ESAFS

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ESAFS 2022

Our Soils Our Future

22-26th AUGUST 2022
Royale Chulan Hotel, Kuala Lumpur
MALAYSIA

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BOOK OF ABSTRACTS

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FOREWORD

I would like to welcome all the participants to Malaysia for the 15th International Conference of the East and Southeast Asia Federation of Soil Science Societies (ESAFS 2022) which will be held at Royale Chulan Hotel in Kuala Lumpur, Malaysia, on August 22-26, 2022. The oral and poster sessions will be on the 23rd and 24th. There will be about 10 oral sessions and about 12 poster sessions which will cover a range of interesting topics. The registered participants are not only from Asian countries but also from the other parts of the world. However, due to the uncertain situation of Covid 19 pandemic, many of the regular ESAFS participants could not join us this time. We hope that the situation will come back to normal so that the next ESAFS conference will attract many more participants.

I am taking this opportunity to thank Dr. Rosazlin Abdullah, the President of Malaysian Society of Soil Science (MSSS) for trusting me in handling the Scientific and Technical aspects of this conference. I am very indebted to all members of the S&T Committee for their efforts in editing, reviewing, and compiling the abstracts into this Book of Abstracts. I wish all participants will benefit from this conference by changing ideas and by having academic discussions during the scientific program as well as during the social events. Although this is an academic conference, please make time to explore Malaysia, its people and the cultures. I am sure that you will enjoy your experience here.

Have an enjoyable and productive conference!!

Samsuri Abd. Wahid, Ph.D
Chairman of Scientific and Technical Committee

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KEYNOTE SPEECHES

KN1
National Agrofood Policy 2021-2030 (NAP 2.0)

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Abstract

The formulation of the National Agrofood Policy 2021-2030 (NAP 2.0) after the end of the previous policy, takes into account the current challenges of Malaysia's agrofood sector, among which is the lack of natural resources compared to the population growth rate, the effects of climate change, the sustainability of the sector as well as the findings of a comparative study of strategies and good agricultural practices in Australia, the Netherlands, China, Thailand and Vietnam. The NAP 2.0 Framework contains 1 Policy Statement, 3 Main Principles, 6 Objectives, 5 Policy Thrusts along with 21 Strategies and 77 Action Plans including 18 Strategies and 58 Action Plans under four sub sectors namely rice; fruits and vegetables; animal husbandry; as well as fisheries and aquaculture. NAP 2.0 focuses on economic, social, and environmental elements as the main target. For example, in terms of macro targets, by 2030, the contribution of the agrofood sector to the Gross Domestic Product is expected to increase to 4.3% and the added value of the agrofood industry is targeted to increase to 5%. As for self-sufficiency level (SSL), the supply of staple food i.e., rice is targeted to increase from 63% to 80%, and the main protein source i.e., chicken and fish will continue to be increased to 140% and 98% while the source of nutrition i.e., vegetables and fruits are projected to increase to 79% and 83% respectively. The policy is aligned with more than forty national policies including the Shared Prosperity Vision 2030 (SPV 2030), the Five-Year Malaysia Plan (5MP), and the 2030 Agenda for Sustainable Development (SDGs). NAP 2.0 aspires to transform the agrofood sector into a sustainable, resilient, and modernised sector and prioritize the country's food security.

Keywords: *food security; modernisation; sustainability*

KN2
Changing Landscapes in Southeast Asia: Impact on Soil and Agriculture

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Abstract

Southeast Asia is unique in terms of geology, soils and agriculture. The region had been subjected to various geological processes taking place throughout the history of its existence. The resultant landscapes believed to have existed in Southeast Asia then were very spectacular. Known to be tectonically stable since the Quaternary epoch, changes in sea level in Southeast Asia was related much to the intermittent decrease (glacial), followed by increase (interglacial) of global temperature during late Pleistocene through mid-Holocene. The highest sea level reached during the Pleistocene was 50 meters above, while the lowest was 100 meters below the present height. A period of sedimentation occurred when the sea level was at its highest, followed by extensive soil erosion when the sea level dropped, resulting in development of Riverine Alluvial Terraces. When the sea was at its lowest level, a large land area known as "Sundaland" appeared in Southeast Asia. During this period of geological history early humans from the north moved down south to occupy the newly exposed land to practise ancient agriculture. The climatic conditions then were suitable for crop growth and/or production. About 4,300 years BP, the sea level in Southeast Asia (based on evidence gathered in the Malay Peninsula and Cambodia) was 3-5 meters above the present height. At that point in time much of the lowland coastal regions was inundated by sea water. Pedogenic pyrite (FeS_2) was mineralized in the flooded sediments along the coast. This happened mostly in the west coast of the Malay Peninsula, Bangkok Plains (Thailand), Mekong Delta (Vietnam) and Kalimantan (Indonesia), forming acid sulphate soils (very low pH) not fit for agriculture, especially rice cultivation. Due to high soil acidity and toxicity caused by excess Al^{3+} and Fe^{2+}, acid sulphate soils are unsuitable for agriculture, unless properly mitigated using innovative agro-tech. Following sea level drop due to climate change, very sandy soils located on conspicuous landscapes in the east coast states of the Malay Peninsula and other coastal regions of Southeast Asia were formed. They are called BRIS Soils (Beach Ridges Interspersed with Swales). Because of too much sand, it requires high agricultural input to make the soils suitable for agriculture. It seems that sea level in Southeast Asia is on the rise again, going to inundate the low-lying coastal regions. By the year 2100, the sea level is expected to increase by 0.5-1.0 meter above the current height; thus, rice fields along the coastal plains will be destroyed. If that happens, food security in Southeast Asia is threatened, causing misery to humanity.

Keywords**:** *acid sulfate soils, BRIS soils, climate change, food security, rice production*

KN3

Sustainable Land Management Strategies to Combat the Climate Change

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Abstract

Our soil is limited natural resource in the planet earth which cannot be replaced at all with artificial media. Tropical soil is also fragile and can be destroyed by mismanagement. Land use change from tropical rainforest to plantation should be carefully monitored in soil physicochemical and biological properties in long term. Soil is also both sink and source of greenhouse gases, such as carbon reservoirs twice as big as atmospheric CO2, while under flooded condition as source of methane, CH4, about 30 times stronger global warming potential in mol basis. Even further for nitrous oxide, N2O, nearly 300 times stronger gas are emitted from soil with lan use change and chemical fertilizer application. Sustainable soil and land use managements are essential to keep healthy life on the earth.

Keywords: *sustainability, degradation, climate changes, SDGs*

KN4
Future Perspectives of Soil Science and Its Threats

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Abstract

Soil is a key to ensuring food security now and in the future. The total global food demand is expected to increase by 35% to 56% by 2050. The main challenge for securing a healthy food production is ensuring the soil health. Interventions and strategic approaches are required to minimize soil degradations and protect the natural state of the soil from the impacts of population and economic growth. Balancing soil conservation and food security is the key to a better future. Soil as a non-renewable natural resource supports agricultural and food production by up to 95%. Producing more food to feed 7.96 billion people in 2022 and 9 billion in 2040 and ensuring sustainability are challenging and need a global strategy. Worldwide land use changes prevail from clearing some of the natural forest ecosystems to croplands, pastures, plantations, and urban areas. These changes are potentially influencing losses of biodiversity and reducing the soil functions due to soil erosion, declining organic matter content, nutrient imbalance, soil contamination, acidification, salinization, and sodification. It can be assumed that global climate change will cause more vigorous hydrological cycles thus accelerating soil degradation. Climate change is considered the most important or severe environmental challenge for food security and the third primary driver of soil change. Climate change has been the subject of an interesting research topic for decades. Climate change strains food security while farming contributes to greenhouse gas emissions. It is then needed to address climate-smart agriculture, which aids in mitigating and adapting to climate change. Soil information emerged as a new branch of soil science in the year of 2000 with the availability of high-power computers, global positioning systems, GIS, proximal and remote sensing information, advanced spatial statistical and numerical analysis techniques. Computers and sophisticated software allow complex soil system behavior to be modeled and predict soil characteristics under various ecosystem manipulation. Mapping a soil has evolved from a polygon-based paper map to digital soil mapping in the early 2000. Digital soil mapping revolutionized the global soil information system to digital form and quantitative relationships of the environmental data (scorpan factors) are used to model and predict soil properties. The availability of vast soil information data expands soil science beyond agriculture to environmental issues, human health, land use planning and many other areas.

Keywords**:** *sustainability; climatology; degradation; soil health; soil threats*

COUNTRY REPORTS

Soil Science Society of Bangladesh

Dr. S.M. Imamul Huq
President, Soil Science Society of Bangladesh (SSSB)

Soil Science Society of Bangladesh is the only national level organization of the soil scientists of Bangladesh. The Soil Science Society of Pakistan was founded in 1958 in Dhaka and a regional branch was later established in what was then West Pakistan. In the First South East Asia Soil Science Conference-1957 held in Manila, Philippines it was unanimously resolved that societies should be formed in all countries of the region to facilitate holding of such periodical conferences. With the emergence of Bangladesh as a sovereign independent country in 1971, the society was renamed the 'Soil Science Society of Bangladesh' in 1972.

The society is responsible primarily for promoting the development of Soil Science in Bangladesh. It disseminates knowledge of soil science to the public; encourages basic and applied research in Soil Science; promotes and safeguards the interests of the soil scientists of the country. It also publishes a scientific journal twice a year, and organizes symposiums, seminars and talks. To promote the knowledge in soil, the society has sponsored the Bangladesh Soil Club, where the graduating students are members. The World soil Day 2019 was celebrated colorfully by the SSSB and the President of the Society presented the keynote paper on the theme of the day and the seminar was held jointly by the Ministry of Agriculture, FAO and the SSSB. Bangladesh Soil Club arranged a soil Olympiad on the occasion.

The activities during 2020 were at the lowest due to covid-19 situation. However, as many as 30 seminars on the various topics on soil were held on the Zoom platform in 2020. The world soil day 2020 program was attended by the President of the society as a special guest and the program was arranged jointly by MoA, SSSB and FAO. Soil Olympiad and an art competition were arranged by the soil club and sponsored by the SSSB. A feature on the theme of 2020 world soil day was published in a vernacular daily which was written by the President of the Society. SSSB council meetings were held in September, October and December 2021 through the Zoom platform. The National Olympiad prior to the WSD celebration was held on Nov 29th, 2021. The President met the electronic and print media to make public awareness on WSD and its theme of 2021 on Dec 3, 2021 The General Secretary, Mr. MJU Shoaib presented the keynote paper on WSD theme.

A seminar (Virtual) on Soil heavy metals contamination and their remediation for boosting soil productivity was held in December 2021. Professor Dr. Abul Kashem, Dr. Tanvir Ahmed Chowdhury, and Mr. Mainul Ahsan, former Director SRDI presented papers on the theme. An article on the 2021 WSD theme was published in a local daily, the writer being the President of the society. The National soil Olympiad was held on the occasion of WSD and was arranged by the Bangladesh soil club under the entrepreneurship of SSSB. SSSB council meetings were held in January and June 2022 and an annual general meeting (AGM) of the society was held in May 2022.

Soil Science Society of China

Prof. Dr. Jing Che
President, Soil Science Society of China

Founded in 1945, the Soil Science Society of China (SSSC) is one of the top level national academic societies under the China Association for Science and Technology. It is a legally registered, trans-industrial, trans-departmental and non-profit organization that is oriented towards promoting progress in soil sciences, supporting all soil scientists in the pursuit of their activities. SSSC finished changing the term of council in 2020.

The current council (2020-2024) constitutes 13 specialty committees, 8 working committees and 3 working groups. In 2021, SSSC established the Department of International Communications to foster exchange and collaboration in the international scientific community. A strategic cooperation agreement with the Soil Science Society of America was signed in March 2021. In addition, the Newsletter of Soil Science Society of China launched on the 8th World Soil Day which is a bimonthly publication that mainly focuses on society news, conference news, research frontiers, publication releases and technical products.

As a national society of soil science, SSSC is actively engaged in academic activities in the past three years. From August 2019 to June 2022, SSSC has organized more than 50 academic events domestically which attract approximately 17,000 participants and the number of abstracts received exceeds 3,000. A few more activities like conference and symposium are scheduled in the second half of this year.

Concerning talent recommendation, SSSC nominated Chinese scientists for the candidates of IUSS Division and Commission officers 2022-2026. Recommended by the society, Prof. Yongguan Zhu won the IUSS Liebig Award 2022 and Dr. Taolin Zhang was awarded IUSS Distinguished Service Medal 2021. Besides, two young Chinese soil scientists, Yuxin Ma (Manaaki Whenua - Landcare Research) and Songchao Chen (Zhejiang University - Hangzhou Global Scientific and Technological Center) won the IUSS Dan Yaalon Young Scientist Medal 2022. Three nationwide awards of the SSSC Outstanding Achievement Award, the Science and Technology Award and the Outstanding Young Scholar Award are presented to its members. Four of SSSC Outstanding Achievement Award, three first prize and four second prize of Science and Technology Award, are selected to award more than a hundred of researchers and thirty companies. In 2021, the society established Fellowships to recognize and honor scientists at home and aboard for their achievement and accomplishment in soil sciences. Inaugural Fellows of 12 scientists are bestowed by the SSSC.

SSSC sponsors or co-sponsors five academic journals: Acta Pedologica Sinica, Soil Bulletin, Journal of Soil and Water Conservation, Arid Zone Research, and Pedosphere (in English). In 2021, the Journal Citation Report (JCR) was released and the impact factor of Pedosphere was 5.514 (9/39, Q1), five-year impact factor reached 6.039. About popularization of science, the society and soil science popularizing working committee have organized more than 50 activities facing students, farmers and workers whose topics involve soil health, crop safety, soil protection and remediation. Except for traditional types of posters, exhibition, report and symposium, online video and courses, experiments and seminars are designed to expand audience reach.

Indonesian Society of Soil Science

Prof. Dr. Budi Mulyanto
The President of ISSS

Abstract

Indonesian Soil Science Society (ISSS) is a professional organization since 1972 in fields that related to the dimensions and values of soil and soil sciences. Its role is real and is needed to deal with various issues related to land and land issues especially in facing life challenges such as forest and land fires, climate changes, GHG emissions, floods and landslides, land-use change, land degradation, etc. ISSS always strives to build commitment and strive at every opportunity to achieve the Sustainable Development Goals (SDGs). The following are some achievements and activities carried out by ISSS in 2020-2022. During the COVID-19 pandemic, the ISSS activities throughout Indonesia are still running by conducting webinars in collaboration between the ISSS Regional commissariat and the Regional University. After the COVID-19 pandemic has declined, face to face seminar activities has been carried out.

After the Covid-19 pandemic transitioned to endemic, several Thematic Soil Science Trainings were carried out to improve field competencies for young scientists, whose educational process during the pandemic cannot be carried out normally. ISSS collaborates with senior scientists who work at the Center for Agricultural Land Resources, the Ministry of Agriculture, and some universities. During the pandemic, some of the ISSS members in collaboration with Prof Budiman Minasny of Sydney University, wrote papers and published in the qualified international journal, among others: Dian Fiantis D, Sri Rahayu Utami S.R., Niswati A., Nurbaity A., Utami S N H., , Husnain, Taberima S., Setiawati T C., Sabrina T., Hairiah K. Lanya I., Rampisela A. Ginting F I., Mukhlis, Mastur S., Nurcholis M., Anda M, Sukarman, Mulyanto B., Gusli S. Minasny B. 2022.

The increasing role of Indonesian women in soil science: Current & Future Challenges. Soil Security 6 (2022) 100050. Related to organization and education of Soil Science, activities such as curriculum development discussion and the establishment of the Soil Science Study Program Communication Forum (APSITI), publication of the ISSS Newsletters, membership card printing and membership fee collection, and preparations for the XIII ISSS national congress which will be held in September 2023 in Lampung. There have been many activities carried out by ISSS including development and implementation of soil sciences, encouragement of member participation, and institutional development.

Japanese Society of Soil Science and Plant Nutrition

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Abstract

JSSSPN was established in 1927 to construct modern theories and technical structures in the study of soil science and plant nutrition. Since the increasing awareness of environmental issues, environmental science was also included in our field. JSSSPN has 2048 members as of Feb. 2022. The purposes of our Society are to solve these global and domestic concerns and contribute to the stable development of the human community in the 21st century. Administration of JSSSPN is composed of the president, vice president, executive director, various directors, auditor, and editor in chief of our journals. We have eight scientific divisions (Soil physics, Soil chemistry and mineralogy, Soil biology, Plant nutrition, Soil genesis, classification and survey, Soil fertility, Fertilizers and soil amendments, Environment, Soil education and cultural soil science), which are further divided into sub-groups. We have annual conferences in different areas of Japan, to which several hundreds of members participate, and a number of oral and poster presentations, symposiums and lectures are held. JSSSPN consists of six affiliates (i.e., Hokkaido, Tohoku, Kanto, Chubu, Kansai and Kyushu), each of which conducts local annual conferences. Annual conferences 2020 and 2021 were held totally online due to the Covid19 pandemic. Hundreds of participants made presentations and enjoyed fruitful discussions. Special lectures were given by Prof. K. Minamisawa and Prof. A. Makino, awardees of Japan Prize of Agricultural Science, Prof. T. Kosaki, past president of IUSS, and Prof. L.B. Reyes Sánchez, president of IUSS. We are editing and publishing our own journals. Soil Science and Plant Nutrition is our English journal published bimonthly. The latest impact factor is 2.389. We also have a journal fully in Japanese as well. It is published bimonthly and includes original articles, notes, technical report, symposium records, branch activity report, etc. In Nov. 2021, we had a symposium entitled “10 years after the Fukushima Dai-ichi Nuclear Power Plant accident – Past, present and future agriculture”. Basic research and practical solutions on the problems that have arisen in the agricultural field, and future perspectives were presented by JSSSPN members who have devoted themselves to restore the agriculture. Supporting and encouraging the JSSSPN young members to join the JSSSPN activities are important especially during the pandemic. We offer various types of support systems to the young members. As an activity related to International Decade of Soils 2015 – 2024, a program for making and sharing videos on soil profiles is ongoing in collaboration with ESAFS members and IUSS Division 4 Commission 4. In 2027, JSSSPN will celebrate its 100th anniversary. We are planning the ceremony and memorial activities in 2027, as well as projects/activities over several years for future JSSSPN, future mankind, and future earth.

Korean Society of Soil Science and Fertilizer

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The Korean Society of Soil Science and Fertilizer (KSSSF, *http://www.ksssf.or.kr*) was established on June 28, 1968, with 127 members and published the 1st Journal of Korean Society of Soil Science and Fertilizer with 12 soil research papers. KSSSF is a non-profit scientific and educational organization that is dedicated to the development of soil science, fertilizer, and agricultural environmental quality in Korea. The KSSSF as a Member of the International Union of Soil Science (IUSS) has about 489 active members out of 704 registrants including 55 organization members, 15 special group members, and student members.

The major purpose of the KSSSF is to communicate recent progress in soil and fertilizer sciences. In the early stage of the KSSSF, research mainly streamed agricultural productivity to solve the national food shortage. Since the 1980s, as environmental consideration demand has risen, research interest has shifted to environment-friendly soil management for sustaining productivity and environmental health. Urban soil management and global warming studies draw much attention from recent soil science. The position of soil science in modern agriculture toward the integrity of agriculture and the environment in Korea has become important.

The KSSSF holds regular academic meetings in spring and in autumn every year and publishes the Journal of Korean Society of Soil Science and Fertilizer every two months (4 issues in Korean edition and 2 issues in English edition a year). Overall, 383 oral presentations and 1,138 poster presentations are delivered by society members during the regular meetings from 2019-2022.

The Korean government enacted March 11 as a national soil day in 2015, and the KSSSF has celebrated it with various academic and social activities such as photo and UCC contests which can show the value of soil. The KSSSF has run an intensive training course for soil judging, and the representatives selected have been dispatched to the international soil judging competition at the World Congress of Soil Science (WCSS) meeting.

Many international and national meetings including workshops, symposiums, and conferences were held to make a vision for sustainable development during the period (Table 1). The KSSSF prepared various prizes including The IUSS Jeju Award, academic achievement, best research paper, and best presentations to encourage the research activities of society members. The IUSS Jeju Award was co-established by IUSS and the Korean Society of Soil Science and Fertilizer (KSSSF) in commemoration of the successful 20th World Congress of Soil Science (WCSS) in Jeju, Korea in 2014. The Award is a strategic award being delivered to a young and mid-career soil scientist who has innovative and outstanding accomplishments in education, research, or extension in soil sciences and has made a substantial contribution to IUSS missions. Initiating in 2018, the IUSS Jeju Award will be given to one awardee every four years at each World Congress of Soil Science. The Award consists of a plaque or equivalent, a certificate, a US$1,000 honorarium, and financial support for airfare and accommodation to attend the presentation at the WCSS. If there is no acceptable candidate, the award will not be given.

Table 1. Academic activities of the Korean Society of Soil Science and Fertilizer from 2019 to 2022.

Year	Topics	Remarks
2019	○ Soils of Urban, Industrial, Traffic, Mining, and Military Areas	SUITMA 10
	○ Nitrogen Cycling and Its Environmental Impacts in East Asia	Annual meetings
	○ Healthy soil and rural society construction	Soil day symposium
2020	○ Production and reduction strategy of fine particulate matter in agriculture	Annual meeting
	○ Agricultural utilization of phosphogypsum	Workshop for specialists
2021	○ Agricultural soil and fertilizer management for carbon neutrality	Annual meeting
	○ Importance of soil as a hidden weapon in the carbon natural era	Soil day symposium
2022	○ Soil organic matter (SOM) in the Anthropocene	8th International symposium on SOM
	○ Carbon neutrality and digital soil management	Soil day symposium

Malaysian Society of Soil Science

Dr. Rosazlin Abdullah

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Malaysian Society of Soil Science (MSSS), a non-governmental organization (NGO) in Malaysia and full-fledged professional entity, was established to promote the study of soil science, specifically within the context of agriculture and to champion environmental stewardship. The objectives of the society are to promote the study of soil science and to create public awareness of the importance of soil conservation within the context of sustainable land management, to review areas of soil study relevant to national development, and to disburse small grants to needy students and to members attending scientific meetings related to soil. Inaugurated on April 2, 1971, in 2021, MSSS celebrated the Golden Jubilee (50 years) anniversary. During the MSSS 50th Anniversary Celebration, MSSS organized various programmes to highlight the valuable contribution of MSSS members and raise public awareness on the importance of soil including national and international Webinar. Photo, short essay, and poetry contests were organized during the Golden Jubilee Anniversary to increase public awareness of the importance of soil to humankind, especially among the young generation. All the programs were held through a Zoom platform and live-streamed on MSSS Facebook due to the pandemic Covid-19. The International Union of Soil Sciences (IUSS) has identified the key roles played by soils in addressing the major resource, environmental, health and social problems that humanity is currently facing. MSSS, as part of the global soil scientist network, is committed to actively supporting IUSS initiatives and is working towards increasing public awareness on soil matters in Malaysia. Every year, MSSS celebrates World Soil Day on 5th December, with the aim of raising public awareness on the importance of soil as part of the ecosystem and food security with emphasis on the importance of soil for the well-being of humanity. MSSS, in collaboration with the Department of Agriculture of Malaysia, is actively involved in Asian Soil. MSSS is also affiliated with the Malaysian Professional Centre which serves as the umbrella body for all professional bodies from different fields and provides a platform for the exchange of information and ideas between different professions in helping the development agenda of Malaysia. To encourage young scientists, MSSS provides thesis awards to recognise outstanding postgraduate students majoring in soil science and soil-related disciplines. With regard to publication, Malaysian Journal of Soil Science (MJSS) continues to be the main scientific and technical knowledge dissemination platform, with issues indexed under Scopus. The society produces two Newsletters annually to update members on the activities of the society as well as a promotional platform for the society which is available on both MSSS and IUSS website. The society actively organizes activities to promote science and technology advancement in the area of soil research, to reach out to the public through conference, workshop, public talk, soil familiarization tour, community engagement programs, soil education programs, and participates in Malaysia International Agriculture Technology Exhibition. The society is currently hosting the 15th International Conference of the East and Southeast Asia Federation of Soil Science Societies (ESAFS 2022) which is held on 22-26 August 2022 in Kuala Lumpur, Malaysia.

Soil is Life. A nation that destroys its soil destroys itself.

Nepalese Society of Soil Science

Prof. Keshav Raj Adhikari, PhD

The COVID19 caused delay or postponement of many activities and even cancellation of some, in the last two years but the members made attempts to keep the society functional. Categorically speaking, the NSSS activities could be summarized in four headings.

One: Increase in size and expansion of membership types. Earlier number 115 is now increased to 125. International and student membership categories have been added. Although these members are not entitled to exercise the voting rights, they still can participate in all other activities that would benefit society and help in career development.

Two: We organized the World Soil Day event every year. The year 2019 was fully physical, 2020 fully webinar, and 2021 hybrid type (physical and webinar, combined). In any modality, the WSD events as we observed, have been successful in contributing to the aims of ESAFS in general and the national society, in particular. In 2020, the WSD theme of the year 'Soil Biodiversity for Healthy Soil' was a major part of interaction where four papers all focusing on maintaining soil biodiversity were discussed. In 2021, WSD theme 'Halt salinization, Boot soil productivity' was changed to 'Managing Soil Acidity for Prosperity in order to suit the local conditions because over two-third soils in Nepal are acidic. The conference effort was directed to create awareness on soil acidity and its management so that it could also contribute to the sustainable development goal of zero hunger. Four technical papers were presented all focusing on the management of acid soils including government policy and technology intervention for improving soil health.

Three: Co-organized farmers field soil testing and results interpretation for land suitability using a mobile soil testing laboratory in the outskirts of the capital city. Ministry of Agriculture, and the society jointly accomplished this outreach program.

Four: The society president participated in an International Soil Science Congress co-organized by Soil Science Society of Pakistan and Agriculture University of Faisalabad during March 9-11, 2022. He presented a technical paper on bio-fertilizer which is receiving increasing importance in soil improvement for sustainable soil management and productivity. On many occasions, the society members also participated in a number of in-country webinars to share knowledge and reach out to farmers particularly on topics such as biofertilizer, waste management, organic agriculture and so on.

Philippine Society of Soil Science and Technology

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Abstract

The Philippine Society of Soil Science and Technology, Inc., (PSSST) is a non-stock, non-profit corporation organization aimed to promote the advancement of soil science and technology in the Philippines; mobilize and encourage soil scientists and technologists of the country to share their knowledge in the development and conservation of Philippine soils; serve as forum for the exchange of ideas and knowledge among soil scientists, technologists and planners; and establish formal and non-formal information linkages with other similar organizations and institutions locally and abroad. Presently, the society has 2,000 members and have continually undertaken the Annual General Meeting and Scientific Conference is a regular activity of the Society to inform the members of its current status (financial, programs and activities and election of officers. Highlight of the conference is the recognition of members with exemplary service and extraordinary achievement to the promotion and advancement of Soil Science and Technology in the country. The Society provides a thesis grant PhP25,000 to select senior soil science students intended for the conduct of their thesis. Amidst the continuing decrease in the number of Agriculture students majoring in Soil Science, Career Orientation Program is conducted annually in various universities to encourage incoming students to major in Soil science. The Society maintained its linkages with the Bureau of Soils and Water Management (BSWM), Philippine Association of Agriculturists (PAA). accredited by the Professional Regulatory Commission of the Philippines, Overview of Conservation Approaches and Technologies (PHILCAT), Fertilizer and Pesticide Authority (FPA) of the Philippines, and the Bureau of Agricultural Research (BAR). Twenty-five (25) years is a very long journey. All of the good works that the Society had accomplished in pursuing its objectives will not become in reality without the support extended by Dr. Cezar P. Mamaril and Dr. Nora B. Inciong who always give their unselfish technical, moral and even financial support. To all other advisers, Dr. Eduardo P. Paningbatan, Jr., Dr. Ireneo J. Manguiat and Dr. Rogelio N. Concepcion, the Society is very thankful for the guidance and directions that they have provided in attaining our objectives of promoting the advancement of soil science technology in the Philippines. Likewise, the PSSST Board of Trustees are continuing their efforts and enthusiasm in convening all the Society Members to unite and strengthen the camaraderie and commitment in protecting and conserving our soil and the environment for the future generation.

Soil Science Society of Sri Lanka

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Abstract

Soil Science Society of Sri Lanka (SSSSL) established in 1969 and it is one of the oldest and active professional societies in Sri Lanka. Presently, the SSSSL has a strength of 366 members representing soil scientists from academia, government institutes and the private sector. During the reporting period, the SSSSL continued its activities for strengthening the capacity of soil scientists and other stakeholders in Sri Lanka. Year 2019 was a remarkable year for the society as it celebrated the golden jubilee. Marking this milestone, the SSSSL conducted an international symposium "Soil: Underpinning Life and Environment" on 5th and 6th December 2019. The society facilitated the participation of six internationally recognized eminent soil scientists to deliver invited speeches and three technical sessions to present recent research findings of soil scientists. The inaugural session of the symposium included a special ceremonial event to felicitate six eminent soil scientists in Sri Lanka to appreciate their service rendered to the discipline. Covid-19 pandemic situation caused a considerable interruption of the activities of the society, especially in the year 2020. However, by the latter part of the year, the society was able to continue its activities as the audience got used to online resources of knowledge dissemination. In November 2021, the society organized a virtual interactive session "Biochar for Improving Soil Functions" in parallel to the 32nd Annual Congress of the Postgraduate Institute of Agriculture, University of Peradeniya. In May 2021, the Government of Sri Lanka took a radical but poorly judged decision to completely ban the use of synthetic fertilizers in Sri Lanka. Considering it as a national responsibility, the SSSSL membership evaluated negative impacts pertaining to this decision on national food security. Moreover, quick actions were taken by the SSSSL to submit a letter to HE the President of Sri Lanka to make him aware and encouraged to reconsider the decision. Moreover, a number of newspaper articles were published by the SSSSL to make the decision makers on the consequences of the decision. The SSSSL conducted a panel discussion on "Way forward to sustain agricultural production with organic fertilizers on 17th May 2021 with the contribution of 13 eminent soil scientists as resource persons. This session served as a forum to discuss the impact on the above-mentioned decision on different crop sectors of the country. The world soil day of 2021 was celebrated by the SSSSL by conducting a technical session on "Halt soil salinization, boosting soil productivity". Four members made presentations during the webinar. On 11th March 2022, a public webinar on using biochar for improving soil fertility on 11th March 2022. The event was attended by nearly 70 participants including farmers, agriculture extension officers, field officers, undergraduate students and members of the SSSSL. The SSSSL contributed for national level activities by submitting its comments on the National Agricultural Policy and Sri Lanka Standard on Specification for Specialty Fertilizer. Presently, the Society is conducting a number of programs for school children and the general public targeting the World Soil Day 2022, these include Quiz Program, Art and Photography Competition. During the stated period, the Society published one abstract booklet. One newsletter and a special publication celebrating the Golden Jubilee of the SSSSL.

Indian Society of Soil Science

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Abstract

Indian Society of Soil Science (ISSS), the oldest among the various disciplines of agricultural sciences in India, established in Kolkata in 1934 with only 30 members and is one of the largest societies enjoining the patronage of about 2700 members at present through its 51 chapters. During the 87 years of existence, the ISSS has had the privilege of serving the cause of soil science by organizing several symposia/conferences/seminars/group discussions at the national and international level and publishing a large volume of scientific publications including textbooks, bulletins, abstracts/proceedings and Journal of the Indian Society of Soil Science (JISSS). The objectives of the ISSS are (i) to cultivate and promote soil science and kindred branches of science; (ii) to disseminate the knowledge of soil science and its applications, through meetings, discussions, and publications; (iii) to promote judicious interactive use of soil, water and other natural resources, fertilizer and other inputs to maintain quality and resilience of soil for sustainable agriculture; (iv) to foster high standards in the teaching and education of soil science; (v) to work in close association with learned societies and organizations having similar objectives; (vi) to create public awareness on the importance of soil as a finite natural resource; (vii) and to carry out research and to perform all other acts, matters, and things that may assist in, or be conduce to, or be necessary for the fulfilment of objectives and purposes of the society. Honorary Members, Life Members, Members, Donor Members, Institutional Members, and Student Members constitute the general body of ISSS. The administration, direction, and management of the affairs of the ISSS are vested in the Council. It is composed of a President, two Vice Presidents, all Past-Presidents as ex-officio Members, a Secretary, a Treasurer, a Joint Secretary, an Assistant Secretary; a Chief Editor and 20 Councillors. Council meets once in four months. Issues concerning election of Council members, finance, fixation of membership subscription, annual review of the programmes, amendments to rules, general policy guidelines, etc. are taken up in these meetings. The annual convention of the ISSS is held regularly every year since its inception in different places of India for organizing various scientific events through one of its Chapters. The Editorial Board is composed of a Chief Editor, 20 Editors and 4 International Consulting Editors for reviewing and selection of suitable articles for inclusion in the JISSS and its timely publication. The ISSS has also done a great service by paying its attention to the development of human resources needed to maintain vibrant soil science in tune with the national priorities. The society recognized its outstanding researchers and visionaries with various honors and awards annually. The ISSS, a full member of International Union of Soil Sciences (IUSS), has had a linkage with it since the beginning and in collaboration with IUSS hosted the 12th International Congress of Soil Science in 1982, in Delhi followed by IUSS sponsored mid-Congress international conferences.

Soil and Fertilizer Society of Thailand

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Abstract

The Soil and Fertilizer Society of Thailand (SFST) has been established since 1981 with the main objective is a core agency of multi-stakeholders in soil and fertilizer technology in either national or international level. SFST is focusing on providing technical information and knowledge of soil and fertilizer, including dissemination, support and encouragement of knowledge to policy makers, academics and farmers in order to use soil correctly according to academic principles and to achieve sustainability. Members of SFST consist of researchers from the government and private sectors, lecturers and students in university and fertilizer companies including land users. For knowledge delivery, SFST established national journals of soil and fertilizer 2 volumes per year which recently became e-journal. SFST also held a special seminar on hot issues related to soil and fertilizer. On fertilizer crisis, SFST, Kasetsart University (KU) and The Science Society of Thailand Under the Patronage of His Majesty the King in collaboration with main private association (Thai Fertilizer and Agricultural Supplies Association and Thailand Fertilizer Producer & Trade Association) held technical seminar responsive to crisis circumstance and provide solution and alternative way for agricultural production. After the UN General Assembly responded by designating 5 December as the official World Soil Day (WSD). Thailand on behalf of the initiative country proposes this celebration every year starting from 2014. On WSD 2022 the celebration will be held at the Land Development station of Tak province in the FAO theme of "Soils: Where the Food Begin". SFST initiated the National Conference of Soil and Fertilizer (NSFC) which is held every 2 years hosted by the regional university and government agencies. This coming December (7-9 December, 2022) Chiang Mai University will host the NSFC 7th on the themes of "Soil, the beginning of food security and sustainability". SFST always participate Webinar provided by Asian Soil Partnership (ASP) such as 1) Implementation of the International Code of Conduct for the Sustainable Use and Management of Fertilizers 2) Soil Biodiversity: a nature-based solution? and 3. RECSOIL: Recarbonization of global soils. CESRA is one of ASP activity which SFST has also worked and communicated closely with GPS/ASP-FAO along with the Land Development Department (LDD). SFST LDD and FAO held the workshop on "Strengthening the CESRA network for Sustainable Soil Management".

Vietnam Society of Soil Science (VSSS)

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1. Fact of Vietnam Society of Soil Science (VSSS)

- Date of foundation: June 8th, 1991
- The past president Dr. **Tran Khai** (since 1991-2011)
- President of the 5th (2011-2016) and 6th term (2016-2022): Prof. **Dr Vu Nang Dzung**
- Office address: 61 Hang Chuoi, Hanoi, Vietnam
- Tel: 84 4 3 821 0374; Fax: 84 4 3 9724757; Email: hoikhoahocdatvn@yahoo.com
- The membership of the Society up to August, 2022 is 810 including 36 branches and centers at different institutions and locations in Vietnam.
- President, board executives are elected by the General Assembly for a 5-year term.

2. Organization and Activities

VSSS have four divisions for covering its activities

1) Information and publication including Vietnam Journal of Soil Sciences
2) International collaboration
3) Development of Soil Sciences and Technology
4) Administrative Assistance

3. Current development

- The main activities of VSSS in the past two years are to organize the workshops to collect information from VSSS members which contributed to establish new policies in land, soil, water and fertilizer management in Vietnam (organized two workshops annually).
- Different themes of soil science should be focused on Vietnam in near future: Soil information; soils and community health; soil nutrition cycle and plant growth and development; soil degradation and restoration; soil resources and climate change; and soil borne diseases.
- The journal “Vietnam soil science” was published quarterly. This journal is of high academic level in the field of soil science of Vietnam. The VSSS also publishes books, handbooks, special reports, textbooks and proceedings to disseminate the knowledge and experiences of local experts.
- Participating in teaching at graduate and postgraduate’s level, especially taking part in the different committees of PhD. defence and nomination of the professors.
- Hundreds of projects and scientific themes have been established and conducted in this period by the VSSS members, are soil fertility limitations and plant nutrition, improvement of problematic soils and rational utilization, land degradation assessment for the whole country and agro-economic zones, provinces, land use planning adapting to the climate change, formulation of soil resources information.

Soil Science Society of Mongolia

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Abstract

Soil study in Mongolia was dated in the first half of the 20th century and became more intensive in 1960 and 1980s. Agriculture development campaign "Atar" in the 1960s and soil research activities are closely connected. National soil classification developed and published soil maps, research articles, books, practical guidelines, methodologies for soil use. Basic knowledge of Mongolian soil and soil properties was established at this time. Due to the transition to a market economy in 1990, the country's social and economic situation worsened, and soil science activities declined. After the 2000 soil study and related activities became more intensive. In 2007 founded Mongolian Soil Science Society and soil scientist collaboration joint activities enhancing, completing several research projects. Mining boom started from 2005 has a negative impact on the environment especially on soil cover. Soil degradation and pollution problems are becoming serious. In 2008 the national soil pollution standard (MNS 5850) was developed, and this is an important document for assessment of soil pollution and protection. In 2010 Mongolian soil scientists developed "Soil ecological economical assessment methodology" and the Ministry of Environment adopted this document as guidelines for protection of soil cover from mining activities. In 2012 Mongolian parliament adopted the "Soil protection and Desertification prevention law" basic conceptual document for soil conservation. All of these soil protection and conservation related documents were developed by national soil scientists. In 2015 Mongolian soil scientist participated in 12th International Conference of the East and Southeast Asia Federation (ESAF) of Soil Science Societies and became a member of ESAF. This event has an important impact on further development of soil science activities in Mongolia. In December 2015 "First Mongolian Soil Scientists Meeting" was organized in Ulaanbaatar where soil science developmental problems of the country were discussed among other activities. In 2016 the "Mongolian Journal of Soil Science" was established by the initiative of Dr. Ochirbat Batkhishig. This journal is an important periodical to support soil research and disseminates soil knowledge in the country. In 2016, a renewed Mongolian national soil classification system using FAO-WRB soil classification criteria and approaches was developed. In 2020 a soil map of the country with a scale of 1: 800 000 using remote sensing tools and digital soil mapping methodologies was initiated. From 2018 onwards, Mongolian soil scientists have been participating in the "Soil Atlas of Asia" international project funded by FAO, European Commission and Global Soil partnership.

Chinese Society of Soil and Fertilizer Sciences (Taiwan)

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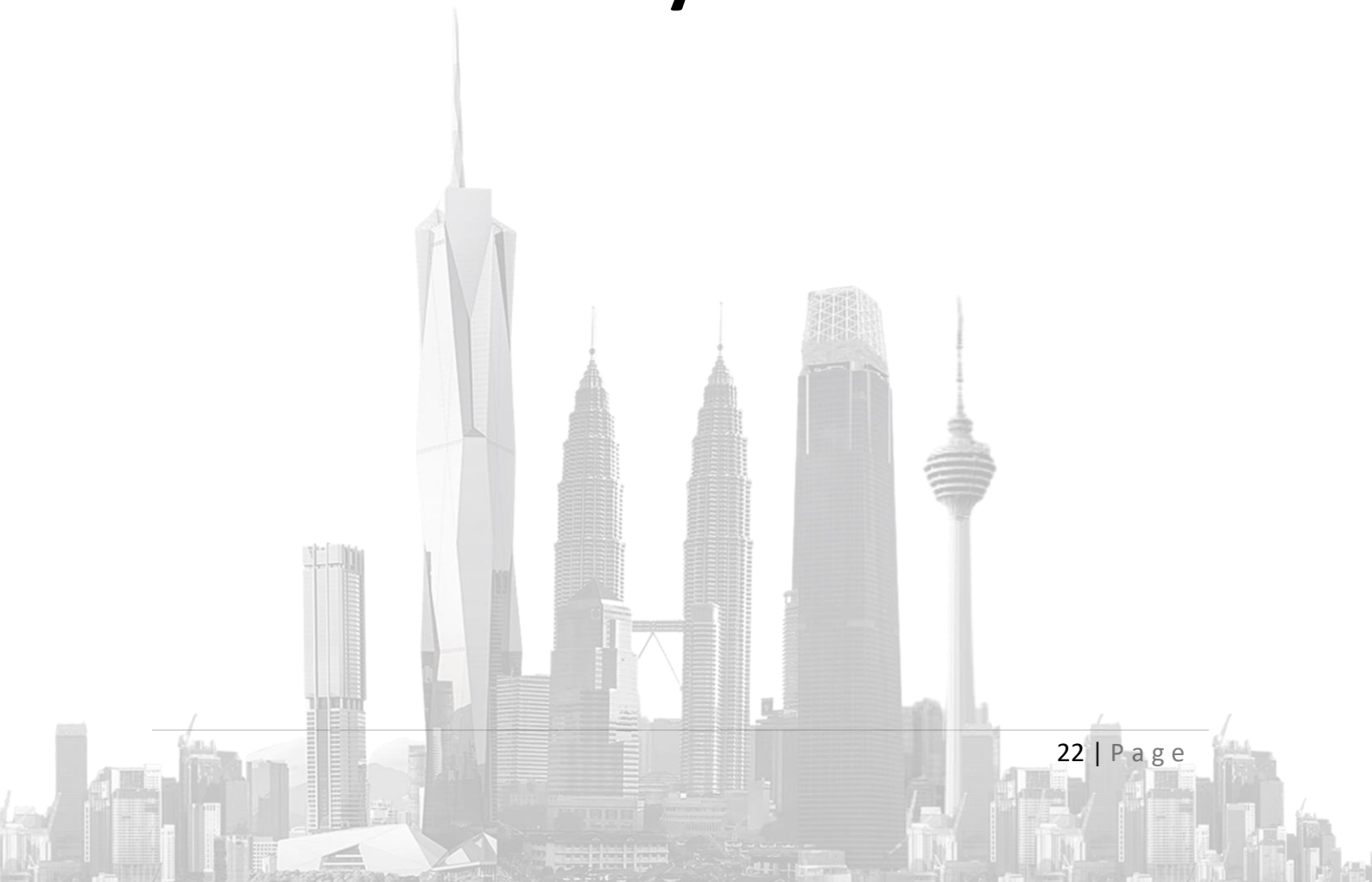
Abstract

The Chinese Society of Soil and Fertilizer Sciences (CSSFS) was established in 1984 to advance the discovery and practice of soil and fertilizer sciences in Taiwan and enhance the communications of Taiwanese and international soil scientists. CSSFS has been a member of the East and South Asia Federation of Soil Science Societies (ESAFS) and the International Union of Soil Sciences (IUSS) since 1990 and 1998, respectively. The current members of CSFFS are about 300 scientists and professionals in Taiwan. The annual meeting of CSSFS is held in December of each year with invited oral and voluntary poster presentations. CSSFFS offers several awards, including the Society Award, Research/Extending Paper Award, Poster Presentation Award, Shuang-Guai Soil Science Award, and Scholarship of Prof. Guo, Kuai-Shih. The award winners are presented at the annual meeting and in the Newsletter of Soil and Fertilizer published by CSSFS annually. CSSFS also publishes monographs and offers workshops for promoting knowledge and technologies in soil management and fertilizer application to professionals and farmers. CSSFS offers summer training of soil surveys every year to undergraduate and graduate students in Taiwan. During the COVID pandemics, CSFFS is still actively seeking ways to connect with its members and maintain interactions among domestic and international soil scientists. Through its activities, CSSFS continues to serve for supporting soil science education to meet the future challenges of soil sustainability and food safety.

ORAL SESSIONS

ORAL SESSION 1
Paddy Soils



OS1-1
Determination of the Amount and Dynamics of Fractionated Organic Matter and Elucidation of Their Controlling Factors in Malaysian Paddy Soils

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Abstract

Depletion of SOM has become a problem especially in peat paddy soils and methods to alleviate it are needed. The objectives of this study were to evaluate the amount and average residence time of physically and chemically fractionated SOM, elucidate its determining factors, and propose rational and sustainable soil management methods for SOM conservation. A total of 40 soil samples, i.e., 13 peaty soils, 17 non-peat soils (west), and 10 non-peat soils (east), were collected from the surface layer of rice paddies in peninsular Malaysia. After particle size fractionation of air-dried soil (≤2 mm) at 53 μm, the coarse-grained fraction was divided into a light fraction (LF) and a heavy fraction (HF) according to specific gravity (1.8 g cm^{-3}) and the fine-grained fraction into a sodium hypochlorite (NaClO) readily degradable fraction (OxF) and a NaClO persistent fraction (NOxF). The carbon content of the four fractions was determined. Mean residence time of some samples was estimated by radiocarbon (^{14}C) dating. Determining factors of the amounts of fractionated C were investigated by stepwise multiple regression analysis using selected physicochemical properties of the soils. The carbon content of all 40 Malaysian paddy soils averaged 26.5 g/kg, with LF 4.0, HF 2.5, OxF 10.1, and NOxF 10.0 g/kg in fractions, accounting for 15, 10, 38, and 37 %, respectively. Thus, the fine-grained fraction contributed to a greater extent to carbon accumulation. The $\Delta^{14}C$ concentrations were -3.8~27.2‰ for peat, -43.3~120.3‰ for non-peat (west), and 14.1~65.9‰ for non-peat (east), suggesting that agricultural patterns in these three types affected the average residence time of fractionated organic carbon. The residence time of NOxF in the fractional fraction was longer than that of the HF and fine-grained fractions, confirming that this fraction contributes significantly to carbon sequestration. Furthermore, NOxF and OxF carbon in peat soils increased with increasing amorphous and humic complex aluminium content, while NOxF and OxF carbon in non-peat soils (west and east) increased with decreasing sand content and amorphous iron. In conclusion, soil management practices that increase amorphous and humus complex aluminium in peat soils and fine-grained fraction in non-peat soils would be necessary to maintain and enhance SOM in the fine-grained fraction (NOxF and OxF) in paddy soils in Malaysia.

Keywords: *Malaysia; mean residence time; paddy soil; sequestration; soil organic carbon*

OS1-2
Ammonia Volatilization in Rice Growing Alfisol Following Addition of Rice Husk Biochar under Two Moisture Regimes

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Abstract

Nitrogen loss as ammonia volatilization (AV) in paddy growing soils could contribute to low use efficiency of fertilizer urea. There is only little information available on this aspect under Sri Lankan conditions. Therefore, the effect of the addition of rice husk biochar (RHB) on AV loss in rice growing soils under flooded or saturated conditions was investigated.
The RHB was prepared at 330 -560 °C temperature using a downdraft double chamber pyrolyzer. Four treatment combinations consisted of two levels of RHB (0%, 2% w/w) and two levels of urea (0, 35 kg N/ha). The treatments were tested under saturated and flooded conditions for 9 days. Ammonia volatilized was trapped into boric acid using a dynamic chamber. pH, NH_4^+ and NO_3^- concentrations in pore water collected through RhizoneFlex® were measured during this period. In addition, urease activity and pH buffer capacities of the soils at the end of the experiment were also measured. In general AV losses were very small under the experimental conditions used in this study and it varied from 0 to 4% of added urea. Under saturated conditions AV was significant ($p<0.05$) in urea added treatments (15-23.5 g N/ha/hr) during the second and third days after fertilization (DAF) but was not influenced by biochar application. Under flooded conditions soil with urea only added treatment showed a significantly high AV ($p<0.05$) at the second day (11.6 g N/ha/hr) while other treatments did not show any significant AV. Low AV in urea added treatments, in comparison to other studies, could be due to relatively low urea application rate used, which limits the NH_4^+ ion concentration in the pore water, and the pore water pH was at near neutral level that retarded the NH_4^+ dissociation in water. The NH_4^+ ion concentration in pore water and the moisture regime were the most influential factors for the AV in this experiment. Pore water NH_4^+ and NO_3^- concentrations under both saturated and flooded conditions varied significantly ($p<0.05$) with time. Analysis of contrasts revealed that, while pore water NH_4^+ concentration was significantly high in urea added treatments under saturated conditions, it was significantly low in biochar added flooded treatments compared to their counterparts. Irrespective of the water regime and urea level, the pH buffer capacity was significantly high (8%) and urease activity was low (17%) in biochar added treatments. Although AV was induced after urea application, this small AV loss (<4%) could be further reduced by amending rice growing Alfisol with rice husk biochar and inundating the soil for a few days after urea application.

Keywords**:** *ammonia volatilization; rice husk biochar; rice; pH buffer capacity; urease activity*

OS1-3

Full Dike System Induced Changes In Soil Physico-Chemical Properties And Farmer Income In Paddy Flooding Regions Of The Mekong River Basin, Vietnam

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Abstract

Flood is a natural process of water flow that occurs annually in the upstream parts of the Vietnamese Mekong river basin and supplies alluvial material and nutrients to soil, which relatively increases rice productivity. Paddy-rice cultivation during the flood season has been made possible by implementing high-dike flood defense and flood control structures. However, the high dike system may affect soil physicochemical properties. The study was carried out with the aim of assessing the soil physicochemical properties inside and outside the dike flood control system of the acid sulphate soil of the Mekong Delta, Vietnam. The number of samples randomly collected was 64 samples corresponding to 64 rice fields, which included 32 samples inside the dike (3 rice crop per year) and 32 samples outside the dike (2 rice crop per year) and the data was collected for two years. The results showed that cultivation of three rice crops per year inside the dike caused the soil pH to be lower than the soil pH outside the dike while the EC of the soil inside the dike was higher than the EC of the soil outside the dike. The organic matter content of topsoil horizon (Ap) of soils inside the dike was higher than that in soils outside the dike. As a result, the cation exchange capacity (CEC) and total nitrogen content of the soil inside the dike was higher than that in soils outside the dike, especially in the surface layer (Ap). In contrast, soils located outside the dike showed greater available soil micronutrients. Meanwhile, total phosphorus and total potassium content did not show any significant statistical difference in soils between the inside and outside the dike. Soil compaction of the Bg horizon was higher in soil inside the dike compared to outside the dike, as indicated by its low soil porosity and soil permeability; and high bulk density and soil penetration resistance. Furthermore, the farmers with fields located outside the dike showed a greater income on average than those whose fields are inside the dike. We concluded that the dike construction in the upstream regions of the Vietnamese Mekong Delta had negative impacts on the soil physicochemical properties, which was reflected by a decrease in farmers' income. Therefore, we propose the integrated cultivation techniques to be implemented to improve the fertility of soils inside the dike.

Keywords: *acid sulfate soil; dike; soil fertility; paddy; Mekong delta.*

OS1-4
Impact of Ammonium Sulfate on Significantly Reducing Ammonia Volatilization from a Rice Paddy Soil as Compared to Urea: Two-year field studies

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Abstract

One of the important nitrogen (N) losses from rice paddies is ammonia (NH_3) volatilization, which leads to low crop yield, deteriorates N use efficiency, and worsen environmental air quality. In general, ammonium sulfate can lower the soil and surface water pH in rice paddy soils, which possibly decrease NH_3 volatilization as compared to urea. However, the effects of ammonium sulfate application on mitigating NH_3 volatilization still remain unclear. The field trial was carried out to investigate NH_3 volatilization in rice paddy soils under different types of N fertilizers such as urea [$(NH_2)_2CO$] and ammonium sulfate [$(NH_4)_2SO_4$] at a rate of 0 (PK, control), 45, 90, and 180 kg N ha^{-1} before the rice transplanting. Biochemical properties (extractable NH_4^+-N in soils and pH, EC (Electrical conductivity) in irrigation water) were monitored during whole rice cultivation. Our result showed that application of both N fertilizers significantly increased the amount of NH_3 volatilization as compared to control. Irrespective of types of fertilizers, NH_3volatilization rates largely increased with increasing N application levels. Ammonium sulfate incorporation significantly reduced NH_3 volatilization, showing approximately 5 times lower emissions than the urea application. In particular, ammonium sulfate addition significantly decreased pH in irrigation water mainly at the initial rice cultivation season, but adversely increased EC in the paddy water. Soil extractable NH_4^+-N contents were higher in ammonium sulfate added soils than the urea applied treatments. Our result showed that more soil NH_4^+-N could be released in ammonium sulfate treatment, but NH_3 volatilization was less due to maintaining low pH condition in the surface water, showing effective reduction of NH_3 emissions. In conclusion, ammonium sulfate application could be a better way to effectively mitigate NH_3 volatilization in rice paddies than the urea. However, other greenhouse gas emissions should be simultaneously monitored with ammonia emissions after the amendment of ammonium sulfate to evaluate overall environmental impacts in the rice paddies.

Keywords: *ammonia, ammonium sulfate, NH_3, nitrogen, paddy, urea, volatilization*

OS1-5
Chemical Composition of Soil Organic Carbon in Paddy Soils under Tropics

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Abstract

The objectives of this study were to determine the chemical composition of soil organic carbon (SOC) in rice cultivation, and to compare the SOC chemical structure between lowland and upland paddy fields in tropical areas. Topsoil samples (Apg horizon) were collected from six locations in Thailand's lowland and upland rice cultivation, and the four regions of SOC chemical composition (carbonyl C, aromatic C, O-alkyl C, and alkyl C) were investigated using solid-state ^{13}C Nuclear Magnetic Resonance Spectroscopy (NMR). The result showed that O-alkyl C regions were the dominant functional groups in SOC in all lowland (27.16% ± 3.01) and upland (27.05% ± 0.33) paddy fields. There were significant O-alkyl C and alkyl-C (13.41% ± 4.56 and 8.50% ± 0.38) regions between lowland and upland paddy soil but no significant differences between upland and lowland rice cultivation in carbonyl C (8.56% ± 1.39 and 9.71% ± 0.30) and aromatic C (18.55% ± 1.25 and 20.01% ± 1.46) regions. Moreover, there was a significant degree of humification (alkyl C/O-alkyl C) between the two site soil samples. This suggests that SOC chemical composition provides important information for soil management and the environment in tropical regions to increase plant productivity and mitigate climate change.

Keywords: *soil organic carbon; paddy soil; ^{13}C NMR; tropical soil*

OS1-6
Impacts of Alternative Paddy Rice Irrigation on the Physical and Physiological Characteristics of Rice Plant

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Abstract

Rice is commonly grown in flooded paddy fields which utilizes vast amounts of water. The present study investigated the use of alternate wetting and drying (AWD) and mid-season drainage (MD) as alternative irrigation methods to the conventional continuous flooding (CF) to reduce water use in rice cultivation. Currently, these water management systems are still not practiced in Malaysia, hence the effect of physical, physiological and yield of rice is unknown. The research was conducted at Ladang 15, Faculty of Agriculture, Universiti Putra Malaysia under a rain shelter. *Oryza sativa* cv. MR297 was cultivated for one cycle (110 days/cycle) by transplanting germinated seedlings into 15 cylindrical tanks. Five tanks were each assigned to the continuous flooding (CF), mid-season drainage (MD) and alternate wetting and drying (AWD) treatments. Soil used in the study was obtained from paddy fields in the district of Pendang in the state of Kedah. Measurements of plant height and leaf greenness (SPAD-502 Chlorophyll Meter, Konica Minolta Inc.) were made weekly from the second week to the 13th week after transplant, while the number of tillers was measured from second week to the 9th week after transplant. Leaf photosynthetic rates were measured on the 5th and 12th week after transplant using a portable photosynthesis system (LI-6800, LI-COR Biosciences Inc.). Rice yields were calculated by measuring grain yield, 1000-grain weight, filled spikelet and number of panicles after harvesting. All measurements were compared between the treatments using ANOVA at $\alpha = 0.05$ for each week the measurements were made. The parameters showed no significant difference ($P<0.05$) between rice subjected to CF, MD and AWD. The result showed that alternative irrigation systems can be effective strategies to minimize water usage while maintaining grain yield of rice production in Malaysia. AWD and MD did not affect the physical, physiological and rice yield of rice plants.

Keywords: *paddy soil; methane emission; irrigation*

ORAL SESSION 2
Land Use and Climate Change

OS2-1
Evaluating the Land Application of Biochar on Carbon Dynamic, Based on the Chemical Properties of Soils from Acidic Soils of Southern vs. Calcareous Soils of Northern Guam

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Abstract

The conversion of natural land conditions to agricultural ecosystems in the tropical island of Guam have caused a depletion of up to 75% of soil organic carbon and the CO_2 is being emitted into the atmosphere. A larger portion of soil carbon can be stored in the soil via land-based management and by carbon sequestration practices. We are evaluating the effect of 'biochar' not only as a soil amendment to improve soil health but also as a management strategy for enhancing the carbon storage capacity. The application of 'biochar', which consists of 60% to 90% carbon, and could potentially reduce CO_2 emission from the soil into the atmosphere. However, the inherent chemical properties of the different soils may be the main factor in determining whether land application of 'biochar' can be a soil carbon sequester or not. Field experiments were established at the University of Guam (UOG) research stations in southern as well as in northern Guam to evaluate the effects of 'biochar' on carbon sequestration on both regions with different soil chemistry. The soils of southern Guam are extremely acidic with average pH of 5.4 while the soils of northern Guam are of calcareous nature with pH of 7.5 and higher. In the northern Guam the following treatments were applied in study plots with four replications of each: 1) control (0 tons/acre); 2) compost (60 tons/acre); 3) biochar (15 tons/acre); and 4) mixed (mixture of 60 tons/acre compost and 15 tons/acre biochar). Corn (*Zea mays*) was planted in each treatment plot to evaluate the effects of mentioned treatments. In Southern Guam however, study plots were under long-term conservation practices where four different tillage techniques are being implemented and monitored for the last 18 years. These practices consist of: 1) no-till; 2) reduced till; 3) conventional till; and 4) conventional till in rotation with a legume crop' (sunn hemp). Each plot then, is divided into two equal sections in which, one section received 'biochar' application as a soil amendment and the other section did not. Up-to-date data have shown that there were no significant differences between treatments and control with CO_2 efflux on northern Guam soils. However, there were significant differences between the 'biochar' treated sections of each plot and the 'non-biochar' sections for CO_2 efflux from the soils in southern regions of Guam. At the UOG Research Station of the northern region however, data showed that plots treated with 'compost' had the highest CO_2 efflux compared to the plots treated with 'fertilizer' and 'compost/biochar mixed'. On the other hand, the plots receiving 'biochar only', had the lowest CO_2 efflux followed by the 'control'. However, plots treated with 'compost only' and the 'compost/biochar mix' showed higher CO_2 efflux than the plots treated with 'biochar'. Data obtained from our research works so far, has shown that the soil chemical properties may be a factor influencing the effect of 'biochar' on soil carbon dynamic.

***Keywords**: soil carbon dynamics; biochar, CO_2 emission; carbon sequestration; Guam soils.*

OS2-2
Life Cycle Assessment of Biochar Utilization on Global Warming in Rice Cropping System

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Abstract

Biochar and compost were accepted as stable organic amendments to increase soil C stock as well as to decrease greenhouse gas (GHG) emissions in rice paddy soils. However, in most studies, their effects on GHG flux were evaluated only within the cropping boundary without considering industrial processes. To evaluate the net effect of utilizing these organic amendments on global warming within the whole rice cropping system boundary from industrial to cropping processes, an estimation via life cycle assessment was done. Fresh, compost, and biochar manures were selected as main treatments applied at a rate of 12 Mg ha^{-1} (dry weight) in a rice paddy and total GHG fluxes were evaluated using closed chamber method. Compared with fresh manure, compost utilization decreased net global warming potential (GWP) which refers to the integrated GHG fluxes and soil C stock changes in CO_2 equivalent by 43% within rice cropping boundary, via a 25% decrease in CH_4 flux and 39% increase in soil C stock. However, 34 Mg CO_2-eq. of GHGs were additionally emitted during composting to make 12 Mg of compost and then increased the net GWP by 34% within the whole system boundary. In comparison, biochar turned paddy soil into a GHG sink, via 56% decrease of CH_4 flux and 13% increase of soil C stock. However, the pyrolysis process emitted a total of 19 Mg CO_2-eq. of GHGs to produce 12 Mg of biochar. As a result, biochar utilization decreased net GWP by approximately 28% over fresh manure within the whole system boundary. Rice grain productivity was not different between biochar and compost manures, while compost considerably increased grain yield over fresh manure. Consequently, biochar utilization significantly decreased GHG intensity which indicates net GWP per grain yield by 33% over fresh manure, while compost increased by 22%. In conclusion, biochar could be a sustainable organic amendment to functionally reduce the global warming impact of rice paddy; however, compost utilization needs careful consideration mainly due to its huge additional GHG emissions during the composting process.

Keywords**:** *manure; greenhouse gas; net global warming potential; pyrolysis; soil organic carbon*

OS2-3
Organic Amendment Management in Rice Paddy: Grand Challenges and Golden Opportunities under Global Warming

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Abstract

Periodical application of organic amendments has been strongly suggested to improve soil quality and sequestrate atmospheric carbon dioxide (CO_2) in rice paddies. However, organic amendments significantly increase the emission of methane (CH_4) which has 28 times greater global warming potential (GWP) than CO_2 for 100 years, and then we faced an inevitable dilemma to organic amendment management in flooded rice fields. Here, we compared the influence of organic amendments on net GWP which combined two greenhouse gas (GHG) fluxes (CH_4 and N_2O) and soil carbon (C) stock changes with CO_2 equivalent in a typical rice cropping field. Finally, we tried to find a way of organic amendment management that can decrease global warming impact in rice paddies. Most organic amendments highly increased annual CH_4 fluxes by around 2-5 times (14.0-27.6 Mg CO_2-eq) over 7.1 Mg CO_2-eq. ha^{-1} in no organic matter addition (NPK). An average 2.1 Mg CO_2-eq. ha^{-1} of soil C stock was annually depleted in the NPK treatment, but most organic amendments except for biochar increased annual soil C stock by approximately 3.7-9.3 Mg CO_2-eq. ha^{-1}. However, this small increase of soil C stock did not contribute to decreasing net GWP. However, biochar showed strong potential to decrease net GWP in rice paddies, due to less CH_4 emission (15.9 Mg CO_2-eq. ha^{-1} $year^{-1}$) and higher soil C stock increase (19.0 Mg CO_2-eq. ha^{-1} $year^{-1}$). Our investigations suggest that most organic amendments except for biochar may have a negative impact on mitigating global warming in the flooded rice cropping system. To address this, we need to develop an organic amendment management technology to reduce net global warming potential in rice paddy.

Keywords**:** *methane; net global warming potential; soil carbon sequestration; nitrous oxide; net ecosystem carbon budget*

OS2-4
Effect of Silicate Fertilization on Rice Production Under Future Climate Conditions

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Abstract

Global climate change aggravates a variety of impacts on rice production due to an increase in temperature and atmospheric CO_2 concentration. These changes improve photosynthesis and increase rice biomass yield. However, it also reduces grain productivity, lower grain quality, and increases disease severity thus posing a threat to food security in the future. Silicate fertilizer contains high contents of silicate compounds, and silicon (Si) is accepted as a beneficial element for rice plant growth. Rice plants accumulate SiO_2 by over 10% of their biomass. This SiO_2 is known to increase the rice plant's erectness, and photosynthetic capacity enhances cell rigidity, decreases lodging damage, and increases rice productivity. However, no study investigated the effect of silicate fertilizer on rice productivity under future climatic conditions. We hypothesized that silicate fertilizer improves rice productivity under global warming conditions. To validate these claims, control (no amendment) and silicate fertilizer were installed as the main treatment in a flooded pot experiment, and two climatic conditions (future and present environment) were installed as sub treatments. The future climatic condition (+200ppm CO_2 and +2°C of the present condition) was done via the installation of an Open Top Chamber (OTC). Silicate fertilizer was applied at the rate of 1.5Mg ha^{-1}. Rice plants (Ilmi) cultivar (Oryza sativa, Japonica type) were selected, pots were arranged in a randomized completely block design, and each treatment was replicated three times. Results revealed that global warming decreased rice yield while increasing straw biomass. In the present environment, silicate fertilizer increased grain yield by 12% and straw biomass by 19% over no amendment. However, under future climate conditions, silicate fertilizer increased rice yield by 18% and straw biomass by 15% over the present environment. The application of silicate fertilizer under a global warming environment also showed higher SiO_2 uptake by 49% due to a higher transpiration rate, and higher leaf chlorophyll content (SPAD value) by 16% over the present environment. Therefore, in future climate conditions, silicate fertilizer is effective in improving rice productivity and soil quality.

Keywords**:** *silicate fertilizer; global warming; rice; soil amendment*

OS2-5
Impact of Land Use on Phosphorus and Carbon Status of Tropical Ultisols

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Abstract

This study investigated the impact of land use for annual and perennial crops on the soil carbon and phosphorus status of tropical ultisols. Surface (0-15 cm) soil samples were obtained from forest, tea, and intensive vegetable cultivated land uses within a sub-catchment of Sri Lanka. Samples were analyzed for available P, organic carbon (OC%), permanganate oxidizable carbon (POXC), pH, and electrical conductivity (EC). Significantly higher ($p<0.05$) concentration of P (mg/kg) was observed in vegetable cultivated soils (356.3) compared to the tea (33.0) and forest (4.6) soils. The OC contents (%) were higher in forest (6.05) compared to tea (5.84) and intensive vegetable cultivation (4.50). However, POXC value (mg/kg) was higher in tea (899.4) compared to forest (803.8) and vegetable cultivated (483.6) soils. Acidic pH was observed in forest (4.70) and tea growing soils (4.72), typical of ultisols. However, frequent liming has increased the pH of the vegetable cultivated soils to near neutral range (6.6). Moreover, significantly higher EC (µS/cm) was observed in vegetable grown soils (130.7) compared to tea (58.2) and forest (39.7) soils. This study indicated that excessive application of organic and synthetic fertilizers has increased the soil P levels to high levels. Despite this, a net reduction of soil OC status was evident in vegetable grown soils due to the enhanced rate of decomposition favored by routine land preparation. Implementation of sustainable soil management practices are important to minimize land degradation, environmental pollution and enhance C sequestration of the tropical Ultisol.

Keywords: *land use change, soil carbon, soil phosphorus*

OS2-6
Combined Organic and Inorganic Fertilizations Simultaneously Mitigate Greenhouse Gas Emissions and Ammonia Volatilization in Arable Upland Soils during Maize and Cabbage Cultivation

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Abstract

Excessive nitrogen (N) fertilization might lead to increased ammonia (NH_3) and greenhouse gases emissions (GHGs), requiring rational fertilization strategies for a better environment. Organic fertilizer such as compost can improve soil cation exchangeable capacity (CEC), reduce N losses resulting in increased crop productivity and mitigate GHG emissions. However, the effects of combined incorporation of organic and inorganic fertilizers on mitigating GHGs and NH_3 emissions and enhancing soil productivity remains unclear. In this study, NH_3 and GHGs emissions were monitored by closed chamber method during maize and cabbage cultivation periods, and GHG intensity (GHGI), soil properties, and productivity were investigated after the harvesting. Four different treatments were set up with an equivalent N rate except control (no fertilizer) which were: NPK (sole inorganic fertilizer), compost (sole compost), NPK+compost (inorganic fertilizer and compost, 50%:50%). Total NH_3 emissions were significantly increased with overall fertilizations as compared to the control. Combined applications of both organic and inorganic fertilizers significantly reduced NH_3 volatilization during cultivation even though the same amount of N was incorporated in all treatments except the control. Compost, NPK+compost applications reduced N_2O emissions by ca. 54-60% compared to NPK treatment. There were no significant differences in other greenhouse gas (CO_2 and CH_4) emissions between the treatments. Maize and cabbage yield was significantly improved with N fertilizations but showed highest at sole NPK treatment, revealing no significant difference with NPK+compost. These results showed that combined applications improved overall soil quality including soil physical (bulk density), chemical (organic C and CEC increase), and biological properties (microbial abundance and diversity), which could lead to reduced N losses and increased crop productivity in upland soils. The GHGI, a sustainable index, was the lowest in the NPK+compost during whole cropping seasons, though there were few differences depending on the location of the upland field. Conclusively, combined applications of inorganic and organic fertilizers could be a promising and sustainable way for alleviating reactive N losses, greenhouse gas emissions, and for enhancing soil productivity and soil quality in arable soils.

***Keywords**: ammonia; combined application; greenhouse gases; upland soil*

ORAL SESSION 3

Soil Fertility and Plant Nutrition

OS3-1
Standing Biomass, Dry-Matter Production and Nutrient Demand of Tenera Oil Palm

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Abstract

Recent advances in oil-palm breeding and agronomic practices may have influenced the dry-matter production and nutrient demand of tenera oil palm since the last comprehensive studies published some three decades ago. This has raised concerns, since updated knowledge of nutrient requirements at various stages of oil palm growth is essential for formulating fertilizer recommendations that meet agronomic, economic, and environmental objectives. We therefore filled in this knowledge gap with the objective to quantify the standing biomass, dry-matter production, and nutrient demand of tenera oil palm of different ages, grown under current agronomic practices. Tenera palms were sampled at 12, 29, 48, 88, 133, 209, and 238 months since nursery planting and separated into spear leaves, leaflets, rachis, petiole, leaf bases, cabbage, trunk, bole, and roots attached to bole for determination of dry weights and nutrient contents. Fruit bunches were harvested, with dry weights and nutrient contents of ripe bunches determined. Annual dry-matter production was calculated from dry weights of different plant parts, and together with nutrient concentrations determined in these plant parts and fruit bunches, annual nutrient demand was calculated. Excluding roots, the total standing vegetative biomass increased almost linearly from 1.3 kg palm^{-1} at 12 months old to 808.6 kg palm^{-1} at 238 months old. Whole-palm dry-matter production increased with palm age but at a decreasing rate, from 1.5 kg palm^{-1}year^{-1} at 12 months old to 285.5 kg palm^{-1} year^{-1} after 133 months, with little increase thereafter. The maximum rates of nutrient demand occurred after 209 months, coinciding with peak production of fruit bunches–except for K, which occurred at month 88 when vegetative growth demand for K peaked. Annual gross amounts of nutrients required to produce 25 t fresh fruit bunches ha^{-1} were 1.99 kg N, 0.28 kg P, 3.94 kg K, 0.42 kg Mg, 0.99 kg Ca, and 2.5 g B per palm. The net amounts of nutrients required to meet similar production levels of fruit bunches were 1.04 kg N, 0.16 kg P, 1.85 kg K, 0.26 kg Mg, 0.47 kg Ca, and 1.3 g B per palm per year if all nutrients contained in the pruned leaves were recycled. These results provide much-needed updated data on the dry-matter production and nutrient demand of tenera oil palm grown under current agronomic practices and also serve as a general yardstick for practitioners to further refine fertilizer recommendations.

Keywords: *Tenera; biomass; tree parts; nutrient concentration; nutrient partitioning*

OS3-2
Preliminary Assessment of Soil and Litter Carbon Stocks of *Shorea roxburghii* G. Don in Segamat, Johor, Malaysia

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Abstract

An undisturbed tropical forest area accumulates more carbon stocks in the living biomass and soil. Southeast Asia's natural forests typically store more carbon, with the capacity to accumulate up to 500 Mg C ha^{-1} and the ability to absorb up to 3 Gt CO_2 yr^{-1}. Our aim is to quantify the prospective C sequestration potential of planted forests in chosen Forest Research Institute of Malaysia (FRIM) Research Stations under the 12th Malaysian Plan. This research aims to determine the early soil carbon sequestration potential of *Shorea roxburghii* at Segamat, Johor, Malaysia. The research was carried out at Segamat, Johor, Malaysia with temperatures typically varying from 22.2°C to 33.3°C with an annual rainfall of 1955.0 mm. *Shorea roxburghii* was planted in the years 2004 (1.95 ha), 2018 (1.53 ha) and 2020 (3.68 ha) respectively. Soil samples were collected in triplicates to obtain 1 composite sample at 0-30 cm depth. Leaf litter on the soil surface was collected using a 50 x 50 cm frame in three replicates to obtain 1 composite sample. Furthermore, the results of the bulk density value for the year 2004 were relatively lower (1.295 g cm^{-3}) compared with the year 2020 which recorded a value of 1.370 g cm^{-3}. Studies showed that the range of bulk density for *S. roxburghii* ranged from 1.19 to 1.54 g cm^{-3}, concurring with our studies. Litter C stocks were similar in the year 2018 (7.06 tC ha^{-1}) and 2020 (7.35 tC ha^{-1}) plots. However, the value was the lowest in the 2004 (6.32 tC ha^{-1}) plot due to the maturity of the trees and the requirement of C input is lower compared to the trees in the early stage years 2008 and 2020. The soil carbon stocks were similar in the years 2004 (41.51 tC ha^{-1}) and 2020 (45.23 tC ha^{-1}) but the least in the year 2018 with 32.69 tC ha^{-1}. The higher values of C stocks is probably due to high C: N values that allow enrichment of soil C via the accumulation of organic matter such as litterfall. However, the lower soil C stock values indicated the land preparation practices in the year 2018. In conclusion, *Shorea roxburghii* is considered a fast-growing species that can be used for rehabilitation purposes as it is able to contribute to soil and litter carbon stocks. Future research should include the estimation of all the carbon pools that contribute to the carbon reservoir of forest.

Keywords**:** *carbon storage; indigenous species; soil properties; planted forests*

OS3-3
Preparation and Characterisation of Nanoemulsion Fertilisers and Their Effects on Vegetative Growth, Yield and Fruit Quality of Rockmelon (*Cucumis Melo. L.*)

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Abstract

The objectives of this study were (i) to synthesise and characterise nanofertiliser via emulsion high energy technique, (ii) to assess effects of nanoemulsion fertilisers on vegetative growth, yield and fruit quality of rockmelon (*Cucumis melo. L.)*. The nanofertiliser formulations (NF3) showed better properties in thermal stability compared to other formulations (NF1 and NF2). The NF3 formulation significantly affected the particle size (90.32 nm), polydispersity index (0.156), zeta potential (39.8 mV), surface tension (42 mNm^{-1}) and viscosity (100.46 mPa s^{-1}). Statistical analysis showed that NF3 formulation at low concentration significantly enhanced the growth of rockmelon plants by ?? percent? in pot experiments compared with control. The LC_{50} values were calculated with 50% seed germination at 31.39 % of NF3 and classified as non-toxic. Higher chlorophyll index values, germination percentage, hypocotyl length, fresh and dry weights, plant height and seedling vigour index were recorded in 0.5 % NF3 formulation. Therefore, 0.5 % NF3 formulation was selected to be tested under field condition. The foliar application frequency of NF# formulation showed a significant increase in vegetative growth, such as plant height, stem diameter, leaf area, chlorophyll content and dried leaves/stem biomass ($p \leq 0.05$) compared to control. Hence, the foliar application of NF3 formulation with AB fertiliser fertigation significantly enhanced the growth development of rockmelon. The fruit weight, fruit diameter, flesh thickness, fruit perimeter and Brix value were significantly ($p \leq 0.05$) increased by 2.92 kg, 17.94 cm, 3.74 cm, 57.69 cm and 9.4 respectively, with split application of NF3 formulation. Thus, four split applications of NF3 formulation could be one of the potential additional foliar applications with AB fertigation in the future.

Keywords**:** *nanotechnology; nanofertiliser; emulsion;foliar application; rockmelon (Cucumis melo. L)*

OS3-4
Effect of Empty Fruit Bunch (EFB) Washing Water as Liquid Fertilizer on Nutrient Recycling Management in Oil Palm Plantation Field

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Abstract

Increased production of oil palm has resulted in a large amount of waste generated; one of which is empty fruit bunch (EFB). EFB can be a serious environmental problem if not managed properly, such as water pollution or air pollution when burnt. At present, one method to reduce the EFB amount is by converting the EFB fiber into carbon neutral biofuel. During the process of this biofuel conversion, a significant amount of potassium (K) is recovered in the washing water. This study aimed to utilize EFB washing water for liquid fertilizer, especially potassium and other plant nutrients which can contribute to nutrient recycling in palm oil plantations. In Malaysia, we conducted joint research with Universiti Putra Malaysia in an oil palm to field test the EFB washing water. We used the soils in the plantation field and EFB washing water from the biofuel production factory in Malaysia for a few studies The incubation experiment was conducted to investigate the effect of EFB washing water along soil profile and the incubation and pot experiment were also conducted to compare the effect of EFB washing water and chemical fertilizer on soil properties, greenhouse gas production and plant growth. Application of EFB washing water increased dissolved organic carbon along soil profile, especially in deeper layers. Furthermore, sequestration of soil organic carbon was observed, suggesting improvement in soil fertility. Combination use of EFB washing water and chemical fertilizer was found to suppress CO_2 emission and nitrification rate. In addition, better plant growth was found when compared with chemical fertilizer. It was suggested that we can use the EFB washing water as a viable liquid fertilizer at the palm oil field.

Keywords**:** *EFB washing water; soil carbon; potassium; greenhouse gases*

OS3-5
Basalt or Mg-rich Synthetic Gypsum as an Alternative Source of Ameliorant to Manage Soil Acidity for Cocoa

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Abstract

The objective of this paper is to elucidate the physico-chemical characteristics of Oxisols as well as to explain the impact of applying ground basalt and Mg-rich synthetic gypsum (MRSG) on their chemical properties and the growth/production of cocoa. In Malaysia, cocoa is partly planted on soils in areas covered by the low pH Oxisols. The soils contain high concentrations of Al^{3+}, Fe^{2+} and Mn^{2+} (with the respective pKa of 5.0, 4.58 and 6.0) in their soil solution. Without alleviating the toxicity caused by the acid metals, cocoa growth and production are reduced or curtailed. If soil pH is raised to the level above the pKa values via agronomic means, the metals are precipitated as inert hydroxide. Normal method of alleviating the acidity/toxicity is ground magnesium limestone (GML) application. Besides increasing soil pH, GML supplies Ca and Mg to fulfill the requirement of cocoa for its healthy growth. Alternative soil ameliorants that can be applied at lower cost are ground basalt and Mg-rich synthetic gypsum. Besides increasing soil pH, negative charge and nutrient contents (Ca, Mg, K, P and S) in the long run, basalt applied on Oxisols adds extra Si into the soil solution. This helps enhance cocoa pod production. MRSG with pH > 7 and containing high amounts of Ca, Mg and S will improve soil fertility via increasing soil pH (that precipitates the above-mentioned acid metals) and adding extra macronutrients. The SO_4^{2-} ions released by MRSG will be adsorbed onto the oxides of Fe in the Oxisols, producing some OH^- (increase pH) with concomitant generation of negative charge. Thus, applying basalt or MRSG on Oxisols would slightly improve their fertility that in the end enhances cocoa growth and/or production.

Keywords**:** *ameliorant; basalt; cocoa; soil fertility; variable charge*

OS3-6
Potassium Availability in Sewage Sludge Compost

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Abstract

Unused biomass resources such as sewage sludge is expected to be used as compost for agriculture. The amount of available potassium (K) is lower in the sewage sludge compost than that animal manure compost although those of available nitrogen and phosphorus are comparable between them. Further, it is unclear how K in the sewage sludge compost is supplied to the plant. This study evaluated the amounts of available K in the sewage sludge composts and determined which K phases in the sewage sludge compost were utilized by the plant. Six sewage sludge composts with different properties and secondary materials were used in this study. The amounts of total, citric-acid (CA) soluble, and water-soluble K in the composts were determined, and then the amounts of exchangeable K were extracted from the gray lowland soil added with the compost at 5 g/kg as compost dried weight. Finally, the plant growth test using Japanese mustard spinach was conducted. The composts were applied to the soil at 100 mg K/kg based on the total K content in the compost. The deficiencies of nitrogen and phosphorus were supplemented with ammonium nitrate and superphosphate. After 28-days of cultivation, shoot fresh weight and nutrient uptake were determined. The amount of exchangeable K in the soil before and after cultivation was also determined. The total K content in the composts ranged from 3.1-7.5 mg/kg, except for a compost. The percentages of water-soluble and CA-soluble K to total K in the composts were 29%-35% (average 34%) and 57%-100% (average 78%), respectively. In the soil amended with the compost, the amount of exchangeable K derived from the compost was higher with the increase in the amount of compost-derived K added, and CA-soluble K in the compost was extracted as exchangeable. Compost K use efficiency ranged from 46% to 80%, similar to or higher than that of the control (potassium chloride: 54%), except for the compost with poor growth. It was estimated that more than 80% of the compost-derived exchangeable K in the soil was utilized by the plant in all but two of the six compost types. These results suggest that although the total K content in the sewage sludge compost is low, its availability is high. CA-soluble K in the compost is extracted as exchangeable K in the soil and is also utilized by the plant with a short-cultivation period. Therefore, it is necessary to evaluate K availability in the sewage sludge compost based on the amount of CA-soluble K.

Keywords: *citric-acid soluble; plant uptake; potassium use efficiency*

ORAL SESSION 4
Soil Ecology and Soil Quality

OS4-1
Growth Response and Yield of Choy Sum Mustard in Vermicompost Amended Potting Media

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Abstract

The growth response and yield of organic choy sum mustard (*Brassica chinensis* var. *parachinensis*) under netted and shaded structures were evaluated using different vermicompost: soil mixture ratios (VC:S, by volume). The vermicompost was formed from *Gliricidia sepium* leaf trimmings, shredded paper, and compost. The experiment was carried out in Serdang, Malaysia, from July 2020 until January 2021. The choy sum mustard was evaluated in six treatments of VC:S, with volume 20:80 (T1), 40:60 (T2), 60:40 (T3), 80:20 (T4), 100:0 (T5) and 0:100 (T6). Liquid organic fertiliser was applied on the control (T6) treatment, while the VC was utilised as organic fertiliser for the rest of the treatments. The variables evaluated were leaf number, plant height, yield, dry weight, plant nutrient content and plant uptake, whereas the quality was evaluated according to the Malaysian Federal Agriculture and Marketing Agency (FAMA) standards. The treatments were arranged in a completely randomised design (CRD) layout with three replications and three cropping cycles. Data were statistically analysed by analysis of variance (ANOVA) and means were separated by Duncan's Multiple Range Test at $p \leq 0.05$. The highest yield, 44.7 g pot^{-1}, was obtained from T4 (80:20 VC:S). In addition, all vermicompost mixed media showed significant differences from control. The leaf number and plant height also showed a significant difference in T1 – T5 treatments compared to control (T6), except in 20:80 VC:S (T1) under plant height parameter. In conclusion, the mixture of vermicompost: soil has improved the yield and other growth parameters of choy sum mustard and yield quality according to FAMA standards.

Keywords: *Gliricidia sepium; vermicast; amendment*

OS4-2
Nematode Diversity in the IADA Barat Laut Paddy Field, Selangor, Malaysia

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Abstract

Nematodes play important roles in the microbially-mediated processes of decomposition and nutrient cycling due to their position in the soil food web. Our study investigated how soil nematode abundance and community structure responded to the paddy rice cropping system, grown under anaerobic soil conditions due to flooding. We examined nematode communities at the land preparing stage of rice. Total nematode abundance and dominant nematode genera were found differently, depending on the sampling area. The dominant genera in the land preparing of the rice phase were the fungi-feeding nematodes group and algae-feeding nematodes which accounted for 39% and 24%, respectively. These were followed by plant-feeding nematodes (17%), predatory nematodes (14%) and bacterial-feeding nematodes (7%). This study suggests that the nematode community structure is different under soil water content and food resources that act as a regulator of nematode community trophic structure in paddy rice systems.

Keywords: *nematode; paddy field; soil ecology*

OS4-3
Nutritional Characteristics of Tea (*Camellia Sinensis*) Planted in the Lowland Area and Their Association with Soil Edaphic Factor

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Abstract

Tea (*Camellia sinensis*) is one of the world's most consumed beverages. Tea is considered an aluminium (Al) hyperaccumulator plant that can adapt to acidic soils. Studies on the beneficial effect of Al on the Al-hyperaccumulators adapted to acid soil were reported by many previous researchers. However, studies on the mineral composition, antioxidant activities among the different clones of tea and the associations of these elements with the physiochemical of soil were less reported. Therefore, the objective of this study was to determine the foliar nutrient concentrations (N, P, K, Ca, Mg, Al and Fe) and antioxidant activities and their relation with the soil physicochemical. The young tea leaves and soil samples were collected from seven different tea clones planted in the lowland BOH Tea plantations at Bukit Cheding, Selangor, Peninsular Malaysia. The concentration of nutrient elements in leaf & soil, total phenolic content, antioxidant activity (DPPH radical scavenging activity and ferric reducing antioxidant power (FRAP)), and other soil properties were determined. We found significant variation in terms of foliar nutrient concentrations particularly K, Mg, Al and antioxidant activities among tea clones. Clone AT53 is considered superior to other clones as it contains high foliar K, Mg, and Al compared to others while Clone 128 exhibited more significant antioxidant activity. The antioxidant activity measured by DPPH radical scavenging activities had a significant association with the foliar K and Al concentrations. Based on principal component analysis (PCA) we found foliar Ca has positive significant association with the elements N, Fe, Al and CEC in the soil. Higher foliar Al concentrations in the tea leaves were found to have less association with the soil edaphic factor which supports the idea that Al is a phylogenetic trait. Understanding the nutritional characteristics of tea leaves, antioxidant activities and soil physicochemical at tea plantations will be useful in managing the tea plantation area in future

***Keywords**: Camellia sinensis; tea; Peninsular Malaysia; antioxidant activities; nutrient concentrations*

OS4-4
Vapor Buoyancy Flux and Its Relationship with other fluxes in the Soil

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Abstract

Fluid mass and heat energy are in constant fluxes in the soil. Two separate partial differential equations govern the fluid mass and heat energy mechanisms by mass and heat conservation equations, respectively. The fluid mass divides into liquid water and water vapor. The presence of water vapor concentrations is assumed instantaneous, and it depends on the concentration of liquid surrounding the soil particle. The current equation governing the vapor flux depends on the vapor concentration gradient, and this mechanism is known as vapor diffusion. Similarly, in the liquid phase, water is subjected to the diffusion process, in addition to the gravity effect pulling water down into soil porous media. While water vapor could be either subjected to gravity or anti-gravity, it could not be neutral to gravity. A simple examination of water vapor molecular weight reveals it is in general lighter than the bulk air molecular weight. Hence, vapor could be buoyant. In the current study, experiments were designed to determine the water vapor buoyancy. The experiments involve designing an instrument capable of segregating vapor diffusion from the potential effect coming from vapor buoyancy. Should only vapor diffusion be present or if vapor diffusion is far more dominant than vapor buoyancy, then the instrument should only indicate the presence of vapor diffusion. Results from our early experiments have shown that vapor buoyancy is present.

Keywords: *vapor movement; vapor buoyant; upward-moving vapor*

OS4-5
Unexpected High Suppression of NH_3 Volatilization Loss Under Plastic Film Mulching in Maize Cropping Land

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Abstract

Plastic film mulching (PFM) has been extensively adopted for promoting crop productivity. It can prevent weed growth, reduce soil water evaporation, and improve soil temperature and moisture content. On the other hand, these improved soil properties can accelerate nutrient mineralization in soil and increase greenhouse gas (GHG) emission. However, the influence of PFM on NH_3 volatilization has not been scientifically investigated. To evaluate the effect of PFM on NH_3 emission loss, plastic film mulching (PFM) and no-mulching were assigned as the main treatments while chemical (NPK) and organic fertilizers were placed. For the NPK treatment, the recommended rate ($N\text{-}P_2O_5\text{-}K_2O$=186-35-74 kg ha^{-1}) was applied on maize. In the organic fertilization, a mixture of barley and hairy vetch was cultivated during the former fallow season and its whole biomass was recycled before maize transplanting. NH_3 gas was collected by a static chamber method. PFM significantly increased soil temperature and water content during the cropping season on average 0.02-0.05 m^3 m^{-3} and 0.8-1.4 ℃ over no-mulching, respectively. These improved soil properties under PFM enhanced maize grain yield by around 95-275 and 85-300% in NPK and organic fertilization plots over no-mulching, respectively. Contrary to our expectation, PFM highly decreased NH_3 emission loss by average 31-45% over no-mulching, respectively. In conclusion, PFM could be a very useful cropping practice to decrease NH_3 emission loss, as well as improve soil properties and crop productivity.

Keywords: *green manure; chemical fertilization; static chamber method*

OS4-6

Influence of Soil Compaction Due to Heavy and Long-term Machinery Usage in Oil Palm Plantation

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Abstract

The aim of this paper is to review the status and acceptance of mechanization in oil palm plantation management. The oil palm industry has adopted mechanization as a panacea for overcoming the issues attributed to unavailability of labour force for carrying out daily estate operations such as harvesting and collection and evacuation of fresh fruit bunches (FFB). However, the frequent use of heavy machinery on the harvesting paths in oil palm plantations have a direct influence on soil compaction which generally affects soil health. Generally, areas that machine passes are mechanical paths, on tyre-track and in-between tyre-tracks. Thus, the influence of soil compaction is only confined within the area where the machine passes. There were studies highlighted on the soil compaction that occurs within the soil depth of 30 cm as a result of an increased soil bulk density over the years of heavy machinery usage. However, it was calculated that only 4% per hectare area was compacted, thus having little effect on the growth and productivity of the oil palm. On the contrary, increased soil compaction due to machinery usage also significantly increased FFB, bunch number and average bunch weight on clay-textured soils (Bernam Series). Frequent use of heavy machinery would generally increase bulk density while reducing total porosity on the affected parts of the paths/soils. With the alteration of soil pores sizes and its distribution, lower infiltration rates are expected to occur in the compacted areas. Thus, the reduction of soil pores and lower infiltration rates contributed towards a high incidence of soil rutting and to some extent water logging in the fields. Continuous application and addition of organic materials such as compost, EFB and cut-fronds had significantly reduced bulk density especially in the areas of inter-palms and inter-row. The soil compaction studies should be carried out and extended to other soil types / series to ensure the impact of heavy machinery had any significance on increase or drop in FFB productions.

Keywords*: soil compaction; machinery; soil pores; FFB; oil palm; infiltration rates; soil series*

ORAL SESSION 5
Soil and Water Management

OS5-1
Simulation of Watershed Management Practices in the Nam Yao Sub-Watershed using SWAT Model Under Climate Variability

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Abstract

Soil and water degradation caused by unappropriated land use utilization is one of the significant problems in Nan Watershed, Thailand, particularly in its sensitivity to upstream catchment. Soil-water conservation practices urgently need to be installed to solve the problem. The reliability of hydrologic modeling, such as the SWAT model, can provide a holistic hydrologic model, including simulated scenarios of appropriate land utilization and best management practices in the watershed. This research uses the SWAT model to select the appropriate land utilization in the Nam Yao sub-watershed for soil and water conservation practices. In the long-term observation of climatological and hydrological historical data from 1997 to 2018, the researchers selected the data for three years for training in the warming period and fifteen years for calibrating, and another four years for validating data. This study employed seven scenarios of watershed management practices: business as usual, reforestation in Watershed Classification (WSC) 1 and 2 area, reforestation in WSC 1 area, parallel terrace, contour farming, combination of reforestation in WSC 1 & 2 and parallel terrace, and combination of reforestation in WSC 1 & 2 and contour farming. The result reveals that the average annual discharge in Nam Yao sub-watershed is 113.8 mm in the wet season and 27.5 mm in the dry season. While average sediment load is 5,287.7 tons in wet season and 468.7 tons in dry season. Nam Yao sub-watershed is dominated by conservation-need areas (WSC 1 & WSC 2). Nevertheless, land use mismatch is increasing 14.5% between 2007 and 2018. Based on monthly-seasonal and yearly average, combination of reforestation in WSC 1 & 2 and parallel terrace give the best result to control flow and sediment compared to the other scenarios. This watershed management practices can reduce flow by 21 mm per year or 2.51% and 796.9 tons of sediment per year or 2.31% in Nam Yao Sub-Watershed.

Keywords: *soil and water conservation; watershed management; SWAT model*

OS5-2
Impact of Water Stress Applied at Different Growth Stages using Different Crop Coefficient (K_C) on Roselle (*Hibiscus sabdariffa* L.) Planted on BRIS soil

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Abstract

Regulated deficit irrigation (RDI) is one of the water stress methods applied to face global water scarcity by applying the water quantities below the crops necessary to satisfy crop evapotranspiration (ET_c) during certain periods of cycle. the objective of the study to assess the RDI effects on Roselle by using crop coefficient (Kc). The experiment was arranged in a randomized complete block design (RCBD) with treatments comprising of four different regimes of irrigation: control (100% full irrigation), ii. 20% RDI (80% irrigation), iii. 40% RDI (60% irrigation) and iv. 60% RDI (40% irrigation) applied at different phenological stages. Parameter evaluations include plant water relations (volumetric soil water content, stem water potential and leaf water potential) and postharvest attributes (fresh and dry weight of individual plant organs, fruit fresh weight, and mineral elements). RDI treated plants had similar values of the above-mentioned parameters with fully irrigation or 100% irrigation plants. In addition, roselle plants experienced moderate water stress (-0.50 MPa to -1.50 MPa) as resulted from plant water relation parameters. The treatment, 60% RDI (40% irrigation) that applied on different crop Kc at different growth stages increased yield as well as water use efficiency and maintained other quality attributes such as fresh weight, dry weight, and some minerals in roselle plant parts. Consequently, the 60% RDI could be the best irrigation scheduling for roselle planted on BRIS soil as it increased water use efficiency, saved 60% irrigation water and, at the same time, enhanced profit for local farmers. The exact amount of water to be applied for roselle plants was 7 m^3/ha or 0.61 L/tree/day. In conclusion, the application of RDI treatments based on different Kc had a potential to increase water use efficiency without adversely affecting the productivity of roselle plants as compared to non-stressed plants.

***Keywords**: regulated deficit irrigation; water use efficiency; sandy soil*

OS5-3
Bentonite: A new potential material as a remedy for sandy soils in Malaysia

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Abstract

Bentonite is a natural deposit consisting mainly of montmorillonite clay mineral. This 2:1 clay mineral is recognized as a very good material for improving sandy soil criteria particularly the clay content which can improve the soil physical and chemical properties and consequently plant growth and crop production. This study highlights its use in Beach Ridges Interspersed with Swales (BRIS) soil as nutrients retention material to solve the problem of low nutrient adsorption in BRIS soil. A series of laboratory scale studies were conducted to characterize the potential of bentonite in improving the BRIS soil physical and chemical properties. Results showed the BRIS soil clay content was 70.83% and the XRD spectra confirmed that montmorillonite was the major mineral detected in the bentonite sample. Meanwhile, the FTIR spectra showed the presence of functional groups including hydroxyl (OH) group in the bentonite which is responsible for binding the nutrients through electrostatic forces. The morphology of bentonite from the SEM micrographs showed that the mineral was porous with the presence of structured clay layers. The surface area of bentonite measured using BET was 4.68 m^2/g. This study revealed that bentonite has the potential to be used as a soil remedy in BRIS soils to improve the soil nutrient adsorbent since the soils are highly porous with low CEC and pH.

Keywords**:** *bentonite; sandy soil; functional groups; surface area*

OS5-4
Grass Hedges and Cover Crops as a Conservation Technique to Reduce Sediment Loss and Surface Runoff on Steep Slope Cultivation Area

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Abstract

Vegetation is the popular conservation technique used widely to reduce soil erosion and optimize slope stability over the world. Grass hedges and cover crops are vegetation which offers a practical and cost-effective way to prevent soil erosion. Therefore, the objective of this study is to evaluate the influence of grass hedges and cover crops systems on surface runoff and soil loss in steep slope cultivation areas. 15 experimental plots (2m length X 1m width) on a 30-degree slope were established at Ladang Puchong, UPM to evaluate sediment loss and surface runoff. The plots with three replications were planted with two types of grass hedges [napier grass (*Pennisetum purpureum*) and vetiver grass (*Chrysopogon zizaniodes*)] and two types of cover crops [mucuna bracteata and cow grass *(Axonopus compressus)*] and one plot of bare soil as control. Soil sediment and water runoff were collected for each precipitation event. The results showed plots with napier grass, vetiver grass, mucuna bracteata, and cow grass reduced soil sediments by 73%, 72%, 72%, and 20%, respectively compared to bare soil plots. Meanwhile for runoff, results showed plots with napier grass, vetiver grass, mucuna bracteata and cow grass reduced soil runoff by 83%, 74%, 80% and 16%, respectively over bare soil plot. Grass hedges and cover crops can be effective alternative conservation techniques for reducing soil sediments and controlling surface runoff on steep slope cultivation areas.

Keywords**:** *hillslope; vetiver grass; napier grass; precipitation; runoff*

OS5-5
Nutrient Supply from Sewage Sludge Compost and Root Development Depending on Soil Moisture and Nutrient Retentions

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Abstract

Sewage sludge can be used as compost for agriculture. The supply of nutrients to the plant from sewage sludge compost and root development may vary depending on the permeability and nutrient retention capacity of the soil. This study conducted the cultivation test using Japanese mustard spinach (komatsuna) and lowland soil mixed with silica sand to understand how the capacity of soil moisture and nutrient retention affects nutrient supply and root development from sewage sludge compost to crops. Gray lowland soil was mixed with silica sand at weight ratios of 75:25, 50:50, and 25:75, and the mixed soils were added with and without the compost at 200 mg-P/kg. Test pots with plant and root compartments were used to divide the lateral root development and plant shoot growth. After 28 days cultivation, plant shoot and lateral roots were collected to determine plant biomass and nutrient absorption. In addition, the soil samples before and after the cultivation were collected to determine the nutrient status.In the soil with the compost, fresh weights of plant shoots were greater with the increases in the ratio of soil mixed. The increased amount of K absorption by the addition of the compost increased with the increases in the ratio of soil mixed compared to other nutrients, and a strong positive linear relationship between plant fresh weight and the K absorption was observed. K use efficiency of compost exceeded 100% in the soil at 75% and 50% of soil mixed, which suggests that K derived from the soil was also utilized. Further, a strong positive linear relationship between the evapotranspiration and K absorption was observed, which suggests that the greater the water migration, the greater the water absorption by the plant and the greater K migration. The increased amount of root by the addition of the compost was lower in the soil with higher ratio of soil mixed, suggesting that the plant can efficiently absorb potassium from the compost without the root development in the soil with high moisture retention. These results suggest that the soil with higher water holding capacity of the soil, the greater the water absorption of the plant, and the greater K absorption, even if lateral root development does not proceed, thereby promoting the plant growth.

Keywords: *lateral root; leaf vegetable; nutrient use efficiency; potassium*

OS5-6
Physical Characteristics of Soil in Dry Land Agriculture in The Ciliwung Hulu Watershed, West Java Province

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Abstract

This study aims to determine the physical characteristics of soil on dry land agriculture in the Ciliwung Hulu watershed, West Java Province and its relation to soil infiltration capacity. This study used a survey method through land surveys and direct observations at the research area, subsequently followed by taking soil samples for soil analysis in the laboratory. The results showed the soil texture was clay, clayey loam, loam and sandy loam. The soil had a very high bulk density, low porosity, and water permeability was moderate to very fast. The physical characteristics of the soil in the Ciliwung watershed can be categorised as bad, so it is necessary to improve the physical properties of the soil.

Keywords: *soil physical properties; soil texture; porosity; permeability*

ORAL SESSION 6
Soil Fertility and Plant Nutrition

OS6-1
Application of Oil Palm Decanter Cake as Soil Ameliorant and Fertiliser Substitute in Oil Palm Nursery

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Abstract

Escalation of by-products produced from crude oil clarification processes in palm oil mills (POM) and stringent environmental protection on its discharge quality has forced the industry player to install more on-line desludging systems such as a decanter machine. Hence, a massive amount of solid waste known as oil palm decanter cake (OPDC) was produced which required a sustainable management approach. Therefore, the objectives of this study were to (i) study the physicochemical properties of OPDC from different POM dumping areas, (ii) study the effect of OPDC application as planting media mixture on oil palm (OP) seedling growth, leaf nutrient status and soil chemical properties. A composite OPDC samples were collected from Sime Darby Merotai oil mill in three different locations namely direct from decanter machine exit silo, OPDC dumping platform and under ex-composting plant roof facility. The results show that OPDC hold high moisture content (>70%), total nitrogen (>2.5%), organic carbon (>40%) and other macronutrients essential for plant growth. Although the above contents are significantly higher ($P<0.05$) in areas with longer retention time, an appropriate rate of fresh OPDC wouldn't cause any harm to the plants due to its stable pH (>5) and low C-N ratio (<25). From this result, a nursery trial was conducted on three months old OP seedlings in Sapong Estate, Sabah. Eight treatments were evaluated using different OPDC and topsoil mixture ratios in the main nursery polybag from 10% (T2) up to 50% (T5 to T8) with multiple levels of nutrients input. The treatments were laid out using Randomised Complete Block Design (RCBD). Seedling height, girth, frond number, rachis length, leaf area and petiole size were measured at 3rd, 6th, 9th and 12th months after sowing (MAS) whereas leaf nutrient level and selected soil chemical properties were evaluated at 12th MAS. Significant improvement ($P<0.05$) on soil chemical properties namely pH, conductivity, organic carbon, and total nitrogen were observed in topsoil treated with OPDC. A minimum of 1:1 OPDC and topsoil mixture ratio suggested a possible reduction of inorganic fertiliser application from 25% up to 100%. Generally, OP seedlings could withstand OPDC application up to 50% mixture ratio with topsoil. Treatment with 50% fertiliser reduction and nil fertiliser input (T7 and T8) was comparable to control (T1) for both growth response and leaf nutrient status after 9 months of growing period. Nevertheless, more nursery trials on different soil types are needed to elucidate the findings of this study.

Keywords**:** *soil amendment; oil palm waste; planting media; fertiliser reduction; soil amelioration*

OS6-2
Detailed Investigation of the Effects of Organic Amendment on the Alleviation of Phosphorus Adsorption in Allophanic and Non-Allophanic Andisols

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Abstract

Organic amendment input is the one of methods for alleviating specific adsorption of phosphorus in Andisols. Formation of aggregates and/or masking of adsorption sites can be the possible reasons, but their contributions are not well understood. The objective of this study was to investigate the effect of such cases on P adsorption in allophanic and non-allophanic Andisols. Allophanic Andisols under the treatments of no fertilizer (NF), chemical fertilizer (CF) and combination of chemical fertilizer and organic amendment (CFOA) were collected from long-term experimental fields in Nagano and Utsunomiya. Non-allophanic Andisol under the treatments of CFOA was also collected in Miyagi, Tohoku. Phosphorus adsorption characteristics were analyzed using Langmuir isotherm for all the samples. For the untreated samples, the maximum adsorption capacity "S_m" of allophanic Andisols ranged from 5.88 to 10.1 g-P kg^{-1}, while that of non-allophanic Andisol was 2.27 g kg^{-1}. S_m significantly increased with the increase in Al_{ox}+1/2Fe_{ox} as an index of the amount of poorly crystalline minerals such as allophane, imogolite or ferrihydrite ($p < 0.001$). S_m of SOM-decomposed allophanic and non-allophanic Andisols increased to 8.09-12.9 and 2.84 g kg^{-1}, respectively, while S_m of disaggregated allophanic Andisols increased to 6.24-10.4 g kg^{-1}, but S_m of disaggregated non-allophanic Andisol was almost unchanged (2.27 g kg^{-1}). Whereas, for the untreated samples, adsorption coefficients "k_a" of allophanic and non-allophanic Andisols were 0.017-0.026 and 0.023 L mg^{-1}, respectively. Those of SOM-decomposed allophanic and non-allophanic Andisols increased to 0.039-0.080 and 0.068 L mg^{-1}, while those of disaggregated samples also increased to 0.019-0.053 and 0.074 L mg^{-1}, respectively. These indicated that decomposition of SOM exposed more P adsorption sites than disaggregation in both allophanic and non-allophanic Andisols, whereas SOM-decomposition and disaggregation contributed to higher affinity for P of allophanic and non-allophanic Andisols, respectively. In conclusion, the alleviating effects on the amount of P adsorption was mainly based on masking adsorption sites by SOM rather than aggregate formation, in both allophanic and non-allophanic Andisols. But those of affinity for P were mainly based on masking in allophanic Andisols and on aggregate formation in non-allophanic Andisol. These results provide a better understanding of how the application of organic amendment can alleviate P adsorption in Andisols.

Keywords: *aggregate; andisols; masking; organic matter; phosphorus adsorption*

OS6-3
Effective Utilization and Influence of Empty Fruit Bunch Washing Water on Soils Properties and Oil Palm Seedlings Growth

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Abstract

Malaysia is the world's second largest palm oil producer with an oil palm planted area of more than 5 million hectares and 451 fresh fruit bunch (FFB) processing mills. The soils in the cultivated areas are mostly highly weathered, leached with low pH and containing low amounts of nutrients needed to sustain oil palm production. As such, high amounts of NPK fertilizers are applied to maintain the productivity of the oil palm in the plantation. Due to the large area under cultivation, high amounts of biomass, especially empty fruit bunches (EFB), are produced in the FFB mills. This EFB can be converted into biofuels through biochemical and thermochemical technologies. However, washing water is discharged during these processes, and it can pose a negative environmental impact if released directly to the waterways. Plant nutrients contents especially potassium K is particularly high in the washing water. Given oil palm trees require a huge amount K to sustain a high production in its economic life cycle, it is possible to recycle this wastewater to the oil palm plantation. Empirical investigation is therefore needed to validate the efficacy of using this material as K supplement in soil for the healthy growth of oil palm. We have conducted a pot experiment in a shadehouse using oil palm seedling to evaluate the performance of washing water against conventional K fertilizer. Among the treatments, we observed that seedlings treated only with washing water were able to sustain the growth of the seedlings as well as improving the K contents in the soils. It was suggested that we can use the EFB washing water as a viable liquid fertilizer at the palm oil field.

Keywords: *EFB washing water; oil palm seedlings; potassium; fertilizers*

OS6-4
Urea Volatilization in an Oil Palm Plantation

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Abstract

Nitrogen is one of the most crucial elements required for oil palm cultivation to sustain high yields especially on soils with low organic matter. Among the common nitrogen sources used are ammonium sulfate, ammonium chloride and urea. Urea has the highest N content and comparatively lower price in terms of cost per unit nutrient. However, application of urea is not often preferred by planters as they have a valid concern of nitrogen loss in the form of volatilization. Among studies conducted on this aspect, most local studies had concentrated on the incubation method or closed chamber method which trapped ammonia gas in a controlled environment. While the results served as a good reference for planters, the volatilization process did not take into account meteorological variables that could ultimately affect the rate of N loss. Here, we deployed Integrated Horizontal Flux (IHF) method (Leuning et al., 1985) in an oil palm field at Lower Perak to assess N loss from urea under field conditions. A mast consisted of samplers coated with oxalic acid and anemometers were installed at different heights; 0.25 m, 0.5 m, 1.0 m, 1.5 m and 2. 0 m after the soil surface after urea application. Monitoring was done over a period of 6 days with sampling conducted daily. Overall, higher N loss was observed in the first 72 hours. Subsequently, a separate laboratory experiment involving the incubation study using soils in the field was carried out to evaluate and compare the results using meteorological approach under field conditions.

Keywords: *urea volatilization; oil palm; Integrated Horizontal Flux*

OS6-5
Effect of Liquid Organic Fertilizer on the Soil Chemical Properties of the Soil Planted with Pak Choy

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Abstract

The objective of this study was to investigate the effects of liquid fertilizer on soil mineral nutrient status. The food waste derived from unmarketable vegetables and fruits were identified and collected from the nearest wet market and incubated in the container with ratio 1:2 (10 kg food waste: 20 L water). The food waste was mixed with 2 types of inducers namely yeast, and shrimp paste with a mass of 1 kg separately on the different containers to boost the fermentation process. The liquid as product from the mixture was sampled and filtered on 60 days of fermentation. The liquid fertilizer was used as treatments in Pak choy cultivation. Each treatment was mixed with 50% NPK fertilizer. The designated fertilizer treatments consist of NPK fertilizer as control (T1), 100% Yeast food waste liquid fertilizer (T2), 50% Yeast food waste liquid fertilizer + 50% NPK (T3), 100% Shrimp Paste food waste liquid fertilizer (T4), 50% Shrimp Paste food waste liquid fertilizer + 50% NPK (T5), The experiments were arranged using a Completely Randomized Design (CRD) with five (5) replications. All these treatments were applied at 14, 19, 24, 29, and 35 days after transplanting (DAT). Soil chemical properties such as pH, EC, CE, soil catalase and urease activity were determined on before and harvest stage. Combination treatment of 60 days 50% Yeast food waste liquid fertilizer + 50% NPK application was shown to give positive results in most of the parameters measured at the harvest stage. The pH, CEC and soil catalase activity were increased by 18.27%, 27.53%, and 11.78% compared to the before harvest stage soil respectively. Therefore, the best method to produce liquid organic fertilizer from food waste is 60 days of fermentation combined with yeast application as an inducer. The combination of this liquid organic fertilizer with NPK fertilizer can increase the soil chemical properties comparable or higher than single NPK fertilizer application. It is sustainable practices that can reduce the uncontrollable disposable of food waste and the use of inorganic fertilizer in Pak Choy cultivation.

Keywords*: food wastes; alternative fertilizers; sustainable agriculture*

OS6-6
Fertiliser Withdrawal Strategy for Oil Palms Prior to Replanting on Riverine Alluvial Soils

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ABSTRACT

The Malaysian oil palm industry has been blessed with favourable crude palm oil prices since the last quarter of 2021 till date. Though favourable prices had been enjoyed since the last quarter of 2021, the industry had also been thrown with numerous challenges amongst them the Covid19 pandemic, acute shortage of labour, shortage and uncertainty of supplies especially fertilisers etc. In the last quarter of 2021, the oil palm industry was taken by surprise with a sudden shortage of fertilisers especially urea leading to an uncertainty where most fertiliser suppliers could not deliver the promised supplies to the plantations in addition to the many fold increase in its prices. These had put pressure on the oil palm agronomists to re-look into their fertiliser programmes and come out with various strategies to cope with the aforementioned scenario. Among such strategies are the withdrawal of fertilisers for palms that are nearing the end of the economic lifespan and to be replanted. In general, fertiliser withdrawal would be practiced between 12 to 18 months prior to replanting as inputs of fertilisers at this period would not provide maximum benefits. To further explore the possibility of withdrawing fertilisers much earlier than 18 months, a trial was conducted on the riverine soils of United Plantations Berhad with 7 treatments among which 100% fertilisers were withdrawn as early as 5 years and as late as 2 years prior to replanting. The study had indicated that it is possible to carry out 100% fertiliser withdrawal as early as 3 years prior to replanting without any significant opportunity losses. The study also indicated that there is also a possibility to carry out 50% fertiliser withdrawal as early as 4 years prior to replanting without any significant opportunity losses.

Keywords: *fertiliser withdrawal; oil palm; replanting*

ORAL SESSION 7
Soil Fertility and Plant Nutrition

OS7-1
The Feasibility Study of Habanero Chilli (*Capsicum chinense*) using Pineapple Leaves Biochar and *Trichoderma* Biofertilizer

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Abstract

Habanero chilli (*Capsicum chinense*) is an important cash crop in Sarawak due to the accelerating food industry business. Habanero chili is a good source of antioxidants, natural colours, and has high nutritional values. However, the application of chemical fertilizers causes negative impacts including soil acidification and mineral depletion in the substrate or soil. In some regions, abundant amounts of pineapple waste are burned or dumped on the ground. *In situ* burning of pineapple wastes is a common practice in the pineapple industry, resulting in pollution of the environment. Hence, this non-commercial value wastes could potentially be produced to become biochar for sustainable agriculture. The use of organic inputs such as biochar and biofertilizer, can reduce or eliminate the negative effects of these synthetic chemicals on human health and environment. Application of biochar could encourage the adsorption of plant nutrient uptake, thus can reduce the reliance on chemical fertilizer usage in a drip irrigation system that may lead to soil or substrate degradation as well as increasing the cost of production. The effects of different combination of pineapple leaves biochar and *Trichoderma* biofertilizer are currently being evaluated on the growth, physiological, yield, and nutritional status of habanero chilli (*Capsicum chinense*) grown under net house with drip irrigation system for a duration of fourteen weeks after treatment (WAT). The preliminary findings suggested the viability of pineapple leaves biochar and *Trichoderma* biofertilizer are able to reduce the reliance on chemical fertilizer.

Keywords: habanero chilli; pineapple leaves; biochar; Trichoderma; biofertilizer

OS7-2
Effects of Salinity and Soil Moisture on Growth and Yield of Beetroot (*Beta vulgaris* L.) Grown on A Silt Loam Soil in The Mekong River Delta, Vietnam

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Abstract

Impact of climate change and salinity intrusion into rivers are important issues for agriculture production in coastal areas in the Mekong River Delta of Vietnam. Crop irrigation based on soil field capacity (FC) can increase water use efficiency in conditions of freshwater scarcity and salt-affected soils. This study aimed to evaluate effects of salinity and soil moisture management on growth and yield of beetroot (*Beta vulgaris* L.) grown on a silt loam soil under net house condition. The experiment was conducted in a completely randomized design with 2 factors including four salinity levels of irrigation water and five levels of soil moisture based on FC. The higher soil moisture can maintain the growth and yield parameters of the beetroot in the context of saline condition. Although soil was watered with saline water of 6‰ and maintaining soil moisture over 50% FC, the beetroot yield was still maintained over 70% of the yield from the treatment of non-saline irrigation. Controlling the amount of irrigation water for the beetroot cultivated on the salt-affected soil can save up to 78% of irrigation water and obtain the high productivity of the beetroot. Findings from the current study suggest that beetroot is a potential crop that can be cultivated in the dry season, under saline and freshwater scarcity conditions.

Keywords**:** *beetroot (Beta vulgaris* L.*), climate change, field capacity, freshwater scarcity and saline intrusion.*

OS7-3
Significant Yield Improvements by Water Management in an Agricultural Commodity on Marginal Soils in Malaysia and Indonesia: A Case Study on Oil Palm (*Elaeis guineensis*)

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Abstract

The objective of this paper is to review and discuss the significant increases in Fresh Fruit Bunch (FFB) yield after the implementation of good water management practices in oil palm *(Elaeis guineensis)*. In Indonesia about 102,80 million ha out of 148 million ha (69.46%) are under acidic nature while there are about 0.5 million ha of acid sulfate soils in Malaysia. In acid sulfate soils, the presence of pyritic and jarosite layers strongly limits the potential for high yield in oil palm. These acid sulfate soils are having major constraints to FFB production in oil palm as these soils are having low bases, cation exchange capacity, water retention, organic matter, water holding capacity and microbial activity. The water-table in the drains is used as an indicator for the water level in the fields. The water-tables in the depth were recorded bi-weekly over a 3-year period from 2019. pH ranging from 2.5 to 3.3 in 2019 increased to a range of 3.5 to 4.1 in 2021 on the study sites of acid sulfate soils in Indonesia. Changes observed in pH, salinity and water levels for the 2019-2021 period gave an indication that significant improvements are taking place for optimizing oil palm yields. Maintaining and controlling of water-table at 45 -60 cm below soil surface has produced a high oil palm yields at commercial scale in many parts of Malaysia and Indonesia. Maintaining water-table below pyritic layer and implementing agro- management practices such as EFB & POME application and inorganic fertilizer application had contributed for a high oil palm yield. Commercial scale FFB yield production ranging from 25 to 35 tonne per hectare per year was obtained on acid sulfate soils in Malaysia and Indonesia. The main purposes of water management on acid sulfate soils are (i) to minimize the effect of flood & high water-table, (ii) to minimize acid toxicity and (iii) to reduce water stress on oil palm especially during dry weather. For monitoring water-level, one water-level marker should be placed at every drain block point. Furthermore, one perforated pipe (piezometer) should be installed for each 250 ha. Dimension of this piezometer should be 200-250 cm long, 7.5 cm diameter and 10 cm above ground. Periodic flushing of the drains is necessary to remove the accumulated toxic polyvalent ions such as Al^{3+} and the extremely acidic water. As a measure against flooding especially on low-lying areas, a bund along the river should be considered by the management. Recommended dimension of bund is 8 meters at base, 5 meter at top and height 4 to 5 meter. This bundle is also motorable, enabling supervision on field condition as well as on bund condition. In order to ensure smooth removal of water during heavy pour, a higher drain intensity of i.e. 1 to 4 or 1 to 2 or every row should be constructed in extreme condition.

Keywords: *pH; salinity; water-table; watergate; oil palm*

OS7-4
Application of soil amendments for sustainable rice production under seawater intrusion in the Mekong River Delta-Vietnam

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Abstract

Seawater intrusion, which is caused by decreased river's water levels and drought, has recently been a challenge for rice production in coastal areas in the Mekong River Delta of Vietnam. This study aimed at using paddy soil for sustainable rice production under seawater intrusion conditions by amending compost, biochar and silicon on soil salinity leaching, changes in soil organic C, greenhouse gas emissions and rice yields. Long-term field experiments were established on alluvial and acid sulfate soils annually affected by seawater intrusion in the dry season. The experiment was laid out in a randomized completely block design with four replicates. Compost from sugarcane filter cake was used at a rate of 5 tons/ha; biochar from rice husk was applied at 20 tons/ha and silicon was applied at 100 kg/ha. The control was managed as a farmer's practice. The experiment has been run through six consecutive crops. In parallel, a column experiment was carried out in the laboratory to monitor the speed of salinity leaching enhanced by different types of biochar. The results consistently showed that amending compost and biochar significantly improved soil porosity, thus enhancing soil salinity leaching/ washing. The ratio of soluble K^+/Na^+ increased in soil added biochar. The fluxes of CO_2 and N_2O emission were higher in the treatments amended with compost and biochar as compared with other treatments, whereas CO2 emission was not determined by the types of biochar. Amending compost and biochar significantly increased soil organic C, but did not significantly enhance the increased rice yields. Role of silicon on soil improvement and rice yield has not been significant yet.

Keywords: *biochar; compost; seawater intrusion; soil amendment; silicon*

OS7-5
Yield, Nutrient Quality and Heavy Metal Content of Compost as Influenced by Carbon-Rich Feedstocks and Composting Methods

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Abstract

This study aimed to determine the yield, nutrient quality, and heavy metal content of compost as influenced by carbon-rich feedstocks and composting methods. The experiment had two factors - five carbon-rich feedstocks and three composting methods, arranged in a Completely Randomized Design and replicated thrice. At the onset, the lead (Pb) and cadmium (Cd) content of the feedstocks and their environments were determined. During termination, compost yield was obtained. Compost samples were analyzed for nitrogen (%N), phosphorus (%P_2O_5), potassium (%K_2O), and heavy metals (ppm Pb and Cd). Results revealed that vermicomposting with indigenous microorganisms (IMO) using sheep manure as feedstock yielded more compost. Utilization of kitchen wastes and sheep manure comparably produced composts with higher N content. Traditional composting of kitchen wastes produced compost with higher P_2O_5 and K_2O content, comparable to vermicomposting of kitchen wastes with higher K_2O content. In terms of heavy metal content, a lower concentration of Pb and Cd was detected in the plant-based feedstocks compared to their soil environment. The level of Pb in the feedstocks followed this sequence of decreasing order: sheep manure > grasses > kitchen wastes > corn stover > rice straw. The declining level of Cd in the feedstocks had this order: kitchen wastes > grasses > corn stover > sheep manure > rice straw. Similarly, higher Pb content was detected in composts derived from sheep manure and kitchen wastes. At the same time, very low concentration was recorded in composts made from rice straw, corn stover, and grasses. Meanwhile, a higher level of Cd was detected in compost derived from kitchen wastes, while lower content was recorded in compost obtained from rice straw. For both Pb and Cd results, it was evident that vermicomposting effectively reduced the level of these heavy metals compared to traditional composting. These results suggest potential feedstocks for vermicomposting to guarantee the quality and safety of amendments which enter the soil-plant continuum.

Keywords: *carbon-rich feedstocks; vermicomposting; lead; cadmium; nutrient quality*

OS7-6
Integrating Pineapple Leaf Biochar for an Improved Agronomic and Nutritional Content of MD2 Pineapple on Alluvial Soil

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Abstract

A substantial amount of pineapple solid waste is generated during harvesting. Most planters would either dispose of the waste, decompose it as an in-situ fertiliser, or recycle it through open burning based on poor waste management practices. Related literature on pineapple residue has highlighted the promising potential of converting pineapple leaf into biochar. This study, conducted at the Farm Management Unit of UiTM Sarawak, examined the effect of pineapple leaf biochar (PLB) as a soil amendment for MD2 pineapples cultivated on an alluvial soil. Five treatments with three plants per treatment, each with a specific combination of PLB and compound fertiliser, were tested in randomised complete block design with 10 replications. The study parameters were growth performance (D-leaf length, D-leaf width, leaf number per plant, and plant biomass), physiological property (SPAD chlorophyll value), yield (number of fruits, estimated yield, fruit weight, fruit length, fruit diameter, crown weight, and crown length), and D-leaf nutrient content. Analysis of variance testing of parameter data identified significant effects on the agronomic, physiological, and nutritional characteristics of each treatment. Treatment 4 (T4) with a 1:1 combination of PLB and compound fertiliser was the most successful treatment for MD2 pineapple cultivation on alluvial soil. T4 increased plant dry biomass and fruit yield to 718.22 g and 80%, respectively. This study highlighted the viability of utilising and recycling pineapple leaf residues as a soil amendment, which increased nutrient content in alluvial soil and MD2 pineapple crop.

Keywords**:** *biochar; MD2 pineapple; pineapple leaf biochar; soil amendment*

OS7-7

Glauconite Deposit as as Indigenous Alternative Source of Fertilizer for Sustainable Development in Egypt

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Abstract

Sandy soils represent about 95 percent of the total area of Egypt. In order to cultivate sandy and calcareous sandy soils sustainably, we must overcome the problems directly related to the coarse texture and low level of organic matter and nutrients, especially potassium in the sandy soils. Egypt is dependent on imports of potash fertilizers to meet its annual requirements. In Egypt, huge resources of glauconite deposits are found in many localities in the Western Desert, New Valley Governorate. Glauconite is a naturally occurring iron potassium phyllosilicate mineral (mica group), mined from ocean sedimentary rocks. The objectives of this study were to examine the effects of glauconite on plant growth and water use efficiency of pea plants grown in sandy soils of Egypt. Two glauconite deposits were investigated, one was coarse textured, and the other was fine textured. The two tested glauconites were applied to the sandy soil at six rates (0, 3,6,9,12 and15 Mg/ha). The application of each of the two different textured glauconites up to the rate of 12 Mg/ha to the sandy soil increased the plant height, fresh and dry weights as well as water use efficiency of the peas, compared to the control. In general, application of glauconite improves the water use efficiency and enhances the plant growth. It could be recommended to use the glauconite at the rate of 12 Mg/ha as an amendment for the sandy soil in Egypt. Its application in the field was eco-friendly as there was no loss of nutrients from the mineral and its price was cheaper than the imported potash.

Keywords*: sandy soil; glauconite; amendment; water use efficiency*

ORAL SESSION 8
Soil Ecology and Soil Quality

OS8-1
Spatial Distribution of Phosphate Solubilizing Bacteria (PSB) and Arbuscular Mycorhiza (AM) Fungi in Oransbari Agricultural Soil

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Abstract

Phosphate Solubilizing Bacteria (PSB) and Arbuscular Mycorrhizal (AM) Fungi are abundant in the soil and play an important role in plant nutrient uptake, especially Phosphate. The objective of this study was to analyzed the population and spatial distribution of PSB and AM Fungi and to study their relationship with some soil properties in some agricultural soils in Oransbari District, South Manokwari. Composite soil and plant root samples (0-20 cm) were taken in some agricultural soils with a total of 37 samples. The population of PSB, AM Fungi spores, percentage of root colonization and some soil properties (moisture content, soil texture, pH, C-org, C/N, N-total, P-total, K-total, CEC) were analyzed. Spatial and geostatistical analysis were performed using ArcGIS 10.3 with the kriging interpolation method. The results showed that the PSB population ranged from 1 x 10^3 to 1716 x 10^3/gram dry soil, while the number of PSB colonies ranged from 67 x 10^2 to 126 x 10^5 CFU/gram soil with a coefficient of diversity of 194.47. %, this shows that the BPF population is very high with a very diverse level of distribution. The average number of AM Fungi spores was 18.66-22.25 spores/50 grams of soil and the percentage of AMF colonization was moderate (48.7%) to very high (56.18%). The results of soil analysis showed that soil water content ranged from 23.8 to 96.31%, soil pH 4.5 to 6.32, available P ranged from 2.96 to 152.61 ppm, C-organic content ranged from 1.66 – 3.99%, and N-total ranged from 0.04-0.4%. The results of semivariance analysis of the number of PSB and AM Fungi are evenly distributed in each location with a spherical distribution graph. There was a correlation between soil properties and the number of PSB and AM Fungi in the soil especially for soil moisture content, pH and N-total.

Keywords*: soil microorganisms; agricultural land; interpolation; correlation*

OS8-2
Effects of Iron Modified Wood Biochar on Phosphate Leaching in Slope-land of Rural Soils

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Abstract

Biochar has been considered as an effective amendment to retain nutrients in soils except for phosphorus. Loss of phosphates will still occur through leaching at slope-land of rural soils even if biochar has been applied, and this will lead to eutrophication in reservoirs. In this study, an iron-modified wood biochar (FeWB) was prepared and used to mitigate the losses of phosphate in the soils. The observation of SEM elemental mapping indicated that FeOOH could be effectively co-precipitated on the biochar. We also found that the maximum phosphate adsorption capacity of the FeWB was 300 mg/g at 25℃ by fitting to the Langmuir isotherm model, and this value was about 6 times higher than the adsorption by the control. Based on the obvious reduction of zero-point charge (ZPC) of the FeWB, we deduced that the main adsorption mechanism of phosphate on the FeWB is by ligand exchange interaction, and might also include a partial electrostatic attraction.

Keywords: *Fe-modified biochar; adsorption; phosphate; ligand exchange interaction*

OS8-3
Modification of Oxidation-Reduction Potential in Rhizosphere of Plants Increases the Microbial Community in Soil and Plant Growth

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Abstract

Plant roots require soil oxygen to respire and function. Soils amended with heavy rates of organic materials such as composts and undecomposed organic soil amendments may create anaerobic conditions in soils which may cause oxygen deficiency and reduced plant growth. We aimed to determine the effects of modification of redox potential in the root zone on the growth of Red amaranth (*Amaranthus cruentus*) treated with vermicompost and kitchen compost as organic amendments @ of 1, 5, 10, and 20 t/ha including control in loamy sand soil in pot trial. The total bacterial load by plate count method at 37℃ for all soil samples, and isolation of rhizobium were also conducted using Yeast Extract Mannitol Agar medium. The maximum redox potential was +438.6 mV found in the Vermicompost with artificial aeration (20 ton /ha) and the minimum redox potential was -88.9 mV reached in the vermicompost without artificial aeration (20 t/ha) after 60 day's addition of soil organic amendments. It was observed that the application of vermicompost with artificial aeration oxidizing condition increased the height and growth of red amaranth by 333% and 233% over the control treatment. Mean bacterial load ranged from 11×108-264×108 cfu/ml and for rhizobium 20×10 1-100×10 1 cfu/ml. The bacterial population in soil increases with the organic amendments application rates while rhizobium in the soil increases in artificially aerated soil. The study suggests that when undecomposed wastes are added to soils the production of agricultural lands could be increased by modifying the oxidation-reduction potential in soils.

Keywords: *organic amendments; vermicompost; kitchen compost; soil redox potential; soil bacteria*

OS8-4
Exploring Microbial Diversity in Okara-Based Compost to Improve Seed Germination and Soil Fertility

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Abstract

Soybean pulp or okara is one of the by-products from the food industry resulting in animal feed or treated as municipal waste. In order to mitigate influx of waste by promoting circular green economy while improving soil sustainability, we aim to investigate suitability of okara as single substrate compared to heterogeneous kitchen waste in vermicomposting by physical and chemical analyses and to identify microbial diversity in vermicomposting using okara as substrate via metagenomic analysis. The results showed that during the active composting period (6 weeks), the temperatures in 3 composting treatments (okara (B+O), kitchen waste (B+K), and combination of okara and kitchen waste (B+C) were ranging between 29°C to 31°C at moisture content levels of 58% to 75%. The pH in B+O was observed between 6.7 -7, whereas in B+K and B+C, pH levels were 5.3-6.8 and 3.7-7.5, respectively. Elemental analyses (C, H, N, S) showed that B+O had a C/N ratio of 18.7 as opposed to B+K and B+C at 20.8 and 0.9, respectively. To evaluate the quality of compost soil, *Brassica rapa chinensis* seeds were used to measure germination rate using Germination index (GI) study. The result showed that B+O, B+K and B+C had 31.9, 30.4 and 28.5, respectively, with higher value signifying faster rate of germination. Metagenomic analyses between the treatment groups including the bedding (B) as control showed high levels of decomposers in all the treatments, suggesting okara can be utilized as substrate for vermicomposting and subsequently facilitate faster plant germination and growth.

Keywords: *microbial diversity; okara waste; vermicomposting; germination index; amplicon sequencing*

OS8-5
Residual Effects of Biochar and Compost on Improving Properties of Salt-affected Soils

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Abstract

Remediation of soil salinity to reduce the adverse effects on crops is of a crucial importance for global food security. This study aimed to evaluate the residual effects of biochar and compost on alleviating salt-affected soils. Field experiments were set up at two salt-affected paddy rice fields located at different sites for six continuous cropping cycles. The treatments were: Control (two rice crops rotated with fallow in spring-summer crop - FRR); FRR plus compost at 3 Mg ha^{-1} $crop^{-1}$ (FRR + Comp); and FRR plus biochar at 10 Mg ha^{-1} $crop^{-1}$ (FRR + BC) all conducted in four replicates. The evaluation was conducted after the sixth crop cycle, with five continuous cropping cycles applied with biochar/compost followed by one unamended crop cycle. Although biochar and compost had an equal input of extractable potassium (K^+) and calcium (Ca^{2+}), an important parameter for leaching of sodium (Na^+), biochar application had stronger effects on removing Na^+ than that of compost. The effectiveness of biochar application on the reduction of exchangeable Na^+ and exchangeable sodium percentage (ESP) was observed even after just one crop cycle. Other soil properties that showed remarkable increase were soluble and exchangeable K^+, and K^+/Na^+ ratio. This suggests that biochar had more beneficial impacts than compost on alternating constraints of salt-affected soils and the residue effects were still maintained after amendment application was stopped.

Keywords: *exchangeable sodium percentage; K^+/Na^+ ratio; rice husk biochar; salinity*

OS8-6
Potential of Seven Phosphate Solubilizing Bacteria Isolations from Highland Peat in Solubilizing P in Mineral and Organic Soil

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Abstract

Management of highland peat for agricultural purposes alters the characteristics of peat soil and the composition of its microbes. This study aimed to examine the potential of phosphate solubilizing bacteria isolated from highland peat on peat and mineral soil. We found seven phosphate solubilizing bacteria isolates on peatland with different usage. This study consists of two separated experiments, inoculating seven isolates in organic (peat) and mineral soil. The experimental design used was a randomized complete design. The results showed that after 30 days of incubation on peat soil, the highest P-solvent bacteria were found in the treatment of isolates from the coffee of 173 x 10^8 CFU mL^{-1}, P-available increased by about 12-63%. Incubation of P-solvent isolates from peatlands on mineral soils (Andisol) obtained the highest bacterial population in the treatment of coffee field isolates at 219 x 10^8 CFU mL^{-1}, and P-available increased by about 23-56%. All isolates of phosphate solubilizing bacteria from peatlands increased P-available on peat and similarly on mineral soils.

Keywords*: mineral soil; phosphate solubilizing bacteria; P- availability; peat soil*

OS8-7
Effect of Nitrogenous Substrates and Composting Methods on the Yield, Nutrient Quality and Heavy Metal Content of Compost

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Abstract

This study determined the effect of nitrogenous substrates and composting methods on the yield, nutrient quality and heavy metal content of compost. The experiment consisted of two factors - five nitrogenous substrates and three composting methods, arranged in Completely Randomized Design with three replications. The lead (Pb) and cadmium (Cd) content of the substrates and their environments were determined before the start of the composting experiment. During termination, compost yield was obtained. Compost samples were analyzed for nitrogen (%N), phosphorus (%P_2O_5), potassium (%K_2O) and heavy metals (ppm Pb and Cd) content. Results showed that utilization of trichanthera (*Trichanthera gigantea*) and swine manure as substrates yielded more compost. The use of kakawate*(Gliricidia sepium)* resulted in compost with higher N and K_2O. Employing normal composting led to higher N and K_2O content while compost obtained from vermicomposting with indigenous microorganism (IMO) had higher K_2O. Using chicken dung as substrate provided more P_2O_5 and K_2O in the compost. Higher P_2O_5 content was obtained when chicken dung was used in normal composting or vermicomposting, comparable to *G. sepium* used in vermicomposting with IMO. In terms of heavy metal content, lower concentration of Pb was detected in the *G. sepium* substrate as compared to its soil medium. The decreasing level of Pb in the substrates is in the order: chicken dung > *T. gigantea* > swine manure > *G. sepium* > *Azolla pinnata*. The level of Cd in the substrates had this declining order: chicken dung > *T. gigantea* > *G. sepium* > *A. pinnata* > swine manure. Higher Pb and Cd content was detected in composts derived from normal composting and vermicomposting of chicken dung, as well as from vermicomposting with IMO of *G. sepium*. Compost derived from vermicomposting of *G. sepium* recorded the lowest Pb and Cd content. Concerning food security and safety under organic agriculture, these findings suggest potential nitrogenous substrates for composting to ensure the safety of food crops and the health of soil.

Keywords: *nitrogenous substrates; composting; heavy metal; nutrient quality*

ORAL SESSION 9
Soil Information and Digital Mapping

OS9-1
Pedogenesis of the soils from andesitic lava and tuff breccia around the volcanic plateau of Huangtzuei Mountain in Taiwan

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Abstract

The bedrocks at volcanic plateau around Huangtzuei mountain in Northern Taiwan include andesitic lava and tuff breccia. However, no study has examined the pedogenesis from these different parent materials of andesites in this area. The objectives of this study were to determine the characteristics of the soils derived from lava and tuff breccia and elucidate the degree of pedogenesis by using a weathering index. Five soil profiles were selected and described, including pedon SF1 from lava, and pedons SF2, GZ1, DL1 and DL2 from tuff breccia. The soil moisture regime and temperature regime are udic and thermic respectively. The diagnostic epipedons of the selected soil profiles were ochric epipedons. The diagnostic horizon of Pedon SF2 was argillic horizon due to the presence of clay coating, and the soil classification was Typic Hapludults according to the USDA Soil Taxonomy. However, the diagnostic horizons of pedon SF1, GZ1, DL1 and DL2 are cambic horizons, and thus they were classified as Typic Dystrudepts. The experimental data showed that the soil primary minerals were similar in all pedons, which include quartz, gibbsite and amphibole. The texture of pedon SF1 was clay loam to sandy clay loam, while other pedons were silty clay to clay in texture. The total contents of Fe and Al in pedon SF1 were 107-170 g/kg soil and 122-197 g/kg soil, respectively which were much higher than other pedons (Fe: 60.6-109 g/kg soil and Al: 92.7-143 g/kg soil). However, the chemical index of alteration (CIA) was not able to discriminate the degree of pedogenesis in the studied profiles since the CIA only considers the relative loss of elements.

Keywords**:** *andesitic lava, tuff breccia, pedogenesis, soil classification*

OS9-2
Effects of Microtopography as a Soil Forming Factor on Polder Soils in the Isahaya Polder Conservation Area, Japan

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Abstract

Polders have been created by artificial drainage along a seacoast for agricultural land uses. The soil development was discussed according to time after reclamation and types of land use. On the other hand, the coastal microtopography has never been addressed despite its effects on soil moisture condition in polder after reclamation. This study aimed to clarify the soil forming process in a polder addressing effects of microtopography on soil development. The conserved area in Isahaya bay polder in Nagasaki prefecture was selected as a study site. The area has appeared after drainage, and then left over under the natural condition without effects of agricultural land uses such as artificial under drain systems. It has been covered with naturally developed vegetation of reed and goldenrod. Soils were surveyed under four vegetation compositions, which were dominated by goldenrods, occupied by high grown reeds, covered with low grown reeds, and mixed with goldenrods and reeds. Microtopography with several tens' centimetres differences affects soil moisture conditions leading to vegetation distribution from goldenrods to reed. Soil samples were collected from all horizons at each site and used for analyses of soil physicochemical properties and ionic composition of soil pore water. Additionally, to compare the effect of toposequence on soil properties under agricultural land uses, the Kojima Bay polder in Okayama prefecture was also selected as a study area. Soils were surveyed at three sites with different elevation. All of these sites are constantly drained by under drain systems. Electric conductivity (EC) and ionic composition of soil pore water changed with depth, indicating continuous leaching of residual seawater by groundwater dynamics after the reclamation of polders. Drainage of soil pore water promotes wet and dry cycles in soil according to elevation, resulting in differences of soil physical and chemical properties. In the Isahaya conserved area, variation in soil structure was observed along with changes in elevation. The microtopography with several tens centimetres variations have led to different frequency of wet-dry cycles in soils by fluctuation of the ground water table, resulting in development of soil structure accompanied by increase in bulk density and decrease in n-value according to elevation. Soils under goldenrods have well developed soil structures, while soils at the lower elevation were structureless. On the other hand, soil physical and chemical properties in the Kojima Bay polder did not vary with elevation, but well changed with depth. Accumulation of oxidized iron was rich in the plow pan layer at three sites in the Kojima Bay polder due to artificial drainage to manage the agricultural land uses. Finally, this study concludes that sequential change in soil properties with elevation indicates the effects of microtopography on soil moisture dynamics leading to variation of soil development and vegetation in the conserved area without agricultural land uses.

Keywords: *microtopography; soil development; polder; drainage; salt leaching*

OS9-3
Comparison of Widely Used Soil Classification Systems for Oil Palm (*Elaeis guineensis*) Cultivation in Malaysia and Indonesia

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Abstract

The objective of this paper is to review and discuss the usage of soil classification systems in oil palm. Planters in Malaysia and Indonesia must have an essential knowledge on soils especially in connection with sustainable oil palm production. Experiences gained by data collection, identification, mapping and interpretation of soils for the betterment of crops including from early days of rubber cultivation paved a way to improve further in oil palm cultivation as transfer of technology was made easier especially in water management and plant nutrition with vast compilation of soil types in both countries. There are two major soil type classifications used, namely from USDA which has 12 major soil types and from FAO/UNESCO which consists of far more different soil types. Meanwhile, the World Reference Base (WRB) is the international standard for soil classification system endorsed by the International Union of Soil Sciences (IUSS). Soil taxonomy has six categories namely order, suborder, great group, subgroup, family and series. Under USDA, there are 12 orders of soils, based on some dominant physical, chemical and biological properties that differ distinctly from each other. Having an in-depth knowledge and skills in identifying and interpreting the aberrant properties as well as the narrowest category/criteria would be an advantage for an oil palm agronomist. Special management is required if there is any limitation(s) possessed by soils inherently. As more details on each property are available up to series/phase level under USDA soil classification, it would be an advantage for oil palm planters to explore further and correlate the detailed property with sustainable oil palm productions. However, there is not enough soil information/description up to series/phase level under FAO/UNESCO/IUSS/WRB soil classification systems. Basically, the FAO/UNESCO/IUSS/WRB soil classification system is a simplified system correlating the variety of soil surveys throughout the world to a common map. FAO/UNESCO/IUSS/WRB is intended for mapping soils at a continental scale, not at local scale. As such, usage of FAO/UNESCO/IUSS/WRB soil classification for the purpose of enhancing oil palm productivity has a little/less merit. By employing the basic principles, functions of each soil category (from order to series), estimating soil-water-crop relationships and sound & sustainable management under USDA soil classification, the oil palm growers particularly agronomists in Malaysia and Indonesia have greater opportunities to deal with oil palm productivity in a sustainable manner.

***Keywords**: USDA; FAO; UNESCO; soils; oil palm*

OS9-4
Development of a Soil Database to Manage Soils of Sri Lanka for the Future

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Abstract

In agricultural countries soils are the wealth of the nation and should be managed in a sustainable manner to reap benefits for the future. Soil degradation is a serious environmental problem which has implications on food security, loss of biodiversity, and climate change. To reduce these degradation processes to tolerable limits needs proper land use planning. To undertake successful land use planning at national, regional and farm levels a proper soil database should be developed and updated periodically. The objective of this paper is to highlight the development of a detailed soil database for Sri Lanka. To structure the collection of the database the three climatic zones, Wet, Intermediate and Dry zones were considered respectively. A total of 130 benchmark sites where 28, 36 and 54 benchmark sites from the Wet, Intermediate, and Dry zone respectively and 12 sites from the Northern region were studied in detail. The accurate location of the benchmark site (Latitude and Longitude) was recorded using a Global Positioning System (GPS), for using the data with Geographical Information Systems (GIS) in soil mapping and compilation of a database. A soil pit was dug and the soil profile was used to study the soil morphology. The landscape features and soil profiles were described, major soil horizons identified according to the FAO method depending on different years of study. Soil samples were collected from each horizon and characterization was done for soil physical and chemical properties using standard methods. A soil database was developed, and soils were classified according to accepted methods of Soil Taxonomy and WRB legend of FAO method. The soil database is presently used for prediction of soil loss from water, for modelling of heavy metals and pesticide revues to ground water and for crop modelling. The data was also used in combination with additional data to develop the organic carbon distribution in Sri Lankan soils. The soil maps are used for soil series-based fertilizer recommendations by plantation research institutes as tea, rubber and coconut research institutes. The nomenclature of soils according to Soil Taxonomy and WRB legend of soil classification are used for agro-technology transfer. These studies were possible due to grants from the Canadian International Development Agency (CIDA) through Agriculture Institute of Canada (AIC) and National Research Council of Sri Lanka (NRCSL).

Keywords: *classification; soil maps; soil database*

OS9-5
Exchange of Pedological Activities Between Taiwan and Japan for Soil Education

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Abstract

Exchange of pedological activities have been held in Taiwan and Japan for our ESAFS members to learn more about soil description and soil survey experiences. In November 2005, forty members of Japanese Society of Pedology (JSP) visited Taiwan for an overseas 5-days field trip of soil survey. Sixteen attendances from Taiwan joined this field trip and Professors Zueng-Sang Chen, Zeng-Yei Hseu and Chen-Chi Tsai organized the trip and prepared nine pedons for observation, description, and discussion, including Melanudands, Dystrudepts, Paleudults, Plinthaquults, Kandiudoxs, Eutrudepts, and Haplorthods. Local Taiwanese scientists introduced the soil profile background of geological, landscape and land use and explained the soil morphological characteristics and lab data for open discussion. In every evening program, Taiwanese and Japanese scientists had mutually oral presentations for pedological topics to get further exchange of experience and knowledge in soil science and these were good learning opportunities for the young generation. Professor Chen was invited to join the 50th Anniversary of JSP in March 2006; Professor Hseu also attended the field trip for Andisols in the JSP annual meeting in 2010. Additionally, Professor Hiroshi Takesako from Meiji University in August 2008 led a big group (about 45 persons) including professors and students from six universities in eastern Japan (Kanto region) to Taiwan for soil survey training courses: chronosequence of red soils on fluvial river terrace in Taiwan from 11 pedons prepared by Professors Chen, Hseu, and Heng Tsai. All students in the chronosequence training were grouped for judging soil profile description and interpretation. In summer of 2013, Professor Takesako led a group again to visit southern Taiwan for alluvial plain soil survey training courses organized by Professors Hseu and Shih-Hao Jien. In August 2014, the JSP invited four professors and three students from Taiwan to join the soil survey training courses on Andisols in Gunma with soil colleagues from the union of six universities in Kanto region, Japan. Through these activities, our ESAFS members learn from each other and promote soil education for sustaining soil resources.

Keywords: *chronosequence; pedology; soil awareness; soil classification; soil survey*

OS9-6
Monitoring of Bioinformatics of Cherry Tomatoes for Optimized Growth Condition in Smart Farm

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Abstract

The smart greenhouse is becoming more popular as the demand for precision agriculture increases. It controls the environmental conditions such as temperature and humidity to be suitable for plant growth as well as the supply of nutrients. Monitoring the plant induced electrical signal (PIES) provides plant growth information to reflect the water and nutrient uptake, which can be non-destructively measured in real-time. Therefore, in this study, the changes in PIES in cherry tomatoes that occur when a plant stem absorbs nutrients and water was monitored according to nutrient concentrations in the media. In addition, physiological activities such as Fv/Fm and SPAD contents of the cherry tomatoes were measured according to air temperature, humidity, CO_2, and photosynthetic photon flux density (PPFD) in the greenhouse. The PIES decreased when the temperature and PPFD were low, which was adversely related to CO_2 indicating that PIES reflected photosynthetic activity. The PIES values of cherry tomatoes with relatively high nutrient contents in the root zone solution were found to be high. SPAD and Fv/Fm values were also relatively high for cherry tomatoes shown with higher PIES. Therefore, PIES is affected by environmental conditions, and can be used as an indicator to monitor plant activity in a smart farm to optimize the growth conditions for plants.

Keywords*: smart farm; sensor; PIES; nutrient; EC*

OS9-7
Improving Dry Matter and Nutrients Uptake of *Zea Mays* L. Using Crude Humic and Fulvic Acids Isolated from a Tropical Peat Soil

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Abstract

A study was conducted under controlled conditions using a mixture of humic molecules with mineral and chemical fertilizers to determine the effects of crude humic acids (CHA) and crude fulvic acids (CFA) on i) *Zea mays* dry matter production and nutrient uptake, and ii) soil pH, ammonium, nitrate, available P, exchangeable K, Ca, and Mg. Crude fulvic acids increased NH_4^+ content in the soil whereas CHA increased P availability. The use of CHA and CFA resulted in 33 and 50% reduction of urea and rock phosphate, respectively. Application of a mixture of 2 g CHA, 10 mL CFA, 1.5 g urea, and 2 g phosphate rock significantly improved maize plant height, dry matter production, and nutrient uptake (N, P, K, Ca, and Mg) in leaves, stems, and roots of maize compared to treatments without CHA and CFA. A field experiment is needed to confirm these findings as this study was conducted in a controlled condition.

Keywords: *humic acids; fulvic acids; Zea mays; tropical peats; fertilizers*

ORAL SESSION 10
Soil Degradation and Remediation

OS10-1
Stabilization of Heavy Metal Contaminated Fine Soil Collected from a High-Pressure Soil Washing Process

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Abstract

Soil could be contaminated by heavy metals at many sites such as at mining areas, near smelting factories and firing ranges. When soil is contaminated with high levels of heavy metals, remedial action should be implemented. In this study, high-pressure soil washing was used to remove heavy metals from contaminated soil using water. During high-pressure soil washing, the fine soils containing high levels of heavy metals can be collected using water. These fine soils cannot be reused without proper treatment, due to the existence of high concentrations of heavy metals. Therefore, in order to remediate the fine soil fractions, the stabilization technique was applied. Soil stabilization processes are widely used to remediate heavy metal contaminated soil and waste such as by using quicklime, fly ash, hydrated lime, etc. In this study, $CaCO_3$ based limestone and scallop shells were used as stabilizing agents to immobilize heavy metals (Pb, Cu and Zn) in contaminated fine soil fractions. The stabilizing agents were applied to the contaminated fine soil fractions at a dosage of 2 - 10 % wt/wt. Particle size treatment effectiveness was evaluated with 10 and 20 mesh size materials. Also, calcination was conducted to investigate the quicklime effect on the leachability of heavy metals in the contaminated soil. Curing periods of one week were evaluated and 0.1N HCl extraction was performed to evaluate the stabilization effectiveness. The stabilization results showed that heavy metal leachability was reduced with increasing stabilizing agent dosage. The scallop shell treatment was more effective than the limestone treatment due to high CaO content. Moreover, the 20 mesh size materials outperformed the 10 mesh size materials in reducing heavy metal leachability. The calcined scallop shells were the most effective stabilizing agent in reducing all Pb, Cu and Zn leachability, with a reduction of more than 98%. This study suggests that $CaCO_3$ and CaO based stabilizing agents could be effectively used to immobilize the heavy metals in contaminated fine soils with optimum dosage.

Keywords: *high-pressure soil washing; stabilization; heavy metals; immobilization; contaminated fine soil*

OS10-2
Concomitant Immobilization of Oxyanions and Heavy Metals using Vivianite

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Abstract

Arsenic (As) and antimony (Sb) are highly toxic metalloids and oxyanions that can be absorbed by crops from contaminated agricultural soils around mines. Agricultural soil is contaminated not only with As and Sb, but also with other heavy metals including lead (Pb) and cadmium (Cd). Because heavy metals and oxyanions in contaminated soil have different chemical properties, simultaneous stabilization of both is difficult. Arsenic and Sb are stabilized by binding to iron oxide, and the heavy metals are commonly stabilized with phosphate. However, vivianite [$Fe_3(PO_4)_2 \cdot 8H_2O$] can simultaneously stabilize oxyanions (As and Sb), and heavy metal (e.g. Pb). The purpose of this study is to evaluate simultaneous stabilization of metalloids and metals in solution and soil contaminated with As, Sb, and heavy metals using vivianite. Arsenic and Sb solution was prepared at 0.5-10 mg/L, heavy metals solutions (Pb, Cd, Cu and Zn) were prepared at 5-100 mg/L, and the concentration of each metal in mixed solution was the same as the concentration in a single solution. Contaminated soil was treated with 1 g/kg of vivianite and metal concentration was analyzed using ICP-OES. All elements except Sb(V) were adsorbed by vivianite and the adsorption rate was higher in the mixed solution than in the single solution. The adsorption of Sb(III) was explained by the Langmuir and Freundlich isotherms, and the adsorption of As, Pb, Cd, Cu and Zn was better explained by the Langmuir isotherm. The pH also affected the adsorption of As, Sb, Pb, Cd, Cu and Zn. The bioavailable concentration of As and Pb in soil decreased after incubation of the soil with vivianite. Therefore, vivianite treatment can simultaneously stabilize As and heavy metals in a soil contaminated by a mixture of oxyanions and heavy metals.

Key words: *adsorption; heavy metals; oxyanions; simultaneous stabilization; vivianite*

OS10-3
A study of Strength Reinforcement of Peat Soil: An Alteration Polyurethane-based Stabilization Agent Using Palm Oil Fiber and Palm Oil Kernel

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Abstract

The use of polyurethane (PU) as a soil stabilizer agent is an unexplored solution that reinforces soil's engineering properties. However, using PU as an alternative material for soil enhancement has not been fully understood, generating much interest in the search for an alternative material that could reduce the use of cement as a stabilizing agent in soil treatment, raising environmental concerns. This research will incorporate PU with recycled plant-based material, such as palm oil fiber (POF) and palm oil kernel (POK), as peat soil stabilizers. It focused on the mechanical and chemical properties, using vane shear, California bearing ratio (CBR) and electrokinetic stabilization (EKS) tests. The aim is to treat and remediate the peat properties in an approach that includes recycled plant-based material. Then, the treated peat sample will be analyzed using scanning electron microscopy (SEM) to observe the insulated peat matrices. The post-treatment peat sample is expected to improve its shear strength and stability. The research addresses a sustainable soil stabilization alternative in the peatlands area by using excessive waste palm oil as secondary raw materials for a sustainable future.

Keywords: *peat soil; soil remediation; soil stabilization; polyurethane foams*

OS10-4
Monitoring of Soil EC to Evaluate the Effect of Nitrogen and Potassium Content on Soil EC Measurements

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Abstract

Precision agriculture and smart farms require automatic nutrient supply, irrigation, and environment control. For this, technologies for real-time monitoring of plant available nutrients should be developed, but there are no direct sensors to measure plant available nutrients in soil. Since soil EC is affected by the nutrients in the soil solution, the soil nutrient can be estimated by monitoring soil EC. However, soil EC is also affected by soil texture, temperature, and soil water content. Therefore, the object of this study is to monitor the changes in soil EC with nutrient addition in various soils and to evaluate the contribution of nitrogen and potassium to the measured soil EC. Effect of water and temperature on soil EC was also evaluated. The results show that soil EC was not affected by temperature because the sensor has been calibrated by the manufacturer, but soil EC linearly decreased with decreasing soil water content from 25% to 15%. Therefore, soil EC was calibrated based on soil water content. In all treatments, the potassium content of pore water showed a high positive correlation with soil EC while nitrogen was less positively correlated with soil EC because of nitrogen transformation. Other nutrients such as Ca, Mg, Na and P also showed high positive correlation with soil EC. Therefore, the monitoring of soil EC can be used as an indicator of plant available nutrients in soil and contribution of potassium to soil EC change was greater than nitrogen.

Keywords: *smart farm; monitoring soil EC; EC sensor; plant nutrient*

OS10-5

The Effects of Premium Humic Acid HIPHAgro on the Growth of Post Nickel Mine Reclamation Plant in Kabaena, Indonesia

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Abstract

Humic acid is part of the organic matter that plays a role in repairing damaged soil and providing some of the heat for plants. This study aims to determine the effects of reclamation plant growth after nickel mining on Kabaena Island. The experimental method used in this study was a completely randomized design with three replications and was conducted for three months from January to March 2022 at the Nursery of PT. Narayana Lambale Harmony. HIPHAgro Premium humic acid ingredients were used with a dose of H_0= 0 gr. $50l^{-1}$, H_1= 125 gr. $50l^{-1}$, H_2= 250 gr. $50l^{-1}$, and H_3= 375 gr. $50l^{-1}$, and H_4 = 500 gr. $50l^{-1}$. They were tested on four reclaimed plants, namely *Cordia myxa*, *Kjellbergiodendron celebicum*, *Metrosideros petiolate*, and *Melaleuca leucadendra*. The observed plant growth variables included root weight, plant height, and stem diameter every week. The results showed the dose of 250 gr. $50l^{-1}$ gave a significant effect on the growth variables in all tested plants. The *Cordia myxa* had a significant effect compared to other reclaimed plants tested.

Keywords**:** *humic acid; reclaimed plant*

OS10-6
Effects of Humic Acid and Organic Manures on the Soil Point of Zero Charge

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Abstract

This study investigated the distribution of the electric charges affected by the addition of humic acid, oil cake, vermi-compost and farmyard manure in agricultural and forest soils using the potentiometric titration method of net electric charge measurement. Both forest (Haplaquept) and agricultural (Fluvaquent) soils bore net negative charge at their soil native pHs. Variability in the magnitude of this charge was attributed to the effect of blocked exchanged sites by Al and Fe or contribution from strongly acidic organic functional groups. The titration curves at different ionic strengths crossed the common point of intersection, the point of zero charge (PZC), or the pH at which the net electric charge is zero. The PZC of forest soil is lower compared to agricultural soil, and this can be attributed to the higher amount of organic carbon and exchangeable Al of the forest soil. Kaolinite (1:1 clay) and bentonite (2:1 clat) bear significant pH dependent positive charges between pH range of 3 to 8 for kaolinite and 3 to 7 for bentonite, respectively. Surface properties of both soil and clay changed drastically when 1 to 2% humic acid and organic manure were applied to the soils. It was observed that PZC values were reduced when humic acid and organic manures were incubated with kaolinite but PZC reduction was maximum when the clay was incubated with humic acid. Among organic manures, vermicompost played a minor role on the pH-dependent surface charge properties. In case of bentonite clay, pH dependent surface charge properties were slightly altered compared to kaolinite clay. The PZC value increased when humic acid was incubated with bentonite clay. Oil cake failed to change the surface properties of bentonite. Among the organic manures, oil cake had the highest influence on PZC value of agricultural soil whereas vermicompost had the highest influence on the pH dependent surface charge properties of forest soil.

Keywords*: electric charge distribution; point of zero charge; humic acid; organic manure*

OS10-7
Early Growth and Mineral Nutrition of Tea Nursery Plants Influenced by Chicken Feather-Derived Biostimulant

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Abstract

A greenhouse experiment was conducted to determine the effect of different doses (0, 1, 2, and 3 g L^{-1}) of chicken feather protein hydrolysate (CFPH), method of application, and fertilizer reduction on the growth and mineral nutrition of tea nursery plants. In this study, protein hydrolysate was produced from chicken feathers using alkaline hydrolysis and it contained about 165 mg of amino acids per gram of feathers. Results revealed that tea nursery plants treated with CFPH exhibited higher leaf, stem, and root dry weights than untreated plants. The highest dose of CFPH (3 g L^{-1}) increased the shoot and root biomass by 33% and 75%, respectively. However, no significant differences were observed for plant biomass and shoot and root morphological parameters, as the plant was treated with biostimulants ranging from 2 and 3 g L^{-1} doses. Significant growth promotion was observed as the foliar application of CFPH was used in treating the plants. Whilst soil drenching showed higher macronutrient concentrations in plant tissues. The effect of biostimulants on tea plants that received a full rate of fertilizer showed higher plant growth compared to half rate. However, plants under half the rate of fertilizer and treated with CFPH (2 and 3 g L^{-1}) as foliar showed similar growth performance to control plants under the full rate of fertilizer. Soil drenching of CFPH with a full rate of fertilizer recorded higher leaf N, P, and K concentrations. Our findings revealed that CFPH produced by alkaline hydrolysis could be used as a potential growth stimulant in producing quality tea nursery plants suitable for field planting.

Keywords: *plant biostimulant; animal protein hydrolysate; plant nutrition; Camellia sinensis* L.*; sustainable nursery management*

POSTER SESSIONS

POSTER SESSION 1A

PS1A-1
Rare Earth Element Concentrations in Soils and Tea Leaves from Taiwan

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Abstract

Tea (*Camellia sinensis*) is one of the most popular non-alcoholic beverage crops in the world. However, tea is suitable for growing in acidic soil where the bioavailability of rare earth elements (REEs) could be high. Therefore, the potential uptake of REEs by tea becomes important for food safety. REEs are a group of seventeen elements with similar physicochemical properties, including lanthanides with atomic numbers 57 to 71 and scandium (Sc) and yttrium (Y). REEs are divided into two groups: Lanthanum (La) to Gadolinium (Gd) are regarded as light rare earth elements (LREEs), and Terbium (Tb) to Lutetium (Lu), Sc and Y are regarded as heavy rare earth elements (HREEs). Since Aluminium (Al) and REEs are trivalent cations in acidic soil, their behaviors may be similar in soil-plant systems. Hence, the objective of this study was to understand the concentration of rare earth elements in the soil and tea leaves in Taiwan. Thirty topsoil samples (0－20 cm) were collected in the tea garden, including Yangmei, Guanxi, Shiding, Pinglin, Pingxi and Xizhi in the northern Taiwan, Yuchi and Lugu in the central Taiwan, Alishan in the southern Taiwan and Luye in the eastern Taiwan. The budding and old leaf samples were freshly picked from the end of the branches at each plantation. The rare earth elements in the soil were determined by the aqua regia digestion, and the tea leaves were digested with HNO_3/H_2O_2. Preliminary results showed that the total rare earth element content in the soils ranged from 119.2 to 123.9 mg/kg, and the ratio of LREEs and HREEs was greater than 1.0, indicating that the content of LREEs in the soil is higher than that of HREEs. The content of Al in the tea leaves ranged from 217.8 to 572.1 mg/kg. Regarding REEs levels, Ce has the highest concentration, ranging from 0.25 to 0.41 mg/kg, and accounts for a large proportion of the total rare earth elements.

Keywords**:** *rare earth elements; Camellia sinensis; bioavailability*

PS1A-2
Assessment of Soil Quality and Plant Nutrition on Labisia Pumila Plantation: A Case Study at Serting Ulu, Negeri Sembilan

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Abstract

Labisia pumila (Kacip Fatimah) is an undershrub herb belonging to the family of Primulaceae. This herb is traditionally prepared by the Malay women for pre and post-partum treatment. In Malaysia, research and development (R&D) on *Labisia pumila* is continuously carried out by local universities and research institutes to ensure the safety and efficacy of these herbal plants for human consumption. To date, there are many *Labisia pumila* products available in local and international markets resulting in high demand for the raw materials. Therefore, there is a need to establish a commercial plantation to meet the demand by industry. Through Malaysia Social Innovation Program (MySI), FRIM has established a *Labisia pumila* plantation using an intercropping agriculture system in one hectare area located at Serting Ulu, Negeri Sembilan. The objective of this program was to help the B40 group in income generation by conducting the plantation and maintenance activities. This program was in collaboration with the Koperasi Peserta Rancangan FELCRA Gugusan Bayai Berhad (KPRFGB) as the beneficial recipients. Raw materials harvested from the plantation will be sold to the buyer company. As to ensure the quality and safety of the raw materials produced, assessment on the soil nutrient and physical properties as well as the plant nutrient and heavy metal contamination were conducted and reported in this paper. The finding from this study is important to certify any final products produced from the site are not only of high quality but also safe for consumption.

***Keywords**: agriculture; heavy metal; plantation; plant nutrition; soil quality*

PS1A-3
Mitigating Carbon Dioxide and Nitrous Oxide Emissions in Pineapple Cultivation on a Tropical Peat Soil Using Clinoptilolite Zeolite

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Abstract

Tropical peat soils drained for agriculture will lead to greenhouse gas emission into the atmosphere due to the large amount of soil carbon and nitrogen stored. A study was conducted to determine whether clinoptilolite zeolite could be used to minimize carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions in cultivated tropical peatlands. The effects of clinoptilolite zeolite fertilization on CO_2 and N_2O emissions from a peat soil cultivated with pineapple were determined using closed chamber method with the following treatments: (i) 25, 50, 70, and 100% of the recommended rate of clinoptilolite zeolite + compound NPK fertilizer, (ii) compound NPK fertilizer, and (iii) peat soil only. Peat soils treated with clinoptilolite zeolite decreased CO_2 and N_2O emissions relative to soils without clinoptilolite zeolite due to adsorption of organic compounds, ammonium, and nitrate ions, and polar CO_2 and N_2O onto the lattices of clinoptilolite zeolite *via* ion exchange, physical and chemical sorption to inhibit organic matter decomposition and nitrification processes. The buffering capacity of clinoptilolite zeolite to increase soil pH during pineapple growth also contributed to low CO_2 and N_2O emissions. Soil CO_2 and N_2O emissions were not affected by soil temperature, but the emissions appear to be regulated by moderate soil temperature variation. Co-application of clinoptilolite zeolite and compound NPK fertilizer also improves soil ammonium and nitrate availability, yield, and fruit quality of pineapples. The findings from the study suggest that monthly fertilization using compound NPK fertilizers in conjunction with 25% to 100% clinoptilolite zeolite could minimize CO_2 and N_2O emissions without reducing peat soil and pineapple productivity.

Keywords: *natural zeolite; greenhouse gases; histosols; compound fertilizers*

PS1A-4
Effect of Rice Husk Filling Type Subsurface Drainer Attached to Tractor for Multipurpose Utilization in Paddy Fields

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Abstract

Drainage is critical to the cultivation of upland crops in paddy fields because poor drainage aggravates growth of crops and decreases yields caused by wet injury. Subsurface drainage is a main drainage method to prevent the wet injury of upland crops cultivated in paddy fields. The existing subsurface drainage method has downsides like high cost and time consuming of its installation. Many studies have investigated the role and importance of subsurface drainage and discovered new techniques and more economical solutions in order to control groundwater. The new techniques include applications of different pipes, envelope materials and their installation. Accordingly, we developed a rice husk filling type subsurface drain attached to a tractor that compresses and constructs rice husks with envelope materials at a depth of 0.5 m underground. This research was conducted to evaluate the effect of the rice husk filling drainage method with a drainer attached to the tractor and its relation to soybean yield in poorly drained paddy fields. In the experiment, three drainage methods were applied: culvert pipe drainage method (CPDM) using heavy equipment, trenchless pipe drainage method (TPDM) using a tractor, and rice husk filling drainage method (RHDM) with a tractor towing machine. The CPDM was installed at depths of 0.8 m and spaced 7 m apart. The RHDM installed corrugated wrap drainage pipes simultaneously filling rice-husk with filter material in 0.5 m depth. The RHDM were installed 2, 3, and 5 m spacing and installed in 0.5 m depth using a tractor towing machine. We investigated soil moisture contents, groundwater levels, and soybean growth characteristics according to the subsurface drainage methods during the cultivation period. RHDM effects were clear as hourly groundwater levels decreased faster in the test plot compared with the control plot (Non drainage). The water table elevations by a RHDM showed a large decline in the 2 m spacing compared to 3 and 5 m lines. During a soybean cultivation period, the soil moisture content and groundwater level steadily decreased after rainfalls, which suggests that the duration of underdrain produced satisfactory results over the soybean cultivation period. The soil moisture contents decreased gradually after the drastic drainage, indicating that the downward bottom flux increased because of drastic subsurface drainage. Moreover, the soybean yield increased significantly by RHDM. The yield of the 3 m spacing was 34% (3,220 kg ha^{-1}) more than that of the control plot (2,396 kg ha^{-1}). In case of soybean cultivation in paddy fields, the use of this new RHDM may help in improving drainage properties and increasing the soybean yields. The results indicated that this RHDM is quite cost-effective. The cost of this new system was reduced by 50% of total drainage costs, less than the costs of TPDM. Therefore, the use of the developed rice husk filling drainage method is expected to help improve the drainage and increase the soybean yield for soybean cultivation in paddy fields.

Keywords: *subsurface drainage; rice husk; soybean yield; water table level; paddy field*

PS1A-5
Evaluation of Physical and Chemical Properties of Different Soil Structures in Three Populations of Moringa oleifera L.

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Abstract

Moringa oleifera (moringa) is gaining worldwide recognition for being a miraculous multipurpose tree species exhibiting excellent medicinal value. Recent studies also revealed the potential of Moringa leaf extract in treating and preventing Coronavirus-related Diseases such as Coronavirus disease 2019 (COVID-19), severe acute respiratory syndrome (SARS), and middle east respiratory syndrome (MERS). Physical properties and various compounds of soil structure are reflected in different soil properties which affect the growth and yield of Moringa trees. Even though Moringa trees can grow in any soil type, selection and improvement of their growing condition on a specific soil type can result in a high biomass yield. Therefore, this study was conducted to evaluate the physical and chemical properties of different soil structures of Moringa mother trees cultivated in various parts of Peninsular Malaysia. Extensive field visits were made to explore and identify potential mother trees and soil samples were collected randomly composited at the depth of 0-25cm and 0-50cm. Soil samples were gathered from three populations, i.e., Port Dickson, Negeri Sembilan (PD), Seberang Perai, Pulau Pinang (SP), and Tangkak, Johor(T) at three to six points near the selected mother tree for each population. Soil samples were dried and processed in the lab and parameters such as total nitrogen(N), available phosphorus (P), exchangeable potassium(K), cation exchange capacity (CEC), soil pH, and soil texture were measured. Generally, the total content of N, P, and K are higher at the upper depth of 0-25 cm for all the soil samples collected from three populations. Soil samples collected from SP contain higher N content compared to other populations. Coarse sand content was higher in soil samples collected from SP followed by PD and T. Soil samples from SP also recorded the lowest content of silt and clay. Information gathered through this study could be used as guidance in the improvement of planting material which could also enhance the yield and development of Moringa cultivation.

Keywords: *selection; moringa genotypes; physical and chemical properties; soil improvement; moringa cultivation*

POSTER SESSION 1B

PS1B-1
Effects of Liquid Urea Rates on Nitrogen Dynamics, Growth, and Yield of Grain Corn

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Abstract

Arbitrary use of urea fertilizer reduces nitrogen use efficiency (NUE) and increases the risk of environmental pollution. An experiment was conducted to evaluate the application methods and rates of liquid urea (LU) on the growth, development and yield of grain corn. The treatments of the study were, U0=control, GU100= Granular urea (GU) 100%, LU100= LU 100%, LU50= LU 50% and LU33= LU 33%, in two equal splits at 10th and 28th DAS in randomized completely block design with four replications. Results of the study showed that plant height, ear height, days of maturity, number of seeds per kernel row, fresh cob weight and 100-grain weight of corn were not significantly different in GU100, LU100 and LU50 treatments. Grain yield of corn was the highest in LU100 (6249.03 kg/ha) treatment whereas the grain yield in LU50 (5666.50 kg/ha) and GU100 (5746.64 kg/ha) were not significantly different. Nitrogen (%) in the plant was the highest in LU100 followed by LU50 treatment which were significantly higher than GU100 treatment. The total N content was also the highest in LU100 (102.83 kg/ha) though the total N content was not significantly different in LU50 (77.62 kg/ha) and GU100 (83.84 kg/ha) treatments. The NUE was the highest in LU50 (66.92%) treatment followed by LU100 (51.47%) treatment. The results of the study suggested that the LU100 was the best application rate while LU50 treatment was comparable to GU100 in grain corn cultivation.

Keywords*: liquid urea; granular urea; NUE; grain corn.*

PS1B-2
Preliminary Findings on the Effect of Zinc Layered Hydroxide Nanohybrid on Soil Properties

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Abstract

A variety of nanomaterials have been recommended for use in agriculture to reduce fertilizer consumption through smart delivery systems with slow-release capabilities, minimise nutrient losses and improve crop yield. The aim of the study was to determine the effect of zinc layered hydroxide nanohybrid (ZLH) on changing the soil properties. The ZLH nanohybrid which contains two plant nutrient sources, nitrate and phosphate, was applied to soil and planted with Kelempayan seedlings as a test plant. Six months after treatment, the plant was harvested, and the soil was analyzed on various parameters. A control plot without any chemical addition was carried out together with commercial fertilizer and raw material treatments with similar concentration as ZLH application. The results showed that soil pH, water conductivity, extractable P as well Zn content were improved after treatment with ZLH. This suggests that ZLH can act as a liming agent and suitable for acid soils amendment and it also improved nutrient availability and soil water conductivity. Due to the positive charges on the ZLH structure, it was able to hold the anionic nutrients in its interlayer region and prevent losses through leaching. The ZLH was also able to release the nutrient anions in a sustainable manner because of its anion exchange properties. Based on the findings, we conclude that ZLH has the potential as a nano delivery material of plant nutrient, and it can also be a Zn source which is a beneficial soil supplement.

Keywords: *zinc layered hydroxide; plant nutrient; nano delivery; slow release*

PS1B-3
Assessment of High-Pressure Washing for Lead-Contaminated Soil with Different Contamination Periods

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Abstract

Lead can contaminate the surrounding water quality and soil environment through several routes, such as mines, smelters, and shooting ranges. When lead leaks into the soil, it is bound to soil particles. If lead contamination is not treated initially, it can undergo weathering and change into a form that is difficult to remove. Therefore, if soil remediation can be conducted in the early stages of contamination, the lead can be removed more easily and efficiently. In this study, the removal efficiency of lead contaminated soil was compared to the period of contamination. Two types of contaminated soils with similar levels of initial lead concentrations were prepared with different contamination periods. Sample A was field soil located near a mine site and was contaminated for several years. Sample B was artificially contaminated and cured for 3 days. In addition, a high-pressure washing method was applied to remediate the contaminated soil. The initial lead concentrations of samples A and B were 1115.0 and 1092.1 mg/kg, respectively. After high-pressure washing, they were 940.2 and 746.3 mg/kg, which showed removal efficiencies of 15.7 and 31.7%, respectively. In order to investigate the existing form of lead in samples A and B, the sequential extraction method test will be conducted.

Keywords: *soil washing; high-pressure washing; weathering; artificially contaminated soil*

PS1B-4
Growth Rate, Mineral Uptake and Nitrogen Use Efficiency of Upland Pepper Fertigated with Different Types and Rates of Fertilizer

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Abstract

Integrated nutrient management (INM) is important not only to ensure crop yield but also to enhance nutrient use efficiency. The 4Rs (right time, rice place, right source and right amount) are a practical methodology implemented in the field. The fertigation, the combination of water and nutrient, is mainly used for vegetable crops cultivation in plastic film houses, and thus the fertigation schedule is widely utilized in several crops. Recently, an advantage of fertigation stands out due to spreading the need of effective nutrient management and greenhouse gas reduction. Therefore, an application of fertigation technique is tried to several major upland crops such as pepper. The objective of this study is to establish fertigation guide based on pepper growth rate and mineral (NPK) uptake pattern. In addition, we investigated the nitrogen use efficiency (NUE) from different types and amounts of fertilizer. Forty days-old pepper (cv. Acetan) seedlings were transplanted in early May 2021 with planting density (0.4 x 0.8m). The NPK application rate after soil diagnosis was determined, and total requirement of phosphorus was applied as basal fertilization. Nitrogen and potassium were divided into three types of fertilization; basal-fertigation (100-0, 50-50, 30-70%), and a basal form is as follows; 1) chemical (urea for N, potassium chloride for K), 2) slow-release, and 3) chemical (50%) + livestock compost (50%). Fertigation was initiated at 15 days after transplanting and supplied at every 10 days with the same amount. Pepper shoots (leaves + stems + fruits) were harvested every 30 days to examine crop growth rate (CGR), NPK uptake, NUE and fruit yield. The CGR and mineral uptake (NPK) were not significant between treatments, however, were preferential at reproduction stage compared to vegetative stage. The NUEs, especially NUtE, were obviously higher in equal division (50:50%) regardless of the types of fertilizer. Additionally, the optimal range of soil nitrate for favourable pepper production was 40 to 50 mg kg^{-1}. We concluded that the fertigation might be an effective tool for upland pepper and is not dependent upon the types of fertilizer.

Keywords**:** *fertigation; mineral uptake; nitrogen use efficiency; upland pepper*

PS1B-5
Growth, Nutrient and Antioxidant Activity of Red Lettuce (*Lactuca Sativa L.*) Grown with Biochar in Hydroponic System

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Abstract

Several substrates have been identified to be suitable for hydroponic cultivation techniques such as a sponge, rock wool, hydroton, coconut coir, perlite, and vermiculite. Moreover, biochar has been reported to be a potential substrate for hydroponic cultivation techniques due to its characteristics that can help to increase vegetable production. Therefore, a greenhouse study was conducted to investigate the effect of biochar as hydroponic substrate on the growth, nutrient uptake and bioactive metabolites of red lettuce (*Lactuca sativa L.*). This study was conducted using a randomized complete block design (RCBD) with five treatment groups, including T1 (hydroton only; as control), T2 (perlite only), T3 (palm kernel biochar), T4 (palm kernel biochar + hydroton) and T5 (palm kernel biochar + perlite). Data analysis revealed the treatment which consists of both palm kernel biochar and hydroton (T4) resulted in a significant increase and yielded the highest plant height (19.86 cm), plant leaves width (14.16 cm), shoot fresh weight (68.19 g) and dry weight (5.23 g). The leaf nutrient content (N, P, K, Mg, Ca) of red lettuce grown in palm kernel biochar and hydroton (T4) substrates suggested the presence of optimal growth conditions for ensuring optimum yield with high quality. Besides, the methanolic leaf extracts from the red lettuce grown in palm kernel biochar and hydroton (T4) showed the highest antioxidant potential based on the DPPH and ABTS assay, as well as FRAP value. In addition, the application of palm kernel biochar (T3) as a hydroponic substrate decreased the algal density in the nutrient solution. Correlation showed there are relationships between plant growth and nutritional content of red lettuce which is the nutrient content (P, Mg, Ca) in red lettuce leaf is positively correlated with plant height of red lettuce. In conclusion, the combination of palm kernel biochar and hydroton (T4) as a substrate was observed to be the best in enhancing the growth performance, nutrient and antioxidant content of red lettuce (*Lactuca sativa L.*) and is therefore recommended to be used as the growth substrate in the NFT system, with supplementation of AB fertilizer.

Keywords: *antioxidant; biochar; growth; hydroponic; nutrient content; substrate*

POSTER SESSION 1C

PS1C-1
Prediction of Brown Spot Disease of Rice Using Soil and Meteorological Big Data

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Abstract

Data-driven research to solve agricultural problems is increasing recently with the advent of smart farming. Crop diseases have a great influence on the annual yield. Therefore, understanding the causes of the crop diseases is, in particular, important to control them at an early stage. In this study, models for predicting the occurrence of rice brown spot disease, one of the major diseases, were constructed based on public big data. Then the performance of the models was tested. Seven machine learning algorithms including Gaussian naïve bayes, gradient boosting, random forest, logistic regression, support vector machine, decision tree, artificial neural network, and K-nearest neighbour algorithm were used to build the predictive models. The public data used for this study were meteorological data observed at 308 weather stations across the country by KMA (Korean Meteorological Administration), soil chemistry data in SIS (soil information system) by RDA (rural development administration) and pest observation data provided by RDA at 2007 sites. Results of the evaluation for performance of the predictive models based on accuracy, precision, recall, and F1 score showed that the models using random forest algorithm had the highest predicting ability. Among three independent variables (soil data, meteorological data, soil and meteorological data) for the seven algorithms, all the models constructed by soil and meteorological data had the highest predictive performance.

Keywords: *machine learning; big data; rice brown spot disease*

PS1C-2
Suppressive Effect of Biochar and Green Manure Incorporation on Soybean Cyst Nematode (*Heterodera glycines*) Suppression and Promotes Free-Living Nematode Populations

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Abstract

Soybean cyst nematode (SCN, *Heterodera glycines*) is a globally pernicious soil-borne pest of soybean. A potential method of control is to grow a species of non-host plant prior to soybean cultivation, the residues of which deposit specific chemicals into the soil which stimulate cyst-hatching of the nematode. In the absence of host, emergent nematodes starve, and potential infection rates of the subsequent crop are curtailed. We hypothesized that biochar, known to stimulate plant growth and increase the longevity of some organic molecules in soil, may improve the efficacy of this control strategy. Hence, we evaluated the effects of two candidate hatch-stimulating plants (*Vigna radiata* and *Crotalaria spectabilis*) in combination with a rice husk biochar on plant growth and their effects on the SCN density. Biochar significantly increased total biomass of *V. radiata* and *C. spectabilis* by 16% and 33%, respectively. For *V. radiata* alone, the number of SCN juveniles (J2 growth phase) increased up to three weeks and then decreased, but in biochar amended soil J2 forms prevailed for three to seven weeks after residue incorporation. In soil incorporated with *C. spectabilis*, the J2 populations were sustained consistently in biochar-amended soil. Nine weeks after residue incorporation, real-time PCR assays revealed that *V. radiata* only significantly reduced the SCN density in the soil by 91%. Its combination with biochar further reduced the SCN density by 96%. *C. spectabilis* reduced the SCN density by 48% and 72% without and with biochar, respectively. Moreover, incorporation of green manure in biochar-amended soil increased microbial activity and modified nematode community structure. Specifically, *V. radiata* increased the composite and enrichment footprints of nematodes, and omnivore and structure footprints were further increased by combination with biochar. Further, the effect of leachate quality under biochar amendment in the topsoil on subsoil properties will be presented in the poster presentation.

Keywords: *hatching stimulant; mung bean; rice husk biochar; showy crotalaria; sustainability*

PS1C-3
The Dynamics of Aeolian Quartz in Soils from Mongolia and Inner Mongolia, China

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Abstract

In winter and spring, as the east Asia monsoon pasted the arid and semi-arid areas in Mongolia and Northern China, the surface dusts could be lifted up by the wind, becoming aeolian dust and spread widely. Aeolian dust could finally pour into the Pacific Ocean and Japan, which has also accumulated into the soil in Japan. The processes of production, transport and deposition of aeolian dust in East Asia have been investigated intensively in various geomorphologic and climatic settings. The aeolian deposits have great potential for understanding the history of dust-climate interactions at regional to global scales. In this study, the oxygen isotope in quartz was chosen as the indicator to trace the source of aeolian dust. Soil samples gathered from topsoil of seven sampling sites in Mongolia and Inner Mongolia, China, and fractionated using sedimentation and wet sieving method according to different dust-transport mechanisms (Pye and Zhou 1989), which divided with 2μm, 10μm, 20μm, 100μm, 212μm, and 500μm. The oxygen isotope content from purified quartz has been measured by CO_2 laser-BrF_5 fluorination system and stable-isotope mass spectrometer (Tanaka and Nakamura 2013, Sharp 1990). The value of oxygen isotope, $^{18}O/^{16}O$ was represented as $\delta^{18}O$. The test showed that $\delta^{18}O$ value's range was 12.1-14.4‰ in 0-2μm, 12.6‰-14.9‰ in 2-10μm, 10.9‰- 13.6‰ in 10-20μm, 9.7‰-12.3‰ in 20-100μm,8.9‰- 13.5‰ in 100-212μm, 8.0‰- 13.7‰ in 212-500μm, and 7.6‰-17.8‰ in 500-2000μm. Basically, the oxygen isotope decreased with the increase in particle size. Previous studies revealed that the $\delta^{18}O$ values of quartz in Japanese soils hosted on igneous rocks are higher than those in the host igneous rocks, especially for fine-grained particles. The $\delta^{18}O$ values of quartz in Mongolian and Chinese soils measured in this study are higher than those in Japanese igneous rocks, suggesting that Japanese soils were exposed to aeolian dust derived from sedimentary rocks with high $\delta^{18}O$ values, which increased the δ18O values in Japanese soils. Based on the above outcome, it would be revealed that soils in Japan were mixed with aeolian dust from East Asia, increasing the δ18O, which was greater than the original volcanic ash. It was confirmed that most of the aeolian dust in Japan originated from the arid and semi-arid regions of the East Asian continent. Those soils could have been lifted and migrated over long distances to Japan.

Keywords: *aeolian dust; oxygen isotope; dust storm; quartz*

PS1C-4
Mangrove Forest Cover Changes and Riverbank Erosion in Kisap Forest Reserve, Langkawi

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Abstract

Kilim Geoforest Park is one of three geoforest parks located in Langkawi, Kedah, Malaysia. One of the popular activities when visiting Kilim Geoforest Park in Langkawi which has been recognized as Geopark by UNESCO on 1st June 2007 is mangrove tour. However, the mangroves near the riverbank are affected due to heavy tour boat traffic and the boat speed exceeds the allowed speed limit. High speed boats can cause the formation of huge waves which then lashed the mangrove coastline, where over the time the mangrove trees can get slanting and finally uprooted. Thus, this study was carried out in order to obtain information of affected locations and measure the extent of mangrove forest cover and riverbank erosion in Kisap Forest Reserve for future restoration activity. As the study area is a specific site that covers only 50 km^2 area, high resolution satellite images were used. Year 2005 was chosen as the baseline where the Kilim Geoforest Park has not yet been recognized as a Geopark by UNESCO. For 2005, we used a Quickbird-2 image of 0.6 meter spatial resolution, while for 2020 Worldview-1 image of 0.5 meter spatial resolution was used. This two time series of images were undergo a few processing step such as (1) image pre-processing to perform geometric and radiometric corrections in order to align both images so that it overlaid correctly and harmonized each other, (2) image processing to classify the land use using Object-based Image Analysis (OBIA) methods in Ecognition software and then perform land use changes in ArcGIS software before the result can be analyze, (3) accuracy assessment to compare classification result with field data, (4) ground truthing in the study site to investigate potential activities contribute to changes and (5) produce maps such as land use map for year 2005 and year 2020, land use changes map and erosion map. The result showed that the mangrove forest cover of the study area has declined about 12.38 ha in a period of 15 years between 2005 – 2020. Meanwhile the average riverbank erosion is about 0.5 m/year. The information on the location of mangrove forest cover changes and the extent of the area affected can be used as a reference to determine and suggest location of affected areas that need to be prioritized for restoration activities. The results of the study can also be used as a reference for the government, local authorities, and other parties to monitor the affected mangrove forest areas in Kilim Geoforest Park and enforce stricter laws to protect this mangrove forest.

Keywords: *mangrove forest; erosion; riverbank; satellite image*

PS1C-5
Effect of Different Mixing Ratio of CRF, Chemical Fertilizer and Compost on the Improvement of Soil Fertility

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Abstract

In the areas where crop productivity is low due to shortage of chemical fertilizer, there must be a way to increase productivity by improving soil productivity. Therefore, this study was carried out to find appropriate treatments for improving productivity using organic resources at Jangheung-ri, Geyonggi province in Republic of Korea in 2021. There were 10 treatments for this study (A: control; B: manure 100%; C: fertilizer 25% + manure 75%; D: fertilizer 50% + manure 50%; E: fertilizer 75% + manure 25%; F: fertilizer 100%; G: CRF (controlled release fertilizer) 50% + manure 50%; H: CRF 100%; I: CRF 100% + manure 100%; J: fertilizer 100% + manure 100%). Rice seedling was transplanted on May 8 and harvested on September 9. Soil characteristics such as pH, $EC_{1:5}$, organic matter, available phosphorus, CEC, exchangeable cations (K, Ca, Mg) were measured before and after rice cultivation. Rice growth factors (plant height, number of tillers, SPAD) and yield factors (number of panicles, spikelets per panicle, maturation rate, thousand kernel weight, amount of harvest) were measured at appropriate time. The amount of organic matter content and CEC of soils for all treatments at harvest decreased compared to those before rice cultivation. The rice growth factors showed significant increase as the ratio of chemical fertilizer increased. Treatments E, F, and J showed the highest rice yield due to chemical fertilizer use.

Keywords: *soil fertility; rice; controlled release fertilizer*

POSTER SESSION 1D

PS1D-1
Assessment of Physicochemical in Sediment and Water Hyacinths For Planting Media Development

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Abstract

Sediments and water hyacinths from Tasik Habu, Cameron Highlands can be considered waste materials and it incurs the high cost of dredging, thus increasing the area dumping sites for those materials to be removed over time. The nutritional properties of sediments and water hyacinth made it possible to be used for plant growth development. Therefore, the objective of this experiment was to develop a fortified plant growth substrate from collected sediments and water hyacinth. The sediment and water hyacinth samples were collected from Tasik Habu, Cameron Highlands between November-December 2021. Physicochemical parameters measured such as soil texture, pH, electroconductivity (EC), total nitrogen (N), organic carbon (OC), and nutrient concentrations. The pH and EC (mean±standard deviation) for the sediment ranged from 6.88±0.13 to 7.34±0.06 and between 58.48±6.85 to 89.03±2.63 µS/cm, respectively. The sand type was identified as the predominant fraction in the particle size by texture analysis (77.60–83.05%). Total N levels in sediment ranged from 0.019%±0.002 to 0.056%±0.009, whereas total N levels in water hyacinth were much higher which is 2.251%±0.165 compared to sediment, and OC has shown some variation in the study site. Water hyacinth consists of plant hormones, which are responsible for stem growth and plant development. Thus, the phytohormones profiling from water hyacinth can serve as a potential value-added component to the development of fortified growth substrates.

Keywords*: sediment; water hyacinth; Tasik Habu, Cameron Highlands, agriculture area*

PS1D-2
Effect of Chicken Manure with Chito-oligosaccharide on Growth and Yield of Baby Corn and Soil Properties in Sandy Loam Soil Texture

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Abstract

The objective is to study the effect of chicken granular manure with Chito-oligosaccharide (COS) coated on growth, yield of baby corn and some soil properties in Kamphaeng Saen soil. The experiment used Randomized Complete Block Design with 4 replications and 4 treatments as consist of non-chicken manure applied (T1), chicken granular manure applied (T2), chicken manure type 1 with COS coated (T3) and chicken manure type 2 with COS coated (T4). The results showed that chicken manure application gave the significant difference of leaf greenness and yield of baby corn. The chicken manure application gave the leaf greenness higher than non-chicken manure application. The chicken manure type 1 with COS application gave the yield higher chicken manure type 2 with COS and chicken granular manure application. Also, the chicken manure type 1 and type 2 with COS application gave the total soluble solid higher chicken granular manure. In addition, the chicken manure type 1 and type 2 with COS application increased the tendency of available water capacity and soil bulk density decreased as compared with chicken granular manure.

Keywords**:** *leaf greenness; total soluble solid; available water capacity; fertilizer*

PS1D-3
Diagnosis of Soybean Water Stress Using Hyperspectral Image Analysis Technology

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Abstract

Water management technology based on soil and evapotranspiration has several disadvantages in terms of cost and wide area application. Hyperspectral imaging technology is a technology that combines existing spectroscopic technology and imaging technology. This technology is being used for analyzing the crop stress and physiological/ecological status, though it is in its initial stage. This study was carried out to diagnose water stress using a hyperspectral camera in soybean. The test was done on soybean cv. Daechan, following the water stress treatment in 5 stages: 1st bifoliar development (V1), 5th bifoliar development (V5), flowering (R1), constriction (R3), and seed thickening (R5). The drought treatment maintained 15% of the Potential Available Water capacity (PAW) for 20 days, and the Over Water (OW) treatment maintained the soil surface submerged for 30 days. For spectral images of beans, a hyperspectral camera (FX10, Specim) was used, and the measured wavelength was 400~1,000nm. For the diagnosis of soybean water stress, hyperspectral image acquisition, image pre-processing, vegetation index extraction, vegetation area extraction, test treatment group extraction, spectral information extraction for each test zone, and water stress index development were performed. Light correction was executed in the sunlight case to standardize image acquisition by minimizing continuous changes during imaging. A poor reproductive growth and yield of soybean due to initial growth dust were found in excess water damage at V1 and V5 treatment period. The R1 period was similar to normal growth due to recovery after over-moisture treatment. However, drought stress at R3 and R5 periods accelerated aging, and drought stress especially at R3 period had the greatest amount decreased. In the case of single soybean, the reproductive growth V1 period was low, and the yield was normal after the recovery stage. However, one pair of V5 and R1 did not recover completely, and the yield decreased. The intensity of damage caused by excess water was higher in the R3 and R5 stage, ultimately weakening growth and significantly decreased yield. The most sensitive wavelength band was 1,240 to 1,280 nm, and the correlation coefficient was 0.77. To develop the water stress index, a vegetation index was developed by combining 550 nm and 1,280 nm. As a result of the evaluation of the 5 periods (August 3, August 17, September 7, September 14, and October 12), it was possible to distinguish between drought and humidity by the stress index. The range of the soybean water stress index was -1 to 1, with a positive number indicating drought, a negative number with humidity, and closer to 0 indicating normal growth. The findings of this study can be used to evaluate the difference between drought and humidity stress through the combination of sensitive wavelength bands for several field crops, but additional data collection and analysis are required for measuring the degree of water stress damage.

Keywords: *soybean; water stress; image analysis; growth stage; management*

PS1D-4
Soil Biological Properties of 9- and 15-year Old Oil Palm Stands Grown on Acidic Soil

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Abstract

A study was conducted to compare soil biological properties of 9-year-old and 15-year-old stands of an oil palm plantation in Bikam, Perak. Composite samples were collected at depths of 0-15 cm and 15-30 cm. The microbial population count was estimated using a spread-plate technique, and the Fluorescein diacetate (FDA) hydrolysis assay was used to measure microbial enzymatic activity. A rapid ethanol-free chloroform fumigation extraction technique was used for microbial biomass extraction. Microbial biomass C and N contents in the soils from both plots were significantly different ($P<0.05$). Variation in the MBC/MBN ratio in soils of both plots indicate that changes occurring in the soil microbial composition are due to the availability of soil organic substrates and N.

Keywords: *oil palm plantation, acidic soil, microbial population, enzymatic activity, biomass C and N*

PS1D-5
The Combined Use of Chemical and Organic Fertilizers for Maize Production and Soil Fertility

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Abstract

Soil nutrient management is necessary to improve soil quality and agricultural production and the combined use of chemical and organic fertilizers is considered a good method to sustain high crop yield. The aim of this study was to investigate the combined effects of different chemical fertilizer application rates with organic fertilizer (compost) on maize growth performance and soil chemical properties under field conditions. Also, this research was conducted to develop a yield predictive model of maize based on the soil inorganic nitrogen (NH_4^++NO_3^-), available P and exchangeable K content. The application of organic fertilizer to the soil increased soil available P proportional to the amount of organic fertilizer applied. Also, the maize yield predictive linear regression model developed through soil fertility showed that soil available P content was the most important factor toward yield prediction followed by soil inorganic nitrogen and exchangeable K content, respectively. These results will be useful for soil nutrient management for agricultural production.

Keywords: *soil fertility; maize; yield prediction; sustainable agriculture; fertilizer*

POSTER SESSION 2A

PS2A-1
Long-Term Assessment of Heavy Metal(oid)s Phytoavailability in Soil with Immobilizing Agents Treatment

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Abstract

Remediation of heavy metal(loid)s (HMs) contaminated soil by immobilizing agents is presently becoming a hotspot. Effectiveness of many immobilizing agents have been proved in reducing HMs availability in soil and retarding uptake by plant. However, long-term effectiveness of immobilizing agents has not been widely studied. In this study, five immobilizing agents (lime, biochar, fly ash, compost, gypsum) were selected and studied their long-term effectiveness using mixed HMs contaminated soil. Pot experiment started in 2014. Selected immobilizing agents were individually incorporated into contaminated soil (35 kg) in 2014 followed by placement in the pots for seven-years with sequential cultivation of crops and fallow under natural precipitation. In 2021, HMs phytoavailability in Chinese cabbage (Brassica *rapa*.) and soil properties inducing changes in HMs phytoavailability were determined. The data obtained in 2021 were compared with the data produced in the previous study in 2014. Even after seven-year incubation, effects of all immobilizing agents still lasted on reducing phytoavailability of As, Cd, Cu, Pb and Zn. Among them lime and biochar appeared the lowest HMs phytoavailability. Except gypsum, the values of pH and DOC with all immobilizing agents were gradually declined, however, they were still within a good range for reducing HMs phytoavailability. Additionally, all immobilizing agents effectively decreased concentration of malondialdehyde (MDA) in *B. rapa* while the highest reduction was observed with gypsum treatment. To conclude, all immobilizing agents used in this study have long-term effectiveness for reducing metal phytoavailability in HMs contaminated soil.

Keywords: *heavy metal(loid)s immobilization; immobilizing agents; metal phytoavailability; remediation; soil chemical properties*

PS2A-2
Evaluation of Applicability of RGB Images for Rice Growth Diagnosis Using Machine Learning Method

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Abstract

RGB images can be easily used due to their low cost and simplicity of access. Therefore, research using RGB images is required for the development of field digital agricultural technology. In this study, time-series images of rice were collected for non-destructive crop growth and nitrogen content diagnosis using RGB images, and a random forest regression model was evaluated. Rice cultivation was carried out in a paddy field in the National Institute of Crop Science, Korea in 2021. The amount of fertilization was classified into a standard fertilization (9kg N $10a^{-1}$) and a non-nitrogen fertilization (0kg N 10 a^{-1}) according to the nitrogen fertilization conditions. Rice canopy images were captured using a drone (Mavic Pro Platinum) from just after transplanting to before harvesting at a height of 5m, and the images were saved in 4000 * 3000 resolution in JPEG file format. From the collected RGB images, canopy coverage and RGB-based color indices were extracted through the image processing process using python. Random forest regression method was performed to estimate the nitrogen nutrition parameters, including dry weight, LAI, N accumulation. 27 RGB color indices extracted from segmented images and used as input variables for random forest regression. The importance of the input variables was calculated, and coverage was significantly more critical than the others in dry weight, LAI, N accumulation estimation models (coverage, RGD, MExG, B, R for dry weight, coverage, RGD, G, R, NB for LAI coverage and B, RGD, R, G for N accumulation were included in the top five indices, respectively). For model training of random forest analysis, parameters were selected through hyperparameter tuning through RandomSearchCV. As a result of analyzing the accuracy between the measured values and the predicted values through training of the random forest regression model, with R^2 of 0.90, 0.84, 0.85 for dry weight, LAI and N accumulation estimation, respectively. Through the development of the digital image analysis technology, it can be used as a base technology for establishing a digital cultivation management system in the field.

Keywords: *rice; RGB image; random forest*

PS2A-3
Digital Assessment of Soil Organic Carbon Stock Under Different Land Use in Zhuoshui River basin of Taiwan

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Abstract

Digital soil mapping (DSM) is a model established by different statistical methods or algorithms based on soil observations and environmental factors to predict soil properties of unsampled areas, which is widely used for agriculture, ecological and environmental issues. Soil organic carbon (SOC) is an essential indicator of soil health, which also plays a key role in climate change mitigation and adaptation. Therefore, accurately predicting the spatial distribution of SOC is important for estimating the carbon stock in soils of different scales. In Taiwan, Zhuoshui River basin is an important agricultural production area, but the spatial distribution of SOC under different land use is still limited. The objective of this study is to model and map SOC in the area of the Zhuoshui River basin using digital soil mapping and assessment techniques. Organic carbon and bulk density of topsoil (0-20 cm) were used to calculate the SOC, and three machine learning models cubist, random forest (RF) and regression kriging (RK) approach were used for modeling and mapping the SOC with the help of 10 environmental covariates. Five land use types including paddy, upland, orchard, forest and other were used in this study. The results showed that the prediction accuracy of RK (R^2 = 0.55) approach was higher than cubist and RF models, and the spatial distribution of SOC was mainly influenced by elevation, multi-resolution valley bottom flatness index (MRVBF), temperature, precipitation and normalized difference vegetation index (NDVI). The average SOC content is 9.97 kg m^{-2}. In total, the soils stored approximately 31.47 Tg carbon within the top 20 cm, the soils under forest had the highest amount of carbon (25.8 Tg). The downstream of the study area was the crop production area (paddy and upland fields), which merely contributed 5.4% of total SOC stock. These results suggest that the SOC stock is highly related to land use types, and the SOC sequestration potential of paddy and upland soils may be higher than those of forest soils.

Keywords: *digital soil mapping; soil organic carbon stock; land use; digital soil assessment*

PS2A-4
Effect of Organic Composts, Livestock Manure and Food Waste-Derived on Nitrogen Use Efficiency (NUE) in Rice Paddy

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Abstract

Advanced eating habits lead to an increase in meat consumption and food types have generated huge amounts of livestock manure and food waste. Thus, these organic wastes are heading to agricultural lands as useful resources for improving soil fertility. However, their inputs often exceed crop requirements for suitable growth and development. In terms of fertilization, they contain abundant mineral nutrients such as nitrogen, phosphorus and potassium. In particular, nitrogen content in most commercial products made of livestock manure and food waste is in the range of 2 - 4%. In this study, we evaluated NUEs from rice plants applied with different types and amounts of organic composts and tried to guide the optimal application levels for favorable rice production. The experiment was designed with the employment of cropping system and organic composts; 1) cropping system - rice only, rice (summer)-Italian ryegrass (winter) and rice (summer)-potato (winter) and 2) organic composts - 100, 150 and 300% of soil-diagnosed recommendation rates of livestock manure and food waste-derived composts implemented for 2 years (2020 - 2021). Additionally, we applied two fertilization rates which are standard and soil-diagnosed recommendations of chemical fertilizer. Four-weeks-old rice seedlings (cv. Saechucheongbyeo) were transplanted in early June at the experimental field of Chungbuk National University (36 ˚37'25" N 12 ˚27'14" E 61m), South Korea. The rice yield was not significant between crop rotation and organic composts. Soil organic carbon (SOC) tended to be enhanced in the treatment of organic composts. As a measure of persistence of fertilization, NAaa (nitrogen accumulation after anthesis) was higher in organic composts compared to chemical fertilizer. The application rates showed a positive correlation with nitrogen uptake ($r=0.81$, $p<0.001$), in contrast, didn't lead to an increase in NUEg (nitrogen use efficiency of grain). Therefore, we concluded that the application of organic composts beyond crop requirement just resulted in excess biomass production without enhanced rice yield although their effects as a fertilizer were maintained during the whole growing season and accumulated soil organic carbon abundantly.

Keywords: *organic composts; crop rotation; rice; nitrogen use efficiency*

PS2A-5

Soil Fertility Changes by the Treatment of Green Manure Crops with Different Mixing Ratio of Chemical Fertilizer and Manure

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Abstract

In the areas where crop productivity is low due to shortage of chemical fertilizer, there must be way to increase productivity by improving soil productivity. Therefore, this study was carried out to find appropriate treatments for improving productivity using organic resources at Chogwa-ri, Gyeonggi-do in Republic of Korea from September 2020. There were 14 treatments for this (A: control; B: manure 100%; C: fertilizer 25% + manure 75%; D: fertilizer 50% + manure 50%; E: fertilizer 75% + manure 25%; F: fertilizer 100%; G: fertilizer 100% + manure 100%; H: control + green manure; I: manure 100% + green manure; J: fertilizer 25% + manure 75% + green manure; K: fertilizer 50% + manure 50% + green manure; L: fertilizer 75% + manure 25% + green manure; M: fertilizer 100% + green manure; N: fertilizer 100% + manure 100% + green manure). Seeds of green manure mixture, hairy vetch (*Vicia villosa* Roth) and rye (*Secale cereale* L.) were sown on September 24, 2020. The green manure mixture was turn over to soil on May 1, 2021. Rice seedling was transplanted on May 10 in 2021 and harvested on September 9 in 2021. Soil characteristics including pH, $EC_{1:5}$, organic matter, available phosphorus, CEC, exchangeable cations (K, Ca, Mg) were measured before and after rice cultivation. Rice growth factors (plant height, number of tillers, SPAD) and yield factors (number of panicles, number of spikelets per panicle, maturation rate, thousand kernel weight, yield) were measured at appropriate time. Results showed that application of organic resources (manure and green manure) increased the amount of organic matter and available phosphorus contents in soil. Although there was not significant difference in rice growth factors between with- and without-green-manure application, the application of green manure increased rice yield until the chemical fertilizer ratio is less than 75%.

Keywords: *soil; fertility; rice; green manure*

POSTER SESSION 2B

PS2B-1
Fate of Nanopesticide and Implication of Its Residual Effects on the Terrestrial Environment

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Abstract

Chemical pesticides usage is unavoidable within the context of pest management. All pesticides used in agriculture activities will end up in the soil. Soil is an important component for crop growth and food production. The application of engineered nanoparticles (ENPs) in the agriculture sector especially in the production of nanopesticide has raised a concern on the fate and behavior of these nanochemicals in the terrestrial environment. The persistence of oil-in-water (O/W) nanopesticides of phenolic acids (i.e., caffeic and syringic) was determined under laboratory conditions to understand the fate and behavior of such a nanopesticide product, in the current study. The nanopesticides were prepared using different non-ionic surfactants which were the Tween80, Termul® 1284 and Termul® 3540, oil carrier palm methyl ester (Edenor®) with the addition of distilled water (5 %) via emulsion technique. The different sterile and non-sterile soils were sandy, clay and organic were treated with the different nanopesticides or the analytical grade of both acids at 10 µg g^{-1} under laboratory conditions. At each sampling time, the residue of the acids was quantified following an optimized analytical method using High-performance Liquid Chromatography (HPLC). Overall, the findings suggested that nanopesticides enhanced the persistence in the soils compared to the analytical grade materials. The use of a nanopesticide could implicate the increase in the bioavailability and length of exposure of an active ingredient in the soil environment, resulting in the better uptake by soil organisms including plants. This will eventually help to increase the resistance of the crops and plants against pathogens. In addition, the content of an active ingredient in the nanopesticide is lower, therefore the nanopesticide is expected to reduce the cost of pesticide production, while having a great advantage in the agriculture sector. However, the concern is on the residual effects on other soil organisms such as earthworms, which are known as environmental indicators of soil health. Therefore, a complete research framework and/or standard protocol regarding the effects of a nanopesticide is needed in order to better understand how the fate and behavior of a nanopesticide product would affect the terrestrial environment.

Keywords: *pesticides; engineered nanoparticles; phenolic compounds; persistence; nanoemulsion*

PS2B-2
Spatial Variability of Nitrogen in Different Monsoonal Changes

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Abstract

The objective of this study was to investigate the spatial variability of N on monsoonal changes. The results showed the N availability increased proportionally in Southwest monsoon (dry period) till monsoonal transition from dry to wet (inter-Oct.) while low availability in Northeast monsoon (wet period). Meanwhile, the geospatial analysis concluded N availability was highly affected by the slope of the study site (26^{o}), limited crop residue due to low biomass production by black pepper, and zero terrace availability. Elevated N concentration was reported in the soil during inter-Apr as affected by repetitive fertilizer application before the wet season initiated. This condition has further increased ion movement in soil dominant with a coarse texture and represents this study's spatial variability. This may conclude the N availability is immensely affected by the condition of the study area and monsoonal changes.

Keywords**:** *spatial variability; monsoonal changes; black pepper; nitrogen*

PS2B-3
Effect of Different Types of Water and Nutrient Managements for Rice Production in Alkaline Soil

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Abstract

Rice cultivation in the Middle East Asia area is quite hard to succeed due to high temperature, high light intensity, shortage of irrigation water resources and extreme soil conditions. Among disadvantageous factors, an alkaline soil (pH, >8.0) leads to poor rice growth and reproduction by limiting factors such as nutrient uptake and nitrogen emission. We tried to solve the problem of poor rice production using nutrients and water management under adverse environmental conditions. Soil pH used for this work was 9.35±0.01 and sulfuric acid solution (adjusted by pH 5.2) was irrigated for 7 days before transplanting. To enhance water use efficiency, rice seedlings were transplanted at the furrow. Chemical fertilizers: ammonium sulfate for N, potassium phosphate for P and potassium sulfate for K, were applied with seven different types; standard, half of standard (N, P and K, respectively) and double of standard (N, P and K, respectively). Rice growth was better in irrigation (reduced) condition (200 ~ 300 mL, 3 times/day) than in relatively oxidized (100 ~ 200 mL, 1 time/day). However, different types and amounts of chemical fertilizers didn't show significant differences between treatments. Additionally, any methodology of water and nutrient management wasn't effective for soil pH adjustment. In conclusion, an irrigation with a furrow cultivation in extreme alkaline soil is capable of expecting better rice production.

Keywords**:** *rice, alkaline soil, pH, water management, fertilizer type*

PS2B-4
Washed Rice Water is a Beneficial Plant Fertilizer

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Abstract

Washed rice water (WRW) is the wastewater left after rice is washed prior to the rice being cooked. Washing rice leaches nutrients from the rice grains into this wastewater, leading to the popular claim that WRW is a beneficial plant fertilizer. Nevertheless, there are no detailed scientific studies to determine whether the benefits of WRW are indeed true. Therefore, this study aimed: (1) to determine the nutrient content and bacterial population of WRW at different fermentation periods, and (2) to determine whether WRW increases the growth and yield of choy sum (*Brassica chinensis*), as compared with conventional NPK fertilizer and control (CON; without any fertilizers). Rice grains were washed in a volumetric water-to-rice ratio of 3:1 and at a constant speed of 80 RPM. The treatments were WRW fermented for 0, 3, 6 and 9 days (labelled as F0, F3, F6, and F9, respectively). A significantly higher bacterial population of 2.12×10^8 CFU mL^{-1} was observed at F3. The results showed that most elements increased with increasing fermentation period: nutrients N, S, P, K, Mg, NH_4^+ and NO_3^- increased, while pH, C, and Cu decreased with increasing fermentation. The glasshouse evaluation of F0, F3, NPK, and CON on choy sum growth parameters showed a significant difference between the treatments, with the highest mostly in the F3 and NPK treatments, both of which higher by 20-70% than CON. The comparative yield of F3 with NPK indicates the cumulative effect of both the nutrient contents and bacterial population contained in the WRW. Therefore, fermentation of WRW for three days contained nutrients and beneficial bacteria that increased plant growth and soil fertility. Conclusively, WRW should be fermented for a maximum of three days.

Keywords: *bacteria; fermentation; nutrients content; plant growth; soil fertility*

PS2B-5
Influence of Soil Amendments on the Growth and Yield of Rice in Acidic Soil

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Abstract

In Malaysia, about 0.5 million ha of acid sulfate soils are found scattered over the east, west, and Sabah and Sarawak regions that can potentially be cultivated with paddy. This type of soil is acidic and not immediately suitable for crop production unless improved by applying some amendments. Thus, the current study was carried out to investigate the effects of various types of soil amendments on the growth, yield, and physiological responses of rice grown in extremely acidic conditions using ground magnesium limestone (GML), basalt, biochar, and compost as soil amendments. The acid sulfate soil with a pH of 3.76 was obtained from a paddy field in Merbok, Kedah. The plant responses were evaluated based on agronomic, physiological, and yield performance. The compost-treated rice showed the best performance in all three criteria. Compost treatment increased the soil pH up to 6.25. Physiological performances such as chlorophyll, photosynthetic rate, and water use efficiency were higher after compost treatment, while transpiration and stomatal conductance showed the highest after GML treatment. It can be concluded that the addition of compost as a soil amendment can increase soil pH and create favorable soil conditions for rice cultivation in acid sulfate soil, leading to improved rice growth performance.

Keywords: *acid sulfate soil; plant physiology; rice growth; rice yield; soil amendment*

POSTER SESSION 2C

PS2C-1
Effect of Soil Texture on Potassium Leaching in Undisturbed Lysimeter

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Abstract

Essential nutrients for crop growth can cause pollution if they flow into the nearby water system. For nutrient management, understanding the movement of nutrients in soil is important. In this study, in order to understand the movement of the potassium, the amount of leached potassium was calculated when sesame was cultivated in undisturbed lysimeters. The soil texture of the experiment plots lysimeters was clay loam and sandy loam soils. Sesame was cultivated from May 25 to August 24 in 2020. The standard amount of NPK fertilizer (N-P_2O_5-K_2O = 2.9-3.1-3.2 kg·10 a^{-1}) was applied. The amount of potassium leaching was calculated by multiplying the concentration and the amount of water drained below 1.5 m soil depth. During the sesame cultivation period, the amount of potassium leaching from clay loam soil was 0.41 kg·10 a^{-1}, and 8.07 kg·10 a^{-1} for sandy loam soil. We found that there was a difference in leaching according to the soil types. Therefore, for sustainable soil management in a field, it is necessary to consider the characteristics of soil to avoid environmental pollution.

PS2C-2
Soil Properties Assessment of Integrated Herbal Plantation at Serting Ulu, Negeri Sembilan

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Abstract

Initial land preparation is important to ensure the long-term success of any crop planting. An early evaluation on soil quality will help in determining the ability of a soil to fulfill its functions in the ecosystem, which are the results of integrated actions of different soil properties. Whereas soil evaluation after field planting is also important to ensure it is free from chemical pollution. Forest Research Institute of Malaysia (FRIM) together with a local community has established an integrated herbal plantation of *Citrus microcarpa* located at Serting Ulu, Negeri Sembilan funded by the Malaysia Social Innovation Program (MySI) under the Ministry of Science, Technology and Innovation (MOSTI). *Citrus microcarpa* from the Rutaceae family was selected in this project as this plant is easy to grow and manage. Furthermore, the seedlings can be obtained from many commercial nurseries. In Malaysia, *Citrus microcarpa* fruit, locally known as "limau kasturi"is popular because it is normally used as seasoning for many dishes such as soups, fried noodles and fried rice. It is also used for the preparation of cordial or fruit juice. Other than that, it is being used as an antidote for poison, treatment of abscesses, sore throat, cough and nausea. The essential oil extracted from the fruits are also used as the ingredients in the herbal bath and aromatherapy formulations. Despite that, soil plays a major role in obtaining high quality and optimum crop production. Thus, FRIM has conducted a study on the assessment of soil properties at Serting Ulu site specifically on the macronutrient compositions and physical texture before and after planting activities has been carried out. The data presented can be used as a guide in the establishment of *C. microcarpa* plantation as well as a reference point for fertilizer management research on the species.

Keywords: *limau kasturi; texture; soil quality; crop planting*

PS2C-3
Assessment Of Cd(II) And Cu(II) Removal Efficiency by Wood Biomass Byproducts

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Abstract

Recently, a large amount of pollutants such as heavy metals, and solvents have been produced because of industrial activities. Wood biomass is widely used as adsorbent because it is cost-effective. Therefore, the purpose of this study was to evaluate the heavy metal removal efficiency of wood biomass byproducts. The Cd and Cu adsorption removal efficiency of the *Cornus controversa* (CC) and *Quercus mongolica* (QM) was evaluated from their kinetics and adsorption isotherms. The batch adsorption experiments were conducted by equilibrating wood biomass samples with aqueous solutions containing various concentrations of Cd (0–200 mg/L) or Cu (0–150 mg/L) for a specified period at 25 °C. The concentration of Cd or Cu in the filtrate was determined using an ICP-OES. The adsorption rate of heavy metals was fitted to a Double First-order kinetic model, and adsorption patterns were fitted to both Freundrich and Langmuir adsorption isotherms. The adsorption of both heavy metals by wood biomass consisted of two phases, initially adsorbed very quickly (rapid step), followed by a very slow adsorption which was significantly described by the Double First-order kinetic model. The reaction rate constant (k) values of the rapid step of CC and QM were 0.21, 0.26 min^{-1} and 0.22, 0.22 min^{-1} for Cd and Cu, respectively. This means that approximately 30 % of adsorption reactions between each heavy metal and wood biomass occurred within about 5 minutes. The selectivity of wood biomass for heavy metals varied depending on the type of wood and heavy metals. Adsorption patterns of Cd and Cu by wood biomass were better fitted by the Langmuir model. This is mainly due to the adsorption and saturation of heavy metals on a single layer of wood biomass surface, which reached equilibrium after the maximum adsorption. The maximum absorbance (q_{max}) calculated from the Langmuir model formula was 4.86, 1.68 mg g^{-1} and 4.88, 3.31 mg g^{-1} for Cd and Cu for CC and QM, respectively. The q_{max} values for Cd were higher than the previously studied on juniper wood (2.8-3.2 mg g^{-1}) and sugarcane bagasse (3.53 mg g^{-1}), suggesting that a variety of wood biomass have a potential to be used as an eco-friendly material for heavy metal removal as evidenced in the current study.

Keywords**:** *heavy metals; adsorption; wood biomass*

PS2C-4
Soil application of Cyanobacteria for Improving N_2 fixation and Salinity Amelioration

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Abstract

Soil degradation is one of the serious environmental problems on a global scale. In the Sustainable Development Goals (SDGs) that the UN adopted in 2015, soil degradation was set as one of the international goals that needed to be resolved. SDG 15.3 states that ‘‘By 2030, combat against desertification, restore degraded land and soil, including land affected by desertification, drought, and floods, and strive to achieve a land degradation-neutral world’’. drought, and floods, and strive to achieve a land degradation-neutral world’’ (United Nations 2015). Cyanobacteria are microorganisms that have photosynthetic and N_2-fixing abilities and some strains have the salt-tolerant ability by secreting extracellular polysaccharides into the soil to protect their cells from salinity stress. We isolated some strains from surface soils in Chiba and Tokyo to compare their growth, N_2 fixation ability and resistance ability to salt stress for application to salt affected soil and salinity amelioration.

Keywords: *cyanobacteria; N_2 fixation; salinity amelioration*

PS2C-5
Soil Fertility Status of Various Ages of *Shorea Roxburghii* Planted in Segamat Frim Research Station, Johor

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Abstract

Shorea roxburghii is known to be fast growing, require minimum nutrients, light tolerant, and has a high percentage for survival with suitable growth for timber production, conservation and for afforestation purposes. The aim of this research was to determine the preliminary soil fertility status of the areas planted with different ages of *S. roxburghii* with minimal silvicultural practices. Soil samples (0-30 cm depth) and growth measurements were collected in plots planted with *S. roxburghii* in 2004, 2018 and 2020. Soil properties were analyzed to determine the soil fertility status whereas growth measurements were computed to display survival, mean diameter at breast height (mean DBH), mean heights (mean H) and mean annual increments (MAI). Results showed that soil C:N ratios were relatively highest in the 2004 stands (C:N:>12) and mean soil fertility index (10.5) was the highest in the 2020 plot. Higher C:N suggests elevated organic litterfall from mature stands enriching the forest floor. Despite that mean diameter growth and heights of the 18-year-old stand were 18.1 cm and 17.5 m respectively, values for MAI were lower than expected compared to 2018 plot due to the nature of the Year 2004 plot without thinning and focused for conservation and rehabilitation planting. Growth values (Mean DBH: 1.0-1.2 cm; Mean H: 6.8-7.8 m) for plots Year 2018 and 2020 agrees with other workers as the stands projected rapid establishment at the initial phase. The survival rates for the year 2004, 2018 and 2020 were 88, 63 and 100% respectively. *Shorea roxburghii* has the potential for rehabilitation and afforestation initiatives due to its inherent characteristics and availability to enrich soil quality, promoting tree growth and survivability. Future research should elucidate the impact of different planting densities in the newly established plots (2018 and 2020) to support plantation forests and timber production.

Keywords**:** *soil quality; dipterocarp; afforestation; various stand ages; forest plantation*

POSTER SESSION 2D

PS2D-1
Evaluation of Soil Nitrogen Sensor on Various Soil Textures And Soil Moisture Contents

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Abstract

These days, farming techniques become more precise and accurate in order to increase crop yields and decrease environmental pollutants. Although the development of soil data is still in its early stages, many techniques have been developed to monitor soil properties, such as soil moisture and electrical conductivity (EC). However, soil nutrients are still measured and analyzed by analytical machines in a lab. In-situ soil nutrient measurement has been developed over years, but it is still in experimental stages and there are no commercial materials (ie. sensor or measurement) for this purpose. As agricultural environments are becoming more automated and digitized, it is important to monitor soil nutrient status in real time. This study developed an ion selective electrode sensor to measure soil nitrogen contents in situ and tested its performance on various soil conditions. This experiment was conducted in a greenhouse located at National Institute of Crop Science in Miryang, S. Korea. Soils were collected across Miryang city and analyzed for soil texture and soil nitrogen contents. These soils were sorted by different soil texture and soil nitrogen contents. Soil textures were classified as sandy loam, loam and silt clay. Soils with less than 0.2% of soil nitrogen were classified as deficit, soils with 0.2-0.4% were as average, and soils with over 0.5% were as excess. Total of 9 treatments were selected and each treatment had three replicates. A soil sensor was developed to measure NO_3^- in soils by an ion selective electrode. The electrode is 20 cm in height and 5 cm in diameter and it was connected to a data communication equipment in order to monitor nitrogen concentration. The sensor was installed to each pot and measured a nitrogen concentration every 10 minutes. Soil moisture was measured by soil moisture sensors every 30 minutes. Soil moisture was set as 15% and increased up to 40% by 5% interval. Each soil moisture content lasted 10 days. Then, soil solution and soil samples were collected from each pot to compare nitrogen sensor readings. These measurements were repeated for each soil moisture content. As a result, the nitrogen sensor showed 0.1 mmol to 0.6 mmol of nitrogen in soil when soil moisture contents were greater than 25%. Accuracy of the sensor was greater than 88%. However, the sensor increased inexactitude of nitrogen measurement as soil moisture contents decreased. Soils with more silt and clay had greater accuracy in nitrogen measurement, while sandy soils did not show a good accuracy. These results showed that the ion selective sensor can be used as a tool of soil nutrient management if it can be supplemented by soil moisture content.

Keywords: soil nitrogen; ion selective sensor; soil texture; soil moisture content

PS2D-2
Load of Heavy Metal(loid)s into Agricultural Soils Nearby Industrial Complex

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Abstract

Since the 1960s, as industrialization has progressed rapidly, environmental pollution has occurred. Contaminants in agricultural soils are highly likely to be transferred to crops, which may threaten the safety of agricultural products. To produce safe agricultural products, regular monitoring of contamination-vulnerable areas, such as farmlands near industrial complexes, is necessary. This study evaluated the level of heavy metal contamination in the agricultural lands near 10 industrial complexes in Gyeongbuk, Korea. Topsoil was collected from two different sections of each industrial complex area; 5 farmlands located within 500 m from the boundary of the industrial complex; 5 farmlands located between 500 m to 1000 m from the boundary of the industrial complex. After pre-treatment of the collected soil samples, heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn) were analyzed. In addition, to evaluate the level of contamination, the Integrated Pollution Index (IPI) for each industrial complex was calculated. As a result, the soil heavy metal concentrations within 500 m from the industrial complex were As 4.46, Cd 0.31, Cr 24.27, Cu 21.10, Hg 0.03, Ni 12.78, Pb 14.07, and Zn 57.51 mg kg-1, and those between 500 m and 1000 m were As 4.07, Cd 0.29, Cr 25.30, Cu 17.44, Hg 0.03, Ni 13.26, Pb 13.44, and Zn 57.36 mg kg-1. None of the farmland exceeded the Korean soil contamination guidelines, however, 7 out of 10 industrial complexes showed an IPI value of 1 or higher. This means that the heavy metal pollution load in farmland near the industrial complex is higher than those in general agricultural soils. The pollution load caused by the industrial complexes may continue to increase, thus, long-term monitoring would be necessary.

Keywords: *heavy metals; industrial complexes; integrated Pollution Index*

PS2D-3
Effect of Boron Application on Selected Bunch Characteristics of Berangan

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Abstract

The objective of this study was to investigate the effect of different boron concentrations on selected Berangan bunch characteristics. The results showed that Berangan treated with B had superior bunch weight compared to T1 (control). It was observed T3 (0.2% H_3BO_3) has the heaviest Berangan bunch weight (8.54 kg) and is followed by T2 (0.1% H_3BO_3) and T4 (0.3% H_3BO_3). The improvement of bunch weight may be caused by active cell division, including synthesis of nucleic acid within the fruit development period once sprayed with B in early and 30 days after the opening of the last hand of flowers. However, the number of fingers and hands comparable among the treatment that represented the effect was insignificant. This may conclude the B application at the rate of 0.2% has the heaviest and largest fruit bunch that benefited the farmer to obtain a high yield.

Keywords**:** *Berangan; boron; spray; banana*

PS2D-4
Integrated Rice-Duck Farming Improves Rice Yield and Soil Properties in a Paddy Field: A Preliminary Assessment

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Abstract

Rice cultivation under conventional farming systems is largely dependent on fertilizer and pesticide applications to produce high yield besides ensuring food security, ecological, and environmental health sustainability. Integrated rice and duck cultivation is a common rice farming system which is widely practiced in Asian countries such as Japan, China, Vietnam, Bangladesh, and Indonesia. Ducks are not only essential to maintain ecological sustainability but also play an important role as a biological control agent in reducing environmental pollution from conventional rice farms. A study was conducted to obtain a baseline data on the ideal number of ducks per hectare basis in an integrated rice-duck farming system. The field trials were carried out at Kampung Alor Sekawan, Pendang, Kedah during the off-season rice farming in 2018. In this study, the effects of duck population on rice yields and soil properties were determined on rice paddy fields with an acreage of four hectares. Treatments evaluated were: (i) Conventional rice-duck farming with different number of duck entries (50, 100, 150 birds/ha); (ii) Conventional rice farming with pesticide application in the absence of ducks (positive control); and (iii) Conventional rice farming without pesticide application in the absence of ducks (negative control). Paddy plants were managed using standard agronomic practices for rice paddy cultivation in Malaysia. Results from the study indicated that rice-duck treatment with a number of 50 birds/ha significantly increased rice yields approximately 20.5% to 39% (1.4 to 2.4 t/ha) and improved soil cation exchange capacity and bulk density compared with conventional rice farming system. However, further field trials are needed on rice-duck farming to determine its impact on the ecological rice ecosystem in the long term.

***Keywords**: integrated rice-duck farming; rice paddy field; sustainable agricultural practice*

PS2D-5
Nitrogen-Associated Gene Expression and Primary Metabolites In Rice Plants Under Different Water Managements

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Abstract

Nitrogen is one of the most important nutrients for plant growth and development. Plants absorb and assimilate the nitrogen as a form of nitrate, ammonium and organic nitrogen, and its preference by plants is strongly dependent upon the redox status of soil, indicating aerobic or anaerobic. A huge number of reports found that nitrogen uptake of rice was facilitated by both nitrate transporters (NRTs) and ammonium transporters (AMTs). However, there is limited information on how nitrogen use efficiency (NUE) of rice differs from nitrogen source and water management. Taken together, we firstly tried to understand the uptake and assimilation in urea-fed rice plants under different water management systems including anaerobic (flooding), alternate wetting and drying (AWD) and aerobic. Two-weeks-old rice seedlings, cv. Jinbong, were subjected to three different water status. Rice samples, leaves (blade and sheath) and roots, were carefully harvested at tillering and heading stage, and used for analysis of nitrogen uptake/assimilation-related genes and primary metabolites. The growth parameters such as plant height, tillering and crown roots were the largest in anaerobic followed by AWD and aerobic. The expression of ammonium transporter genes (*OsAMT1;1* and *OsAMT1;2*) and assimilation genes (*OsNiR*, *OsGS*) was higher in aerobic compared to anaerobic in roots. While the *OsNADH-GOGAT1* gene was highly expressed in anaerobic condition. The nitrate transporter genes (*OsNRT*, *OsNPF*) were not significant between water status conditions. Most of the primary metabolites, especially sucrose and glutamine, were abundant in aerobic roots. We conclude that rice roots in an aerobic condition mainly take up ammonium to directly assimilate amino acids such as glutamine and are tried to expand their volume through the utilization of sucrose.

Keywords: *rice; nitrogen-associated genes; primary metabolites; water management*

POSTER SESSION 3A

PS3A-1

Effect of Biostimulants and Seed Priming Techniques on the Seed Germination and Root Formation of the Pakchoy Varieties (*Brassica rapa* L. subsp *chinensis*)

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Abstract

Biostimulants and seed priming could be used to enhance seed germination and root growth of leafy vegetables. An experiment was conducted for investigation of different priming effects on germination rate, germination percentage, and root length, shoot length, weight per plant and root – shoot weight of selected Pakchoy variety (*Brassica rapa L subsp.chinensis*). It was conducted in a growth chamber at CEPB laboratory at The University Nottingham. The CRD experimental design was used with three replications. The treatments include three priming methods (hydropriming, nutripriming and biopriming) with different levels of concentration (0.2% and 0.4% v/v). The results showed a significant priming effect on the germination rate in all treatments. The best germination rate and percentage were recorded in hydropriming treatment with three-hour soaking followed by a six-hour soaking period and one hour soaking period. While nutripriming using type A at 0.2% concentration showed opposite distinct results compared to type C biostimulants at 0.2% and 0.4% concentration. All treatments for the priming method showed a significant result in root development especially in biopriming, however it does not affect the shoot length in all varieties. The root– shoot weight was also not significant for biopriming effect. From these laboratory results it showed that biostimulants using microbes had a potential for direct use. Testing in nursery condition with the priming seed and direct application of microbes showed significance of more root formation and higher fresh weight of the germinated seedlings. Clearly, seed priming and application of biostimulants did enhance germination which leads to uniform growth and more root formation in the seedlings.

Keywords*: biostimulants; priming; germination*

PS3A-2
Pool size of Microbial Biomass Potassium in Various Farmland Soils

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Abstract

Potassium (K) is the major intracellular cation in all kinds of organisms including soil microorganisms. This study for the first time presented the potassium pool size in microbial cells in various farmland soils and the effect of land use and organic matter application on the contents. Microbial biomass potassium was determined for several paddy field soils under various managements in different areas, together with some upland, orchard, and pasture field soils, to estimate the potassium pool size in microbial cells in the farmland soils. The contents of microbial biomass potassium ranged from 9 to 65 mg K kg^{-1} soil in the paddy field soils and showed no difference among soil groups of the paddy fields. The biomass potassium content was higher in the pasture field (183–187 mg K kg^{-1} soil) than that in the paddy, upland (8–51 mg K kg^{-1} soil) and orchard (25–50 mg K kg^{-1} soil) field soils. The average ratio of microbial biomass potassium to exchangeable potassium was 0.25 for all the soils and the average values for paddy field (0.31) and pasture field (0.53) soils were higher than those for upland field (0.06) and orchard field (0.08) soils. Positive correlations were found between the contents of microbial biomass potassium and microbial biomass carbon and nitrogen. Application of organic matter significantly increased microbial biomass potassium in the farmland soils. These findings indicate that microbial biomass potassium plays an important role in potassium supply to crops as a reservoir of potassium and also suggest that the contribution of microbial biomass potassium to the potassium source for crops could be relatively higher in paddy field and pasture field soils than upland field and orchard field soils.

Keywords**:** *exchangeable potassium; farmland soil; land use; organic matter application; soil microbial biomass potassium*

PS3A-3
Polyhalide Application on Growth of Rubber Seedlings under Rain Shelter Condition

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Abstract

Polyhalide can be used as an excellent solution to increase natural rubber production sustainably while preserving the environment through the efficient planning of agro-management. Polyhalide (Ph) which are contains natural combination of potassium (14% K_2O), sulphur (19% S), magnesium (6% MgO) and calcium (17% CaO), is a potential new cost-effective S-fertilizer because of high of S and also holds the added bonus of having valuable amounts of K, Ca and Mg. The objective of the study was to determine an optimum rate of Ph to be applied in combination with nitrogen (N) and phosphorus (P) fertilizers, with an innovative fertilizer formula for growth of rubber seedling under rain shelter conditions. Three-months-old rubber seedlings from RRIM 2002 clone were placed in medium size polybags (12" x 12"), filled up with 5 kg of Bungor Series (an Ultisol) and Munchong Series (an Oxisol) were conducted at Field 15 rain shelter, Faculty of Agriculture, Universiti Putra Malaysia. The experiment was set up in a Randomized Completely Block Design (RCBD), with ten replications. The soils were treated with nine levels of fertilizer rates at three months interval (0, 3, 6 and 9 months) which were T1 [NPKMg (using RISDA 1 fertilizer compound grade 10.7:16.6:9.5:2.4)], T2 [NP], T3 [NP+Ph (50% `equivalent amount to recommended K rate of RISDA 1)], T4 [NP+Ph (75% `equivalent amount to recommended K rate of RISDA 1)], T5 [NP+Ph (100% equivalent amount to recommended K rate of RISDA 1)], T6 [NP+Ph (125% equivalent amount to recommended K rate of RISDA 1)] and T7 [NP+Ph (150% equivalent amount to recommended K rate of RISDA 1)]. The results showed significant differences were observed among treatment levels ($p \leq 0.001$). Significant differences were also observed in plant height increment, leaf area, root volume increment and root to shoot ratio of rubber seedling at 3, 6 and 9 months after treatment application. While, girth increment, chlorophyll content and root length increment of rubber seedling displayed significant differences across treatment levels ($p \leq 0.001$) at 3, 6 and 9 months after treatment application. However, no significant differences were observed between soil series except at 6 months after treatment application. The growth of the rubber seedlings was enhanced (3.32-8.54% of enhancement) using T5, which is 100% equivalent to the recommended potassium rate of RISDA 1 (fertilizer that is commonly applied by the farmers) compared to other treatments. In conclusion, polyhalide could potentially be used as an alternative fertilizer for rubber seedlings.

Keywords: *mineral fertilizer; growth parameter; K fertilizer*

PS3A-4
Effects of PEG-Induced Water Potential, Mechanism of Drought Tolerance in Rice (*Oryza Sativa L.*) Seedling Roots

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Abstract

Global climate change is leading to elevated CO_2 level and temperature as well as unusual rainfall patterns, limiting suitable water supply for crop production. Drought imposes a vital stress in plant growth and development with a huge alteration of physiological metabolism related to photosynthesis and water/ion uptake. In terms of influx/efflux of water and ions, the suberin, deposited in root endodermis, plays a key role for in/out of water as a physical barrier. Therefore, it is important to expand our knowledge of how plants cope with drought with suberization, and this provides a clue to develop drought-resistant/tolerant strategies. To do this, we employed three-weeks-old rice seedlings with diverse water potentials using polyethylene glycol (PEG) 6000. Rice seedlings were grown under aerobic containers including 1/2-strength of Hoagland nutrition with four levels of water potential (0. 8, 10 and 20 % of PEG 6000). The roots were carefully harvested after 7 days of the initiation, and used for gene expression, ABA- and suberization-related genes, qRT-PCR. The expression patterns of selected genes were greatly dependent upon the strength of drought, moderate (8%, initial wilting), severe (10%, permanent wilting) and irreversible (20%). In the range of initial to permanent wilting point, ABA biosynthetic- (*OsNCED1*, *OsABA2*) and ABA signaling-genes (*OsPP2C09*) were 2 to 8-times higher compared to the control (1/2-strength of Hoagland nutrition only), and suberin biosynthetic-genes (*OsCYP86B1*, *OsGPAT5*, *OsGPAT16*) significantly increased by 5 to 12-fold. On the contrary, the expression of those genes was not perturbed at an irreversible water stress (extreme drought), indicating an overload of drought-responsive mechanism in roots. Finally, it was found that physiological defense via the development of a physical barrier against drought stress was within the range of wilting point of plants, and, together, further direction should be implemented why ABA-mediated suberization is inhibited under extremely negative water potential using high throughput techniques, i.e. omics.

***Keywords**: drought; water potential; ABA; suberin; root*

PS3A-5
Effect of Illite-containing Fertilizer on Growth, Nitrogen Uptake and Antioxidant Activity of Lettuce Plants

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Abstract

Illite, a 2:1 clay mineral of silica-alumina-silica layer, includes high potassium (K) content. Despite being used as a material in various industries including agriculture, the relatively insufficient physico-chemical properties such as relatively low cation exchangeable capacity (CEC) limit its usage in agricultural practices. The aim of this study is to investigate effects of illite-containing prototypes on growth and antioxidants of lettuce. To achieve these goals, we made three types of illite-containing prototype; 1) illite + soil amendment (CB-1), 2) illite + NPK (CB-2) and 3) illite + compound fertilizer (CB-3). Two-weeks-old lettuce seedlings (cv. Cheongchima) were transplanted plastic containers (0.2 x 0.2 x 0.3 m) including illite, NPK, CB-1, CB-2 and CB-3, and application rates were calculated as a result of soil diagnosis. We also used two types of soils with different soil pH (acidic, 5.1; alkaline, 8.0). Lettuce samples (n=3) were harvested 30 days after transplanting. In acidic soil, lettuce growth tended to increase in all illite treatments containing soil amendment or fertilizer compared to the control, in contrast, it was not significant in alkaline soil due to higher levels of mineral nutrients. Nitrogen content (mg g^{-1}, DW) in both acidic and alkaline soils was significantly higher in CB-2 and CB-3 compared to other groups. Antioxidants such as total polyphenol and flavonoids, and ABTS+ and DPPH radical scavenging activities were compared between treatments. Antioxidant activity was the highest in illite-only treatment in acidic soil, by contrast, in the control in alkaline soil. In conclusion, the treatment of illite-containing fertilizer is effective for improving soil pH, EC, lettuce growth and nitrogen uptake, however, has little effect on antioxidant activity. Therefore, it is suggested that illite-containing fertilizers could be used as alternative resources for soil amendment and crop growth promotion.

***Keywords**: illite, illite-containing fertilizer, growth, nitrogen uptake, lettuce*

POSTER SESSION 3B

PS3B-1
Investigation of *Bacillus* consortium Immobilized on Oil Palm Kernel Shell Biochar on Growth Performance and Metabolite Profiles of Oil Palm Seedlings *(Elaeis guineensis)*

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Abstract

Biochar is derived from the thermal degradation of biomass, and it serves as a potential carrier for microbes in several biotechnological applications including the agriculture sector. One of the common agricultural biomasses converted into biochar in Malaysia is the oil palm kernel shell (OPKS). Over the years, research has shown the practicability of this material to be used as a carrier for effective microbes designed for bioremediation purposes, but little is known about its potential to be utilized as an inoculant carrier for agriculture use. Hence, an experiment was conducted to immobilize *Bacillus* consortium on oil palm kernel shell biochar using a central composite design (CCD) where the inputs are the operating parameters such as temperature, agitation speed, pH and sago starch concentration as co-carbon source, with bacterial viability (CFU/mL) as the output. The optimized formulation (PKSBBc) was applied on 3-months old oil palm seedlings (*Elaeis guineensis*) for a duration of 6 months with the following treatments: T1: Control, T2: 100% chemical fertilizers (CF), T3: 100% OPKS biochar, T4: 100% *Bacillus* spp., T5: 100% PKSBBc, T6: 50% PKSBBc + 50% CF and T7: 30% PKSBBc + 70% CF. From the kinetics analyses, linearized PSO with R^2 value higher than 0.90 for all *Bacillus* strains and *Bacillus* consortium was observed. Meanwhile for the isotherm studies, all data fit Freundlich isotherm indicating that the bacterial cells may adhere on the heterogeneous surface of the material. OPKS biochar surfaces were suitable for the attachment of the biofilm from the *Bacillus* spp. due to the presence of several functional groups that encourage EPS production. The immobilization of *Bacillus* consortium on OPKS biochar can be achieved by optimizing the operating parameters: temperature should be 33 degrees Celsius, pH 7.50, agitation rate of 145 rpm and 10% (w/w) of sago starch, to have an optimized formulation of co-carbon source such as the starch. From the glasshouse trial, the 30% application rate of optimized OPKS biochar immobilized with *Bacillus* consortium could reduce the usage of chemical fertilizer usage in the oil palm seedlings nursery as the growth is comparable to treatment using 100% of chemical fertilizers.

Keywords: *Elaeis guineensis; biochar; probiotics; metabolomics*

PS3B-2
Synthesis of Zero Valent Iron (ZVI) Using Green Tea by-products and Evaluating Its Removal Efficiency of As(V)

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Abstract

Zero Valent iron (ZVI) is in the spotlight as a new method of treating contaminated soil and groundwater, mainly targeting chlorinated organic pollutants, inorganic anions, and metals. Polyphenol is a substance with an antioxidant effect and is easily reduced, so it is suitable for synthesis of ZVI. Among various plants containing polyphenols, ZVI was synthesized using by-products of green tea, which is commonly cultivated in South Korea. In this study, polyphenols from green tea by-products were extracted under various conditions, and ZVI was synthesized using the extracts (GT-ZVI). In addition, As(V) removal efficiency of GT-ZVI was evaluated. The results of the green tea by-products showed that the polyphenol content was found to be high in the order of $EtOH_{50}$ > 80 ℃ distilled water > 60 ℃ distilled water. The average total polyphenol contents for green tea by-product were 18.1 GAE mg g^{-1}. The experiment was conducted with a solid-liquid ratio of green tea by-product and distilled water of 1-30% (w/v), and the highest value was 15-25%, but 15% was observed to be the most economical extraction condition. As the result of analyzing GT-ZVI with Nano Tracking Analyzer (NTA), 50% (D50) of GT-ZVI was composed of particles of about 240 nm or less. As a result of reacting GT-ZVI with As (V) at 0-1,000 mg L^{-1}, GT-ZVI rapidly adsorbed As(V) in aqueous solution and reached the maximum adsorption amount of 166.67 mg g^{-1} after equilibrating for 6 hours. The GT-ZVI synthesized from green tea by-products are organic resources that can be recycled in an environment-friendly way, and it can be applied to soils and wastewater contaminated with heavy metals because of its high efficiency in removing As(V) in aqueous solution. However, further studies on biotoxicity along with persistence will be needed.

Keywords**:** *ZVI; As(V); adsorption; green tea; polyphenol*

PS3B-3
Macro and Micromorphological Characteristics of Soils at the Abandoned Fields of Mines, Ningyo-toge, Japan

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The Ningyo-toge mine is a uranium mine that has stopped operating. This mine is dominated by granite and the mining activities carried out there include mining and smelting in the 1950s through the 1980s. After that, in order to restore vegetation, sandy soil was moved to the open-pit excavation. The vegetation of open-pit excavation mining sites has not evolved twice over time. The present work was conducted to understand the soil macro and micromorphological characteristics of the open-pit excavation site. The study site was the Ningyo-toge open-pit mine. The Ningyo-toge uranium mine is located around the boundary between Kagamino-cho, Tomata-gun, Okayama Prefecture and Misasa-machi, Tohaku-gun, Tottori Prefecture. The mean annual precipitation is 2632 mm, the mean annual temperature is10.3 ℃. In this area, *Miscanthus* was the dominant vegetation. We selected two sampling sites (Site A and Site B). In site A, the vegetation is *Miscanthus*, in site B the vegetation is *Cyperus microiria*. Soil samples were taken from each horizon of the soil profiles for chemical analysis. The thin sections were prepared from soil core samples (0-5cm, 10-15cm, 30-35cm depth of site A and site B). The results show that in the open-pit excavation of the Ningyo-toge mines, the BC horizon of Site B has a lower Eh, which may be due to the less voids in the underlying soil, which results in seasonal accumulation of water. And the soil thin section observation showed that the 0-5cm of soil is in good structure, but the soil in the lower layer is not fully developed and it has a blocky structure. External human factors have a large influence by mixing a large amount of black residue and wood chips. In addition, the content of the five speciations of Fe and Mn are in the order of: the residual form > oxide-bound form > organic-bound form > carbonate-bound form > exchangeable form at this study site. The content of the exchangeable form, which is the main form of which Mn and Fe can be adsorbed, was very low in the soil. But, the content of oxide-bound form was very high, and this form can be converted into the exchangeable form under appropriate water content and the redox potential. Therefore, this can be a potential source of Mn excess. The electron probe micro-analysis (EPMA) results showed that in an area where the Mn concentration was high, high concentration of Fe can be detected at the same area. This indicates that the distribution of Mn is related to the distribution of Fe.

Keywords: *ecology; abandoned mine; soil analysis*

PS3B-4
Effects of Bauxite Mining to Nutrient Availability in Oil Palm Plantation

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Abstract

Mining activities have caused the disruption of nutrients availability in soils. The current status of soil in the ex-bauxite mining area in Kuantan is still unknown. Evaluation of nutrients in large areas is difficult to manage, hence the use of geographic information system (GIS) to quantify the soil spatial variability is important. This study focused on the geospatial evaluation of nutrients using GIS and geostatistical tools in a mined bauxite area at Bukit Goh, Kuantan. The findings from this study showed the availability of exchangeable nutrients in the soil samples was in the following order: $K_{ex.}$>$Ca_{ex.}$>$Fe_{ex.}$>$Mg_{ex.}$>$Zn_{ex.}$>$Mn_{ex.}$>$Cu_{ex.}$ which were at considerably high concentrations. Geospatial mapping provides a good visualization in determining hotspot areas which later can be used for soil rehabilitation programmes. Based on the coefficient of variation value, the occurrence of all nutrients was more than 35% indicating the possibility of anthropogenic inputs. The Pearson's correlation coefficient showed a significant positive correlation between Mg, K with Mn; Mg, Mn with Fe; and Fe, Cu with Mn. This is in line with the principal component analysis (PCA) results that showed Mg, Ca, Mn and Fe were interrelated as they were in the same group, indicating the same source of origin. Soil pH showed a negative correlation with all exchangeable nutrients except K and Zn, while total organic carbon (TOC) showed negative correlation with Ca. Otherwise, all exchangeable nutrients had poor correlation with pH and TOC. The findings of this study were crucial to monitor the current soil status and provide initial remediation activities for abandoned mining sites.

Keywords**:** *nutrients;oil palm; geographic information system (GIS)*

PS3B-5
Estimation of Soil Texture using AutoML Vision Edge

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Abstract

Soil texture can be estimated by the composition of particles viz sand, silt, and clay. Visual inspection with naked eyes, and the 'hand-feel' method by experts are the most common techniques used in the on-site study to estimate the soil texture. However, employing these methods requires an expert with many years of experience and labour consumption. Thus, this study aims to develop an automated tool that can estimate the soil texture using AutoML Vision Edge. A total of 1080 soil images representing three classes of soil particles (sand, silt, and clay) were used as training data sets to construct predictive models using Artificial Neural Networks (ANNs). The particles in soil images were obtained using object detection. The confidence scores of each particle were then extracted and used to build the predictive models. The accuracy performance of the predictive models was measured using the independent testing dataset with 105 soil images. As a result, the best predictive model can estimate the soil texture with an average accuracy of 93.0% (mean precision: 0.94, mean recall: 0.94, F1-score: 0.94). In addition, a mobile app was also developed, and the best predictive model embedded into it. Overall, this finding shows that the mobile app can be used as an alternative tool to estimate the soil texture automatically. With further improvement, in the future, there is a possibility to use it during the on-site study.

Keywords**:** *soil particle analysis; machine learning; ANN; mobile app*

POSTER SESSION 3C

PS3C-1
Land Area Potential for Grain Corn Plantation Using GIS: Case Study of Northern Peninsular Malaysia

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Abstract

Grain corn plantation is expected to rise following the interest from government bodies and private sectors due to the high demand for livestock food supply as well as concerns for national food security. However, grain corn is scarcely planted ever since the 1990's attributed to higher costs of production with lower returns. The lack of suitable land is one of many contributing factors hindering farmers to plant grain corn due to the low yields, which is very much linked to the soil and land issues. In this study, the Geographic Information System (GIS) was used to find suitable areas for optimal grain corn growth based on the soil properties as well as the current land use within the Northern Peninsular region with clear dry month period. Analytical hierarchy process (AHP) coupled with a Weightage Overlay method was used to categorize four types of classification, including restricted, unsuitable, marginal and suitable area for grain corn plantation. The results showed that of the three states of Perlis, Kedah and Pulau Pinang, 43.7% of the areas were classified as marginal, 15.3% as unsuitable, and only 2.7% as suitable areas. Early findings indicated that the majority area of Northern Peninsular fit the necessary criteria for grain corn plantation, however, intervention and appropriate management practices are needed for optimal plant growth. Thus, it can be determined that GIS with addition to geo-statistics could serve as one of the potential methods for locating arable land for ideal grain corn plantation.

Keywords: *geospatial; maize; AHP; weightage overlay; geostatistics*

PS3C-2
Combined Use of DOC Coagulants and Lime for a Simultaneous Decrease of Heavy Metal(loid)s Phytoavailability in Agricultural Soils

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Abstract

Heavy metals have a higher affinity to dissolved organic carbon (DOC) than to soils. This means that decreasing DOC is one of the ways to reduce plant-available heavy metal(loid)s in soils. This study aims to find effective DOC coagulants for use in heavy metal-contaminated agricultural soils. Three coagulants, AlS, Al(II)S, and phosphorus gypsum (PG), were treated in isolation and with 0, 0.2, 0.5, and 1 % lime. Lettuce was grown in each treatment, and heavy metal concentrations in lettuce leaves were analyzed. Also, plant-available heavy metal(loid)s, DOC, and pH changes in each soil were analyzed. When the coagulants were treated in isolation, soil pH showed no significant changes, but DOC decreased in every treatment. As in lettuce were remarkably reduced in every treatment, but Pb had no difference. This was because of the different chemical movements of anion and cation. Usually, the cation movement decreases with increasing soil pH, so lime was added to each treatment with different ratios. After lime was added, all of As, Cd, and Pb were noticeably reduced with decreasing DOC of the soils and increasing soil pH. Under 0.2~0.5 % lime treatments, soil pH 7~7.5 was maintained effectively reducing plant-available heavy metal(loid) and increased plant growth. In conclusion, PG with lime treatment would be better used for agricultural soils to decrease plant-available heavy metal(loid)s and positively affect plant growth.

***Keywords**: heavy metals; lime; phosphorus gypsum; phytoavailability*

PS3C-3
Soil Carbon Dynamics of Oil Palm following Replanting

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Abstract

Oil palm (*Elaeis guineensis* Jacq.) absorbs carbon dioxide (CO_2) via photosynthesis throughout its growth. Excess photosynthates produced by oil palm will be excreted out into the soil via root exudation and will eventually be part of the soil organic carbon (SOC). Oil palm fronds (OPF) which are periodically pruned are commonly left on the soil surface to decompose and will form SOC. Absorbed CO_2 through photosynthesis forms the structural component of the standing palm, storing the absorbed carbon in the palm's biomass. However, all the absorbed carbon throughout the growth of oil palm is quasi-permanent. Replanting of oil palm disrupts the physically protected SOC which exposes it to the elements and microbial decomposition, resulting in the release of carbon to the atmosphere as CO_2 emission. The decomposition of the felled palm will potentially result in emissions of CO_2, although a portion of the carbon in the biomass will be transformed to SOC. The question that arises is, will all the absorbed carbon from the previous planting cycle be completely lost as CO_2 after replanting or will a portion of it be retained as soil carbon? The present study quantified the soil carbon of an oil palm ecosystem that is at the end of its economic cycle, a newly replanted oil palm ecosystem and oil palm that are in the early to mature stage to determine its carbon dynamic due to replanting. As most oil palm plantations in Peninsular Malaysia are established on inland and coastal soil, the study was conducted at two sites, one on coastal soil while the other on inland soil. The study was conducted at Sime Darby Carey Island Estate, Selangor (coastal soil) and oil palm plantation around UPM campus managed by Pusat Pertanian Putra (inland soil). At both sites, dynamics of soil carbon was measured by taking soil samples from the 0-15 cm layer on oil palm ages 5, 10, 15 years old, and newly replanted oil palm (inland soil) and ages 4, 14, and 24 years old (coastal soil). For each age, soils were sampled at the three distinct sections within an oil palm tree; the frond heap pile (FH), the harvesting path (HP), and the inter-row (IR). Five measurement replications were made at the three sections within each age. At the coastal soil plot, soil carbon was only significant between plot ages 4 years old (4.34±1.42%) and 24 years old (3.46±0.69%). Between sections, soil carbon was significantly lower at WC (3.35±1.04%) compared to the HP (4.39±1.20%). Meanwhile, at the inland plot, the mean soil carbon content was 2.24% but there was no significant difference between ages in all plots. Meanwhile between sections, the soil carbon at FH (3.10±1.42%) was significantly higher than the other sections. Our results showed that age was not the main factor that influenced soil carbon. The different sections of the plantation yielded different results hence measurements of soil carbon should consider these different sections to properly represent the whole plantation.

Keywords**:** *oil palm; soil carbon; inland soil; coastal soil*

PS3C-4

Effect of Organic Resource Treatment on Greenhouse Gas Emission During Organic Rice Cultivation

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Abstract

Compared to conventional agriculture, organic farming not only reduces greenhouse gas emission during cultivation, but also plays a positive role in the ecology, such as soil carbon storage and biodiversity enhancement. However, research on greenhouse gas emission by organic farming so far is limited. Therefore, this study was carried out to find out the effects of various organic matter and water puddles on the amount of greenhouse gas emission during organic rice cultivation. After cattle manure was applied to the entire rice paddy, 5 treatments were prepared: C (Control), G (Green manure return), R (Rice straw return), PG (Puddle + Green manure return), PGR (Puddle + Green manure return + Rice straw return). Rice was transplanted on June 26, 2020, and was harvested on November 2, 2020. CH_4, CO_2, and N_2O emissions were measured 8 times during rice cultivation with Gasmet (Gasmet Technologies, Vantaa, Finland). The measured amounts of CH_4, CO_2, and N_2O were converted to the amount of gas emission during the entire cultivation. The global warming potential (GWP) was calculated with the amount of gas emission. Treatment G showed the highest GWP, which is three times higher than C. The amounts of CH_4 and CO_2 emission were the lowest at treatment PGR. Presence of puddles showed less CH_4 and CO_2 emission compared to the absence of puddles.

Keywords: *organic farming; greenhouse gas; global warming potential*

PS3C-5
The Combined Use of Chemical and Organic Fertilizers for Maize Production and Soil Fertility

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Abstract

Soil nutrient management is necessary to improve soil quality and agricultural production and the combined use of chemical and organic fertilizers is considered a good method to sustain high crop yield. The aim of this study was to investigate the combined effects of different chemical fertilizer application rates with organic fertilizer (compost) on maize growth performance and soil chemical properties under field conditions. Also, this research was conducted to develop a yield predictive model of maize based on the soil inorganic nitrogen (NH_4^++NO_3^-), available P and exchangeable K content. The application of organic fertilizer to the soil increased soil available P proportional to the amount of organic fertilizer applied. Also, the maize yield predictive linear regression model developed through soil fertility showed that soil available P content was the most important factor toward yield prediction followed by soil inorganic nitrogen and exchangeable K content, respectively. These results will be useful for soil nutrient management for agricultural production.

Keywords: *soil fertility; maize; yield prediction; sustainable agriculture; fertilizer*

POSTER SESSION 3D

PS3D-1
The Nature and Properties of Tanjung Lipat Soil Family at Bongawan Papar Sabah

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Abstract

Utilization of ultisol is dominated by plantation crops such as rubber, oil palm and cocoa with diverse agricultural crops due to the suitable climatic condition and favourable physical soil properties even though the fertility level is low. Determination of the nature and properties of these soils is very important. One of the major families in the Ultisol in Sabah is the Tanjong Lipat Family. In this project, the pedon of Tanjung Lipat Family (Orthic Acrisols - FAO, Typic Paleudults - USDA) located at hilly area with coordinates N 05° 31' 49.8''/ E 115° 56' 03.0''. For the landform description, the physiographic position of the site was lower slope and microtopography is hummocky. The slope of the site was 23° in a single slope which means steeply sloping. Major vegetation was secondary forest and bamboo. As we went down the soil profile, the soil color changed from brownish yellow to reddish yellow. The soil texture changed from clay loam (Horizon Ap) to sandy clay loam (Horizon Bt1). The soil structure was all subangular blocky for every horizon and the grade is weak to moderate. There were abundant very fine and frequent fine roots in Horizon Ap and few fine and medium roots at horizon Bt2. There are typically well and moderately well drained soils occurring on a range of gentle to intermediate slopes from ridgetops to lower slope positions. Orthic Acrisols are soils having an argillic B horizon (accumulation of clay by downward movement) and a base saturation of less than 50 percent within 125 cm of the surface. Tanjong Lipat Family contains 25 to 40 percent clay in the argillic horizons with A, Ab and a few Bt horizon sequences. Soil organic carbon was in the range of 0.25% to 1.62% which was highest in Horizon A and lowest in Horizon Bt1. Most of the soil texture found in this profile were sandy clay loam except Horizon Ap and Bt2 which was clay loam. The silt components decreased not consistently as we went down the soil profile in the range of 17.95-32.00%. Contrary to the silt, the fine sand increased with depth, the range is between 35.80 - 59.86%. Soil pH values determined with water were less acidic than the soil pH determined with 1 M KCl, both were in the range of 4.02-4.32 and 3.23 – 3.65 respectively. This rating shows that the soil was either strongly acidic or extremely acidic.

***Keywords**: Tanjung Lipat family; ultisol; clay; argillic; endopedon*

PS3D-2
Effect of Polyhalite Fertilizer on Yield and Quality Improvement of Rockmelon in Soilless Culture

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Abstract

The objective of this field study is to evaluate the effects of polyhalite fertilizer to the yield and quality of rockmelon in soilless culture. Three fertilizer treatments namely; the recommended hydroponic AB set (T1), the standard farmer's practice (T2), and Hydroponic AB set with additional polyhalite fertilizer (T3) were evaluated for enhancement of vegetative growth, yield and fruit quality of rockmelon in soilless culture. Results showed that application of polyhalite in addition to the hydroponic AB set treatment produced higher average fruit weight compared to treatments without polyhalite. Sensory attribute mean scores obtained from a consumer panel showed preferred color and texture of the fruits treated with polyhalite, most likely due to the availability of secondary nutrients such as calcium and magnesium in sulphate form. Next, polyhalite application could reduce the buffer treatment of the cocopeat medium, thus providing additional savings in fertilizer and labour costs. In conclusion, polyhalite application has considerable potential for enhancement of yield and quality of rockmelons cultivated under soilless culture.

Keywords: *polyhalite; fertilizer; yield; quality; soilless culture*

PS3D-3
Dual coated Bacillus salmalaya 139SI as Sustained Release Biofertilizer for Plant Growth and Soil Nutrient Enhancement

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Abstract

One of the issues the agriculture sector is currently facing on a worldwide scale is how to produce crops sustainably for a population that is expanding quickly. As a result, chemical-based fertilisers are now widely produced and used because of their important function in promoting plant development and maximising agricultural productivity. The majority of fertilisers, however, can be harmful to people while degrading soil fertility and causing eutrophication. Instead, the employment of bacteria based on plant growth promoters helps to boost plant growth under a variety of stress circumstances. Unfortunately, temperature and other environmental conditions cause bacterial activity to decline. A straightforward double coating bio-polymer approach was used in this investigation to create the dual coating of *Bacillus salmalaya* 139SI, consisting of rice protein/alginate capsules coated with 0.5% low molecular weight chitosan. Systematic research has been done on the effects of the biopolymer to bacteria mass ratio, cross-linker concentration, and chitosan pH on the coating process, shape, and bioactivity features of coated *Bacillus salmalaya* 139S1. Using a biopolymer formulation of 3% sodium alginate, 1% brown rice protein isolates, cross-linked by 0.15M calcium chloride, and double coated with 0.5% chitosan at pH 6, *Bacillus salmalaya* has been successfully coated for the sustained release of biofertilizer in soil application. This is further morphologically confirmed by the presence of bacterial rod-like structures on the crushed layer of capsules. Based on the morphology and bioactivity properties in several time intervals, it can be concluded that dual coated *Bacillus salmalaya* 139SI using a simple double coating bio-polymer technique has the potential for plant growth and soil nutrient enhancement by sustained release due to the degradation of the coating biomaterial.

Key words: *soil nutrient; PGPR; biofertilizer; coating biomaterial*

PS3D-4
Determination of Nitrogen and Potassium Requirements of Different Textural Soils in Screenhouse for Increased Potato Yield

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Abstract

Since nitrogen and potassium are the first two crucial nutrients for potato nutrition, a glass house experiment was conducted in October, 2020 to assess the effect of different rates of nitrogen and potassium on different textured soils on potato growth and yield. The experiment was conducted in three different textured soils in pots in a glasshouse in the National Potato Research Program, Khumaltar. The 3 types of soil were silt loam, sandy loam, and loamy sand. The pot was 40 x 24 x 24 cm in dimensions. The different nitrogen and potassium rates were based on fertilizer recommendation for potato i.e., 100:100:60 kg/ha NP_2O_5:K_2O. The phosphorus is kept constant in all treatments. The experiment consists of 3 factors; nitrogen rates, potassium rates, and soil texture and was conducted in a factorial RCB design. The nitrogen was applied at the rates 50, 100, 150 and 200 kg/ha. One treatment was made with no any nitrogen added i.e., without any nitrogen fertilizer. The potassium was applied in 4 rates as 30, 60, 90, 120 kg/ha. The total treatments were 49 and replicated thrice. The variety was Janakdev which was a full season variety and also late blight resistant. In sandy loam type soil, the highest yield (547 gram/plant) was observed with Nitrogen 200 kg/ha and Potassium 90 kg/ha**.** In loamy sand type soil, the highest yield is given by (504 gram/plant) the treatment nitrogen 100 kg/ha and potassium 90 kg/ha. In silty loam type soil type, the highest yield is 442 gm/plant provided by nitrogen 100 kg/ha and potassium 90 kg/ha. It can be concluded that whether we increase nitrogen up to 200 kg/ha, the yield is optimized by potassium at a higher rate up to 90 kg/ha for increased potato yield in different textured soils. Also, sandy loam type soil is best for potato high yield production.

Keywords*: soil texture; resistant; nitrogen; potassium; recommendation*