience, Vegetables

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ID 107

Determination of the correct harvesting age of rhizomes of ginger (*Zingiber officinale* Roscoe) as seed material based on vegetative growth

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Abstract

Ginger (*Zingiber officinale* Roscoe) is known as one of the most valued crops in the world, because of its unique pungency, taste, and medicinal value. The harvesting age of rhizomes for seed purposes is considered as nine months after planting (MAP). However, adverse climatic conditions can cause early senescence of ginger starting from about 7th MAP onwards before the rhizome properly matures. This causes the use of immature, inferior quality seed rhizomes for planting, while increasing the cost of seed ginger. Further, there is no information available on the yield of ginger based on the maturity of the seed rhizome. Therefore, this study was conducted to determine the maturity and the best harvesting age of ginger rhizome, based on the vegetative growth of the plant, and to determine the sprouting as an indicator of rhizome maturity. Two experiments were conducted at the Central Research Station of the Department of Export Agriculture (DEA), Matale, during May 2019 - March 2020 with two types of cultivation methods. The first experiment was carried out using seed ginger 7, 8, 9 and 10 months old, but planted at the same time. In the second experiment, planting was done at the same time, but harvesting was done at 7, 8, 9 and 10 months after planting. Both experiments had three plots each as replicates, each plot consisting of forty-four plants. The number of leaves per plant and plant height were measured at the time of harvesting. The seed rhizomes harvested in the above two experiments were allowed to sprout in a shade house, using coir dust as the rooting medium, and the number of sprouted rhizomes were counted after 30 days and 45 days. The study showed that the best vegetative growth of ginger was obtained with the seed rhizomes of 8, 9 and 10 months, while growth with 7-month-old rhizomes was significantly inferior. Therefore, ginger seed rhizomes aged 8 months, 9 months or 10 months could be used for better vegetative growth with higher sprouting ability.

Keywords: Age, Harvesting, Rhizome Seed, Sprouting

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ID 116

Growth, Yield and Plant Health of Rice Grown Under Different Eco-Friendly Fertilizer Technologies (EFTs) in Intermediate and Dry Zones of Sri Lanka

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Abstract

Two field experiments were conducted in Maha season, 2020 at Batalagoda (BG) and Maha illuppallama (MI) to evaluate the effects of several Eco-Friendly Fertilizer Technologies (EFTs) on growth, yield, and plant health of rice variety Bg 352. These EFTs were developed using site-specific fertilizer recommendations, biofertilizers containing locally isolated phosphate solubilizing bacteria and cyanobacteria and biochar-urea based slow-release fertilizers (SRF), individually or in combination to minimize the present usage of synthetic fertilizers. Number of tillers/hill and panicles/hill, plant height at maturity, root volume and root dry weight after harvesting, incidence of brown spot disease and leaf eating and leaf rolling pest damage in different EFTs were compared with the fertilizer recommendation by the Department of Agriculture (T2) which is completely based on synthetic Nitrogen (N), Phosphorous (P) and Potassium (K) fertilizers and, a control treatment (T1), which contained no N and P. All the tested growth and yield parameters significantly differed ($P < 0.05$) between the two locations and among treatments. Compared to the plants grown without N and P (T1), tillers/hill, panicles/hill, plant height, root volume and root dry weight were significantly higher ($P < 0.05$) in the rest of the treatments at both locations, with the exception of the number of tillers/hill and root dry weight in MI-grown plants. In BG-grown plants, tillers and panicles/hill showed no significant difference between T2 and T3 treatments (i.e., 100% N in the form of urea as a site-specific recommendation). T4 and T5 treatments at MI have resulted in significantly higher number of tillers and panicles/hill and root volume and dry weight. T4 and T5 treatments contained 65% of site-specific N recommendation in the form of SRF. T1 reported the highest brown leaf spot incidence at both locations. No significant difference was reported in the incidences of leaf rolling and leaf eating pest damage between the locations and among treatments. Results revealed the possibility of implementing EFTs, especially T3, T4 and T5 in a location specific manner without compromising the tested growth and yield parameters and susceptibility to studied pest and diseases and most importantly by reducing the present usage of urea by about 30%.

Keywords: Biofertilizers, Site specific nutrient management, Slow-release fertilizers

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ID 130

Potentials and challenges of introducing *Dracaena sanderiana* (Lucky bamboo) in Hambantota, Sri Lanka

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Abstract

Sri Lanka has been identified as a reliable supplier of good quality floriculture products worldwide. *Dracaena sanderiana* is an attractive foliage plant with a high demand in export market. Though export-oriented *D. sanderiana* cultivations are limited to wet zone in Sri Lanka the supply from the country still has not catered the demand. This study aims to identify the future potentials and challenges of introducing *D. sanderiana* to Hambantota district as commercial foliage. Randomly selected 40 flower growers from Sooriyawewa, Thissamaharama, Hambantota and Beliatta Divisional Secretariat Divisions (DSDs) were interviewed administering a pretested semi structured questionnaire during early 2022. According to the findings, majority (60%) of them grow floriculture crops as a full-time employment and middle-aged females were widely engaged in floriculture operations. Seventy percent (70%) of the respondents were willing to include *D. sanderiana* as a new floriculture crop to their nurseries with required support since they (50%) have excess lands (up to 0.25 acres) with natural shade. Sixty percent (60%) of them preferred to train on value addition of *D. sanderiana* by knitting. and were willing to enter to export oriented market channels. Fifteen percent (15%) of them had already established shade net houses and other infrastructure. The *Dracaena* grower society in Beliatta DSDs is ready to share their experience with new growers. Respondents understand the importance of marketing the product as a group to reduce the transportation cost. Major challenge was the initial investments on growth structures, net houses, and irrigation. Most of the growers (70%) were expecting financial support from the government. Lack of awareness of the crop husbandry, low availability of planting materials, increased transportation costs and low availability of fertilizer and fungicide in the markets were other challenges. Awareness and training programs, production assistance, trading facilities and credit support is required to introduce *D. sanderiana* as a successful future export crop to Hambantota district. Further research activities are suggested to identify the best growth conditions of *D. sanderiana* in Hambantota district prior to export level operations

Keywords: Challenges, Crop husbandry, *Dracaena sanderiana*, Hambantota, Potentials

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Poster Presentations

ID 36

Flowering stability of different rice (*Oryza sativa* L.) varieties under the variation of natural atmospheric temperature with the gradient of daytime solar radiation

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Abstract

Rice is the main staple food crop in Sri Lanka contributing to more than 40 % of the daily calorie requirement. There is a wide variation in flowering among the rice varieties that originated in Asia which are distributed in a range of agro-ecological zones in the region. There is a genetic multiplicity among accessions as they display a wide variation in morphology and flowering. Climatic changes are mainly occurred due to concentrating the atmospheric pollutants which straightly influence the increase of global temperature. The increasing global atmospheric temperature is critically affecting to agricultural crop yield losses due to infertility. Obtaining rice varietal screening and identifications of early flowering ability is very important to breed the varieties escaping heat stress under the local environmental conditions. Therefore, this experiment was conducted to prescreen the flowering ability of the rice varieties under the local conditions. The experiment was laid out in randomized complete block design (RCBD), with five rice varieties including the Bg 11 802, Bg 358, Bg 374, IR64EMF and EMF with three replicates. The experiment was carried out under the DOA recommended fertilizer level (N - 105 kg/ha-1, P2O5 - 25 kg/ha-1 and K2O - 35 kg/ha-1). During the experimental period time taken to flowering, plant growth and grain yield were recorded. Analysis of variance was performed using STAR for Windows version 2.0.1 and means were separated using LSD. The rice variety EMF was prone early morning flowering ability (average time to flower opening at 7.20 AM and average time to flower closing at 10.15 PM) comparatively to Bg 11 802 (9.55 AM to 1.00 PM), Bg 358 (10.05 AM to 1.10 PM), Bg 374 (10.02 AM to 12.25 PM) and IR64EMF (9.30 AM to 11.15 PM) and variety EMF shows the early flower heading ability (69 days) comparatively to Bg 11 802 (77 days), Bg 358 (75 days), Bg 374 (76 days) and IR64EMF (71 days). Genes of rice variety EMF is responsible for the early flowering ability which important to escape the heat stress caused by atmospheric temperature therefore these genes can be incorporated to the future rice breeding.

Keywords: Flowering, Growth, Rice, Temperature, Yield

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ID 86

Molecular variability and genetic relationships of *Sporisorium scitamineum* isolates, the causal organism of sugarcane smut disease of Sri Lanka

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Abstract

Sugarcane smut caused by *Sporisorium scitamineum* is a devastating disease of sugarcane. Production of smut-resistant varieties is one of the major objectives in sugarcane breeding programs in almost all sugarcane-producing countries including Sri Lanka. Since no adequate scientific information is available, this research was aimed to get an insight on the genetic variability of sugarcane smut pathogen in Sri Lanka in order to support an effective breeding program for sugarcane smut disease. The genetic diversity of 83 *Sporisorium scitamineum* isolates was comprehensively evaluated in this study. The isolates were collected from 15 different sugarcane varieties that were grown in seven major sugarcane growing areas of Sri Lanka. Genomic DNA extracted from the fungal colonies originating from diploid teliospores were subjected to PCR using bE4 and bE8 specific primers and ITS 4 as well as ITS 1 universal primers. PCR products were sequenced. Sequence results using both primers showed 99% sequence similarity among the isolates. Using 16 ISSR primers, we used the inter-simple sequence repeat (ISSR) polymorphism molecular marker approach. The ISSR primers produced 104 amplified DNA fragments that are 100% polymorphic. The polymorphic information content (PIC) values ranged from 0.25 to 0.46 with an average of 0.37, indicating that the collected isolates exhibit a moderate degree of genetic diversity. Genetic differentiation coefficient (G_{st}) was estimated to be 0.241, meaning that only 24% of the total genetic variation originates between populations, while 76% originates within populations. Gene-flow (Nm) was calculated as 1.572, indicating that gene flow across populations occurs at a faster rate. The collected isolates clustered into five genetically distinct groups which did not correspond to their geographical origin. The result of this study suggests that considerable genetic variation exist among isolates collected from major sugarcane growing areas in Sri Lanka. Therefore, it is suggested to use a mixture of sugarcane smut isolates collected from all sugarcane growing areas when screening for smut-resistant sugarcane varieties for the industry in Sri Lanka to address different adoptive potentials of the isolates.

Keywords: Genetic relationship, Inter-simple sequence repeats, Sugarcane, Smut

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ID 97

Records of fruit flies (Diptera: Tephritidae: Dacinae: Dacini) in a selected mango (*Mangifera indica* L.) (Karutha kollomban) cultivation in Ambalanthota, Sri Lanka

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Abstract

Fruit flies are one of the widely distributed insect pests and they mostly damage economically important fruits and vegetables in the tropical region. However, there are no recently published reports of fruit fly assemblages associated with commercial fruit plantations in Sri Lanka. Hence, the present study aimed to investigate the abundance and diversity of fruit flies attracted to the methyl-eugenol field traps in a selected mango cultivation ("Karutha kollomban" variety) in Ambalanthota, Sri Lanka. Six fruit fly traps (5 cm diameter, 10 cm height, two circular opening-1mm radius and a methyl-eugenol coated sponge) were hung (1.5- 4 m above the ground level and 20m inter-trap distance) in six mango trees which were located in the middle of each randomly selected six sampling plots (400m²) in the cultivation (0.54 ha). Trapped flies were collected twice a month from October to December 2021 (during the fruiting season) replacing new traps in each sampling round. Collected samples were identified using standard taxonomic keys by observing under the light microscope (Nikon-ECLIPSE-E100) (10×4). Two indices; Simpson Population Dominance Index and the Abundance Index were calculated. The variation of species abundance was compared using one-way ANOVA test. Seven fruit fly species; *Bactrocera dorsalis* (Hendel), *B. kandiansis* (Drew and Hancock), *B. correcta* (Bezzi), *B. latifrons* (Hendel), *B. tuberculata* (Bezzi), *B. nigrofemoralis* (White and Tsuruta) and *B. cacuminata* (Hering) were recorded in this study. Out of the total 803 specimens examined, *B. dorsalis* had a significantly higher abundance (412, 51.31%) ($P < 0.05$) than other species, and *B. cacuminata* had the lowest abundance (26, 3.24%). The highest Simpson Dominance index (0.26) was recorded for *B. dorsalis* while other recorded six fruit fly species were less dominant in the selected mango cultivation. Study findings will be important for fruit cultivators to design and implement fruit fly control measures.

Keywords: Abundance, Dominance, Fruit flies, Mango plantations

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ID 113

Extracts of local medical plants as an alternative organic fungicide for pathogens causing cinnamon rough bark and leaf blight

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Abstract

Cinnamon is a major export spice crop in Sri Lanka. Rough bark and leaf blight diseases are fungal infections that threaten most of the cinnamon cultivation in Sri Lanka. The common practice of management of these diseases is the fungicide application. Food products grown under agrochemical use rapidly losing favor with consumers, due to their known detrimental residue effects on human health. Furthermore, studies shows that pesticide usage might irreversibly harm the environment. As a result, organic food is becoming more popular in Sri Lanka, necessitating the development of plant-based fungicides. Secondary metabolized phytochemicals with antibacterial and antifungal properties are produced by plants. The antifungal activity of plant extracts against the rough bark and leaf blight disease was evaluated in vitro in this study. Pathogenic fungi were isolated from rough bark and leaf blight symptomatic cinnamon plants. The screening of antifungal activity of ten different plant extracts prepared in aqueous and methanol extracts of five plant species namely, *Zingiber officinale* (Ginger), *Allium sativum* (Garlic), *Ocimum sanctum* (Tulsi), *Azadirachta indica* (Neem), and *Tithonia diversifolia* (Wild sunflower) were assessed against *Colletotrichum aenigma*, *Pestalotiopsis papuana* and *Colletotrichum* sp. isolated from rough bark infected cinnamon stems and fungi from leaf blight infected leaves. The three isolated causative agents were identified based on ITS sequence similarity. The antifungal activity of the ten different plant extracts was compared using the poison plate method. The results of this study revealed that the growth of *Colletotrichum* sp. was completely inhibited by *Z. officinale* and *A. sativum*. *A. sativum* and *A. indica* completely inhibited *C. aenigma* among other crude plant extracts. Five crude plants extracts failed in completely inhibiting the *P. papuana*. All methanol plant extracts showed 100% antifungal activity at 0.2 gmL⁻¹ concentration, except *O. sanctum* against *C. aenigma*. The value of minimum inhibitory concentration (MIC) of plant extracts was determined and values ranged from 0.001- 0.3 gmL⁻¹. This finding of the study concluded that methanol extracts of *Z. officinale*, *A. sativum*, *O. sanctum*, *A. indica*, and *T. diversifolia* have an antifungal effect over their fresh crude extract. This study makes the way for developing organic fungicide with the added benefits of an environmentally safe and economically viable product.

Keywords: Cinnamon rough bark disease, *Colletotrichum aenigma*, Minimum inhibitory concentration, *Pestalotiopsis papuana*, Plant extracts

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ID 30

Comparative Evaluation of Varietal Performance of Elite Short Round Grain Type Rice Varieties (*Oryza sativa* L.) Cultivated in the Low Country Dry Zone of Sri Lanka

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Abstract

Rice (*Oryza sativa* L.) is included in the family Graminae, is one of the most essential cereal crops and obliges as the main source of staple food for more than half of the global community. Approximately, around 90 % of the global rice is cultivated in the Asian continent and constitutes a staple food for 7.9 billion people worldwide. Demand for rice in the Asian region is expected to grow substantially as the population is currently growing rapidly and rice consumption is rising faster than that of any major food. Short round grains type rice cultivars such as At 373, Bg 360, and Suduru samba are normally grown in the low country dry zone of Sri Lanka expecting to fulfill the short round grain requirement. However, locally available short round grain type rice varieties were not achieved the national yield requirement. Comparative studies among the short round grain type rice varieties are very important to understand the performance of each variety under the local condition. A field investigation was carried out at Ambalantota Rice Research Station, Sri Lanka during the 2020/21 *Maha* and 2021 *Yala* seasons. The experiment was laid out in randomized complete block design (RCBD), with four rice varieties as At 373, Bg 360, At 09 - 898 (crossed between IRFAON 32/Bg 2571) and Suduru samba (Traditional variety) with four replicates where used the similar seed rate (400 seeds per m²) for each variety. The experiment was carried out under the Department of Agriculture recommended fertilizer level (N - 105 kg/ha, P205 - 25 kg/ha and K20 - 35 kg/ha). During the experimental period plant height, tiller count per unit area, panicle count per unit area, leaf area and grain yield were collected. Analysis of variance was performed using STAR for Windows version 2.0.1 and means were separated using LSD. Rice variety At 09 - 898 was shown significantly higher yield (average yield 7.58 t/ha) comparatively to At 373 (average yield 6.42 t/ha), Bg 360 (average yield 6.71 t/ha), Suduru samba (average yield 2.95 t/ha) therefore further improvement of At 09 - 898 variety may be achieve the national demand.

Keywords: Grains, Panicle, Rice, Tiller, Yield

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ID 63

Quality Variation in Processed Cinnamon along the Value Chain in Southern Province of Sri Lanka

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Abstract

For decades, Sri Lanka has been regarded as the world's largest producer of real cinnamon (*Cinnamomum zeylanicum* Blume) and a destination for high-quality cinnamon. Sri Lanka, currently provides around 90% of the true cinnamon to the world, earning 206 million US dollar of foreign exchange in 2020. Cinnamon may expose to a wide range of contaminations along the value chain, and this may greatly reduce the export quality, ultimately affecting the export income. In this study, samples of processed cinnamon quills from three major value chain players of processors, collectors and exporters in Galle, Matara and Hambantota districts were extensively analyzed for physio-chemical properties under 8 major quality parameters for its relative compliance to the Sri Lanka Standard (SLS 81:2021) and International standards (ISO 6539:2014, Codex GSFA) as a two factor factorials design taking the districts and different levels of the value chain as the factors. Moisture content significantly varied along the value chain but not among the districts. The highest moisture content (19%) was observed at farmer level which was higher than the recommended. Sulphur content was significantly varied along the three levels as well as the districts. No sulphur residues were detected at farmer and collector levels. Even the highest sulphur content observed in the level of exporter was lower than the Maximum Recommended Level (MRL). Volatile oil content and total and acid-insoluble ash content were not different in three levels or among districts. However, total ash content exceeded the required levels in the standards (5%) in all levels of value chain and all districts. Insect count, microbial count and water activity in the three levels showed a significant difference in all districts. Lowest insect count and microbial count were observed in the exporter level. The highest microbial contaminants were observed in Hambantota district. Mean percentage values of colour for three levels of value chain in three districts showed no significant difference. This study could be the baseline for further research to identify the reasons for the quality gaps in each level and possible ways of overcoming them.

Keywords: *Ceylon Cinnamon*, Quality, Sri Lanka, Standards, Value Chain

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ID 127

Growth and yield performances of cabbage grown under polytunnel in low country wet zone in Sri Lanka as affected by rate and split application of Albert fertilizer

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Abstract

An experiment was accomplished in the low country wet zone of Sri Lanka from October 2021 to January 2022 in a protected house to study the effect of rate and split application of Albert fertilizer on growth and yield performances of cabbage (*Brassica oleracea* L. var Green Coronet). The experiment was carried out in a two-factor factorial (2×3) Completely Randomized Design with four replicates. The tested two factors were, rate of fertilizer; A₁ (1.0 g/plant/day), A₂ (1.5 g/plant/day), A₃ (2.0 g/plant/day) and number of split applications of fertilizer; F₁ (1 time/plant/day), F₂ (2 times/plant/day), F₃ (3 times/plant/day). Treatments were applied daily. Average day temperature inside the protected house was 32.5 °C and average night temperature inside the protected house was 27 °C. Growth parameters (plant height, canopy diameter and number of loose leaves per plant) were taken fortnight intervals while cabbage heads and total biomass yield were taken as yield parameters after 110 days from transplanting. The data were analyzed using ANOVA and means were separated by least significant difference (LSD) at 5% probability level. There was no significant effect of split of fertilizer and no interaction effect between rate and split of fertilizer. Plant height, canopy diameter and number of loose leaves per plant significantly influenced by amount of fertilizer. The treatment of 2.0 g/plant/day gave significantly higher values for above growth parameters with compared to 1 and 1.5 g/plant/day treatments. Even though, no significant difference was recorded in biomass yield, significantly highest head yield was recorded in the treatment of 1.0 g of Albert fertilizer/plant/day. When considering the economic yield, it can be concluded that the treatment of 1.0 g/plant/day is the best fertilizer rate for cabbage grown under polytunnel condition in low country wet zone of Sri Lanka. Also, fertilizer application once per day can be recommended when considering the energy use efficiency since there is no significant effect of split applications of fertilizer.

Keywords: Albert fertilizer, Cabbage, Polytunnel

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Food Technology and Nutritional Sciences



Keynote Speech

Valorization of agrifood waste for bioactive recovery – challenges and opportunities

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Abstract

Agriculture and food industry are generating substantial amounts of waste material, either on farm or during food processing. Whilst at present much of the waste ends up in landfill or as animal feed, there is huge potential to be utilized for other, more targeted purposes, including recovery of high value ingredients. Indeed, there is an increasing interest to utilize extracts or individual compounds from these waste streams to develop different downstream applications such as feed additives, food, and nutraceuticals. Our recent research has considered different waste streams, including remainders of the citrus and beet juicing industries. Approaches that were applied involved different extraction techniques such as microwave, ultrasound or enzyme assisted, as well as comparisons between solvent and alternative more sustainable solutions. With the extraction aiming for polyphenols as well as other bioactives and biopolymers, there are a number of considerations apart from extraction, including stability and the requirements of the targeted applications. Our findings emphasize the importance of optimizing extraction workflows from individual sample types to tailor for groups/compounds of interest and functionalities associated with these. As demonstrated through RSM (response surface methodology), extraction performance for polyphenols and other antioxidants from mango and avocado peel waste can differ markedly. Further, extraction-specific presence of citrus flavonoids from citrus waste can determine their associated antimicrobial activities such as antifungal and antibacterial properties, with the latter able to modulate anticariogenic biofilm formation with potential to modulate oral health. There are limitations to some approaches, e.g., enzyme assisted extraction from beet waste, resulting in loss of betalains. Associated with the extraction of potential high value compounds, may be the need to purify some of these, which was recently achieved in our group for betalains using flash chromatography, allowing the study of a range of in vitro and cellular biological properties to determine their potential for applications in the food but also non-food sector.

Oral Presentations

ID 13

Mathematical models to describe thin layer drying kinetics and determine the drying rate of grapes in raisin production processed by different convective drying methods

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Abstract

During the peak season of harvesting, grapes are flooded onto the market, causing price decreases and farmer losses. To reduce the losses, an alternative is to dry the product. In this context, the main objective of this article was to describe the thin layer drying of seedless grapes. To describe the convective drying processes (such as fast heating (107 °C) (T1), slow heating (55 °C) (T2), Open sun drying (T3) and drying under shade (T4)) some mathematical models are normally used. In this article, there are three empirical models were selected to simulate experiments of thin layer drying accomplished with grapes. In the selection, it was imposed that mathematical expressions must be obtained from each model to calculate the moisture ratio and also the processing time. The processing time ranged from 14 hours (107 °C) up to 35 days (drying under shade). The maximum drying rate occurs at the beginning of the process and varied as 13.73 g/100g/hour (107 °C), 0.724 g/100g/hour (55 °C), 0.299 g/100g/hour (open sun drying) and 0.18 g/100g/hour (drying under shade). The statistical indicators showed that the Page model was the best one to describe the drying kinetics of grapes. The best-fitted model was selected based on the R² and constants values. While R² values were 0.9923, 0.9750, 0.9721 and 0.9638 and k values were 3.1702, 5.4672, 4.9687 and 6.0645 for T1, T2, T3 and T4 respectively. As a result, the empirical equation for the page model allows for the creation of mathematical expressions for the moisture ratio and process duration, and it is best suited for all treatments.

Keywords: Drying Kinetics, Grapes, Moisture content, Thin layer models

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ID 17

Prediction of glycemic indices of coconut (*Cocos nucifera* L) jaggery and value-added coconut jaggery through in vitro method

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Abstract

Sweeteners are highly interconnected with non-communicable diseases such as obesity, type II diabetic and heart diseases. Hence, there is a huge demand for natural sweeteners with low blood glucose responses. Food Glucose responses can be determined in vivo using human subjects or in vitro using enzymatic digestion systems. In comparison to in vivo, the in-vitro approach is less expensive and more convenient. Coconut (*Cocos nucifera* L.) jaggery is an alternative sweetener specially among rural Asian communities. The focus of this study was to evaluate the in-vitro digestibility and prediction of glycemic index (PGI) for four types of coconut jaggery namely: jaggery produced from traditional sap collection method using hal bark (*Vateria capalifera*) (HAL Jaggery), the jaggery prepared from pure sap collected from a novel sap collection device (NSCM Jaggery), jaggery prepared from collected sap through a novel sap collection method with the value added by 0.2 % cinnamon (*Cinnamomum zeylanicum*) (CIN Jaggery) and the jaggery value added with 0.05% of nutmeg (*Myristica fragrans*) (NUT Jaggery) and cane sugar. Glucose was used as a standard. Digestion and digestibility tests for each type of sweeteners were carried out. Results revealed that the rate of starch hydrolysis of glucose was significantly higher than the other sweeteners and four types of jaggery have different hydrolysis rates from 30 to 180 minutes. Hydrolysis Index (HI) of cane sugar was significantly higher than that of the others (55±0.023 %) whereas the lowest HI was observed in NUT Jaggery (32±0.014%). According to the in vitro glycemic prediction, all four types of coconut jaggery samples were categorized under a medium GI sweetener while cane sugar categorized as a high GI (69.91±0.02) sweetener.

Keywords: Coconut Jaggery, In vitro starch digestibility, *Myristica fragrans*, Predicted glycemic index, *Vateria capalifera*

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ID 18

Glycemic responses by coconut (*Cocos nucifera*) jaggery and cane sugar (*Saccharum officinarum*): A comparative study

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Abstract

Cane sugar (*Saccharum officinarum*) and coconut (*Cocos nucifera*) jaggery are prominent sweeteners in food industry. The aim of this study was to evaluate Glycemic Indices (GI) of cane sugar and coconut jaggery using healthy human subjects. The sugar profile and starch fractions (Total starch – TS, Resistant starch-RS, and Digestible starch – DS) of cane sugar and coconut jaggery, two test foods, were studied using thirty-six (n=36) healthy volunteers aged 20 – 40 with a body mass index of 18-25 after a health screening. Fifty grams of digestible carbohydrate containing test food portions were given for each subject who had been fasting for 8 - 12 hours. Intravenous blood samples were collected to analyze blood glucose concentration. It was known that cane sugar contained high percentages of TS (95.86 ± 1.58 %), and DS (95.73 ± 1.59 %) while showing and RS was just 0.13± 0.02% while coconut jaggery contained a lower percentage of sucrose (76.12±1.62 %) and glucose (5.22±0.11%) compared to cane sugar. In addition, healthy volunteers (25.95±3.62 years) who were having healthy fasting blood glucose concentrations (73.54±8.89 mg/dL) and HbA1c (5.05±0.35 %) were tested with glucose, and the two test foods. There was no significant difference (p<0.05) between blood glucose response curves as well as GI of coconut jaggery (65.19±36.53) and cane sugar (60.76±35.80), where both can be considered as moderate GI sweeteners.

Keywords: Cane sugar, Coconut jaggery, Glucose response, Glycemic Index

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ID 48

Formation of milk protein-based coconut and sesame oil edible oleogels as spreadable products: A proof-of-concept study

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Abstract

Edible oils are conventionally converted to spreadable form via hydrogenation. However, hydrogenation leads to the formation of trans-fatty acids that cause metabolic syndrome and cardiovascular diseases. Oleogelation is an emerging technology that converts liquid oils into spreadable form without hydrogenation. The present study investigates the possibility of converting coconut oil and sesame oil into spreadable fat products using milk protein-assisted emulsion template oleogelation. In this study, oil in water emulsions with a range of milk protein concentrations (2% (w/w), 3% (w/w) and 6% (w/w) in the aqueous phase) were prepared using sesame oil, coconut oil and reconstituted milk powder solutions. The emulsions were gelled using acidification and dewatered by pressing at 2.6 kNm⁻² pressure to obtain oleogels. Stability measurements in room temperature (around 29°C) and optical microscopic images revealed that the stability of oleogels improved with the increase in protein content, due to the formation of a compact gel network. In coconut oil oleogel samples, the oil separation index was significantly decreased ($p < 0.05$) from 12.4 to 8.4 as milk protein concentration increased from 2% (w/w) to 6% (w/w). The oil separation indices of sesame oil oleogels made with 2%, 3% and 6% milk protein concentrations were 4.5, 5.7 and 2.4, respectively. Increase in protein content from 2% (w/w) to 6% (w/w) led to a significant increase ($p < 0.05$) in the moisture content of oleogels. Coconut oil oleogels made with 2% (w/w), 3% (w/w) and 6% (w/w) milk protein concentrations had 20.6% (w/w), 25.7% (w/w) and 33.0% (w/w) moisture, respectively. Similarly, sesame oil oleogels made with 2%, 3% and 6% milk protein concentrations had 21.0% (w/w), 24.5% (w/w) and 29.4% (w/w) moisture, respectively. Visual observations of sesame oil oleogels showed better stability and spreadability than coconut oil oleogels, in all protein concentrations studied. This study demonstrates the possibility of applying milk protein acid gelation to form spreadable oleogels using coconut and sesame oil.

Keywords: Acid gelation, Coconut oil, Emulsion template, Oleogelation, Sesame oil

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Poster Presentations

ID 20

Anti-cancer effect of Katupila (*Flueggea leucopyrus*) plant extract

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Abstract

Katupila (*Flueggea leucopyrus*) plants, which are utilized in indigenous medicine in Sri Lanka, are thought to have significant anti-carcinogenic properties. As a result, the current study was designed to investigate the influence of Katupila on cervical cancer prevention. The plant materials were subjected to methanol and water extractions and freeze dried. A set of serial dilutions was prepared from each extract at concentrations of 1:1 1:2, 1:3, 1:4, 1:5, 1:6, 1:7 and 1:8 (v/v; water: extracts). A 10 µl drop of dilutions were added to a normal Vero cell line, which were already incubated with 90 µl of culture medium until sub confluency, and further incubated for 24 h. 3-(4,5-dimethylthiazole-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay was performed to detect the toxicity, a non-toxic dose selected from each plant material were 1:6, 1:7 for Katupila methanol and Katupila water extracts, respectively. The selected doses were added to sub confluency, HeLa cell cervical carcinoma cell line and incubated for 24 hours followed by MTT assay. All the plant materials used had significant ($P<0.05$) anti-proliferative effect on cervical carcinogenesis in vitro. Moreover, Katupila leaves extract had significantly higher ($P<0.05$) efficiency than other parts of plant materials. The study concluded that Katupila leaves had an anti-proliferative effect on cervical carcinogenesis in vitro, with Katupila leaves being significantly more effective. As a result, the plant elements analyzed can be effectively used to create an organic anti-cancer medication. Further studies must be conducted in order to find an anti-cancer medicine derived from local medicinal plants.

Keywords: Anti-carcinogenic, Cell line, Cervical, Katupila, MTT assay

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ID 26

Evaluation of mixed jam prepared from ripen *Solanum lycopersicum* and *Capsicum annuum*

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Abstract

In today's world, people are paying more attention to the concept and intake of fruits and vegetables in order to live a healthy life. Tomato is a vegetable with high amount of biologically active substances and Vitamin C. It is an ideal vegetable in making jam due to its natural orange reddish colour. However, utilization of tomato for the production of value-added products is still to be revealed. Red pepper is one of the major spices consumed globally, recognized for its aroma and nutrient properties. An effort was made in this study to prepare the best combination of ripened tomato and red pepper pulp levels for jam production, which can enhance the spicy taste of mixed jam. Based on the findings of preliminary studies, four formulations of mixed jam were created by blending different ratios of ripened tomato, red pepper pulp, and ginger extracts at various levels for jam preparation. T1 (tomato 100g + capsicum 0g + ginger 10 g), T2 (tomato 70g + capsicum 30g + ginger 10 g), T3 (tomato 60g + capsicum 40g + ginger 10 g), and T4 (tomato 50g + capsicum 50g + ginger 10 g) are the treatments. The prepared formulations were nutritionally and sensorily evaluated. For the treatments, chemical analyses such as pH, titratable acidity, total soluble solid, moisture content, and ash content were performed. Color, taste, texture, aroma, and overall acceptability were evaluated by 20 semi-trained panelists using a nine-point hedonic scale. The nutritional analysis revealed an increasing trend in pH (4.35 ± 0.01 - 4.87 ± 0.02), TSS (71.93 ± 0.08 - 71.95 ± 0.15), ash content (0.38 ± 0.03 % - 0.48 ± 0.05 %), and a decreasing trend in titratable acidity (0.57 ± 0.01 % - 0.53 ± 0.03 %) and moisture content (61.29 ± 0.04 - 55.52 ± 0.07 %) with an increase in red pepper pulp from 30 g to 50 g. The formulation T2 with 70g ripened tomato and 30g red pepper, had the highest overall acceptability. In terms of sensory and nutritional properties, all formulations differed significantly ($p < 0.05$). As a result, ripened tomato and red pepper pulps supplemented with ginger extract have a high potential for jam production.

Keywords: Ginger extract, Mixed jam, Nutritional properties, Red pepper, Ripen tomato

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ID 52

Evaluation of Antioxidants at Different Maturity Stages of Soursop (*Annona muricata*) Fruit

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Abstract

Soursop fruit contains various bioactive compounds and has been used as valuable fruit in Sri Lanka. Different maturity stages and extraction method used could affect antioxidant activity of fruits. Therefore, present study investigated antioxidant activity of soursop at four different maturity stages (unripe stage (UR), harvesting stage 1 (HS1), harvesting stage 2 (HS2), and well-ripened stage (WR) extracted using two extraction methods. Sonication and stir plate were used as extraction techniques while absolute ethanol and 70% (v/v) ethanol were used as extraction solvents. The analyses of antioxidant activity conducted were Total Phenolic Content (TPC), Ferric Reducing Antioxidant Power (FRAP), and 2,2-diphenyl-1-picrylhydrazyl (DPPH) Radical Scavenging Activity. From the analyses, the TPC, FRAP assay and DPPH activity was significantly ($p < 0.05$) changed with maturity stages. The highest TPC (165.67 ± 2.86 mg GAE g^{-1}) was identified in 70% ethanol extract of WR stage with sonication extraction method. The highest ($p < 0.05$) FRAP (393.91 ± 4.23 $\mu\text{mol Fe}^{+2} \text{L}^{-1}$) value was identified in 70% ethanol extracts of HS2 with sonication extraction. The highest DPPH activity ($IC_{50} = 60.13 \pm 0.18$ ppm) was identified in 70% ethanol extract of WR stage with sonication extraction. The content of all the antioxidant compounds by three different assays increased ($p < 0.05$) as maturity progressed. Hence, it can be concluded that soursop extracted using 70% ethanol extract of WR stage with sonication extraction method had powerful phenolic content, 70% ethanol extracts of HS2 with sonication extraction had powerful FRAP values and 70% ethanol extract of WR stage with sonication extraction had powerful IC_{50} values, suggesting their potential applications as health promoting functional ingredients.

Keywords: Antioxidants, Maturity stages, Soursop, Total phenol

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ID 53

Sensory acceptability of cinnamon flavoured beverages developed with Cinnamon (*Cinnamomum zeylanicum*) leaf extract

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Abstract

The world looks for bold and exotic new food flavours to the food industry. Ceylon cinnamon (*Cinnamomum zeylanicum* Blume) is designated globally as the true cinnamon due to its distinct characteristics. The taste and aromatic characteristics of cinnamon drastically vary with the origin. Although a substantial number of products have been developed using Ceylon cinnamon bark, there has been a wider hiatus in development of new food products from cinnamon leaves. The present study attempted to recon the sensory acceptability of newly developed two cinnamon-based beverage products which are made from semi-mature *C. zeylanicum* leaf, a hot beverage, and a cold beverage. A trained sensory panel (n=20) was given these two-leaf cinnamon flavoured beverages to study the sensory acceptability in cinnamon leaf flavoured beverages towards novel product development. A nine-point hedonic-sensory evaluation was done for each product. As per the results of the sensory test, the willingness of drinking leaf based cinnamon tea (hot) and carbonated beverage (cold) seemed favourable as like response (hedonic score 6, 7, 8, 9) of overall acceptability is 72.22% and 100%, respectively. Colour, brightness and aroma of the tea have reported 55.56%, 61.11% and 72.22% like responses, respectively. The bitterness of the product was identified as 22.22% of very much like (hedonic score 8). The colour, aroma, taste, cinnamon flavour, carbonation, acidity, body, mouth coating and after feel of carbonated drink reported as above 80% of like responses (hedonic score 6, 7, 8, 9) while colour, aroma and cinnamon flavour has 63.16%, 57.89% and 57.89%, respectively of very much like responses (hedonic score 8). However, the sweetness of the carbonated drink seemed high as more than 50% of dislike response reported from the sensory panel with 26.32% of slightly dislike (hedonic score 4) because cinnamon itself has sweetness and need to maintain low sugar levels when utilizing cinnamon leaves as a food flavour for beverages. The cinnamon leaves have a good potential to use as a flavour compound for beverages.

Keywords: Ceylon cinnamon, Cinnamon-flavoured beverage, Cinnamon leaves, Cinnamon tea, Sensory evaluation

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ID 55

Performance comparison of five different steam chambers used to produce straight and single form of rice noodles strings

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Abstract

Over gelatinization of extruded rice noodles during open wet steam cooking is a major problem in food processing industry. This occurs due to condensation of water droplets which come into contact with noodle strings during steaming process. This issue may arise due to the presence of stuck noodles in the finished product. The design of a steam chamber is also very important aspect in order to produce straight and single form of rice noodles strings. As a result, five prototype designs were created: the wooden frame enclosed with polythene sheet (A), the wooden frame enclosed with gray cloth (B), the wooden frame enclosed with plywood sheet with two steam inlets in the galvanized door (C), the wooden frame enclosed with plywood sheet with multiple steam inlets in the galvanized door (D), and the completely enclosed galvanized chamber (E). All steam chambers had multiple steam inlets in lateral walls except the chamber with gray cloth. Red rice noodles were prepared from the combination (16% MC, 200 μ m, water at ambient temperature (30 \pm 2 $^{\circ}$ C), control atmosphere, 20 minutes) and fed into five different types of prototype designs in order to complete the cooking (gelatinization) process. Performance of the five prototype designs were evaluated in terms of percentage of dried noodles coming out of each design in single straight form. According to the results, the percentage of dried noodles coming out of each design was analyzed (A-50.0 \pm 7.1%, B-15.0 \pm 5.0%, C-15.0 \pm 5.0%, D-50.0 \pm 7.1%, E-77.5 \pm 4.3%). The mean values of all designs revealed that best prototype design was "design E" (steam chamber consisted of completely enclosed galvanized chamber with the multiple steam inlets in the two lateral sides). When compared to other designs, it produced a larger percentage of straight single noodles. To conclude, design E is the ideal steam chamber for producing straight single rice noodles for the market.

Keywords: Over-gelatinization, Rice noodles, Steam chamber, Straight single noodles

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ID 62

Sri Lankan consumer perspective and prospective behaviour on anti-diabetic functional foods and nutraceutical products

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Abstract

Herbal plant extracts and their isolated bioactive compounds have gained much popularity in the management of diabetes mellitus. Delivering their benefits across functional foods or nutraceuticals will offer great future prospects. This comprehensive survey evaluated the perspective, preference, and prospective consumption behaviour, on antidiabetic food products and nutraceuticals, by the Sri Lankan consumers and provides an insight into identifying the novel food types with higher consumer preference for further product developments. The data analysis and the interpretation were based on the ANOVA and cross-tabulation analysis. The survey data revealed that 27% of the respondents were moderately aware about antidiabetic food options and more than half of them (51.56%) preferred antidiabetic products in food form rather than the nutraceutical form. Further, 85.43% of the respondents preferred consumption of new food products incorporated with plant materials traditionally known to reduce the risk of diabetes. The majority of the respondents favoured consuming antidiabetic foods as a snack product (49.82%), followed by the other different types such as noodles (20.14%) and bakery products (19.11%) as a breakfast food, ready to serve fruit drink (33.75%), ready to serve herbal drink (23.34%), tea (32.49%) as beverages, yoghurt (37.10%), curd (23.23%) as dairy products. The nutrient content of the product (response with 25.27%) and the taste (24.56%) were the major factors that the respondents indicated as they may consider when selecting a novel food item in the market. It was further inferred that consumers mostly prefer the tablet form if given as a nutraceutical (38.80%). According to the Chi-Square test (at $p < 0.05$) the age of the respondents was the major determinant of the consumer awareness of the anti-diabetic foods/beverages, as well as their interest in purchasing anti-diabetic foods or nutraceuticals in the market. According to findings, the majority of respondents preferred to consume functional foods in antidiabetic form than nutraceuticals, and these findings will be helpful in deciding on novel functional food types for future development.

Keywords: Antidiabetic, Consumer's preferences, Functional foods, Medicinal herbs, Nutraceuticals

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ID 105

Development of cashew (*Anacardium occidentale*) apple flour incorporated cookies

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Abstract

The wastage of cashew apple is high in Sri Lanka. With a view to improve the utilization of cashew apple by value-addition, it was processed into flour and used in the making of cookies. Cashew apple flour (CAF) was blended with wheat flour, at levels of 0%, 10%, 20%, 30% and 40% (w/w) for making cookie dough and the weight (g), diameter (cm), height (mm), volume (cm³), density (g/cm³) and, spread ratio like physical parameters of cookies were measured. The products were subjected to sensory evaluation. Sensory properties of cookies were evaluated by 30 semi-trained panelists using a 7-point Hedonic scale (7 for 'like extremely' down to 1 for 'dislike extremely'). The formulation with the best organoleptic properties was used to determine the proximate compositions against the control containing 100% wheat flour. The CAF and wheat flour blend cookies were not significantly different ($P>0.05$) in terms of their weight, diameter, height and spread ratio. However, significant differences were present in the volume and density of cookies. The best sensory attributes resulted from 30% CAF and 70% wheat flour in the cookie. The new formulation reported relatively lower crude protein (12.33%), crude fat (16.25%), and ash (1.57%) contents while it had higher fibre (6.33%) content compared to the control (15.04%, 18.36%, 1.68%, and 5.56%, correspondingly). The moisture content of fresh cookies made from the flour blend was relatively higher (7.46%) than that of control (6.43%). Cookies were stored in LDPE bags at room temperature. Cookies incorporated with 30% cashew apple flour could be introduced as a value-added food product after further studies on its shelf-life.

Keywords: Cashew apple, Cookies, Flour, Physical properties, Sensory attributes

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Agricultural Economics and Agribusiness



Oral Presentations

ID 21

Online purchasing behavior of fast-moving consumer goods during COVID-19 post lockdown period: A study in Kurunegala district

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Abstract

Fast-moving consumer goods (FMCG) are items that are sold quickly and at a low price. Online FMCG shopping is defined as the ability for consumers to order and have groceries delivered to their home via the internet. The short term COVID-19 pandemic impacts are the widespread lockdown and the social distancing which destroys the traditional shopping behavior of the consumers. Because of the COVID-19 pandemic, online FMCG buying from supermarkets is being used more frequently these days to safeguard people from COVID-19. This study can be useful to improve the e-commerce usage among the consumers in Sri Lanka and for supermarkets to enhance their online FMCG shopping method to increase the customer loyalty. To identify the changers happened in online purchasing of FMCG before and after COVID lockdown, this research was conducted as survey type research using quantitative data. The research design was an online questionnaire survey where data was collected through an online form. The target population was people who are buying FMCG from supermarkets and have at least one-time experience in online FMCG shopping, from the consumers who are living in the Kurunegala district. Wilcoxon Signed Ranks Test revealed a statically significant change in online FMCG buying behavior before and after COVID-19 lockdown periods, $z=2.66$, $p < 0.05$, R-value is 0.16 indicating that the effect was too small. It is clear that online FMCG shopping behavior increased after the COVID-19 lockdown period. Online purchases were significantly greater during the COVID-19 lockdown periods than before and after it. When compared to the middle-aged group, the younger age group had a greater influence on online FMCG intention. Gender had no effect on online FMCG purchase intention. These findings can be used by supermarkets to increase the convenience of online FMCG purchasing by minimizing potential risk factors that influence their intention.

Keywords: COVID-19, Online FMCG, Perceived risks, Purchasing behavior, Purchasing intention

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ID 34

An empirical analysis of the effect of agricultural sector determinants on economic growth in Sri Lanka

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Abstract

The role of agriculture has been significantly emphasized in improving the living standard of the population and economic framework of any country. Rostow (1960) in his Stages of Economic Growth explained that agriculture is crucial for the “take-off stage” of a nation’s economic growth and development. Agriculture has been an important sector in Sri Lanka which contributes 7.4% to the GDP, 25.5% of the total labor force, and 20.62% to the foreign earnings and Livelihood Avenue for 2.1 million households in Sri Lanka. The contribution of agriculture sector determinants food, forestry, fishery and livestock: to the GDP shows a declining trend during the last four decades. Therefore, this study attempts to examine the effect of these determinants on economic growth over the period of 1987-2019. Secondary data was extracted from the Central Bank of Sri Lanka. This study adopted econometric modeling to confirm the stationary, long run relationship, and short run relationship among the variables. The Augmented Dickey-Fuller and Phillips-Perron unit root tests were confirmed that all the variables are stationary only at I (0) and I (1) and ARDL (3,4,4,3,4) model. The Wald test found a co-integrating relationship between the variables under considered in this study. The findings of Auto Regressive Distributed Lag (ARDL) bound test shows that the food production, forestry have negative relationship, fishery and livestock have positive relationship with GDP in the long run. Even though all the explanatory variables have relationship with GDP, only livestock has statistically significant impact on RGDP at 5% significant level in the long run in Sri Lanka. The Error Correction version of the ARDL test discovered that food production, forestry, and livestock have a positive and significant short-run impact on RGDP. While economic growth can return to a long-run steady state at a rate of 35.75 % in each year following external shocks. As a result of this research, the Sri Lankan government should prioritize concentrating on several subsector variables in order to accelerate the country's economic growth. Hence, Sri Lanka needs efforts on agricultural; based structural transformation by adopting new technology to increase labour and land productivity, improving farm-market linkages, investing in value chains, and also generating off-farm employment to absorb excess labour in the rural areas. In addition, Sri Lanka needs to redouble her efforts to build sustainable agriculture food systems that are better able to withstand crises and shocks in the future.

Keywords: Agricultural sub sectors, Auto regressive distributed lag model, Economic growth (RGDP), Sri Lanka, Time series analysis

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ID 37

The impact of value addition on profit and pricing mechanisms of skipjack tuna dried fish processor in southern and western coast of Sri Lanka

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Abstract

The degree of value addition in dried fish products is critical in price determination. However, price determination and profitability analysis are critical in shaping the structure, conduct, and performance of the dried fish market. Having lesser studies on dried fish value chain analysis, lacunae exist in determining of relevant market prices and profitability to console between processors, traders, consumers and the government. Thus, this study attempts to examine the impact of value addition on pricing mechanisms and profit of skipjack tuna dried fish processors in the south and the west coasts of Sri Lanka., The skipjack tuna dried fish value chain has been selected as it is the highly consumed large-pelagic dried fish variety in Sri Lanka irrespective of the geographical differences. A questionnaire survey was conducted with 60 dried fish processors by using simple random sampling from Hambantota, Matara, Gampaha and Puttalam. Secondary data were collected from published materials. Data were analyzed descriptively and inferentially. According to the findings, 40% of processors perform any value-added function other than grading, sorting, and packaging. Color-based grading is common for skipjack tuna. The quality ranges from top to bottom as red/pink, red mix, and white/yellow respectively. Accordingly, price changes was observed as +23.52%, +0.98% and -8.23% in each respective products comparatively normal/non-value added product price (Rs.510/=). Major 02 types of dried fish grade were identified as hard and soft and the prices changes with +11.37% and -0.98%, respectively. According to the size, there are major 04 grades as full, halves, broken and blocked portion (10-15g). Price changes are being observed in broken and blocked portions as -2.94% and +30.98%. Polythene packed products indicated 94% price increment comparatively normal/non-value-added product price. The 20% processors in the sample produce animal feed and fertilizers using the by-product. They sell these products in between Rs. 50/kg- Rs.60/kg prices. Processors who engage with grading (color-40.16%, texture-67.16%, size-64.32%) and packing (486.58%) received the highest profit than normal processors. Further, there was significant improvement of price due to value addition on color ($p=0.00$), texture ($p=0.00$) and size ($p=0.007$). The study concluded that, processors engage with very low number of value-added activities in the area. However, value addition significantly affecting to skipjack tuna dried fish price and processor's profit improvement. Therefore, a fair price was received by processors who engage with value addition than normal processors. It was recommended that the mechanism for setting up fair dried fish price and enhancing value addition toward policy measures.

Keywords: Average price, Dried fish, Pricing mechanisms, Profit, Value addition

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ID 38

The effects of seasonal variations of weather on tea production: A Ricardian analysis

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Abstract

The Ricardian approach has broadly been used in the literature to estimate the economic impacts of climate change on net revenues from agriculture in different geographies due to its ability to account for farmer adaptation. However, its application in the plantation sector is quite limited. Having lower adaptive capability with largely cultivated extents of perennial crops, plantation lands are principally vulnerable to climate change. However, even with strong trends and the likelihood of future changes are evident in the seasonality of weather, its impacts on plantation economies have not been properly evaluated. This study aimed to estimate the economic impact of seasonality of weather on Sri Lankan tea production and its spatial heterogeneity across major tea growing regions. The study employs a panel Ricardian technique, utilizing a largely collected data set including climate and non-climate data from 49 tea farms from 2004 to 2018. The results of the regression analysis suggested that the weather variables of the major monsoonal seasons have a significant impact on the revenue generation of Tea plantations. The marginal impact analysis of the study quantifies the economic impact of these weather variables. Specifically, a 100mm increase in southwest monsoon rainfall increases the tea plantation net revenues by 14.2%, and a 1°C increase in mean temperature during the southwest monsoon season decreases the net revenues by 2.2%. Accounting for the spatial heterogeneity of impacts, 1°C increase in mean temperature during southwest monsoon season is found to be affected to revenue generation from tea plantations in Up Country by 14.3% positively and in Low Country by 6% negatively. Overall, we find that long-term weather variables can explain about 5-6% of the variation in net revenues across tea estates. The evidence from this study may be useful for Sri Lankan policymakers to facilitate greater preventive measures during the main seasons to counteract seasonal uncertainty.

Keywords: Climate change, Panel data, Perennial crops, Seasonality, Sri Lanka

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ID 56

Analysis of the productivity determinants of spine gourd (*Momordica dioica roxb*) farming in southern dry zone of Sri Lanka

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Abstract

Spine-gourd is a naturally grown vegetable crop which locally introduced as *Thumbakarivila*. Due to its medicinal and nutritional values, deliciousness, limited production and seasonality, this vegetable crop fetches good demand and high price in the market. Despite its' demand, organized cultivation of spine-gourd was lack due to its short harvesting period, low yield, tuber dormancy and lack of standard propagation techniques. After introducing hybrid spine-gourd by the Department of Agriculture, production of this crop has noticeably increased during the current decade. This study aimed to estimate total farm productivity and factors determined the spine gourd productivity. Sixty-nine (69) spine gourd farmers in *Monaragala* and *Hambantota* districts were randomly selected to be in the sample by employing multi-stage sampling procedure. Primary data were collected through a structured questionnaire. Major productivity determinants used in the analysis were Gross Margin analysis (GM), Total Factor productivity (TFP) and Partial Factor Productivity (PFP) analysis. Ordinary Least Square (OLS) regression methods were employed to identify major factors that influencing the productivity. Results indicated that gross margin (profit) was Rs. 1,410,219 with total cost of Rs. 1,377,657 per hectare. Mean TFP was 4.7 with minimum of 0.4 and maximum of 12.8. Linear function (OLS) shows that predictors of education, cultivated extent, total labour, amount of fertilizer and income through spine gourd farming had significant association with TFP. According to PFP analysis, the highest factor productivity was incurred by extent cultivated. Amount of fertilizer and labour days used also decisive factors for productivity enhancement. Study concluded that spine-gourd is still a profitable business for dry zone farmers albeit diseases and lack of planting materials were found as major issues. Study recommended expanding cultivation further through facilitating farmers with healthy planting materials or providing technology for own planting material production. Controlling virus and bacterial incidences will leads for advantageous to the consumer for buying spine gourd at reasonable price without harming producer's average profit margin.

Keywords: Gross margin, OLS regression, Productivity determinants, Spine gourd, Total factor productivity

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ID 57

Environmental and technical efficiency in agricultural production in Asia

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Abstract

Although the agricultural sector contributes to economic development and livelihood, pollution in the agricultural sector can result in a number of environmental and health risks. As a result, improving agricultural productivity while avoiding environmental degradation is currently one of the primary priorities of Asian countries depending on agriculture. Therefore, this study attempted to examine both the technical and environmental efficiency of agricultural production in Asia using a stochastic frontier analysis with a panel data set consisting of 48 Asian countries from 1990 to 2018. According to the findings, all considered factors of production *viz.* land, labor, fertilizer, and pesticides show a positive impact on agricultural production while the total agricultural production is highly dependent on fertilizer use. The average technical efficiency of agricultural production in Asia is 71% and ranges from 69 to 75%. This indicates that countries are on average executing about 71% of best practice output in their use of agricultural inputs and technology. Nonetheless, there is still potential for increased agricultural productivity with the same levels of inputs and technology. The chemical pesticide is treated as the only environmentally harmful input for calculating environmental efficiency. The typical value of environmental efficiency for ecologically harmful input ranges from 20% to 25%, with an average value of 22%. The low environmental efficiency shows that the agricultural production value could be maintained by reducing the pesticide input use by 78% while using observed values of other inputs. Therefore, there is a great potential for reducing the environmental impact of agricultural production by the optimum use of pesticides and enhancing the environmental efficiency of Agriculture in Asia. Technical and environmental efficiency scores follow the same pattern, with small diminishing tendencies over time. The findings demonstrate the value of reallocating input resources such as pesticide inputs and enhancing agricultural environmental efficiency. As a result, ecologically harmful inputs should be used in a sustainable manner to minimize the negative externalities of agricultural production on the environment.

Keywords: Agriculture, Environmental efficiency, Stochastic frontier analysis, Technical efficiency

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ID 78

**Work life balance and job satisfaction of women employees in public sector organization:
A case study in Sri Lanka Export Development Board**

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Abstract

In the present scenario, balance between professional and personal life of women employees is highly desirable as it has a significant impact on job satisfaction and their individual performance. The purpose of this study was to examine the impact of work-life balance on job satisfaction, as well as to assess the challenges associated with professional and personal life and to suggest strategies for maintaining a healthy work-life balance. Primarily, data were collected by using pre-tested structured questionnaire from randomly selected 50 female executive employees in Sri Lanka Export Development Board. Work life balance and job satisfaction were measured by five-point Likert scale. Descriptive and inferential statistical methods were utilized to analyze the data. The results reveal that the women employees were having overall moderate level of work life balance where mean value (M) was 3.25. Non-job responsibility (M=4.54) was the most effective factor and duration of work (M=1.3) was the least effective factor for the work life balance. They were having a nearly moderate level job satisfaction (M=2.504) and most effective factor for job satisfaction was salary provide by the organization (M=3.16). Pearson Correlation Analysis revealed that work life balance factors such as non-job responsibility ($r=0.791$), mental pressure ($r=0.130$), duration of work ($r=0.351$), workload ($r=0.910$), personal problems ($r=0.911$), policies of the organization ($r=0.631$) and demographic factors ($r=0.748$) were positively and significantly effect on their job satisfaction. Further Chi-square test indicated that the age, educational level, number of children, time spent on transportation, child-care responsibility, responsibility of dependents, mental pressure, working hours, opportunities for promotion, workload and comfort ability of workplace ($p < 0.05$) had a significant influence on personal and professional life challenges. The majority of respondents believed that creating a current work environment, flexible working hours, and family welfare programs were critical to achieving a better work-life balance. The study concluded that work- life balance of women employees had an impact on their job satisfaction and professional life challenges. Findings are assisting to improve the overall efficiency of women employees by creating a better work culture, which leads to improved organizational citizenship behavior.

Keywords: Job satisfaction, Professional life, Women employees, Work life balance

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ID 94

Role of downstream value chain actors on upgrading the *Moringa oleifera* value chain of Sri Lanka

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Abstract

Moringa oleifera cultivation for commercial purposes has recently been promoted in Sri Lanka. Though Sri-Lanka is still at an infant stage, understanding the nature of the available value chain will aid in continuous improvement of the business eliminating its bottle necks. Therefore, the study intended to identify the value chain profile of the upstream, midstream, and downstream actors in order to identify their roles and functions in the *Moringa* value chain and to find out the involvement of downstream actors on value chain upgrading. Focus group discussions, non-participatory observation and interviewer administered structured telephone interviews were instrumental in gathering data. Data were gathered during the first quarter of 2021 using snowball sampling technique. Focus group discussions and non-participatory observations were conducted with the participation of 42 stakeholders (20 farmers, 05 collectors, 02 processors, 05 retailers, 05 wholesalers, and 05 exporters) distributed island wide. Results revealed the existence of *Moringa* growers, input suppliers, training-cum institutions, governmental institutions, and NGOs that act as supportive and regulatory institutions as the upstream actors. Collectors and processors recognized as the mid-stream actors while retailers, wholesalers, exporters, and importers/buyers represented the downstream value chain actors. Upstream actors' main role concluded by producing a quality *Moringa* leaf harvest. Midstream actors' role span from the point of reception of the fresh harvest and ended up with producing a value-added product. Downstream value chain actors involved in distributing the final product and bridging the value-added product with the end market. Up-stream actors' share of profit was 6% while mid-stream actors' share of profit was 5%. Down-stream actors recorded the highest share of profit; 89%. From the study it was revealed that value chain fairness in terms of sharing the monetary returns is an issue. Further the value chain is demand driven. Thus, the study recommends government and the related institutions' mediation in receiving bulk orders from foreign countries and popularizing Ceylon *Moringa* as a unique brand. Furthermore, value chain re-structuring by incorporating novel technologies such as block chain enabled traceability will enhance the accountability and transparency in the value chain.

Keywords: Downstream, Mid-stream, *Moringa*, Upstream, Value chain

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ID 104

Assessment on dimensions of employees' wellbeing and job performances: A case study in apparel industry

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Abstract

The apparel sector has become a prominent source of Gross Domestic Production in Sri Lanka. An escalating number of job opportunities are being created annually enabling access to different age groups of the community. Satisfactory welfare structures in an organization influence the employees' wellbeing and their performance. However, some apparel sector organizations were still evading employees' well-being over profit generation. This study was conducted to assess the welfare facilities and to identify the influence of employees' physical, psychological, and social wellbeing dimensions on their job performances. Primary data were collected using a pre-tested questionnaire through a survey over randomly selected 100 machine operators of an apparel company. The selected performance indicators were employee productivity, job satisfaction, and absenteeism. Both descriptive and inferential statistical methods were utilized to analyze the data. The sample was 76 females and 24 males. The majority 72% were in between the 25-35 age group and the rest 28% were above 35 years revealing a substantial existence of the younger generation in the apparel sector. The results revealed that training and development, allowances and health care were having a significant positive relationship with physical, psychological, and social dimensions of wellbeing. Employees' performance in view of productivity has significantly influenced by physical ($p = 0.000$), psychological ($p = 0.003$) and their social wellbeing ($p = 0.010$). Moreover, employees' job satisfaction also has significantly influenced by physical ($p = 0.004$) and psychological ($p = 0.000$) wellbeing. However, social wellbeing ($p = 0.022$) has not been significantly influenced employees' job satisfaction. In contrast, employees' absenteeism has negatively impacted by the physical ($p = 0.000$), psychological ($p = 0.006$) and social wellbeing ($p = 0.001$) of the employees. In conclusion, training and development, health care, and allowances favorably influence the physical, psychological, and social wellbeing factors of the employees enhancing workers' overall welfare leading towards higher job satisfaction and thereby productivity of the workforce.

Keywords: Employees' performances, Job satisfaction, Physical wellbeing, Psychological wellbeing, Social wellbeing

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Poster Presentations

ID44

Farmer level constraints in use of eco-friendly technologies against synthetic chemical fertilizer in paddy farming in Sri Lanka

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Abstract

An excessive use of synthetic chemical fertilizer (CF), mostly with low quality standards, has resulted significantly adverse effects from the socio-economic and environmental points of view. Further, these have recently been led to create turbulences in the fields of political and legal. As a remedy to overcome the negative issues of CF, a package of eco-friendly technologies (EFTs) including a "Bio Fertilizer" (BF) and 'Bio-char' (BC) was invented through a multi-objective multi-phased research. BF was formulated by using microbial inoculants to improve the soil nutrient content, while BC would assist to sustain systematic nutrient release to the soils. This study was focused to explore the potential constraints faced by farmers to adopt those EFTs generated in paddy farming over the use of CF. The potential constraints pre-identified by way of a series of multi-stakeholder consultations were enlisted to receive farmer responses on a likert-scale directed from '-5' ("highly negative") to '+5' ("highly positive") with '0' as "neutral/no-difference". The structured questionnaire contained those were administered with a cross section of farmers registered under this project (n=85) from the *Kurunegala* and *Anuradhapura* districts to gather data through face-to-face interviews during October/November 2020. The Exploratory Factor Analysis carried out with the values of Mean Attribute Score [MAS] derived has classified those constraints into five key factors, including: (1) 'Market' [4.53]; (2) 'Price' [10.0]; (3) 'Government' [3.17]; (4) 'Information' [5.38], and (5) 'Production' [5.28]. It was revealed that the 'Price' related factors highly affected the farmers, and they were mostly suffered by 'market price volatilities' of essential inputs and the outputs. Overall, the outcome of analysis stresses the value of formation of a sensible policy framework reflecting the principles of co-regulation (i.e., public/government & legal systems jointly with markets/private) and follows the merits of science, system, and practical orientation. In fact, minimizing those constraints in that way would guarantee achieving the goals of the state of transforming to an 'eco-friendly green economy' at its earliest possible.

Keywords: Chemical fertilizer, Constraints, Eco-friendly technologies, Green agriculture, Paddy sector

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ID 91

Consumers' attitudes towards artificial flavored seasoning cubes and market potentials for spices seasoning cube: A Study in Matara area

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Abstract

Present study was undertaken to identify potentials for innovative Sri Lankan spices seasoning cube in Matara area. Commercial seasoning cubes in the local market contained with some unhealthy ingredients. These harmful substances have a negative impact on human health. The study's sample frame was determined to be 201 people in the Matara DS division. The information was gathered using a questionnaire that included questions on artificial seasoning cube consumption. Gender, age, and monthly income are among the demographic data. Employment status, marital status, and education levels are all factors to consider. Health-related articles and publications were used. SPSS statistical software and a multiple regression model were used to evaluate the data. The findings suggest that while purchasing fake seasoning cubes, most individuals consider their health. Consumption of artificial seasoning cubes is harmful to human body. According to result of first objective (objective 1- To identify consumers' attitudes of artificial seasoning cubes), six variables were significantly affected on monthly expenditure of artificial seasoning cubes. These variables were education level, marital status, employed status, healthiness, artificial seasoning cubes have good quality (R squared value was 0.330. That suggest 33% of the variance in monthly expenditure of artificial seasoning cubes were predicted from independent variables). According to result of second objective (objective 2-Identify potentials to introduce Sri Lankan spices seasoning cubes to market), mainly four variables were significantly affected on willingness pay for spices seasoning cube (per month). These variables were gender, employed status, monthly income; artificial seasoning cubes have good quality. This investigation has presented evidence to suggest that there are demographic, attitudinal, opinions of the consumer factors towards consumption of artificial flavored seasoning cubes. This study reveals that the quality of artificial seasoning cubes has a significant impact on their consumption, with a survey revealing that individuals are more concerned with the artificial seasoning cube's quality (84.7% of the sample).

Keywords: Artificial flavored seasoning cubes, Attitudes, Multiple Regression Model, Potentials, Spice

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ID 103

Upgrading vanilla value chain through supportive services

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Abstract

Being the second most expensive spice in the global market, demand for vanilla is increasing daily and vanilla production is a high-income generating agribusiness. Vanilla farming in Sri Lanka has been limited to home gardening crops that generate hand-cured vanilla. Since vanilla cultivation has been limited only for the particular districts of the country, this study aims to upgrade the vanilla value chain through supportive services such as extension, finance, research and development, ICT and novel technology applications. Finance, knowledge, and technology based supportive services strengthen the farmers with skills, knowledge, experiences and stability of business. Primary data were collected through surveying 62 vanilla value chain actors in the districts of Kandy, Kegalle, and Rathnapura, as well as through focus group discussions and in-depth interviews. Descriptive analysis with qualitative techniques was applied for the analysis of the data. Both non-governmental and governmental organizations are actively involving in supplying supportive services to vanilla value chain actors. Almost all the farmers are already joined to the farmer communities, hubs, and relevant organizations to secure their business. Although there are some gaps between the value chain actors and the supportive services relating to finance, extension, research and development, processing and post-harvest management technology, knowledge dissemination, market orientation and export market. At both ends of the value chain, supportive service gap is moderate and in the middle of the value chain it is considerably higher. With the advancement of modern technology, an ICT-based online platform is the most convenient way to bridge the gap between value chain actors and supportive services. This online linkage should be modified to link all the financial services, extension services, value chain actors, government and non- government organizations, farmer communities, research stations and all other relevant parties. Well customized mobile app can be suggested as the online platform since almost all the value chain actors are used mobile phones in their day-to-day life. Well-developed supportive services without supportive service gaps will minimize the inefficiencies in each and every stage of value chain and will increase the overall productivity of the vanilla value chain.

Keywords: Mobile app, Online linkage, Supportive services, Value chain, Vanilla

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ID 108

Young consumers' response during milk powder unavailability: A case of Faculty of Agriculture, University of Ruhuna

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Abstract

Stock-outs of product goods are a common problem in the retail industry. The Sri Lankan media recently reported on an island-wide shortage of milk powder. However, there is a lack of information and very little is known about consumer responses during stock-out situations in Sri Lanka. As a result, the current study was designed to investigate how the relevance of items to objective needs, consumer preference, and emotional effect influence consumers' behavioral responses to milk powder unavailability. The study adopted the scales used by previous researchers and all the measurements were taken using 7-point Likert scale. First and second-year undergraduates of the Faculty of Agriculture, University of Ruhuna were selected as the target population who represent the segment of young consumers (N=435). A Google form-based structured questionnaire was prepared and emailed to the respondents. They were asked to fill out the questionnaires based on the milk powder buying behaviour of them during the stock-out. Accordingly, 100 responses have been obtained with a 23% response rate. The relationships among the main constructs considered in the study were tested using SMART PLS 3.0 with the bootstrap re-sampling method. Results revealed that the emotional effect ($t= 2.566$; $p= 0.011$) of the consumer significantly influenced the behavioural responses (number of milk powder packets bought) during the milk powder stock-out, at 5% significant level. Furthermore, relevance to objective needs ($t= 1.343$; $p= 0.180$) and consumer preference ($t= 1.055$; $p= 0.292$) did not influence the behavioural responses during the stock-out. The study concluded that young consumers' emotional effects lead to the changed milk powder buying behaviour and they tend to buy more milk powder packets during the stock-out. The findings of the present study are of a great significance for the milk powder marketers and retailers to understand the behaviour of the young consumers during stock-outs and to avoid negative behavioural responses to minimize negative consequences.

Keywords: Consumer responses, Milk powder, Stock-out

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ID 135

Mapping gender roles in dried fish value chains: Case study in Kalpitiya Sri Lanka

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Abstract

Mapping gender roles and gender analysis in value chains are essential in understanding different roles and involvement of men and women in dried fish industry. However, women's contribution to dried fish value chains are frequently overlooked, and the true advantages of their participation are seldom quantified. Therefore, this study designed to explore the level of gender involvement, different roles performed by men and women, and to determine the pay disparities between men and women. A mixed method approach was adopted employing both quantitative and qualitative data collection methods including in-depth interviews (n=8), and questionnaire survey (n=30). A convenience sampling technique was used to select processors (n=20) and traders (n=15) from *Kalpitiya*, highest dried fish producing area in Puttalam District, appropriately representing men and women. Data were analyzed using descriptive method. Women and men involvement at the processor segment is 20% and 80% respectively. In contrast, the values are 5% and 95% respectively for wholesaling and retailing. De heading is mainly practiced by men (90%). Cleaning (60%), de-scaling (90%), salting (75%), washing (85%) and drying (70%) are largely done by men. Women's activities include de-skinning, degutting, cutting and drying fish. At the wholesaling segment, sorting and grading is mainly accomplished by men (70%). Male involvement is prominent in processors and traders segments of value chain in *Kalpitiya* where as women participation is marginal may be due to the Muslim dominating socio-cultural background. Yet, women engagement is substantial in small-scale pelagic dried fish processing (30%). Accordingly, men received highest daily payment LKR 1750 -2000 and LKR 1200 for women. Despite the total numbers of working hours are same for men and women, a daily pay gap of LKR 550 – 800 is noticeable, discriminating women hard work. In fact, it is concludable that the roles and tasks performed in the dried fish value chains are gendered. Despite the literature iterated a female dominating dried fish industry, the level of involvement depends on the socio-cultural context of the community. However, women labor has been discriminated by paying lesser daily wage.

Keywords: Dried fish, Gender involvement, Gender roles, Pay gap, Value chain

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Livestock, Poultry, and Aquaculture



Keynote Speech

Considerations in risk assessment and vulnerability- adaptation studies for climate smart livestock farming

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Abstract

Animal and human welfare are interlinked with each other and to climate change as well. The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability to climate change as “the degree to which a system is susceptible, or unable to cope with adverse effect of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.” Exposure is the nature and degree to which a system is exposed to significant climatic variations. Sensitivity is the degree to which a system is affected, either adversely or beneficially by climate-related stimuli. Adaptive capacity is the ability of a system to adjust to climate change including climate variability and extremes, to moderate the potential damage from it, to take advantage of its opportunities, or to cope with its consequences (IPCC 2001). Vulnerability indices for large communities, crop agriculture, businesses/industries, and regions/counties have been prepared and are commonly used by developmental agencies in quantifying climate change vulnerability and prioritizing fund allocation. Besides climatic variables, such as livestock sector has special consideration for experimental data like feed and fodder compositions and availability, soil nutrients, animals’ blood biochemistry, prevalence diseases, incidence of metabolic diseases like mastitis, reproductive performance of animals etc. The commonly available vulnerability models have no provision for including this type of data. Therefore, there is need for exploring the possibility of quantifying vulnerabilities and adaptive capacity in livestock production systems, factors (called indicators and sub-indicators; reported and available from reliable sources). There are very few models for mathematical representation of vulnerability in animal production systems. These indices can be used for mathematical quantification of vulnerability which can help in prioritizing fund allocation for climate change adaptation and mitigation strategies.

Key words: Adaptation, Climate change Livestock, Vulnerability

Introduction

Two distinct notions of vulnerability are – bio-physical vulnerability and social vulnerability. Bio-physical vulnerability is concerned with the ultimate impacts of a hazard event and is often viewed in terms of the amount of damage experienced by a system as a result of an encounter with a hazard. Social vulnerability, on the other hand, is viewed more as a potential state of human societies that can affect the way they experience natural hazards. In most studies’ vulnerability has been assessed at regional or national level. The vulnerability of crop farmers as well as fisherman have been widely assessed, but livestock-based farming has remained mostly unassessed for vulnerability.

The identification of indicators and sub-indicators is a key step in assessing livestock rearers’ vulnerability to climate change. Table 1 enumerates some of the identified indicators and sub indicators used by the researchers at the Central Institute for Research on buffaloes, Hisar, India for assessing vulnerability in buffalo production systems.

Table 1. Indicators and sub-indicators identified for vulnerability assessment for buffalo production

Indicators for Adaptive Capacity: includes socio-economic aspects which helps in overcoming losses due to climate change
A. Human asset
1. Family education status
2. Household head social asset
3. Training in scientific livestock production (head of family/Any member)
4. Practicing animal farming for
5. Sources of climatic information/ Awareness – Radio, TV, Advisory services on mobile, Newspaper etc.
B. Social aspects
1. Social and Community participation i.e., participation in important decision-making processes for the local community he/she resides in
2. Community cohesiveness i.e., the ability of all communities to function and grow in harmony together
3. Extension contacts (Number i.e., in contact with expert extension organizations like Veterinary officer, KVK etc.)
4. Social migration (e.g., migration in distress/ draught or other such causes)
5. Farmer to farmer extension
C. Physical and natural asset
1. Availability of modern farm equipment used
2. Animal Sheds
3. Climate resilient technologies for cost cutting
4. Source of water for animals
5. Geographical location of farm
D. Financial Asset
1. Ownership of livestock farm
2. Productive animal in the expenditure to livestock herd
3. Availability of credit

4. Value addition to farm produce
5. Financial assistance from outside (e.g., non-governmental sources like NRIs, Businessmen living outside the village)
E. Exposure Indicators: Climatological parameters - based on relevant metrological data of over 30 years
1. Number of Days when Temp. Max crosses 40°C in plains and 30 °C for hilly areas
2. Number of warm nights (i.e., actual Temp. max is more than or equal to 40°C and minimum temperature departure is more than or equal to 5°C or more)
3. Number of days temp. min below 10°C
4. Number of Heat Waves/Cold Spells
5. Number of extreme climatic events (sandstorms, heat/cold waves, hailstorms, heavy rains etc.) experienced
6. Annual precipitation
F. Sensitivity Indicators (animal factors which make production system more vulnerable to climate change) Based on experimental data and/or authenticated records on health and breeding indicating occurrence/prevalence of common diseases influenced by adverse weather conditions
1. Total digestible component of ration (feed + fodder) offered
2. Concept of ration balancing incorporated in animal
3. Critical mineral deficiency in ration (feed + fodder) offered
4. Soil Analysis
5. Blood haematology analysis
6. Blood biochemistry analysis
7. Herd size
8. Age at first calving (primiparous animals)
9. Return to estrus (for multiparous animals)
10. Persistency and lactation of milk yield
11. Calving interval (i.e. period between two successful calvings)
12. Mastitis
13. FMD & HS

14. Parasitic infestation related to buffaloes
15. Milk fever
16. Pest/ fly control in household or animal surroundings or provision for reducing pest attack

Based on the indicators and sub-indicators, a climate change data sheet can also be developed with help from scientists, researchers and local field functionaries especially Veterinary Officers.

Techniques/Methodology for data collection: Data collected for identification of the risk factors. Existing data/metadata Data collection and experimentation details are described in below Table 2 and 3.

Table 2: Data collection

Data type	Source
Socioeconomics	Farmers/reports/web-portals/questionnaires/interviews/others
Housing	On site evaluation
Epidemiological	Reports from Vety hospitals & dispensaries
Health & reproduction related	Health check-up of animals
Feed & fodder availability	Reports/ questionnaires/interviews/others

Table 3: Experimentation details

Parameter	Source
Blood related	Progesterone profiling, mineral profiling, brucellosis
Mastitis & udder health	SSC/CMT, Thermograms
Calf health	Physical examination
Health, reproduction, and production related	Physical examination, Rectal palpation, Thermograms

Modelling Vulnerability for buffalo farming systems –

Subsequently, calculations were made by converting different data type to a common form using 3-point Linkert scale and/or 3-point Ordinal scale. All text information represented mathematically on 1-3The developed model, gave quantitative measurement of vulnerability:

$$\text{Vulnerability Index} = \text{Adaptive Capacity} - (\text{Exposure} + \text{Sensitivity})$$

$$\text{i.e., VI} = \text{AC} - (\text{E} + \text{S}) \text{ -----Eq (1)}$$

The number of indicators varied for each index and therefore there is variation in the score weight. Mathematically, for a system to be in balance/equilibrium i.e., no vulnerability, adaptive capacity should be equal to sum of exposure and sensitivity

$$\text{i.e., } 0 = AC - (E+S) \text{ -----Eq (2)}$$

$$\text{Therefore, } AC = (E + S) \text{ -----Eq (3)}$$

Considering that exposure and sensitivity are equally important, mathematically

$$E = S \text{ -----Eq (4)}$$

Further, a score weight for each sub-indicator under each index was assigned as to satisfy Eq (1). Each sub-indicator under adaptive capacity was assigned a weightage of 1, therefore overall total score of AC become 20. Considering equations 2,3 and 4 all indicators were assigned score weight as indicated in Table 4 below:

Table 4: Score weight for all sub-indictors

Type of index	Indicators (standard)	Number of Sub-indicators	Scale of sub-indicator	Score weight	Maximum score	Minimum score
Adaptive capacity (AC)	Human, Social, Physical & Natural, and Financial assets	20 (5 for each indicator)	1-3	1	5x4x3 = 60	5x4x1=20
Exposure (E)	Exposure indicators	6	1-3	1.67	6x3x1.67 = 30	6x1x1.67=10
Sensitivity (S)	Sensitivity indicators	16	1-3	0.625	16x3x0.625=30	16x1x0.625=10

This is worth noting that although there are unequal number of indicators, score meet the criteria described as per equation 3 i.e., AC equals sum of E and S. assigned to All indicators although with unequal number of sub-indicators. The indicators are dynamic i.e., indicators and weightage can be deleted/ added /modified as per need. For a resilient, stable, and sustainable systems adaptive capacity should be higher.

Conclusion:

Climate is a critical factor in the lives and livelihoods of the people and socioeconomic development as a whole. Climate change will be a major challenge in the near future for the world society which is supposed to affect all living beings on the earth. Livestock are crucial for global food security and livelihoods. Demand for animal products is anticipated to increase significantly in the future while competition for resources will intensify, dictating that livestock systems must increase both productivity and efficiency. All livestock production systems are sensitive to climate change and at the same time also contribute to the phenomenon. Animal and human welfare are interlinked with each other and to climate change as well. Climate change related worries can be effectively addressed following the ‘Three P’ principle – Predict, Plan and Prepare.

Oral Presentations

ID 28

Phytoplankton assemblage in Puttalam lagoon, Sri Lanka

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Abstract

Puttalam Lagoon, the second largest (32,700 ha.) lagoon in Sri Lanka is located in the Puttalam District of the Northwestern Province. The lagoon is fed by two rivers namely, Kala Oya and Mee Oya. Phytoplankton is sensitive to the changes in water quality thus is effective indicators of environmental conditions. The objective of this study was to determine the diversity and composition of the phytoplankton in Puttalam lagoon. Plankton sampling was done once in July 2017 from fifteen sampling locations. Samples (N = 36 samples/lagoon) were drawn by filtering 50 L of water collected at a depth of one meter from the surface using a 20 µm nylon plankton net. The filtrate was concentrated to 100 mL for each station. Three drops of Lugol's solution were added to each sample to preserve the phytoplankton and allowed the organisms to settle. Then quantitative analysis was carried out through sub sampling technique using a Sedgwick rafter cell under a compound microscope. Species were identified to the nearest taxonomic level following the standards guides. Shannon diversity index of phytoplankton was calculated. A total of 39 phytoplankton taxa belonging to two phylum (Ochrophyta and Dinoflagellata), and three classes (Bacillariophyceae, Coscinodiscophyceae and Dinophyceae) were identified. Bacillariophyceae (diatom) is the most abundant class which included 22 species. This was followed by Coscinodiscophyceae which included three species. Also, thirteen species were included in class of Dinophyceae. The dominant toxic phytoplankton species were identified as *Prorocentrum* sp, *Photoperidinium* sp, *Ceratium furca*, and *Noctiluca scintillians*. The highest abundance (27250 total individuals/ml) of phytoplankton was observed at sampling location, KL 12 (Northern part of the lagoon) and would be due to the less human disturbance. The lowest abundance (2467 total individuals/ml) of phytoplankton was recorded at sampling location, KL 1 (Southern part of the lagoon near the Puttalam town). This might be due to the high loads of pollutants discharge into the lagoon from Puttalam town area. The Shannon diversity index of 1.52 indicates lower species diversity in the lagoon.

Keywords: Diatom, Phytoplankton, Puttalam Lagoon, Shannon diversity index

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ID 33

Effect of feeding total mixed ration (TMR) briquettes on plasma metabolites in early lactating dairy cows in Sri Lanka

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Abstract

The negative energy balance (NEB) in early lactating cows is associated with metabolic disorders. Plasma metabolites are one of the major indicators to monitor metabolic disorders and NEB. The objective of the study was to examine the effect of feeding a TMR briquette on plasma metabolites in early lactating dairy cows. Nine, Jersey × Sahiwal crossbred dairy cows (avg. body weight = 275±33 kg) in the second week of the third lactation were selected and assigned randomly to three treatments in a replicated 3 × 3 Latin Square Design consisting of three periods. Each period included 14-d diet adaptation followed by 21-d measurement period and was separated by 14-d washouts. Three treatments were control (CTL) - Guinea grass (*Panicum maximum*) + commercial cow feed, TMR1 and TMR2. Both TMR1 and TMR2 were formulated using different proportions of air-dried forages and agro-industrial by-products. At the beginning and end of each period, blood samples were drawn from the jugular vein of cows and plasma was separated. The plasma samples were analysed in triplicates for glucose, blood urea nitrogen (BUN), β hydroxybutyrate (BHBA), non-esterified fatty acids (NEFA), albumin (ALB), immunoglobulin (IgG) and calcium (Ca) by using assay kits following the manufacture's guidelines. Concentrations of plasma glucose, BUN, NEFA, ALB, IgG, BHBA and Ca were not significantly ($p>0.05$) different for cows fed with three different treatment diets. Plasma glucose levels of the present study (61.98 - 64.22 mg/dL) were considered as a better range for milk production. The BUN concentration (19.61 - 20.68 mg/dL) indicates sufficient protein contents in treatment diets. Low plasma NEFA contents of cows (8.14, 5.53 and 8.78 mg/dL for CTL, TMR1 and TMR2, respectively) indicate that they do not suffer from NEB. The concentration of ALB and IgG ranged within 1.69 - 2.10 mg/dL and 0.70 - 0.73 mg/dL, respectively. The BHBA concentrations were 3.80, 3.51 and 2.41 mg/dL in CTL, TMR1 and TMR2, respectively showing a lower risk of metabolic disorders. The plasma Ca contents ranged within 1.53 - 2.50 mg/dL. Since feeding the cows with formulated TMR briquettes did not negatively affect plasma metabolites, it is recommended to feed such diets to avoid metabolic disorders in early lactating dairy cows.

Keywords: Blood urea nitrogen, Metabolic disorders, Negative energy balance, Non-esterified fatty acids

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ID 45

Enriching of pre-cooked chicken sausages with eggshell powder: physicochemical, calcium and sensory attributes assessment

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Abstract

Enriching of Calcium in dietary products with chicken eggshell which has high bioavailability of calcium became a solution to provide dietary calcium intake for human. This study was aimed to evaluate the effect of enrichment of calcium with eggshell powder (ESP) on physicochemical and sensory attributes of pre-cooked chicken sausages. In this study, series of preliminary trails were conducted to select the best calcium incorporation level in chicken sausages by incorporating sterilized ESP (particle size $>32\ \mu\text{m}$). Four ESP enriched sausages; 0.50%, 0.75%, 1.00%, 1.25% (w/w) and control which had 0% calcium were prepared. The highest consumer acceptability was obtained by 1.00% (w/w) ESP incorporated sausage out of the 4 levels tested. The selected ESP enriched sausage and control were subjected to determining the calcium content and keeping quality parameters with three replicates per treatment. Color, water holding capacity (WHC), shear force, pH, 2-Thiobarbituric acid reactive substances (2-TBARS) and total aerobic viable counts (TAVC) were measured during three weeks of storage at -18°C . Complete Randomized Design (CRD) was used as the experimental design. With respect to the sensory attributes, 1.00% (w/w) ESP incorporated sausage had significantly higher values ($p<0.05$) compared to the control. The 1.00% (w/w) ESP enriched sausage showed significantly higher ($p<0.05$) pH value (6.6-6.8) and shear forces values ($2.8\pm 0.2\ \text{N}$) over to the control. There was no significant difference ($p>0.05$) in 2-TBARS and TAVC of the sausages during three weeks of the storage period. Therefore, the sausages were microbiologically sound and safe products for human consumption. The calcium content of 1.00% (w/w) ESP enriched sausage was 0.88% higher ($p<0.05$) than the control. Results of the current study revealed that the optimum level of ESP to be incorporated in chicken sausages was 1.00% (w/w) which can increase the calcium content of pre-cooked chicken sausage by 0.88% while maintaining favorable physicochemical and sensory attributes of sausages under ethical conditions.

Keywords: Calcium, Chicken sausage, Enrichment, ESP, Sensory

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ID 59

Autoclave assisted chitosan extraction from Whiteleg shrimp (*Litopenaeus vannamei*) processing shell waste

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Abstract

Shrimp shells are potential sources for shell bio-refinery due to their abundance as a result of waste from processing plants. This waste has not been productively used for any industry. Therefore, the objective of this study was to introduce a reliable and effective chitosan extraction protocol from shellfish waste, using Whiteleg shrimp (*Litopenaeus vannamei*) shells, with autoclave assisted extraction method. Cleaned and dried shells were deproteinised with Sodium hydroxide (NaOH) at 100°C and subsequently demineralised with Hydrochloric acid for 3 hours. Then decolourised using Potassium permanganate followed by Oxalic acid treatments. To test the most effective autoclave assisted deacetylation technique, in which chitin is converted to chitosan, the dried chitin was subjected to four different treatments: autoclaving at 121°C & 15 psi for 15 min with 40% NaOH (Treatment 1); 24 hours steeping at 40% NaOH followed by autoclaving at 121°C & 15 psi for 15 min (Treatment 2); autoclaving at 121°C & 15 psi for 15 min with 50% NaOH (Treatment 3); 24 hours steeping at 50% NaOH followed by autoclaving at 121°C & 15 psi for 15 min (Treatment 4). Treatment 4 recorded the highest degree of deacetylation (80.17%) calculated from the Fourier Transform Infra-Red spectra. Even the X-Ray Diffraction spectrum of treatment 4 confirmed the semicrystalline chitosan structure by the evidence of typical fingerprints. Therefore, chitosan extracted by treatment 4 was selected for further characterisation. Scanning Electron Microscopic images showed the typical porous structure that resulted after the removal of CaCO₃ by the acid treatment, and it was further evident by the absence of calcium peaks in the Energy-Dispersive Spectroscopy image. This result confirms the effective demineralisation of shells. The differential thermal analysis confirmed that the chitosan extracted by Treatment-4 has good thermal stability up to 350.95°C. Its mean dynamic viscosity was 100.27±0.55 and whiteness value was 73.28±1.12. Therefore, this study confirms 24-hour steeping at 50% NaOH followed by autoclaving at 121°C & 15 psi for 15 min as the effective deacetylation techniques to extract chitosan from the Whiteleg shrimp shell waste while preserving standard characteristics.

Keywords: Autoclave, Chitosan, Whiteleg shrimp

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ID 101

Characterization of inherently small indigenous cattle in Sri Lanka

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Abstract

Indigenous cattle in Sri Lanka are a major neglected genetic resource that will become endangered if not preserved. This study was carried out to describe a geographically isolated inherently small indigenous cattle (SIC) population in Mannar and Jaffna districts in the Northern Province of Sri Lanka. Farming system information and phenotypic parameters of each animal were recorded, and data were statistically analyzed using SPSS software. The mitochondrial gene cytochrome C oxidase I (COI) was used to assess the SIC's divergence from reference genotypes. Thirty-four animals were sampled for phylogenetic comparison where DNA extracted from the selected samples were sequenced to capture the diversity of COI gene. Reference sequences were retrieved from National Center for Biotechnology Information for comparison using MEGA X software. Results revealed that SIC are reared for purposes such as milk production, draught power, meat production, manure, and cultural activities in both districts. Since the system of rearing is extensive management with grazing on natural grasslands and shrubbed lands, the SIC are reared as a low-input activity in both the study areas. SIC in both locations appeared to be well adapted to the high environmental temperature conditions prevailing in the respective areas (average ambient temperature of 32 °C in Mannar and 31 °C in Jaffna). SIC could be generally described as a cattle type with a small body carrying a narrow head, small ears, and a brownish coat with short hair. Comparison of phenotypic characters showed no significant difference between the cattle populations from the two study areas. The phylogenetic clustering pattern of the SIC from two geographical regions occupied the same cluster with *Bos indicus*, and separated from *Bos taurus* cattle, suggesting that *Bos indicus* and small indigenous cattle from two geographical regions have a close genetic relationship. The findings of the study will help in drawing conservation strategies for the indigenous cattle genetic resources of the country.

Keywords: Small Indigenous Cattle, Sri Lanka

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ID 117

Association of Mangrove Bark Properties and Manglicolous lichen establishment; A case study from Rekawa lagoon, Southern Coast of Sri Lanka

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Abstract

Many lichenological studies, carried out in Sri Lanka have focused mainly on lichen diversity but not on the ecological prospects. Moreover, 'Manglicolous lichens' have received lesser attention when compared to other terrestrial lichens. Mangrove trees are frequently exposed to very harsh conditions like frequent inundation, hypoxic conditions, high irradiance etc. Therefore, the primary goal of this study was to study 'Manglicolous lichens' concerning bark properties of mangrove species such as girth, bark pH, salinity, and texture. An association between Manglicolous lichens and bark properties was tested by surveying mangrove trees in the Rekawa Lagoon in the Southern coast of Sri Lanka. The lichen survey was conducted first in selected eight plots (10m×10m). Accordingly, *Ceriops tagal* was found to be the most common mangrove species in the study sites while *Avicennia officinalis* was the least. Furthermore, *Aegiceras corniculatum* hosts the majority of lichens (Species 117) identified while *Avicennia marina* has the lowest number of lichens (species 6). Pearson's chi square test revealed that there was a significant association between the mangrove species and lichens ($p < 0.05$). According to Kruskal-Wallis H test results, bark salinity and bark texture were significantly associated with the lichen establishment. The rest studied was non-significant. Previous literature suggests bark texture i.e., smooth peeling barks and rough barks with fissures tend to have less lichens. Also, the continuous salt spray from the ocean which lead to the deposition of salt on the superficial bark of mangroves have a "potential" to create a sort of "stressed" environment for lichens and limit their growth. These two factors might explain the association of lichens and mangroves in the study sites up to a certain extent, however, it is strongly suggested that more specific studies are needed to investigate the individual (lichen species) responses towards these different factors. Further, it is recommended to take light intensity, air quality, and humidity into account in future research.

Keywords: Bark properties, Lichens, Mangroves, Manglicolous lichens, Rekawa lagoon,

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Poster Presentations

ID 64

Effect of heat treatment on the yield and quality of fish oil extracted from yellowfin tuna (*Thunnus albacares*) heads by wet reduction process

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Abstract

Fish processing offcuts, especially heads, are frequently discarded without realizing its potential in extracting fish oils. Among many fish oil extracting methods, the wet reduction process (WRP) is industrially popular as it is environmentally safe. As the processing conditions of the WRP affect the yield and quality of oil, two heat transfer methods: direct heating and indirect heating at three pre-treatment temperatures: 55, 75 and 95 °C were evaluated in the present study by using yellowfin tuna heads. The effect of heat treatment on the quality of the extracted fish oil was studied by free fatty acids percentage (FFA%), acid value (AV), peroxide value (PV), *p*-anisidine value (*p*-AnV), total oxidation (TOTOX), oil colour, and Attenuated Total Reflectance - Fourier Transform Infrared (ATR-FTIR) measurements and compared to the oil extracted using Bligh and Dyer method (BDM). The optimum process conditions were direct heating at 75 °C for 30 minutes, followed by pressing whereas the extraction yield and recovery were 4.35 ± 0.55 % and 57.43 ± 7.32%, respectively. Oils extracted by different pre-heat treatments resulted in significant differences ($P < 0.05$) of FFA, AV, PV, *p*-AnV, TOTOX and colour values. Further, the increased heating temperature increased the amount of extracted yield but reduced the oil stability as all FFA% had exceeded the maximum allowable limit (3 mgKOH/g) specified by WHO. However, the PV showed a downtrend with increasing temperature. Comparing the *p*-AnV of oils extracted, it can be stated that the WRP had less effect on the secondary oxidation of oil than the BDM. Since oil from the BDM showed high *p*-AnV that exceeded the maximum allowable limit (20), thus, resulted in an elevated TOTOX value. Therefore, the WRP exhibits a favourable effect on the oil quality than the BDM. All ATR-FTIR spectra confirmed the presence of important functional groups at wavenumbers of 3012 cm⁻¹, 2922 cm⁻¹ and 2853 cm⁻¹ confirming the existence of PUFA. Nevertheless, this study identified yellowfin tuna head as a good source of fish oil that can be extracted by the wet reduction process.

Keywords: By-product, Fish oil, Pre-heat treatment, Wet reduction, Yellowfin tuna head

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ID 75

A review on people's perception of biodiversity, climate change and water resources in Sri Lanka

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Abstract

Biodiversity, climate change and water resources have become current topics related to the environment in last few decades. Preventing biodiversity loss, sustainable water management, mitigating and adapting to climate change are essential. The objective of this study was to conduct a review on research studies based on people's perception of biodiversity, climate change and water resources. Using Search, Appraisal, Synthesis, and Analysis (SALSA) framework as the methodology, Google Scholar and PubMed were used as academic databases and data was summarized in a Microsoft Excel sheet as follows: Article name, Author, Year of published, Category, Publication type, Focused area, Research type (qualitative, quantitative, mixed) and Location. Studies focused on biodiversity, climate change and water resources perception related to citizen science, conducted in Sri Lanka, published in academic, peer-reviewed literature, published in past three decades (1990-2021) in English were considered as inclusion criteria. Fifty studies were qualified for the study. In terms of key findings, the majority of studies have focused on biodiversity perception (45%), while the fewest have focused on water resources (24%). Since 2005, there has been an increase in the number of studies in relation to these three disciplines. As a percentage, 86% of biodiversity studies, 86.67% of climate change related studies, and 91.67% of water resources related research were carried out after 2005, while 86% of studies were carried out after 2005. The majority of the studies employed quantitative and qualitative mixed methods (52%). The number of qualitative studies was extremely low (4%). Human-wildlife conflict, green coverage, and biodiversity education were the primary focus of biodiversity research activities. In biodiversity sector, most of the articles have been focused on the human-wildlife conflict (27%). Climate change research activities have primarily focused on adaptation, and majority (53%) of studies have done focusing farmers. Water resources studies were primarily concerned with water resource management (25%). The lack of access to safe drinking water was one of the most common issues identified across several areas in Sri Lanka. Even though there are studies conducted on these disciplines, numerous aspects of these topics are yet to be discovered.

Keywords: Biodiversity, Climate change, Perception, Sri Lanka, Water resources

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ID 87

Evaluation of ornamental fish farmers' knowledge on common freshwater fish diseases and treatments in Galle district

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Abstract

Adequate knowledge in aquatic health management is one of the most vital components in sustainable ornamental fish farming. One of the major drawbacks in the Sri Lankan ornamental fish farming sector has been noted as a lack of knowledge in aquatic health management. Few studies have been reported in Sri Lanka that addresses the farmers' knowledge of aquatic health management. The main objective of this study was to evaluate the knowledge on common freshwater fish diseases and treatments among ornamental fish farmers in Galle district. The Galle district has 35 Km² of inland waters, a rich coastal area, and a tropical climate. Primary data was collected using a telephone-based survey followed by statistical analysis. The study revealed that only 76.74% out of 215 respondents are currently engaged in ornamental fish farming. Several reasons were identified for the reduced interest in long-term engagement (> 5 years) in ornamental fish farming. Platy (29.10%) was reported as the most commonly farmed species. White spot (36.90%) was the most commonly reported disease, followed by fin rot (21.80%), dropsy (11.50%) and anchor worm infection (7.87%). The most common practice reported by the respondents to control diseases was frequent water changes (81.20%). This study revealed that majority of the fish farmers (68.43 %) in the study area do not practice recommended treatment methods. Therefore, this study highlights the importance of adequate knowledge in terms of disease identification, treatment and prevention among the ornamental fish farmers in the study area.

Keywords: Diseases, Ornamental fish farming, Precaution, Treatment

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ID 112

Combined effect of milk source and pre-acidification method of cheese milk on yield, meltability and colour of mozzarella cheese

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Abstract

Mozzarella, a soft un-ripened variety of cheese originated in Italy belongs to pasta-filata or stretched group of cheeses and has shown a remarkable growth in production over the last century. The yield and the desirable properties of mozzarella depend on a number of factors including type of milk and pre-acidification method of cheese milk. A 3×3 factorial arrangement of treatments in a completely randomized design was used to find out the combined effect of milk source {cow (CM), buffalo (BM) and mixed (CM:BM 1:1 ratio)} and the method of pre-acidification {starter culture (SC): *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus* 1:1 ratio, acetic acid (AA) and citric acid (CA)} of cheese milk on yield, meltability and instrumental colour of mozzarella cheese. Cheese made using BM and pre-acidified with SC served as the control. Main effects of milk source and method of pre-acidification showed a significant ($p < 0.05$) effect on yield of cheese whereas interaction effect was not significant ($p > 0.05$). The yield of cheese made from BM ($13.97 \pm 0.78\%$) was observed to be higher than that of the cheese made from CM ($8.88 \pm 0.52\%$) as well as mixed milk ($9.96 \pm 0.54\%$). Further, cheese milk pre-acidified using CA and AA showed a higher cheese yield (11.26 ± 2.27 and $11.41 \pm 2.43\%$, respectively), compared to that of the cheese milk pre-acidified with SC ($10.15 \pm 2.18\%$). A significant ($p < 0.05$) interaction effect between milk source and method of pre-acidification of cheese milk was observed for meltability and b^* value (variation from yellow to blue colour) of the resultant cheese. Meltability was superior in mozzarella cheese manufactured from CM pre-acidified using CA (9.13 ± 0.28 cm) compared to the control (4.03 ± 0.05 cm). Cheese made using CM pre-acidified with CA and AA showed significantly ($p < 0.05$) higher b^* values (22.99 ± 1.46 and 20.19 ± 2.80 , respectively) compared to the control (14.98 ± 1.37). Therefore, the milk source and the method of pre-acidification of cheese milk are closely linked to the yield, meltability and colour of mozzarella cheese and hence, careful selection of raw materials and manipulation of processing conditions are required to get an optimum quality end product.

Keywords: Combined effect, Instrumental colour, Meltability, Mozzarella, Pre-acidification.

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ID 124

Study of goat farming systems in Ampara district

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Abstract

Ampara district is mainly crop-growing region with a significant number of paddy lands. In addition, a large number of rural households engage in goat farming and rely on it for a considerable amount or all of their income. Goats are valuable animals in smallholder farming systems because they assist disadvantaged farmers in improving their socioeconomic level. Behind goat farming, there are a number of known and undiscovered issues. The objective of this study was to investigate goat farming systems and problems associated with the goat farmers in Ampara district. Using simple random sampling techniques, a survey was conducted in Ampara district's goat farmers (n=50) from nine (09) veterinary regions by face-to-face interviews, structured questionnaires, and field observations. The collected data were analyzed by SPSS (Version 25.0). The results revealed that, all the farmers (100 %) from the study; rearing goats for meat purpose; 56 % of goats' famers were involved in this industry for primary income and rest (44 %) as auxiliary income. Throughout the study Jamunapari, Saanen, Kottukachchiya and Sri Lankan Boar varieties of goats were observed. From the sample population 56 % of males and 44 % of females were practiced goat farming in Ampara veterinary region. Further 50 % of farmers have above five (05) years of experiences in goat rearing. In farming system 64 % of sample population was practiced integrated farming system. Predominantly 97 % of farmers practiced semi-intensive management system. The primary feeding management was browsing but 46 % of farmers practiced cut-and-feed system. Breeding was mainly (94 %) done by Natural mating. Major constrains in the studied area were, high number of middlemen (50 %) in meat supply chain, poor infrastructure (38 %) and market unavailability (12 %). The survey concluded that considerable amounts of the farmers in the study area were kept goat farm as a primary source of income with an adequate experience. But poor extension services for goat production, no demand for goat milk and high cost of concentrates were major challenges in goat production to carry out successful and sustainable goat farming in Ampara district.

Keywords: Ampara district, Constraints, Goat rearing, Management systems

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Innovative Agricultural Technologies



Keynote Speech

Advanced Technologies and Training and Research for Optimizing Agricultural Production

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Advanced Technologies and Training and Research for Optimizing Agricultural Production.
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Humans are inventive; human innovations can be seen throughout timescale, back in the ice age, or even beyond that period. Humans of this modern-day are very innovative, and future generations will take further steps towards surpassing their ancestors continuously. Things were invented and evolved for two main reasons: necessity and curiosity; however, both play together most of the time. Curiosity is a mix of the desire to explore, investigate, and learn. The demand can be divided into quantitative and qualitative; quantitative demand comes first, and qualitative demand becomes second most of the time. Continuous demand and curiosity drive the complexity and advancement of technologies (literally everything around us). New technologies have been introduced, leaving older ones obsolete. Eventually, technological adaptations would be continual and rapid in order to reap the greatest benefit from the most recent technology. This holds true for all industries, including agriculture.

Technological advancement entails more than just upgrading or applying technologies; relevance and feasibility must also be addressed. The cost-effectiveness of the approach should also be examined. As a result, improvements should be carried out with caution and adjusted to minimize over- or under-utilization. It is necessary to go through a problem-solving cycle in order to identify acceptable technologies and optimize technological adaptation. Developing economies, for the most part, do not use such approaches to identify efficient technology solutions to specific problems, most likely due to a lack of research, resources, and knowledge base. Furthermore, the implementation of imported technologies created to solve the same problem in another country may fail due to a lack of optimizations. Thus, the enhancement of training and research capacity of the agricultural sector is an absolute requirement. The capacity should be improved in two folds: research capability, particularly funding and laboratories with modern equipment, and human resources with not only knowledge and experience but also enhanced intellectual ability (difficult part of problem-solving is creative thinking and know-how. Knowledge is conveniently available).

With an aging population and shrinking land space, a country like Sri Lanka requires advanced technologies to satisfy future local agricultural demands. Furthermore, as society advances and pushes toward more advanced technologies, quantitative and qualitative expectations typically rise. Then, because export agriculture is competitive, profit maximization necessitates fewer labor-intensive technologies. As a result, the need for aggressive technological adaptation in the agriculture industry cannot be overlooked. Surprisingly, the human resources required to develop such technologies can be found within the country. However, the difficulty is that those resources were not successfully exploited in the agricultural sector. Moreover, agricultural curriculum and research should be expanded to train human resources with the capability to work conveniently with techniques such as mechatronics, machine learning, and artificial intelligence. Those are the critical skills expected from modern-day agricultural engineers, but the fundamental knowledge should not be forgotten.

Key Words: Automation, Conventional Knowledge, IOT, Innovation, Invention, Machine learning, Mechatronics, Patents

Oral Presentations

ID 27

Normalized difference vegetation index (NDVI) associated with plant height and leaf area index of sugarcane (*Saccharum* spp. Hybrid)

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Abstract

Plant height and leaf area index are two parameters commonly used in crop growth monitoring to assess yield expectations and monitor crop health. Recording of in-situ data on plant height and leaf area index by direct methods is difficult due to cost, time consumption and skilled labor requirements. This problem is critical for large-scale sugar cane plantations. Therefore, indirect methods are introduced to alleviate this situation. Current study used free satellite data available to develop a mathematical model to simulate plant height and LAI in Sri Lankan rain-fed sugarcane plantations. Two regression models for predicting the plant height and leaf area index of sugarcane crops were developed. Sentinel-2 Level 2A (L2A) data and crop growth data of the sugarcane plantation sites in Sevanagala, Sri Lanka for two consecutive sugarcane crop cycles during 2018 to 2020 were used for the analysis. The regression model developed for plant height simulation and leaf area index had satisfied agreement with the actual data. The index of agreement values between the actual and simulated data of plant height and LAI were 0.71 and 0.66, respectively. The two models could be recommended as rapid and low-cost method compared to direct or manual method in estimating sugarcane plant height and the leaf area index for large scale rain-fed sugarcane plantations.

Keywords: Leaf area index, NDVI, Remote sensing, Sugarcane

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ID 35

Development and characterization of palmyrah (*Borassus flabellifer* L.) tuber starch and gelatin incorporated edible composite biodegradable packaging material

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Abstract

Non-biodegradable synthetic packaging materials cause tremendous harmful effects on ecosystem. Hence, biodegradable packaging materials processing research is essential for the food and allied industries globally. Starch is one of the most important polysaccharides used in the formulation of edible biodegradable packaging such as edible films and coatings. Palmyrah (*Borassus flabellifer* L.) tuber is a rich source of starch, widely available in Northern, Eastern and Southern provinces in Sri Lanka. Although the Palmyrah tuber starch is available as a low - cost ingredient in Sri Lanka, scientific investigations and product development of bio-degradable packaging are scanty. The objective of the present research was to formulate, develop and characterize edible bio-degradable films for coating or packaging the food products. In addition to palmyrah tuber starch, gelatin and glycerol were used as ingredients. Treatment formulations with 60, 70, 80, 90, 100% (w/w) total solids were Palmyrah tuber starch. Gelatin and glycerol were added as hydrocolloid and plasticizer respectively. The thickness, moisture content, solubility, tensile strength, elongation at break and water vapour transmission rate of films were measured. Data analysis was done using Analysis of Variance (ANOVA) and Tukey's test using Minitab 17 statistical software. Palmyrah tuber starch yield extracted from fresh tubers was 15.6 %. The tensile strength increased, while increasing the gelatin concentration and reducing the water solubility of the composite films. The elongation behaviour at break was uniform. And the water vapour transmission rate increased with the higher gelatin concentration. The optimized formulation with palmyrah tuber starch (4%), gelatin (1.0%) and glycerol (1.5%) of the film - forming solution has exhibited significantly high tensile strength (10.0 ± 0.0 MPa) and low water vapour transmission rate (4.10 ± 0.00 g/m².d). Thickness (0.14 ± 0.01 mm), moisture content (14.43 ± 0.02 %), solubility (63.09 ± 0.03 %) and elongation at break (41.00 ± 1.41 mm) were measured. The composite edible film has been exhibited biodegradability in soil within six days. In conclusion, the optimized formulation with palmyrah tuber starch, gelatin and glycerol has high potential as the edible composite biodegradable packaging material for food products. Further investigation on application on different nature of food products is recommended.

Keywords: Biodegradable film, Edible, Gelatin, Palmyrah tuber, Starch

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ID 40

Determination of suitable image capturing approaches to develop a machine learning application for accurate diagnosis of cinnamon leaf spot disease through teachable machine

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Abstract

Accurate and timely identification of pests and diseases is critical for effective pest and disease management; however, information and expert consultations may not be readily available to farmers and may be expensive. Mobile phone technology with cloud computing Artificial intelligence disciplines have advanced significantly over the years, making mobile phones with cameras widely available to people at lower costs and easily usable for identifying plant pests and diseases, surpassing the constraints of conventional techniques. The effect of using mobile phone cameras and phone camera-attached lenses to train an Artificial Intelligence (AI) engine to identify cinnamon leaf spot disease was experimented under several conditions. Three smartphone cameras (64 MP, 48 MP, and 8 MP), two camera attached lenses (10x and 30x magnifications), with or without flashlights, and two sides of the leaf (upper and lower) were taken as different conditions to make 24 treatment combinations. Fifty images of diseased leaves and 50 images of healthy leaves were obtained under each combination and image processing engines were trained for each combination by the open-source application called "Teachable Machine" by uploading images of diseased leaves and healthy leaves for each class. Then engines developed were validated with 10 healthy and 10 images with diseased leaves captured from a 9.5 MP camera under the same treatment combinations. Results revealed that the quality of the camera, AI lens, and flashlight conditions used to take the images did not affect the accuracy of identification by the engine. The trained engines could be deployed to develop a mobile-based disease diagnosis app for field use.

Keywords: AI engines, Cinnamon leaf spot, Disease diagnosis, Teachable engine

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ID 68

Farmers' perceptions and willingness to adapt hydroponic systems: a study in Welimada, Sri Lanka

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Abstract

Hydroponics has many advantages over conventional farming, including improved nutrition management, increased quantity and productivity, shorter growth intervals for many plants, high propagation success rates, lower fertilizer costs, no pesticides or herbicides, and better use of space. This study investigates farmers' perceptions of accepting Hydroponic Systems as well as their willingness to adopt them. A survey was undertaken in Badulla District using a convenience sample of 132 vegetable farmers to discern this study's scope. The selected farmers represent a homogeneity in terms of the vegetable mix cultivated, climate, and geography, whereas heterogeneity in willingness and demographic factors. The survey findings suggest strong evidence of farmers' willingness to adopt agricultural innovations and favourable perceptions toward such technologies. The results of the probit estimation of farmers' willingness to adopt hydroponic systems indicate that the age and gender of the participants were statistically significant; farmers aged up to 47 years exhibited a positive attitude toward hydroponics systems in contrast to those above 47 years. In addition, female farmers were more willing to introduce hydroponics farming than male farmers. These findings revealed that implementing the hydroponic system would be effective among the youth and women.

Keywords: Hydroponic systems, Post-Pandemic Economy, Probit Model, Willingness

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ID136

Development of an Aloe vera (*Aloe barbadensis*) Enriched Herbal Soap and Assessment of Physico-Chemical Properties and Consumer Preference

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Abstract

The soap has been playing a key role in personal hygiene practices in industries, service sector and households. The demand for hand washing soap is continuously increasing due to the recommendation of frequent hand washing as a safety precaution for Covid -19 pandemic. Numerous studies have been conducted to develop soaps with various herbal incorporations. Aloe vera has several medicinal properties including antibacterial, antiviral, wound healing, soothing effects *etc.* Food and non-food industries use black tea extract as natural coloring and lemongrass oil as a natural fragrant. The present study aims to develop a herbal soap by incorporating aloe vera gel, tea extract and citronella oil. The soap base was synthesized by saponification of coconut oil and NaOH at 40 °C. Scientific trial and error design was applied in value addition; the product was optimized with 8% w/w aloe vera gel for soothing effect, 4% w/w citronella oil as a fragrant agent and 4% w/w black tea extract as a coloring agent. The developed soap was kept for a setting time of 72 h at room temperature (32 °C) and visual product quality was evaluated by referring to colour, aroma, texture, washing quality and soothing effect. The density, NaOH ratio, free alkali content and total fatty matter (TFM) (SLS 34:2009) were analyzed. Consumer preference was evaluated through an evaluation panel. The soap had a brownish golden colour, a soft consistent texture, a pleasant-mild aroma and soft soothing effect on hands. The density, NaOH ratio, free alkali content and TFM values were 0.95 mg/ml, 4.16, 0.007 mol/dm³ and 79.6%, respectively, which are compiled with general soap formulations and previous studies. According to TFM value, developed soap was classified as grade 1, which is associated with high quality and less hardness. The product has received a consumer preference of 8.65/10 mean rank value with the acceptance of 96% of panelists with favorable comments on soft and soothing washing quality. The finding of the study demonstrated the potential use of natural herbal soap as a hand washing soap. It is suggested to carry out competitor evaluation and standard quality evaluation prior to commercialization of the soap.

Keywords: Citronella oil, Hand washing, Natural colors, Natural fragrant, Tea

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Poster Presentations

ID 29

Effect of packaging material extracted from peanut shell on post-harvest storage parameters of guava fruits

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Abstract

Research on the usage of biodegradable packaging materials extracted from natural sources in the packing of food products increased recently in order to overcome the problems associated with synthetic petroleum-based packaging materials. The present study revealed the potential of agar bio-based films containing cellulose and microcrystalline cellulose extracted from peanut shells, as well as their effect on storage quality and shelf life of guava (*Psidium guajava*) fruits. Cellulose and microcrystalline cellulose films were made using the solution casting method by pouring the solution into the petri-dishes. Seven different packaging materials were prepared using peanut shell powder (1 and 2%), cellulose powder (1 and 2 %) and microcrystalline powder (1 and 2 %). Packaging film prepared from agar and glycerine used as control. The potential application of these packaging materials to fresh fruit preservation was tested. The guava fruits were covered with 1% and 2% (w/w) concentrations of peanut shell powder, cellulose and microcrystalline cellulose incorporated packaging materials and stored at 30°C (room temperature) and 10°C (refrigeration temperature). Post-harvest storage conditions such as physiological weight loss, ascorbic acid, pH, total soluble solids, reducing sugar, titratable acidity and ash content of fruits were measured at three days intervals up to nine days. According to Tukey's Studentized Range Test changes in physiological weight loss (0.35 ± 0.07), titratable acidity (0.03 ± 0.03), pH (0.02 ± 0.01), total soluble solids (1.15 ± 0.21), reducing sugar (0.78 ± 0.03) and ascorbic acid content (0.2 ± 0.12) were significantly ($p < 0.05$) lower in guava fruits stored in 2% microcrystalline cellulose packaging material at 10°C (between 6th day to 9th day of storage) compared to other packaging materials. The findings of this study indicate that the development of biodegradable packaging material for the preservation of guava fruits with minimal changes in the postharvest storage properties is a possible task.

Keywords: Biodegradability, Guava fruit, Post-harvest losses, Preservation, Shelf-life

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ID 96

A study on comparison of water usage of automated drip irrigation system in two different growing media

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Abstract

Home gardening in Sri Lanka has faced many difficulties due to the busy lives of the people and the scarcity of water resources. Water would be the main requirement of backyard farming. The purpose of the study was to evaluate the water consumption of an automated drip irrigation system for different types of grow bags for the growing of *Capsicum annum*. This experiment was done in the Faculty of Agriculture, University of Ruhuna. The experiment was carried out with two different growing media according to Randomized Complete Block Design with eight replicates. Two different growing media were included; commercial coco peat grow bag and a multilayer gunny bag. Sensor-based automated drip irrigation system was established to compare the water consumption of two growing media. The automated drip irrigation system was prepared using Arduino mega microcontroller resistive soil moisture sensors, submersible water pumps, water tubes, tanks, and microchip. The yield parameters of two growing media were compared. According to the results multilayer gunny bag showed lower daily water consumption and it was significantly different compared to the commercial coco peat grow bag. Multilayer gunny bag can also be used as successful growing media with higher yield of Chilli in domestic level compared to Commercial coco peat grow bag.

Keywords: Automated irrigation system, Chilli, Growing bags

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ID 110

GIS-based classification of the land use of man-made reservoirs and ponds for agricultural use

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Abstract

Irrigated agriculture in Sri Lanka is mainly sourced from reservoirs and ponds spread across the country. These reservoirs and ponds, however, cannot be efficiently used due to the issues such as imprecise mapping, in accurate classification and lack of scheduled maintenance. The objective of the study was to develop a classification model to monitor the land-use of reservoirs and ponds that can be used for agricultural purposes in North Central Province using Remote Sensing (RS) and Geographic Information Systems (GIS) in conjunction with supervised classification. The study applies supervised classification and index-based approaches to identify reservoirs and ponds and major forms of Land Use Land Cover (LULC) in the study area. This study analyses the Landsat 8 bands from 2016 to 2021. The Maximum Likelihood Classification (MLC) and Interactive Supervised Classification (ISC) have shown promising results. In addition, Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), Modified Normalized Difference Water Index (MNDWI), and Automated Water Extraction Indices (AWEI-1 and AWEI-2) can be used to verify our findings. Our approach uses resultant raster layers to establish the ground. Maximum Likelihood Classification records the highest overall prediction accuracy with 70%. AWEI-I and MNDWI indices were able to identify water at accuracies of 93% and 87%, respectively. This makes the AWEI-I index to be the most promising index to identify water bodies. Extracted tank layer classifies irrigation tanks into large, medium, and small categories. This includes 13 large-scale reservoirs, 41 medium-scale reservoirs and 3519 small-scale. In summary, the model classifies 3572 tanks in the study area. It can map 1036 tanks with the existing physical labels. However, model predicts 2536 tanks without labels.

Keywords: Automated water extraction index, Classification model, Geographic information systems Irrigated agriculture, Remote sensing

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ID 114

Exploring the user satisfaction of agricultural mobile application with special reference to “Govi-Nena” mobile app

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Abstract

Despite the availability of a significant number of mobile applications, stakeholders in the agriculture domain have not been able to achieve their goals as expected due to the shortcomings of such information platforms available in Sri Lanka. Even though user satisfaction reflects the success of such apps, insufficient exploration regarding it triggers this problem. Therefore, this study aimed to evaluate the user satisfaction of an agricultural mobile-based application with special reference to the “Govi-Nena” agricultural mobile application, which provides information for Sri Lankan commercial farmers that will be useful to make quality decisions for successful farming. A group of “Govi-Nena” mobile app users was considered as the target population (n=276) and data were collected using a Google form-based structured questionnaire with a response rate of 30% (n=83). Based on previous research, the major elements of the study were identified as general user impression, screen content, terminology and communication with the system, system capabilities, and ease of learning. Relationships between constructs considered in this study were tested applying Structural Equation Modeling (SEM) using the Partial Least Squares (PLS) method. According to the results, the majority (87%) of the users were using the “Govi-Nena” mobile app for agricultural purposes while others were using it for academic and learning purposes. Findings further revealed that there was a statistically significant relationship between users’ general impression of the system and user satisfaction of the “Govi-Nena” agricultural mobile app ($t= 2.080$; $p=0.038$). Further, a statistically significant relationship was observed between screen content and user satisfaction of the app ($t= 8.273$; $p=0.000$). However, the impact of ease of learning ($t=0.218$; $p=0.828$), system capabilities ($t=1.270$; $p=0.205$), terminology, and communication of the system ($t=0.671$; $p=0.503$) on the user satisfaction of the “Govi-Nena” agricultural mobile app were statistically not significant. Hence, the present study suggests that administrators’ apparent effort is required to develop the application in a more user-friendly way through sufficient and accurate information, user-preferred screen design, suitable general and overall reaction of the system, and proper screen sequence. The results of this research would be of a great significance for administrators of common agricultural apps to introduce user-demanded improvements for the system while ensuring higher satisfaction for the users of agricultural apps.

Keywords: Agricultural mobile app, Govi-Nena, Mobile applications, Usability, User satisfaction

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Paper production from filamentous algae (*Mougeotia* sp.)- Experimental study

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Abstract

The paper making is one of the largest industries in the world, with 390 million tons of annual production. The main source of cellulosic fibre which is used in the pulp for paper production comes from wood and non-wood fibres are used to a lesser extent. However, a renewed interest exists in the use of non-woody raw materials for paper pulp due to their abundance, low-cost and eco-friendly. Therefore, developing an alternative method for paper production using non woody fibre-based pulp is vital. *Mougeotia* sp. is filamentous green algae with the rapid growth forming a dense mat under eutrophic condition in freshwater habitats worldwide. It is growing as a weed and eradicating is difficult. Thus, use it as a raw material helps to control their growth in the aquatic environment. The study aimed to find a method for making paper pulp using green algae of *Mougeotia* sp as a non-woody fibre source. *Mougeotia* sp. sample (5g) was boiled at 100 °C with 250 mL of water for 45 minutes. Then the boiled sample was sun-dried for five hours after the addition of 25 mL of Sodium Hypochloride (NaOCl), the mixture was left for 20 minutes for bleaching. Finally, excess of NaOCl was washed out using tap water. The paper pulp was prepared by mixing 100 mL water and 50 mL of slime which was obtained from cactus species of *Opuntia* sp. with the bleached sample of *Mougeotia* sp. *Opuntia* is a highly abandoned invasive plant and obtaining slime is a low-cost process. The resulted mixture was filtered using muslin clothes and the product was spread on the plastic strainer to form a thin layer. After three hours of drying under sunlight, the thin layer was removed as a sheet of paper. GSM value (63.904) and thickness (1.067 x 10⁻¹ cm) of the product were tested and they were equally to normal paper. Thus, the results highlight the potential of making an eco-friendly and cost-effective paper pulp by using filamentous green algae of *Mougeotia* sp. as a non woody fibre source and invasive plant species of *Opuntia* sp. as a source for obtaining slime.

Keywords: *Mougeotia* sp., Paper pulp, *Opuntia* sp

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