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ABSTRACT BOOK

The Organizers

Vietnam Society of Soil Science (VSSS),
The East and Southeast Asia Federation of Soil Science Societies (ESAFS),
Thai Nguyen University (TNU),

In collaboration with

Soils and Fertilizers Institute (SFRI),
Thai Nguyen University of Agriculture and Forestry (TUAF),
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International School of Thai Nguyen University (ISTNU),
International Union of Soil Sciences (IUSS)
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ESAFS 2024
Documents

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KN1

Precision agriculture in soil, plant nutrition and fertilizers
Crop Imaging for Phenotyping and Precision Agriculture

Prof. Steve Shirtliffe (Canada)
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Abstract

Western Canada Agriculture: Spring seeded annual crops (wheat, canola, barley, oat, lentil, pea), short season, dry climate (water normally limits yield), very large farms (no-tillage agriculture, 1000- >5000 ha, large fields 50-200 ha). Highly variable land in many locations, concerns about agriculture, need agronomic methods to manage variability. Digital Agriculture in Managing spatial and temporal variability. Estimating Soil Organic Carbon using archived satellite imagery. Computing platform: Google Earth Engine. Cloud based repository and analytical engine for earth observation data. Precision technology to map, model and classify in Canada. Prairie Precision Sustainability Network Marginal land mapping. Activity 1: Build a network of growers. Activity 2: Develop techniques to identify and cost marginal areas at the field-level. Activity 3: Map marginal areas across regions using satellite imagery. MAP yield, marginality and profitability. Estimates of marginal acreage by grower, crop and year. Use yield maps to train machine learning model of remotely sensed variables to classify marginal land. Within-field spatial variability in crop productivity. Yield estimation- harmonic map in Extract long-term biomass accumulation/productivity. Vision: Map and understand within field spatial variability in crop yield for EVERY field in Western Canada.

Key words: *Crop imaging, phenotyping, precision agriculture*

KN2

How to Achieve Carbon Neutrality in Staple Food Production in China

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Abstract

To meet the staple food requirement of the 1.4 billion population, China produces more than 600 million ton of rice, wheat and maize each year, with large consumption of water and chemical fertilizer, making a major contribution to national greenhouse gas emission. It has been unclear whether it is possible to make the staple food production carbon neutral.. Here, through a comprehensive life-cycle assessment the greenhouse gas emission rom crop production in China, we show that an integrated biomass pyrolysis and electricity generation system coupled with commonly applied methane and nitrogen mitigation measures can help reduce staple crops' life-cycle greenhouse gas emissions from the current 666.5 to −37.9 Tg CO_2-equivalent yr^{-1}. Emission reductions would be achieved primarily through avoiding crop residue returning to rice paddy, carbon sequestration from biochar application to the soil, and fossil fuel displacement by bio-energy produced from pyrolysis. We estimate that this integrated system can increase crop yield by 8.3%, decrease reactive nitrogen losses by 25.5%, lower air pollutant emissions by 125–2,483 Gg yr^{-1} and enhance net environmental and economic benefits by 36.2%. These results indicate that integrated biochar solutions could contribute to China's 2060 carbon neutrality objective while enhancing food security and environmental sustainability.

Key words: *crop production, methane mitigation, carbon sequestration, biochar*

KN3

Heavy metal pollution: Current situation, challenges and solutions for agricultural land in Vietnam

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Abstract

Heavy metal pollution in agricultural soil is a major challenge for agricultural countries around the world, especially Vietnam where agriculture is currently ensuring the livelihoods of over 60% of the population living in the rural areas, accounting for 30% of the country's labor force and nearly 12% of GDP. Heavy metal pollution in soil tends to increase every year, having many negative impacts on soil quality, environment, ecology, and consequently affecting the quality of agricultural products and threatening human health. The goal of the presentation at this ESAFS -14 conference is to share and exchange scientific information, experiences as well as policy directions on the problem of heavy metal pollution in agricultural soil in Vietnam. The main contents that will be presented include 3 major issues: (1) Sources of pollution and the current situation of heavy metal pollution in agricultural soil; (2) The results of research and application on treatment of heavy metal pollution in agricultural soil that are suitable for Vietnam's conditions; (3) Policies and solution strategy of Vietnam related to preventing heavy metal pollution in soil. Regarding situations and sources of heavy metals in agricultural soil in Vietnam, current research data showed that beside small amount of heavy metals already presented in soils were from rocks and parent materials, there are large amounts of heavy metals in the soil from human impact factors, such as excessive use of agricultural chemicals, use of polluted irrigation water, industrial and mining wastes, in which mineral exploitation has become an important source of heavy metal pollution in agricultural soils. For treatment of soil heavy metals, bioremediation and physical-chemical measures have been researched and applied widely in Vietnam. Bioremediation methods using mainly native plant species to absorb heavy metals, and/or combining plants with heavy metal adsorbing microorganisms, have been proven to be very effective and suitable for economic conditions in developing countries like Vietnam. For physical and chemical measures, focus on manufacturing and using environmentally friendly adsorbent materials such as biochar products from agricultural residues, combined with adsorbent materials manufactured using the modern methods such as modified nanomaterials compounded with layered double hydroxides to adsorb/immobilize many heavy metals including cations and anions. Vietnam's management and policy solutions related to heavy metals in agricultural soil will be mentioned, including some current government regulations on heavy metal standards in soil and agricultural products; regulations and guidelines to limit sources of heavy metal contamination in soil.

Keywords: *Soil, heavy metals, challenges, remediation, policy, Vietnam*

KN4

Current knowledge on the storage and fate of organic carbon in global soils

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Abstract

Soil organic carbon (SOC) determines multiple ecosystem services that soils provide to humanity. However, land use and climate change may alter the current soil carbon balance and convert the land surface into either a source or sink of atmospheric CO2, altering soil properties and functions. Using a large number of global soil profile observations, environmental datasets, and a variety of modeling approaches, we conducted studies to (1) quantify the magnitude and uncertainty of global and regional SOC estimates, (2) predict SOC changes under projected climate extremes, and (3) investigate how the Coupled Model Intercomparison Project phase six Earth System Models project the future changes in global SOC stocks. We found large ranges in global estimates of surface (0-30 cm) and profile (0-1m) SOC stocks with varying predictive accuracies across depth intervals and biomes. Comparatively, the SOC estimates for cropland were more accurate than those of other biomes. Our results show distinct, biome-specific effects of climate extremes on SOC dynamics, with most extremes (22 out of 33 assessed extreme types) causing SOC loss globally. In contrast, the CMIP6 Earth System Models predict global soil carbon gain under the high emission scenario. In summary, substantial knowledge gaps exist in our understanding of both the current global SOC storage and its fate under changing climatic conditions. Global collaborative efforts on (1) harmonizing SOC profile observations and collecting samples from under-sampled biomes, (2) conducting in-situ warming experiments across depths and environmental gradients, and (3) representing soil-forming processes and pedogenic feedbacks in Earth System Models are necessary to reduce the uncertainty that exists both in the magnitude and fate of SOC.

Key words: *Soil organic carbon; climate change; soil carbon vulnerability; Earth system models*

KN5

Soil health in Vietnam - Current status and solutions

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Abstract

Soil health is an issue of concern in Vietnam, although knowledge and information about soil health is still very limited. This presentation introduces basic information about Vietnamese soil, the current status of soil quality degradation and some solutions to protect and improve soil quality or soil health in Vietnam. As a country with limited land and a large population, the area of agricultural production land is only about 11.6 million hectares and the average rate of agricultural production land area per person is among the lowest in the world (0.11 hectares/person). Furthermore, most agricultural production land is "problem soils": 75% of the land area is sloping land, of which 50% has a slope of over 20 degrees causing strong soil erosion and acidification, 60% of the area has erosion potential of over 11 tons/ha/year and 30% of the area has potential erosion rate of over 20 tons/ha/year. 70% of the land area in Vietnam is acidic, 50% of the land area is poor in nitrogen, 70% is poor in phosphorus, 60% is poor in potassium, 72% is poor in calcium and 48% is poor in magnesium. Due to the impact of natural conditions (climate change) and humans (irrational farming, excessive use of fertilizers and pesticides, construction of hydroelectric projects...) the land/soil has become more degradation. The latest survey results show that up to 44% of agricultural production land in Vietnam is degraded to varying degrees, the strongly degraded areas are the Northern Midlands and Mountain areas, North Central and Central Coastal areas and Central Highlands. Although there have been many policies and technical solutions to improve soil quality in Vietnam, in the coming time, we propose: 1) There should be appropriate policies to support farming in slopping land; 2) Limit the use of delta land, especially rice land, for industrial zones; 3) Greater emphasis on scientific research on soil health management; 4) Organize World Soil Day annually on December 5 by the government; and 5) Develop a national strategy and action plan on soil health management.

Key words: *Soil health, land degradation, soil fertility declining, improper farming*

CONTENTS

CR2

Country Report of China (The Soil Science Society of China)

Prof. Xiaoyuan Yan

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Abstract

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. The current council (2020-2024) constitutes 13 specialty committees, 8 working committees and 5 working groups. As a national society of soil science, SSSC is actively engaged in academic activities in the past two years. During July 2022 to February 2024, SSSC has organized more than 50 academic events domestically which attract approximately 18000 participants and the number of abstracts received exceeds 3000. A few more activities are scheduled in the coming 2024. Concerning International communications, several formats of international conferences like webinars, symposiums and forums were held in 2023. SSSA President-elect Prof. Michael L. Thompson came to China, joined the symposium and discussed further cooperation with Prof. Jiabao Zhang, SSSC President. Both sides are seeking more detailed cooperation and exchange after the strategic agreement signed in 2021. 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). The Pedosphere was founded in February 1991 and published bimonthly in English by Elsevier Limited and Science Press. Its impact factor reached 5.7 (9/37, Q1) according to Journal Citation Reports 2023. Besides, SSSC launched a dedicated Newsletter in December 2021. It is a bimonthly publication that focuses on societal and conference news, research frontiers, publication releases and technical products. You can subscribe our newsletter on our website. About promotion efforts, the society dedicates to sharing soil knowledge to the public through publications, lectures, etc. As the host of Inter-congress 2024 and WCSS 2026, we advertised the congress in many occasions, hoping to engage more researchers, policymakers, agents and societies around the world.

CR5

Country Report of Korea
(The Korean Society of Soil Science and Fertilizer)

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Abstract

The Korean Society of Soil Science and Fertilizer (KSSSF) was established in 1968 as an organization dedicated to agricultural soil and fertilizer research and academic activities in Korea, marking its 56th year this year. As of 2023, approximately 516 members are registered from 55 institutions and 15 universities. The society publishes four volumes of academic journals annually and holds academic conferences every year. Additionally, it organizes various events such as the Korean Soil Day celebration, university student soil survey competitions, and soil appreciation photo exhibitions annually. In 2023, a total of 54 papers were published, and the 55th academic conference was successfully held in Boseong, Jeollabuk-do, with 383 participants registered. At the 2023 academic conference, seven sessions were conducted, featuring 55 oral presentations and 166 poster presentations. The Korean Soil Day celebration included a symposium with nine speakers and panelists under the theme "Digital Soil Management in the Era of Food Security." The soil survey competition involved 21 teams from 10 universities and three institutions, conducting a four-day soil survey education and competition (individual and group). In terms of international activities, the society hosted the 8th International Symposium on Soil Organic Matter in 2022, followed by the 4th Global Soil Security Conference in Seoul in 2023. Plans are underway to organize annual events such as the Soil Day celebration, academic conferences, and soil survey competitions in 2024. Furthermore, the publication of a book titled "Soils of Korea" is scheduled for release.

Keywords: *KSSSF; Korean Soil Day; Soil Judging Competition; Soils of Korea*

CR7

Country Report of Nepal
(The Nepalese Society of Soil Science)

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Abstract

Nepalese Society of Soil Science (NSSS) joined ESAFS in 2015. Nevertheless, the society has been putting sustained efforts toward promoting research, technology and dissemination, for local and regional benefits. These are very much aligned with the objectives of ESAFS in the region. Likewise, NSSS is also celebrating World Soil Day every year not just in the federal capital but also in several districts of the country in collaboration with institutions such as line ministry of the government, universities, national agriculture research council, FAO, farmers' organizations and agro-industries. Many soil scientists have also presented their research papers in Nepal and different countries of the world. The society also has a tradition of organizing events such as speech delivery from eminent speakers on current issues and frontiers of soil science.After the end of COVID19, we are experiencing amicable environment for work. NSSS is constantly working to increase the number of members in the society not only from the core area of soil science but also welcome those graduated in allied sciences and possess interdisciplinary degrees. As the current global trend is towards ecosystem and one health perspective is more dominating, we understand that necessity of sustainability of natural resources should broaden the boundaries of study and field of research in all biological sciences. We are also in the process of amending our by-law to accommodate new changes and make it more flexible so that scientists find more rooms for engaging themselves in societies mission while crafting themselves into a better professional.Finding that current national policies can't address sufficiently, we reiterate on the issues by featuring presentations on national TV channels and hold dialogues related to needs for developing conservation and utilization policy of soil resources. We are therefore, in the process of drafting guidelines to help develop national policies so that the role of different institutions could be defined and necessary arrangements made for consolidated efforts to put on this agenda. Due to strong academic and technical human capital available in the NSSS, it could be a right platform to initiate and forward this matter to the concerned government agencies and to the cabinet.

CR8

Country Report of Philippine Society of Soil Science and Technology

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Abstract

Programs and Activities of the Philippine Society of Soil Science and Technology, Inc. The Philippine Society of Soil Science and Technology, Inc (PSSST) continues to perform its mission: to advocate and promote the importance of soils and its management in sustainable crop production and environmental protection; strengthen the capacity of soil scientists, technologists, and researchers; and establish and maintain local and international networks and linkages. After the Covid-19 pandemic, the PSSST carried out its face to face 23rd Scientific Conference and Annual Meeting last May 17-19, 2023, with the theme "Save the Soils for Future Generations". More than150 researchers and students attended the conference and actively participated during the technical presentations and open fora. Aside from this conference, PSSST renewed its linkage with State Universities and Colleges (SUCs) and soil science student societies. It organized the 1st PSSST Soil Science Quiz Bee with more than 200 students from four (4) SUCs. This event was also registered in the FAO-GSP website as one of the activities in celebration of the 2023 World Soil Day. In addition, PSSST continued its Thesis Grant program which provided support for five (5) undergraduate students who are implementing their thesis study this CY 2024. This program is now on its 18th year of implementation and has served more than 80 students, as of CY 2023. Another major activity of PSSST is the conduct of career orientation program to encourage the agriculture students to take up soil science as a major course. Early this year, career orientation was conducted in two SUCs and participated by more than 100 students. It has also completed the preparation of the proposal and module for the "Adopt A School" program to encourage high school students to pursue agriculture as an undergraduate course. On May 28-30, the 24th PSSST Scientific Conference and Annual Meeting will be held in Agusan del Sur, with the provincial government and House of Representatives as its major partners. The PSSST is committed to strengthen these aforementioned programs to support the advancement of soil science and technology and contribute to the country's goal in ensuring food and nutrition security,

CR9

Country Report of Sri Lanka (The Soil Science Society of Sri Lanka)

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Abstract

The Soil Science Society Sri Lanka (SSSSL) is a professional society, established in 1969 with a vision to provide scientific knowledge to promote beneficial soil management practices to sustain the soil resource of Sri Lanka, focusing mainly on the provision of food, income and a quality environment. Since its inception the society has granted membership for over 370 individuals representing soil scientists from the academia, government institutes and the private sector. During the reporting period (July, 2022 to February, 2024), the SSSSL continued its activities for strengthening the capacity of soil scientists and other stakeholders in Sri Lanka. Addressing the challenges the country was facing at the time, SSSSL organized a webinar to general public on "Minimizing shortage of rice: suggestions to face Maha 2022/23" as the midterm session in July, 2022. Four eminent speakers made presentations during the webinar. In line with the theme of The World Soil Day (WSD) 2022; “Soils: Where food begins”, the SSSSL has organized a series of activities to demonstrate the importance of soils and popularize soil science among school children and the general public. The activities included “Soil for Life” Inter-School Quiz Competition among the schools in the Central Province of Sri Lanka, an all-Island photography competition, an all-Island drawing competition among school children, launching of a special publication of on "Soils of the Northern Region of Sri Lanka" book, and a Guest Lecture on "Soil for Nutrition". The SSSSL organized the annual technical session and the Annual General Meeting in March 2023 and the members joined a two-day field visit to explore the soils in the Dry Zone of Sri Lanka and its impact on land uses. The mid-year technical session was conducted in November, 2023 to improve knowledge and develop skills of the membership on the use of GPS and drone technologies for sustainable soil management. The SSSSL celebrated the WSD-2023 with activities aiming to increase awareness of different stakeholder groups on the importance and relationship between soil and water in achieving sustainable and resilient food systems. The SSSSL collaborated with the Ministry of Environment, the Rajarata University of Sri Lanka and the Provincial Department of Education in the North Central Province in organizing WSD-2023 program. The activities included “Soil for Life” Inter-School Quiz Competition among schools in the North Central Province of Sri Lanka, “Soil, Water and Life” drawing competition among schools in the Kekirawa Educational Zone of the North Central Province, a photography competition among undergraduate students of universities in Sri Lanka, a field program for the farmers on managing soil organic carbon to improve soil health, and a public seminar on “Soil and Water, Sources of Life” targeting the school children, undergraduate students and general public. The SSSSL is presently organizing the AGM-2024 and a field visit to the Tea Research Institute of Sri Lanka on 21st and 22nd March, especially to increase awareness among membership on experimental approaches for soil and plant nutritional studies in tea.

CR10

Country report of India
(The Indian Society of Soil Science)
Eighty-eight years of Service of Indian Society of Soil Science

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Abstract

Indian Society of Soil Science (ISSS) was established in 1934 at Presidency College, Calcutta (Now Kolkata) University with only 30 members. It is the oldest society among the various disciplines of agricultural sciences in India, and is one of the largest societies enjoining the patronage of about 2700 members at present through its 53 chapters. During the 88-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 fulfillment 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 Councilors. 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 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 of 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 linkage with it since 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. The Society is organizing the "Global Soils Conference 2024 - Caring Soils Beyond Food Security: Climate Change Mitigation & Ecosystem Services" during 19-22 November 2024 Under the Aegis of International Union of Soil Sciences (IUSS).

Key words: *Indian Society of Soil Science; Origin; Members; Council; Publication*

CR11

Country report of Thailand (The Soil and Fertilizer Society of Thailand)

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Abstract

Since the 13 May, 1981 the Soil and Fertilizer Society of Thailand was established by a collaborative team of soil scientists from government organizations, universities, national institutes, and private sectors. The primary objectives of the SFST society include exchanging information and skills in soil science and research, facilitating the sharing of fertilizer management knowledge among soil scientists in Thailand. SFST hosted a biennial academic conference in collaboration with rotating regional universities as co-hosts, thereby fortifying our institutional relationships. In the year 2023, the 7th National Soil and Fertilizer Conference, themed 'Soil: The Foundation of Food Security and Sustainability' took place from December, 7-9 at the Mae Hia Agricultural Research, Demonstrative and Training Center, Chiang Mai University. In the meantime, the Soil and Fertilizer Society of Thailand was honored with the King Bhumibol World Soil Day Award 2023, acknowledging the society's outstanding efforts in advancing sustainable soil management practices in the region. Supported by the Kingdom of Thailand, this award recognizes the lifelong contributions of the late King Bhumibol Adulyadej, whose dedication significantly enhanced the quality of life for millions through sustainable soil management. For international engagements, the SFST partnered with FAO to co-host the 11th Global Soil Partnership Plenary Assembly (GSP PA) from July 8-15, 2023, at the FAO Headquarters in Rome. The event was held under the theme 'Healthy Soils for Healthy Food'. In our ongoing commitment to advancing carbon credit policy, we are dedicated to elevating public awareness and understanding through a multifaceted approach encompassing a diverse array of events and initiatives. Our society's publication, now transformed into an internet-based media platform to cater to the needs of this generation. Several publications, including "The glossary of fertilizer terms", are currently undergoing revision to incorporate the latest advancements in technology.

CR12

Country report of Vietnam (The Vietnam Society of Soil Science)

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Abstract

Vietnam Society of Soil Science (VSSS) was established under the Decision of the Vietnam Council of Ministers, the Government of the Socialist Republic of Vietnam No. 181-CT dated June 8, 1991. Over 30 years of establishment and development, the Society has constantly strived and operated under its Charter to gather and unite people doing scientific and technical work in the field of soil sciences, soil plant relations ship, participating in social consultancy and criticism for the State authorities in the field of expertise, disseminate knowledge, transfer agricultural technical advances, organize domestic and international seminars. Participate in training in specialized fields, land classification investigation, land assessment, land use planning...; Publish information, magazines and other publications related to the activities of the Society. Up to now, VSSS has grown strongly with the number of 24 branches and more than 500 members across the country, with mainly undergraduate and postgraduate qualifications, including scientists, retired and working staff. In addition, the VSSS has established 5 non-profits units for operating according to the functions of the Society. The Society and its branches, members have actively contributed to the work of consulting, criticizing and assessing society for a number of important programs, projects, topics and works of the State and government, typically: Suggesting amendments to the Land Law; Cooperative Law; formulate and giving advises in different land management programs such as anti-desertification and desertification programs; projects to develop national parks; hydroelectric power projects, resettlement projects; programs on agricultural, rural development and new rural construction; decrees and circulars on land assessment survey, land use price, resettlement support, sustainable land use management. Successfully organized many national and international seminars in the field of soil science and related fields. Since 1991, VSSS publishes periodically 4 number per year, Vietnam Soil Science Journal with full paper in Vietnamese and abstract in English, https://tapchikhoahocdat.vn/. Every five years, VSSS organizes its Congress to elect the members of the committee of the society and nominates its President as well as to revise the activity of the term and formulate the mission of the period coming. The recent Congress of the VSSS was in Dec 2022.

ORAL SESSION 1: SOIL HEALTH; SOIL ECOLOGY AND BIODIVERSITY

OS1-1

Soil microbial community, carbon use efficiency and turnover rate under different soil pH in Subtropical Okinawa, Japan

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Abstract

For optimal soil organic carbon (SOC) management in the tropics and subtropics, it is necessary to understand SOC dynamics by evaluating microbial carbon use efficiency (CUE) and turnover and elucidating their factors. Soil pH generally control the microbial community and its function, yet there is still limited information about how soil pH affects the microbial functions such as CUE and turnover with different land uses. The objective of this study was to evaluate the effects of soil pH and land use at different soil pH conditions on microbial communities, CUE, and turnover. Soil samples were collected from Ishigaki island, Okinawa, Japan, i.e., the 19 samples from Cropland sites (pH 4.22-8.44), and the 14 samples from Forest sites (pH 5.22-8.20) to cover the broad soil pH conditions. The collected 33 samples were into three pH categories, Acidic: pH < 5.5, Neutral: 5.5 < pH < 7.0, and Alkaline: pH > 7.0. K_2SO_4 extractable C (DOC), Inorganic N (IN: NO_3-N, NH_4-N), and Available P (AP) were measured as soil nutrient condition. Microbial biomass C/N/P (MBC/MBN/MBP) were also measured and C:P imbalance was calculated as the ratio of C:P nutrient to C:P microbial biomass. Bacterial/archaeal (V4) and Fungal (ITS) communities were assessed by amplicon sequence. The microbial CUE was assessed by measuring the amount of ^{13}C-labeled glucose incorporated into the microbial biomass and respired as CO_2. The microbial substrate turnover time was also calculated as follows: Substrate turnover time (day)=MBC/ΔMBC. Both soil pH and land use clearly differed the Bacterial/Archaeal and Fungal communities in this study. On the other hand, network analysis showed that microbial communities of Cropland and Forest had many common ASVs (Amplicon sequence variant) in Alkaline condition than in Acidic and Neutral conditions. Oligotroph:Copiotroph ratio was also different for land uses only in Acidic and Neutral, but not in Alkaline, and it was consistent with the result of soil nutrient conditions, such as DOC:MBC and C:P imbalance. It indicates that the microbes which can survive in such stressful alkaline condition may similar in both land uses, resulting in similar communities only in Alkaline soil. CUE in Cropland was 0.48-0.75, while CUE in Forest was 0.41-0.75, and there were no significant differences between the land uses, nor between soil pH ranges. On the other hand, microbial turnover time was affected by land use only in Acidic (and Neutral), but not in Alkaline, and this was same as the results of microbial communities. These results suggest that land use changes in Alkaline conditions are unlikely to cause the changes in microbial communities and its functions, and thus consequent soil C dynamics, compared with Acidic (or Neutral) soil condition.

Key words: *Microbial community, Carbon use efficiency, microbial turnover, land use, soil pH*

OS1-2

The effects of multiple inter-tillage weeding on greenhouse gas emissions in no fertilizer and pesticide rice paddy field - Results from four consecutive years -

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Abstract

In the multiple inter-tillage weeding (MIW) inherited from the Edo era of Japan was known that, even if the paddy field receives no fertilizer and pesticide, the yield can be obtained as high as that of conventional farming, when MIW is conducted four or more times. Therefore, MIW is expected to be a sustainable farming. But paddy fields emit a particularly large amount of methane (CH_4), which is a major source one of the greenhouse gases (GHG), and it is the cause of a global warming. However, it has been rarely known about the interactions between MIW and CH_4 from paddy fields, as well as nitrous oxide (N_2O) and carbon dioxide (CO_2) from heterotrophic respiration (RH). Thus, we evaluated the effect of MIW on GHG emissions in no fertilizer and chemicals (pesticide/herbicide) paddy fields in Hokkaido, Japan. The study was conducted in the rice paddy fields of the Field Science Center for Northern Biosphere, Hokkaido University, from May 2020 to September 2023. Our study site has been cultivated without fertilizers and chemicals since 2019. Treatments were established in three replication of four treatments: zero (T0), two (T2), and five (T5) times MIW and conventional farming (CF). GHG fluxes were measured by a static closed chamber method. And chlorophyll content, residue inputs, net primary production (NPP), brown rice yield, soil temperature, pH, redox potential (Eh), and soil surface physicochemical properties (NH_4^+-N, NO_3^--N, SO_4^{2-}, Fe^{2+}, WEOC) were measured to identifying the dominant factors in GHG emissions. Sampling was conducted every 10 days during MIW period, every 14 days during the rest of the growing season, and every month during the fallow season. The brown rice yield at 4 years was significantly lower in T0 than in CF. In addition, the yield increased with increasing the number of MIW. Although the chlorophyll content was higher in T5, the concentration of NH_4^+-N during cultivation period was significantly higher in CF than in T treatments. There were no significant differences among T treatments. MIW contributed to nitrogen mineralization, but its supply was much less than that of chemical fertilizers. Cumulative RH and CH_4 emissions during the cultivation period were higher in 2021 than in 2020, might be due to higher amount of carbon input (residue and weed) in 2021. There were significant positive correlations between soil temperature and RH flux and between soil temperature and CH_4 flux in T treatment in 2021, respectively indicating that high organic matter inputs at high soil temperatures may accelerate its decomposition and increase RH and CH_4 emissions. In T5, O_2 supply by MIW may have further enhanced organic matter decomposition and increased RH and CH_4 emissions. Cumulative N_2O emission in T5 was highest among T treatment. O_2 supply by MIW might not only promote nitrification and denitrification, but also inhibit complete denitrification, which would enhance N_2O production. The GHGI (GWP/yield) was large in the order of CF, T2, T5, and T0. In T0, GHGI was significantly higher than that in CF. T0 showed the highest GHGI due to low yield and high GWP. In T5, the yield slightly increased by MIW, but the O_2 supply may increase GWP emissions and consequently reduced GHGI.

Key words: *"Greenhouse gas, Multiple inter-tillage weeding, Rice paddy field"*

OS1-3

Soil Tillage and Application of Organic Materials on Oil Palm Plant disc and their Effects on Soil Properties

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Abstract

Various efforts have been made to achieve sustainability of oil palm plantation. The environment of the oil palm disc was modified through tillage and the application of organic matter, and evaluates its effect on the physical, chemical and biological properties of the discs of oil palm plants. The experiment was conducted at two estates Bukit Sentang estate (soil type Ultisol) and Adolina estate (soil type Inceptisol). The study design used was a factorial randomized block design with 2 factors. First factor was tillage consisting of 2 treatments, without tillage and with tillage. The second factor was doses of organic matter (OM) consist of 4 treatments: without application, 50 kg, 100 kg and 150 kg OM tree^{-1}. Organic matter applied at Adolina was empty fruit bunches and cow manure compost for Bukit Sentang. The results showed that soil tillage significantly increased porosity in Adolina, but in Bukit Sentang resulted in a marked decrease in soil porosity. Chemical properties of soil changed due to tillage and the application of OM in both estates. Increasing the dosage of OM boosted the C and K content in Adolina's oil palm disc soil, however no similar pattern was obtained for other soil chemical properties.

keywords: *Inceptisol; organic matter; oil palm plant disc; tillage; ultisol*

OS1-4

Field-scale Soil Salinity Prediction using Machine Learning Algorithms in the Prairie Area of Saskatchewan, Canada.

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Abstract

Soil salinity is recognized to be a major threat to agriculture in the Prairies Region of Canada. Salinization not only reduces the yield of agricultural crops but also limits the range of crops that can be grown, thereby reducing the potential economic returns to farmers. Despite decades of soil surveying, field-scale soil salinity maps are not available. This study explores the potential use of remote sensing in soil salinity mapping at the field-scale level. Field data collection was conducted in 2020, 2021, 2022 with a total area of 3241 ha (8008 acres) in Saskatchewan. The field data includes (1) electrical conductivity (EC) measured using a truck-mount electromagnetic induction device (EM38) and (2) a total of 680 soil samples collected (by a truck-mount soil sampler to the depths of 0 to 20 cm) on 30 sites by stratified random sampling approach. From soil samples, the electrical conductivity of soil saturation extract (ECe) or estimated soluble salts was quantified in a lab. Predictors were extracted from multiple source satellite imagery, including Sentinel-1, Sentinel-2, Landsat-5, Landsat-8, OpenLandMap, and Alos Palsar (DEM) with 41 predictors being used. These included some directed sources, such as Digital Elevation Model (DEM) from Also Palsar. However, the majority of variables were extracted from Sentinel 2, Sentinel 1, and Landsat 8. Several vegetation indices (VIs) were used to map soil salinity. A Stratified Random Sampling approach was used to collect data points. Classification and Regression Tree - CART, Random Forest - RF, and Gradient Boosted Regression Tree – GBRT, which are available in GEE, were used for the prediction. Leave-one-field-out cross-validation was used for evaluation. The accuracy evaluation metrics include Root Mean Square Error (RMSE), Mean Absolute Error (MAE), and coefficient of determination (R^2). The results indicated that RF was the best model for ECe estimation (R^2 = 0.65, RMSE = 0.56 dS/m, MAE = 0.38 dS/m); and the top five important variables are stdDev NBR (Landsat 8), mean NDYI (Sentinel 2), stdDev TCW (Landsat 8), median SI3 (Sentinel 2), mean B3 (Landsat 8). The coefficient of determination in this study is comparable to previous studies given that our ECe value range is lower (0 to 3.86 dS/m). Visually there was good agreement between the predicted and measured soil salinity. We believe this approach has the potential to improve the sub-field soil salinity prediction across large areas.

Key words: *Soil salinity; remote sensing; machine learning; Google Earth Engine (GEE)*

OS1-5

Conservation Agriculture minimizes negative nitrogen balance and increases nitrogen use efficiency and soil carbon stock in rice paddy systems

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Abstract

Conservation Agriculture (CA) having increased residue retention under strip tillage appears to be a sustainable approach for intensively cultivated (3 crops yr^{-1}) rice-based cropping systems that produces higher crop yield and huge residues annually. The present study has assessed how CA practice alters nitrogen (N) balance (difference between inputs and outputs) in soil under strip tillage with high residue retention with low to high doses of fertilization in the wheat-mungbean-rice and rice-rice-rice cropping systems. We have examined the effects of soil disturbance levels - strip tillage (ST) and conventional tillage (CT), two residue retention levels –15% residue by height (low residue, LR) and 30% residue (high residue, HR) for rice and wheat and the whole stover for mungbean; and three nutrient rates - 50% or 75% as low dose (LD), 100% as recommended dose (RD) and 125% or 150% as high dose (HD). It is estimated that N loss by NH_3 volatilization is 17%, denitrification 12% and leaching 6% which has major implications on GHG emissions. Results revealed that CA practice in the triple-rice cropping pattern decreased the negative N balance by 42 kg N/ha while for the wheat-mungbean-rice pattern, the N balance due to CA practice was close to zero and it was only -20 kg N/ha for conventional practice which clearly reflects the contribution of mungbean residue incorporation. The main driver of negative N balance is the removal of most crop residues from fields and this is substantially decreased under the CA practice. We had another observation that with 9 years practicing, CA with increased residue retention under strip tillage the crops had higher N use efficiency, grain yield and annual gross margin in the rice-wheat-mungbean cropping system while the N fertilizer requirement increased minimally. The soil organic carbon stock (0-15 cm) after 9 years increased from 21.5 to 30.5 t ha^{-1} due to the effect of ST plus high crop residue retention. Hence, to minimize N depletion, it is not justified to just increase the use of N fertilizer; instead it is important to leave the crop residues in the field as much as possible for carbon sequestration as well as for arresting N fertility depletion.

Keywords: *Dentrification, Leaching, Residue retention, Strip tillage, Volatilization*

OS1-6

Some organic manures contribute excellent charges on soil system and improve crop productivity

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Abstract

Organic matter is known to play a role in maintaining soil fertility through its influence on surface charge to absorb nutrient ions in soils. The charge properties of these soils will be investigated by measuring the extent of permanent structural charge by cesium adsorption and variable charge will be quantified by simultaneous proton titration and background electrolyte (LiCl) adsorption measurements. In this study 8 soil samples were collected from three different states of India. Results of this study revealed that the soil's charge behaviour was dominated by variable charge and the negative surface charge increased with on increasing P^H. The investigating soil exhibited similar charge behaviour, with no pronounced effect of differences in either organic carbon or Fe and aluminium oxide content. In all cases the presence of small quantities of 2:1 clay minerals had significant surface charge properties of these soils. The characteristics of surface charge were shown to be consistent with the behaviour of mixture of clay minerals, organic manures highly influence the surface charge properties of these soils and which is directly proportional to the productivity of these soil. The research should provide a better understanding of the influence of organic manures on charge properties of soils and that helps in improving the productivity of the soil.

OS1-7

Change of Population and Characteristics of Non-Symbiotic Bacteria in Tropical Peat soil by Application of Soil Ameliorant and Nitrogen Fertilizer.

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Abstract

Peatlands in Indonesia are widely used to develop oil palm plantation. Peatland development is faced with the problem of low peat soil fertility levels. Efforts made to increase the fertility of peat soil are by applying fertilizer. However, the high price of fertilizer requires other alternatives to support a more efficient supply of nutrients, one of which is the use of bacteria that are able to provide nutrients for plants, such as non-symbiotic nitrogen-fixing bacteria. Non-symbiotic N-fixing bacteria are one of the biological potentials found around plant cultivation areas. This bacterium is used as an agent for fixing free N in the air. This research aims to isolate and characterize non-symbiotic N-fixing bacteria and nitrifying bacteria from peat soil. The experiment used a completely randomized factorial design with nitrogen fertilizer and soil ameliorant each at 3 levels and 3 replicates. Soil sampling was taken by using purposive sampling. The medium used in this study was Ashby's, NFB, TSIA and Burk's medium. The criteria used as observation parameters in identifying bacterial isolates are the morphological characteristics of bacteria including macroscopic characteristics and microscopic characteristics of bacterial isolates, biochemical tests and physiological tests. The data on the number of bacteria obtained was analyzed statistically using variance, then continued with the Least Significant Difference (LSD) test at the 5% level. A total of 36 isolates of non-symbiotic N-fixing bacteria were successfully isolated on Ashby's and NFb medium. Also obtained were 36 isolates of nitrifying bacteria from TSIA and Burk's medium. The results of the potential test for non-symbiotic N-fixing bacteria showed that 18 isolates were able to form pellicle on Ashby's medium and 18 isolates were able to change the color of the medium on NFb medium. The potential test to produce ammonium and nitrate was measured using a spectrophotometer. Isolates A32 and B32 are isolates that have a low ability to produce ammonium and nitrate so they can be used in peat soil. The results of Gram staining of isolates of non-symbiotic N-fixing bacteria and nitrifying bacteria were all Gram negative. The catalase test results showed that all isolates of non-symbiotic N-fixing bacteria and nitrifying bacteria were classified as aerobic bacteria.

Key words: *Peat, Bacteria, soil ameliorant*

OS1-8

Growth of Seedlings of *Garcinia atroviridis* Griff ex T. Anders on Various Growing Media and Applications of Catappa Leaf Extract

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Abstract

Local farmers create their innovations to enhance their plant growth, such as modifying seedling's media growth and the usage of extract catappa and fermented palm sap. This study aims to obtain the alternative planting media and determine the effectiveness of catappa extract in stimulating the growth of *G.atroviridis* seedlings. Two stages of the experiment were carried out in this study. The first study examined the effect of several catappa leaves extractants (water, coconut water, and fermented palm sap) on *G.atroviridis* seed germination. The second study used a factorial randomized block design with two factors. The first factor was media consisting of 5 treatments, topsoil+paddy husk (1:1), subsoil+paddy husk (1:1), subsoil+paddy husk +cow dung (1:1:2), subsoil+paddy husk+goat litter (1:1:2), subsoil+paddy husk + vermicompost (1:1:2). The second factor was catappa leaf extract consisting of 3 treatments 0 mL, 5 mL, 10 mL of catappa extract. All treatments had six replications. Result found that modification of media by mixing subsoil with husk, cow dung, goat litter, and vermicompost inhibited the growth of *G. atroviridis* seedlings compared to topsoil and husk media. Catappa extract did not significantly affect seedling growth, and catappa leaves extracted with fermented palm sap reduced seedling germination.

Keywords: *extract catappa leaves; growth media; indigenous plant; subsoil*

OS1-9

Characterizing soil bacteria targeting to develop a biofertilizer to reduce the use of inorganic phosphorous fertilizers in paddy cultivation

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Abstract

A study was conducted to characterize phosphate solubilizing bacteria (PSB) targeting to develop a biofertilizer, reducing phosphorous fertilizer usage in cultivating rice (*Oryza sativa*). Bacteria isolated from rhizosphere of rice cultivated in paddy fields in the dry and intermediate climatic zones of Sri Lanka were used in the study. A total of eleven PSB isolates (8K2A, 5A2A, 3K2A, 2K3A, 6P5A, 1A2A, 7P5A, 9P4A, 7A2A, 1A2B2, 12P5A) were cultured on Pikovskaya's (PVK) agar medium supplemented with tri-calcium phosphate (Ca-P) and phosphate solubilization index (PSI) was calculated. Further the isolates were tested on their ability to solubilize Ca-P, aluminum phosphate (Al-P) and iron phosphate (Fe-P) in liquid media. The isolates were further tested for plant growth promotion activities like catalase, Indole Acetic Acid production and protease activity. The 11 isolates were identified using 16S rRNA gene sequencing technique. The effect of bio-priming of rice seeds of four varieties (Bg 360, Bg 362, Bg 409 and Bw 367) at pre-germination with the 11 bacterial isolates on seedling vigor was tested in a pot experiment. The efficiency of biopriming when applied on seeds treated with Imidacloprid (insecticide) was also evaluated. The PSI of the isolates ranged between 3.48 ± 0.51 and 5.87 ± 0.81. All the isolates tested showed significant ($P<0.05$) ability to solubilize the three different forms of phosphates to varying degrees. All strains demonstrated an efficient solubilization of Ca-P more than Fe-P and Al-P. As these PSB increased soluble P, they concurrently decreased the pH of the medium. Five isolates out of 11 produced IAA; 6 out of 11 were positive for catalase activity and 3 out of 11 were positive for extracellular protease production. The molecular analysis indicated that the promising strains belonged to seven genera (*Staphylococcus, Bacillus, Xanthomonas, Pseudomonas, Lysinibacillus, Acinetobacter,* and *Stenotrophomonas*). Bio-priming seeds with PSB significantly ($P<0.05$) improved seedling vigor. Insecticide application as a seed treatment did not have a significant impact on efficacy of PSB. This study highlighted the potential of these PSB strains for enhancing phosphorus availability and promoting plant growth of rice. Therefore, the strains can be used to develop a biofertilizer and test under field condition.

Key words: *Phosphate solubilizing bacteria; Bio-priming; Plant growth promotion*

OS1-10

Preliminary assessment through contributions of organic farming to a sustainable environment

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Abstract

Agriculture is the foundation of the world's food supply and lives, making it one of humanity's most important endeavors. It is essential to both the health and survival of the planet's population as well as to the planet's overall well-being. However, conventional agricultural practices, while meeting immediate food demands, have been associated with a range of ecological challenges, including soil degradation, water contamination, loss of biodiversity, and contributions to greenhouse gas emissions. These challenges intensify in the face of climate change and the imperative to feed a growing global population. In response to these challenges, organic farming has emerged as a paradigm rooted in the principles of sustainability and ecological stewardship that compliance along with sustainable development goals (SDG) such as climate action (SDG 13) and life of land (SDG 15). Hence, organic agriculture emphasizes reduced chemical input, soil health preservation, and biodiversity conservation, offering a promising alternative to conventional methods. This preliminary assessment seeks to explore and elucidate the multifaceted contributions of organic farming to the creation and maintenance of a sustainable environment. In this study, a qualitative multi-criteria approach was taken and each step emphasized transparency. The methodological approaches will be conducted from the APPGM-SDG studies using different methods of organic farming and are characterized by the following aspects such as divergence within and between farming systems, comparison system on the relative scale, and appropriate indicator selected based on the Organization for Economic Co-operation and Development (OECD) list. Hence, these innovative methods and approaches make trends towards sustainable farming systems and enhance productivity in relation to the farmer's life quality in an environmentally friendly way. In conclusion, this assessment provides a foundational framework for further research and discourse on the vital role of organic agriculture in addressing contemporary environmental challenges, supporting food security, and fostering a harmonious coexistence between humanity and the natural world.

Keywords: *biodiversity conservation; ecosystem preservation; green agriculture; food security*

OS1-11

Nematodes associated with citrus in the Mekong delta and development of a quantitative detection method for *Tylenchulus semipenetrans* Cobb in soil by real-time PCR assay

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Abstract

Citrus is one of the most abundant fruit crops in the Vietnamese Mekong Delta (VMD) region. Plant-parasitic nematodes infestation is probably a factor damaging citrus production worldwide, but it has not been studied in the VMD. Nematodes from soils from 109 samples belonging to diverse fields in the Vinh Long, Dong Thap, and Tra Vinh provinces were isolated. A total of 11 herbivores' nematodes were recorded. Among them, *Aphelenchus* was the most dominant genus, with a frequency appearance in 81 samples (74.3%) and an average of 235 inds/20 g soils (1–2778 inds/20 g soils), followed by *Tylenchulus semipenetrans* (186 inds/20 g soil). *Pratylenchus* was recorded in 44 samples (40.4% frequently), followed by *Aphelenchoides* (38 inds/20 g soil) in 17 samples, *Rotylenchulus* (31 inds/20 g soil) in 5 samples, *Tylenchus* (23 inds/20 g soil) in 14 samples, and *Helicotylenchus* (14 inds/20 g soil) in 17 samples. A few *Filenchus, Tylenchorhynchus*, *Ditylenchus, Criconemella*, and *Meloidogyne* populations were also recorded. Bacterivores were the most abundant group, representing 377 inds/20 g of soil, followed by fungivores (180 inds/20 g of soil), plant parasitic nematodes (46 inds/20 g of soil), omnivores, and predators (13 and 3 inds/20 g of soil, respectively). Interestingly, the nematode community composition is correlated with the plant symptoms above ground. Good-growth plants showed a good relationship with *Aphelenchus*, bacterivores, and fungivores, while moderate-growth plants were related to *Tylenchulus semipenetrans, Aphelenchoides*, and *Tylenchus*. Poor and very poor-growth plants were related to *Pratylenchus*, *Rotylenchulus,* and *Criconemella*. A real-time PCR-based detection method for *T. semipenetrans* was developed, and the major soil was used from the citrus field in Vinh Long province. Difference numbers (5, 20, 100, 200, and 500) of juveniles were added to 20 g of air-dried soil not containing *T. semipenetrans*. The soil was homogenised by a ball mill to make homogenous samples, and then 0.5 g of the soil was used for DNA extraction. There was a strong negative correlation between the cycle threshold number (Ct) and the inoculated numbers of *T. semipenetrans*. An equation was proposed as [$y = -2.099\ln(x) + 41.914$] ($R^2 = 0.8994$, y: Ct value, x: number of *T. semipenetrans* in 20 g soils).

Key words: diagnosis - fruit crops - parasitic nematodes - disease symptoms - sustainability

OS1-12

Digital soil mapping of Soil pH in the Wet Zone of Sri Lanka

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Abstract

Soil pH is a critical soil property determining yields, especially in tropical regions with abundant rainfall. Therefore, it is essential to explore the spatial variability of soil pH, understand it's environmental controllers, and develop high-resolution maps in these regions. This study was conducted in the wet zone (with a mean annual rainfall > 2500 mm and covering 13500 km2) of Sri Lanka to identify environmental controllers of soil pH and to evaluate appropriate digital soil mapping techniques for assessing its spatial variability. Four hundred and three surface soil (0-30 cm) samples were collected across the wet zone, air-dried and sieved using a 2 mm sieve. These samples were analyzed for pH by using a 1:5 soil to water suspension. Exploratory data analysis revealed a substantial variability of soil pH within the wet zone, ranging from 3.0 – 8.8 with a coefficient of variation of 16.7%. Thus, soils of the wet zone exhibited strongly acidic to strongly alkaline pH. The average soil pH revealed that the majority of soils of wet zone are acidic (pH=5.4). Among external factors examined, only precipitation showed a significant relationship with the soil pH (r =-0.3). Increased precipitation leads to the leaching of basic cations such as Ca+2 and Mg+2 from the soil profile, enriching hydronium ions and consequently decreasing the soil pH. However, elevation and temperature did not show relationships with the variability of soil pH (r = 0.04 and -0.007, respectively). Analysis of soil pH within different land uses revealed significantly lower soil pH values in land uses namely tea, paddy, and rubber lands. Additionally, this study revealed considerable variability of soil pH between great soil groups and agro-ecological regions of the wet zone of Sri Lanka showing such legacy information can be used as secondary variables for mapping of soil pH. This study employed random forest machine learning approach to characterize the spatial variability of soil pH. Cross-validation of predictions revealed that random forest approach is a promising digital soil mapping technique to resolve variability of soil pH in complex soil scapes of the wet zone of Sri Lanka. In conclusion, the wet zone of Sri Lanka exemplifies a large spatial variability in soil pH which is mainly determined by rainfall distribution patterns in the region.

Key words: *Soil pH; Wet zone; Spatial Controllers; Land use*

OS1-13

4 per 1000 Initiative in Bangladesh: An Important Agenda of Soil Health Restoration

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Abstract

Soil organic matter (SOM) is a vital component of soil health and soil quality maintenance. To combat nutrient mining, soil health should be given top priority to sustain food security and ecosystem restoration. However, the amount of SOM has been declining significantly in the high land and medium high land sites of Bangladesh due to intensive agricultural practices with improper management. In Bangladesh, high land, and medium high land covers about 50 percent of the agricultural lands which are being used for intensive crop production, housing, settlements, brick fields, fishponds, settlements, and other infrastructures etc. As a result, higher lands are decreasing at an alarming rate and simultaneously SOM are decreasing due to the low residual input with higher cropping intensities without any fallow periods. Moreover, mono cropping is practiced in most of the agricultural lands without the planning of conservation agriculture. As a consequence, the physical fertility of the soil is worsening the agricultural production scenarios. Considering these issues, a study was conducted to evaluate the effects of peanut residues on soil quality and bio-resource management over other green residues. The experiment was laid out in pots comprising of 7 treatments viz T_0=Control, T_1= Azolla (*Azolla pinnata)* @ 100 g/pot, T_2= Grass (*Phleum pretense)* @ 100 g/pot, T_3=Water hyacinth (*Pontederia crassipes)* @100 g/pot, T_4=Peanut (*Arachis hypogaea)* @ 100 g/pot, T_5= Azolla @ 50 g/pot, + Water hyacinth @ 50 g/pot, and T_6= Peanut@ 50 g/pot + Grass @ 50 g/pot. It was found that SOC increased three times in the pea nut treated soils over a year. Thus, peanut residues are a useful and vital solution for improving the soil quality in the agricultural soils of Bangladesh or similar climatic zones. It is therefore recommended that sustainable soil management practices such as vermicomposting, application of organic residues, bio-slurry, nano fertilizers, agro-industrial wastes, farm wastes, farmyard manures, poultry manures, domestic wastes, farmyard wastes etc. should be encouraged by initiating carbon tax or carbon incentive program to accomplish the goal of '4 per 1000 initiative'.

Keys words: *4 per 1000 Initiative; Soil health restoration*

ORAL SESSION 2: SOIL FERTILITY AND PLANT NUTRITION

OS2-1

Evaluating the Potential of Alternative Organic Fertilizers in Japan's Strategy for Sustainable Food Systems

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Abstract

This study investigates the feasibility of integrating alternative organic fertilizers into Japan's Strategy for Sustainable Food Systems, a nationwide initiative dedicated to decarbonizing the food sector through sustainable agricultural practices. This research quantitatively models the practicality of substituting chemical fertilizers with calculated quantities of nitrogen (N), phosphorus (P), and potassium (K) derived from livestock manure, food refuse compost, and sewage sludge compost. The study evaluates this proposed initiative on both national and prefecture scales for the target year 2020. In the first approach, 25% of chemical fertilizer NPK was replaced by food refuse compost and unutilized livestock manure in organic agriculture, and in the second scenario considered, 5% of chemical fertilizer NPK was offset by sewage sludge compost and livestock manure. Efficiencies of composts compared with chemical fertilizers were 40% for N and 85% for P and K, while livestock manure was modeled with a N, P, and K efficiency of 50%. Results indicate that on a national scale, food refuse compost could replace 25% of the P and K content of chemical fertilizer, but the limited N content of food compost requires additional unutilized livestock manure to supplement the N content for organic agriculture. Similarly, while sewage sludge compost could replace 5% of the N and P content of chemical fertilizers, additional livestock manure would be necessary to compensate for the low K content of sewage sludge. Overall, these results present a promising strategy to feasibly reduce national chemical fertilizer use by 30% and increase the planted area for organic agriculture by 25%. To assess such an initiative on the prefecture level, the variances in population, sewage output, crop types, and livestock numbers between prefectures must be considered. This research demonstrates the viability of utilizing organic fertilizers on a national scale, although it necessitates adaptive, localized planning to address the unique agricultural landscapes of individual prefectures.

Key words: *Food refuse; sewage sludge; prefecture scale; strategy for sustainable food system; unutilized livestock manur*

OS2-2

Bioavailability and Physiological Effects of Ce, Gd, and Y to *Brassica rapa* in Soil-plant System

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Abstract

Rare earth elements (REEs) have been considered as emerging pollutants, but the bioavailability and physiological effects of REEs in soil-plant system are still poorly understood. Therefore, the aim of this study was to investigate the effect of different dosages of cerium (Ce, 0-100 mg/kg), gadolinium (Gd, 0-120 mg/kg), and yttrium (Y, 0-100 mg/kg) on the growth response of *Brassica rapa* such as REEs accumulation, biomass, photosynthetic pigments (chlorophyll a + b and carotenoid), triphenyl-tetrazolium chloride (TTC) reduction, and proline content in three soils with different textures and pHs. The tested crops were grown in soil under 60% of field capacity for 35 days, and before harvesting, soil pore water was collected through the Rhizon moisture samplers. In the soil with silty clay loam and pH 5.05, the crop shoot biomass was significantly ($p < 0.05$) higher at low dosages of Gd and Y treatments (30 and 25 mg/kg, respectively) compared to the blank of REEs, but became low at high dosages (120 and 100 mg/kg, respectively). However, the effect of Gd and Y treatments on biomass was different in the other two types of soils with coarser texture, due to high REEs concentration in soil pore water. In addition, the TTC reduction and proline concentration increased at low REEs dosage, but decreased again at high dosage in soils with higher pH (5.31 and 5.05). The accumulation of REEs in roots and shoot increased with increasing concentration of REEs in the soils. Regarding Gd and Y, when the transfer factor of aboveground part/root increased, all photosynthetic pigments decreased, indicating Gd and Y clearly affected the functions of photosynthesis. Hence, the bioavailability and physiological effects of REEs to *Brassica rapa* was dependent on soil texture and pH.

Key words: *Rare earth elements; Bioavailability; Physiological effects; Brassica rapa*

OS2-3

Differences in properties and greenhouse gas emissions between aerobic and anaerobic composting of cattle waste in Central Vietnam

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Abstract

Composting reforms organic waste into a valuable product for soil and plants. This study aims at evaluating the properties and greenhouse gas emissions of cattle waste compost under aerobic and anaerobic conditions. Cattle waste was composted with rice straw and rice husk at a ratio of 40:2:1 (w/w) at a moisture content of 60% under aerobic and anaerobic methods for 3 months. For the aerobic composting, the raw materials were mixed, piled, and turned over on days 0, 5, 14, 28, 56, and 84. For the anaerobic compost, the raw materials were piled up layer by layer and kept without mixing after covering the surface with a plastic sheet. In the first month, the temperature was higher in the aerobic compost than in the anaerobic compost. Total C content decreased and total N increased continuously in both composts. The C/N ratios of aerobic and anaerobic compost were 9.6 and 10.3 at the end of the experiment (day 84), respectively, which were in the range of mature compost. Aerobic composting resulted in higher NO_3^--N content than the anaerobic compost after day 56. *E-coli* was not detected in both composts at the end of the experiment. We will further report the quality differences in aerobic and anaerobic compost to determine the merits and demerits of each composting method.

Keywords: *Aerobic, anaerobic, livestock waste compost*

OS2-4

Mineral contents in agricultural soils determined by X-ray powder diffraction analysis and their relations to selected soil properties in Japan

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Abstract

Minerals in agricultural soils contribute to various soil functions such as nutrient cycling but their contributions are often underestimated due to insufficient quantitative information. Therefore, the objective of this study was to establish a refined protocol to determine the mineral contents in soil and to investigate their contributions to soil functions in Japan. Soil samples (0–15 cm depth) were collected from 79 agricultural fields widely in Japan. Air-dried and 2 mm-sieved soils were mixed with corundum as an internal standard at a ratio of 4:1, subsequently milled to obtain random powder specimen, which were scanned over the range of 5−65°2θ using Ni-filtered Cu Kα X-ray radiation. We established our reference library of standard X-ray powder diffraction (XRPD) patterns using pure minerals, which were used for mineral quantification of soils with two methods: mineral intensity factor (MIF) method and full-pattern summation (FPS) method using powdR package for R. The quantitative values were compared with the values obtained by traditional wet chemical method (WCM). The mean absolute difference (Δ) and correlation coefficient (r) between WCM and two XRPD methods (i.e., MIF and FPS) for the selected minerals were as follows: quartz (Δ = 5.6 wt.%, 5.6 wt.%; r = 0.83, 0.82), micas (Δ = 6.0 wt.%, 3.2 wt.%; r = 0.36, 0.83), K-feldspar (Δ = 4.2 wt.%, 3.1 wt.%; r = 0.51, 0.71), and plagioclase (Δ = 15.8 wt.%, 5.3 wt.%; r = 0.72, 0.88). These comparisons clearly indicated that FPS method was comparable to or more reliable than MIF method for mineral quantification. The FPS method determined the major type of crystalline minerals in Japanese agricultural soils to be plagioclase (19.1 wt.%), quartz (19.0 wt.%), K-feldspar (4.1 wt.%), and micas (2.3 wt.%), whereas it also showed that amorphous phase (represented by allophane and organic matter) was abundant (43.5 wt.%). The contents of micas, plagioclase, and amorphous phase showed significant correlations with the nonexchangeable K content ($r = 0.59$, $p < 0.001$), clay content ($r = -0.64$, $p < 0.001$), and cation exchange capacity ($r = 0.78$, $p < 0.001$), respectively. Thus, the improved precision of the mineral quantification allowed the linkages between individual minerals and soil functions to be more clearly demonstrated.

Key words: *agricultural soils; full pattern summation; mineral intensity factor; mineral quantification; X-ray powder diffraction analysis*

OS2-5

Effect of organic matter application on the nitrogen budget in a field with paddy–upland rotation on gray lowland soil in northern Japan

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Abstract

In recent years, in northern Japan, it has been pointed out that soybean yield declines in long-term paddy–upland rotation systems with soybean cultivation due to declines in soil nitrogen (N) fertility. Recently, a negative N budget (i.e., N loss from the field) during soybean cultivation has been reported as a factor for the decline in soil N fertility. To maintain the soil N fertility, improvement of the negative N budget by application of organic matter is required. In this report, we evaluated the N budget of soybean cultivated with different types of organic matter applied during upland period and rice cultivated without organic matter (high-yielding rice) in a paddy–upland rotation field. The study was conducted in three gray lowland soil lysimeter plots with different histories of organic matter application in the Akita Agricultural Experiment Station, northern Japan. In upland period (2014–2015 and 2019–2020), soybean was cultivated in a control plot with no organic matter application, a HV plot cultivated and plowed with hairy vetch, a leguminous green manure crop (C/N ratio: 10.1–12.1), and an LMC plot applied with livestock manure compost (cattle : poultry =9:1, C/N ratio: 17.8–20.8). During the rice cultivation period (2016–2018), all plots were cultivated with a high–yielding rice variety with no organic matter applied except for rice straw after harvest (chemical fertilizer only). Nitrogen flow of inputs (seeds and seedlings, N deposition, symbiotic N_2 fixation [soybean], irrigation water [rice]) and outputs (harvested grain, leaching, surface drainage [rice], N_2O emission) to the field were measured and the difference was calculated as the field N budget. In the control plot during soybean cultivation period, as in previous reports, N inputs, which were mainly symbiotic N_2 fixation, were exceeded by N outputs, which were mainly harvested grain and leaching, resulting in N loss (–13.2 to –6.3 g N m^{-2} y^{-1}). In the HV plot where N mineralization of applied organic matter is faster, the N loss was mitigated (–7.9 to +0.1 g N m^{-2} y^{-1}), while in the LMC plot, N accumulation was occurred (+0.1 to +11.6 g N m^{-2} y^{-1}). The N budget of the high-yield rice paddy resulted in a N loss of about -7 g N m^{-2} y^{-1}. The history of organic matter application during upland soybean cultivation period did not affect the N budget during the subsequent rice paddy period. Assuming a five-year field rotation system of two years of field (soybean) and three years of paddy (high-yield rice), the N losses during the upland soybean and rice paddy periods were the same in the control plot, resulting in a N loss of about 40 g N m^{-2} over the five years. In the organic matter-applied plots, the N loss was reduced by 13 and 30 g N m^{-2} (over 5 years) in the HV and LMC plots, respectively, due to the improved N budget during the upland soybean period.

Key words: *hairy vetch; lysimeter experiment; livestock manure compost; nitrogen budget; paddy–upland rotation*

OS2-6

The double pot technique identified multiple nutrient deficiencies in sands of south-central coastal Vietnam for crop production

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Abstract

Infertile sands covering more than 330,000 ha of the North and the Southern Central regions of Vietnam are expected to have multiple nutrient deficiencies restricting crop production and livelihood of small landholders. This study identified nutrient constraints on a range of sands commonly found in Binh Dinh and Ninh Thuan provinces of south-central coastal Vietnam. The double-pot method used here is a modified version of Janssen (1974, 1990) which involves growing the desired test plant (maize) in a soil-packed container placed above a pot containing nutrient solution, so that the plant roots can access nutrients from both the soil and the nutrient solution. Five field experiments were also conducted on the same sies from where soils were collected for double pot experiment. Equivalent rates of nutrients were applied to match the double pot experiment using maize and peanut as two test crops. Nine treatments included a benchmark treatment with all nutrients (All) to compare crop growth against other treatments by omitting specific elements as follows: All-N, All-P, All-K, All-S, All-B, All-Cu, All-Mo, and All-Zn. Field experiments were arranged in a randomly complete block design with 4 replications. Results indicated that omission of K had the most significant impact on dry matter yield of maize compared to all other nutrients. Omission of S had lesser effect on dry matter yield in comparison to other major elements like K and P. The double-pot experiment also identified micronutrient (Cu, B, Zn and Mo) deficiencies, however, the actual suite of deficiencies varied among sands as in the field experiments. All the field experiments also showed multiple nutrient deficiencies restricting peanut pod yield. While the first three sites from Binh Dinh province expressed deficiencies of K, S, B and Cu on peanut pod yield, a different suite of deficiencies limiting peanut yield were observed in An Hai and Phuoc Dinh from Ninh Thuan province. There are many parts of Vietnam and elsewhere in Asia and Africa where the double-pot technique could be used for systematic screening of soils for nutrient deficiencies that are limiting crop production. Overcoming nutrient deficiencies is a critical step for food security in many parts of the world.

Key words: *"Double pot, nutrient deficiency, peanut, sandy soil"*

OS2-7

Investigation of Rice Husk Biochar Application with or without Organic Manures and their effects on Soil Chemical Properties Changes, Growth of Paddy Rice and Greenhouse Gas Emissions

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Abstract

Rice is an important staple food, especially in East and South Asia, the Middle East, Latin America, and the West Indies. As some Asian regions intensively cultivate rice, farmers rely more on chemical fertilizers, especially nitrogen fertilizers. However, plants absorb less than half of the applied nitrogen fertilizer, while most of the remaining nitrogen is lost to the environment and significantly affects greenhouse gas emissions. In this regard, the role of biochar has become important in agriculture, not only to improve soil fertility, but also to reduce greenhouse gas emissions. Despite the positive effects of biochar on soil, its relatively low nutrient composition and resistance to biodegradation, depending on production temperature, may limit its use as a sole nutrient supplier. Therefore, the combined application of biochar and organic manure is a good option for improving nutrient requirements. Although livestock manures are common and can be used as organic fertilizers in agriculture, the nutrient composition may vary with individual manure. To date, information on the effects of biochar application combined with different organic manures on soil chemical properties, crop growth, and greenhouse gas emissions is still limited. Hence, a precise pot experiment was conducted with normal soil and sandy soil to (1) determine the changes in chemical properties of paddy rice soil and (2) investigate the best combination of rice husk biochar and various organic manures to improve rice production without increasing N_2O and CH_4 emissions. This study was conducted under greenhouse conditions at Ehime University, Japan. There were seven treatments with five replications in both soils: (i) control (without biochar), (ii) rice husk biochar 5 (t/ha), (iii) rice husk biochar 10(t/ha), (iv) rice husk biochar 5(t/ha)+ chicken manure 5 (t/ha), (v) rice husk biochar 5(t/ha)+ cow manure 5 (t/ha), (vi) rice husk biochar 10 (t/ha)+ chicken manure 5 (t/ha) and (vii) rice husk biochar 10 (t/ha)+ cow manure 5 (t/ha). The results indicated that the application of rice husk biochar 5 (t/ha) combined with chicken manure 5 (t/ha) improved the number of tillers, dry biomass, and grain yield in both normal and sandy soils. There were no significant differences in plant height and SPAD values among the treatments, except for the control. In addition, the combined application of rice husk biochar 5 (t/ha) and chicken manure 5 (t/ha) showed a decreasing C/N value, whereas there was an increase in the soil available NH_4^+-N, NO_3^--N, and exchangeable K in both soils. It was highly apparent that all combined applications of rice husk biochar and cow manure significantly increased the soil available P, regardless of the soil type. The lowest CH_4 emissions were recorded in the control in both the soils. However, the effect of the combined application of biochar 5 (t/ha) + chicken manure 5 (t/ha) and biochar 5 (t/ha) in normal soil was not significant. Regarding N_2O emissions, soil amendment with biochar 5 (t/ha) and chicken manure 5 (t/ha) produced the significantly lowest N_2O emissions during the pot experiment. Overall, the application of rice husk biochar 5 (t/ha) and chicken manure 5 (t/ha) is an effective combination to fertilize the soils increasing soil chemical properties, adjusting soil C/N value, thereby reducing nutrient loss, and increasing the grain yield.

Keywords: *rice husk biochar; organic manures; paddy rice; soil chemical properties; greenhouse gas emissions*

OS2-8

Nitrogen Management Options for Increasing Nitrogen Use Efficiency

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Abstract

Nitrogen (N) is an essential element for all living beings. It is widely used in agriculture for increasing crop yields to feed the global population. But N use efficiency (NUE) is too low (20-40%), while its loss is unreasonably high (60-80%). Excessive use of N raises the cost of production and brings manifold threats to the environment and treated as Godfather of environmental pollution. Unexploited reactive N (Nr) degrades soil health, augments environmental menace, and increases greenhouse gas emission. There are several N managements tools and apps available in Bangladesh and other countries. Therefore, to increase NUE and find out an efficient tools or app for rice cultivation the present experiment was conducted using five treatments *viz.*, zero N control, soil test-based N (STBN), leaf color chart based N (LCCN), soil plant analysis development meter-based N (SPADN) and Soil Resource Development Institute (SRDI), Bangladesh developed N app (SRDIN). The study was conducted in Boro season (dry season rice with full irrigation) using the variety BRRI dhan29. The findings revealed that rice grain yield was significantly highest in the LCCN and STBN treatments (6.67 t ha^{-1}), followed by SRDIN (6.2 t ha^{-1}), SPADN (5.89 t ha^{-1}) and control (2.98 t ha^{-1}). Agronomic efficiency of N was appeared significantly highest in the LCCN and SPADN treatments (25 kg grain kg^{-1} N applied) compared to all other treatments. The significantly highest physiological efficiency was found in the SPADN (46 kg grain kg^{-1} N uptake), while LCCN (40 kg grain kg^{-1} N uptake) and STBN (38 kg grain kg^{-1} N uptake) treatments were found statistically similar, and the lowest was in the SRDIN treatment. Nitrogen recover efficiency was found the significantly highest in the LCCN (63%) followed by SPADN (53%), STBN (42%) and SRDIN (35%). Findings revealed that LCC can be recommended as farmers practice for N fertilizer application to increase rice yield and NUE. The global scientists are in thirst for innovating location specific best management options to raise NUE to a reasonably higher level from the present state. A holistic approach in selecting the guidance considering locally available resources, farmers' interests, economics, and the environment might be effective for better N management and achieving a higher NUE.

Key words: *Leaf color chart (LCC); Reactive nitrogen; Agronomic efficiency; Physiological efficiency; Recovery efficiency*

OS2-9

Prediction of Plant Available Nutrient Levels Soil Using EC sensor

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Abstract

Precise nutrient and water management is required for stable crop yield and soil environment in open field. However, there is no sensor that can be used to directly monitor soil nutrients. Since soil electrical conductivity (EC) is affected by the nutrient contents in soil solution, soil temperature and water content, EC sensor can be used to evaluate plant available nutrient levels. Therefore, the objective of this study is to evaluate plant available nutrient levels in soil using EC sensor. Soils with different physicochemical properties were collected from 60 different agricultural lands. Physiochemical properties of the soils including soil texture, pH, EC, organic matter, and available nutrients were analyzed and soil EC was monitored by EC sensor (TEROS 12) in laboratory. To evaluate the field applicability of EC sensor to predict nutrient contents, soil EC was monitored in the open field of pepper. Pepper soil was collected periodically for measuring pH and EC and analyzing the available nutrient contents. Principal component analysis (PCA) was performed to evaluate the relationship between sensor EC values and available nutrient contents. Sensor EC showed a strong positive correlation with nitrate nitrogen in both 60 collected soils and pepper soils. Linear regression of soil properties showed that sensor EC can be described by 0.669×nitrate nitrogen + 0.389×potassium. Therefore, for proper nutrient management, EC sensor can be used to predict plant available nutrient levels in open field.

Key words: *EC sensor; nitrate; precision agriculture; smart farm*

OS2-10

Potential of reducing greenhouse gas emissions in rice production from improved water and rice residue managements: a case study from Vietnam

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Abstract

Rice is the most important food crop in Asia. In Vietnam, annual rice consumption provides 60% of protein and 50-70% of calories of the dietary intake. Vietnam is one of the largest rice producers and exporters in the world. What the rice cultivation generates equates to approximately 43 million tons of rice residue per year in Vietnam. Traditionally, Vietnam farmers removed rice residue from fields to be used as cooking fuel, roof thatch for houses, fodder or animal bedding and organic composting. Unfortunately, the rice residue management has been changed in Vietnam as well as many other Asian countries. While a substantial quantity of these residues is used for animal feed, soil mulching, or fuel purposes, a large portion is burned on-farm. The burning of crop residues not only causes environmental pollution through greenhouse gas emissions adding to global warming but also results in the depletion of valuable nutrients such as nitrogen (N), phosphorus (P), and potassium (K). With current increasing trends in cropping intensities, the amounts of residues that are burned on the field are expected to increase dramatically, unless crop residues are managed more sustainably. In this study, we investigated the effects of rice residue and water management and water regime on greenhouse gas emissions and rice yield. The study was a 2 x 4 factorial design, including utilizing safe alternate wetting and drying (AWD) and conventional continuous flooding (CCF), with four material treatments: Control (CT), compost manure (CM), open burning rice residue (B), and incorporation of rice residue (I). A control treatment without organic matter incorporation in both the AWD and CCF water regimes was also included in the study; all treatments received equal amounts of minerals (N, P, K). Our data demonstrate that the treatment I led to the highest CH_4 emissions, while the control (CT) showed the lowest CH_4 emissions under both water management systems. Rice yields were slightly higher for treatments including organic fertilizers compared to only mineral fertilizer (CT). In conclusion, we recommend a combination of treatment incorporation of rice residue with AWD water management, as this combination resulted in reduced greenhouse gas emissions while ensuring high rice yields.

Key words: *Mitigation of methane emissions, Nitrous oxide emissions, Rice farming, Rice residue management, Water management, Vietnam.*

OS2-11

Chemical speciation and phyto-availability of legacy phosphorus in rice paddy soils in Taiwan

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Abstract

Phosphorus, as one of the macronutrients for plant growth, is often added to agricultural lands in the form of fertilizers to increase crop yields. However, long-term excessive use of phosphorus fertilizers in Taiwan has led to environmental pollution, making the problem of legacy phosphorus soil hardly be ignored. To understand whether legacy phosphorus in the soil is sufficient to supply the nutrients needed by crops without fertilization and in what form phosphorus species are released into the soil, this study conducted measurements of total phosphorus, plant-available phosphorus, pH, and other properties in rice field soils from different regions. Phosphorus speciation was analyzed with X-ray absorption near edge structure spectroscopy (XANES). The results showed that the soils in Yilan, Hualien, and Taitung, which are acidic soils, had lower levels of plant-available phosphorus and total phosphorus. In contrast, the soils in the regions with alkaline soils, including Yunlin, Chiayi, Kaohsiung, and Pingtung, had plant-available phosphorus levels two to three times higher than other regions, indicating regional differences in soil phosphorus content. The linear combination fitting results of XANES showed that the major phosphorus species supplying plant-available phosphorus in the soil were likely calcium phosphate or aluminum phosphate. The findings will contribute to a reevaluation of recommended phosphorus fertilization methods for rice, with the aim to reduce phosphorus fertilizer application to decrease phosphorus mineral consumption and simultaneously lower legacy phosphorus levels in rice paddy soils to mitigate phosphorus pollution.

Key words: *Legacy phosphorus; X-ray absorption spectroscopy; Rice paddy soil; Plant-available phosphorus*

OS2-12

Free Energy change of ion exchange reactions and cation exchange capacity estimated the potassium movement and status in soil

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Abstract

The potassium (K) supplying capacity of some selected agricultural soil was investigated by employing the quantity-intensity (Q/I) approach. The values of potential buffering capacity (PBC^K), labile K (K_L), specific K (K_0), specific K sites (K_X), equilibrium activity ratio (AR^K) and free energy change ($-\Delta G$) were estimated from the quantity-intensity curve. Higher cation exchange capacity and lower organic carbon favours labile K pool. All Q/I parameters has a direct relationship with chemical composition and clay mineralogy of the soil. The changes of Q/I parameters is associated with contents of clay, organic matter and clay mineralogy of the soil. High exchangeable cation in the soil matrix and higher CEC favours labile K, specific K and specific K sites. Equilibrium activity ratio of potassium increases with decreasing free energy change as well as increasing CEC and exchangeable cations.

Key words: *Labile K, specific K sites, free energy change, equilibrium activity ratio, Q/I relationship*

OS2-13

Effect of soil P level on *in-situ* sugarcane-AMF symbiosis P absorption in tropical alkaline soil, Okinawa, Japan

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Abstract

Phosphorus (P) is one of the essential nutrients for plant growth, while its availability for crop production is generally low because of the adsorption with Al, Fe, Ca, or organic matter in the soil. In alkaline soil, Ca fixes the most labile P of soil (becomes less labile Ca-P), causing low P use efficiency. Arbuscular mycorrhizal fungi (AMF) generally improve the plant P uptake by expanding the nutrient absorption area. However, only some *in-situ* studies focus on the P absorption ability of AMF, and it is unclear whether AMF can absorb those less labile P or not. In this research, we aimed to evaluate the amount of P absorption by AMF under different P fertility sugarcane cropland fields in Japan. We conducted a sugarcane cultivation experiment with a special mesh bag in Okinawa, southern Japan. The soil type is Jahgaru (alkaline soil), and we prepared four different P-level fields, i.e., HB1 (Bray2-P; 117 mg P kg−1), HB2 (357 mg P kg−1), HB3 (245 mg P kg−1), and HB4 (211 mg P kg−1). The special mesh bags were made from nylon mesh, which had small halls (37 μm) that hyphae of AMF can intrude but roots cannot. The bags were filled with each field's soil and buried near the sugarcane in April 2023. As AMF intrusion (+I), the bags were buried directly, while as non-AMF intrusion (−I), the bags were put in the plastic pot to prevent the sugarcane roots and AMF intrusion. After six months, we collected both buried bags. We analyzed the fractionated soil P using the Hedley fractionation method: Resin-P as labile, NaHCO3-Pi/Po as moderately labile, and NaOH-Pi/Po (Fe-P, Al-P) and HCl-P (Ca-P) as less labile. We found a significant difference between the +I and −I only in HB1 and HB4, where the soil P-level was relatively low. In HB1, NaHCO3-Pi was 22.2 (−I) > 18.7 (+I), NaOH-Pi was 53.4 (−I) > 43.1 (+I) (mg P kg−1), and in HB4, NaHCO3-Pi was 25.7 (−I) > 24.0 (+I) (mg P kg−1). In contrast, no significant differences existed between +I and −I in HCl-P (451 - 711 mg P kg−1) in any fields. These results indicate that NaHCO3-Pi and NaOH-Pi are absorbed by sugarcane-AMF symbiosis only in the low P conditions (HB1), while the most abundant Ca-P (HCl-P) was not utilized in any P condition in this study.

Key words: *AMF; mesh bag; Hedley-fractionation method; tropical alkaline soil; sugarcane*

OS2-14

Effect of rhizosphere nutrient levels on cherry tomato growth and fruit characteristics in a greenhouse

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Abstract

The decline in farmland area and agricultural workforce has drawn attention in enhancing productivity per unit area and automating agricultural systems. In greenhouse, water and nutrient management in rhizosphere is important not only in terms of crop productivity but also economic feasibility. Therefore, the objectives of the study were to investigate and compare the growth and fruit characteristics of cherry tomatoes in rhizosphere with different electrical conductivity (EC) for effective supply of nutrients. Cherry tomatoes were grown in rooms A and B, and after the vegetative growth of cherry tomatoes, the EC of the medium in room B was lowered to half compared to the EC in room A. Plant vitality was monitored using plant induced electrical signal (PIES), which can measure the degree of nutrient uptake of the plant by inserting stainless steel needles into the stem. Additionally, to investigate plant growth and fruit characteristics, SPAD, Fv/Fm, fruit weight, leaf length, leaf width, and fruit width, etc. were measured. The PIES showed lower value in cherry tomatoes grown in room A where the EC of the medium was higher than room B indicating reduced plant activity due to the high concentrations of salts. In addition, PIES was highly correlated with leaf width, shoot length, and stem diameter, and also showed a positive correlation with fruit weight. Although rhizosphere nutrient concentrations were higher in room A, yield parameters were higher in room B, indicating that reduced EC had a positive effect on cherry tomato growth and quality.

Key words: *Electrical conductivity (EC); Plant induced electrical signal (PIES); Smart farm; Yield; Nutrient*

OS2-15

Impact of Methane Fermentation Waste Fluid Application Rates on Maize Growth and Fate of N with special reference to Soil Textures

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Abstract

Efficient nitrogen (N) management is critical for improving fertilizer utilization in crop cultivation. Methane fermentation waste fluid (MFW) has been shown as a promising biofertilizer for the cultivation of maize (*Zea mays* L.). However, a comprehensive understanding of the maize growth and N pathway resulting from various MFW application rates across different soil textures remains poorly understood. To address this knowledge gap, the pot experiments were conducted over two years with three different levels of MFW rates (365 mg N pot^{-1}, 750 mg N pot^{-1}, and 1500 mg N pot^{-1}), chemical fertilizer (NH_4Cl) at 750mg N pot^{-1}, and control treatment, using sandy loam (SL) and clayey loam (CL) soils. To trace the fate of inorganic N derived from fertilizer (Ndfif), the amount of inorganic N was substituted with 20% of the N with $^{15}NH_4Cl$ (99%) in each treatment. Our results indicate that the growth of maize was significantly enhanced by MFW application rates, which were significantly improved by SL soil and influenced by the cultivation year. It led to a significant dependence of Ndfif fate on soil textures, fertilizer types, and cultivation conditions. The percentage of Ndfif recovered by the plant was significantly higher in SL soil (54.6 ± 3.5% to 67.9 ± 1.7%) than in CL soil (22.9 ± 1.8% to 65.9 ± 0.8%). However, this recovery does not display a linear relationship with MFW rates. Contrastingly, although the proportion of Ndfif retained in soil significantly decreased with increasing MFW rates, it was significantly higher in CL soil (18.1 ± 1.8% to 26.0 ± 1.1%) than in SL soil (13.3 ± 0.8% to 20.2 ± 2.5%). The Ndfif loss resulting from MFW application was mainly caused by NH_3 volatilization and NO_3-N leaching, which were more severe in CL soil. In addition, chemical fertilizer had the highest N recovery rate (up to 85.0%), but it could not significantly raise the yield of maize compared to the MFW application. To determine the optimum rate of MFW for each soil texture, we tried to find the maximum distance between the total biomass or yield of maize and the N loss regression lines by the min-max nominalization method. The suitable rate of MFW for SL soil can be used in a range from 700 mg N (2022) to 1000 mg N pot^{-1} (2021), while it was acceptable from 500 mg N pot^{-1} (2022) to 776 mg N pot^{-1}(2021) for CL soil. Our findings suggested that determining the optimum MFW rates for maize production while minimizing the environmental impacts, even though it depended on the cultivation year or planting conditions, should be concretely considered with soil textures.

Keywords: *Upland field, Biogas waste, N distribution, Environmental impact.*

OS2-16

Evaluating the Potential of Alternative Organic Fertilizers in Japan's Strategy for Sustainable Food Systems

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Abstract

This study investigates the feasibility of integrating alternative organic fertilizers into Japan's Strategy for Sustainable Food Systems, a nationwide initiative dedicated to decarbonizing the food sector through sustainable agricultural practices. This research quantitatively models the practicality of substituting chemical fertilizers with calculated quantities of nitrogen (N), phosphorus (P), and potassium (K) derived from livestock manure, food refuse compost, and sewage sludge compost. The study evaluates this proposed initiative on both national and prefecture scales for the target year 2020. In the first approach, 25% of chemical fertilizer NPK was replaced by food refuse compost and unutilized livestock manure in organic agriculture, and in the second scenario considered, 5% of chemical fertilizer NPK was offset by sewage sludge compost and livestock manure. Efficiencies of composts compared with chemical fertilizers were 40% for N and 85% for P and K, while livestock manure was modeled with a N, P, and K efficiency of 50%. Results indicate that on a national scale, food refuse compost could replace 25% of the P and K content of chemical fertilizer, but the limited N content of food compost requires additional unutilized livestock manure to supplement the N content for organic agriculture. Similarly, while sewage sludge compost could replace 5% of the N and P content of chemical fertilizers, additional livestock manure would be necessary to compensate for the low K content of sewage sludge. Overall, these results present a promising strategy to feasibly reduce national chemical fertilizer use by 30% and increase the planted area for organic agriculture by 25%. To assess such an initiative on the prefecture level, the variances in population, sewage output, crop types, and livestock numbers between prefectures must be considered. This research demonstrates the viability of utilizing organic fertilizers on a national scale, although it necessitates adaptive, localized planning to address the unique agricultural landscapes of individual prefectures.

Key words: *Food refuse; sewage sludge; prefecture scale; strategy for sustainable food system; unutilized livestock manur*

ORAL SESSION 3: SOIL CLASSIFICATION AND MAPPING; SOIL EVALUATION AND LAND USE; INFORMATION ON UPLAND SOILS; SERPENTINE SOILS AND WETLAND

OS3-1

Fractionation and potential risk of rare earth elements in soils derived from felsic to ultramafic parent rocks

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Abstract

Rare earth elements (REEs) have been recognized as one of the technology critical elements and emerging contaminants, which give rise to uncertain threats to soils, one of the final recipients in the ecosystem. Naturally, the concentration and constitution of REEs in soils are dominated by the type of their parent materials. Moreover, the dynamic of REEs in soil profiles was affected by the ongoing alteration of soil characteristics during pedogenesis. Nevertheless, the fractionation and potential risk of REEs as well as their causation with soil properties have often been overlooked while considering the geological diversity. Thus, this study elucidated the amount of total and labile pools of REEs in 50 soil profiles derived from felsic/intimidate/mafic igneous rocks, sedimentary rocks, and ultramafic metamorphic rocks, which encompassed diverse soil types attributed by intense pedogenesis processes in Taiwan. The total REEs concentration in the studied soil was 119 ± 67.7 mg/kg, which was lower than that in the Earth's Crust (169 mg/kg) and all individual REE were at the minimal contamination level as estimated by the enrichment factor. Additionally, the REEs abundance decreased as the following order of soil parent materials: granite (171 ± 92.9 mg/kg) > sandstone and shale (160 ± 34.6 mg/kg) > mafic rocks (150 ± 64.6 mg/kg) > andesite (90.4 ± 42.6 mg/kg) > ultramafic metamorphic rocks (55.0 ± 43.6 mg/kg), while soils from granite, sandstone and shale, and andesite were enriched in light REEs (LREEs, Z = 57–63) and the others were enriched in heavy REEs (HREEs, Z = 39, 64–71) compared with the Earth's Crust. Regardless of the sources, REEs accumulated in B horizons corresponding with their higher geoaccumulation index (average I_{geo} was -1.19) than those obtained in A and C horizons (average I_{geo} was -1.30 and -1.49, respectively). The labile pool of REEs significantly ($p < 0.01$) increased with the increasing total amount of REEs, which was categorized as significant contaminated by the pollution loading index. Additionally, the stronger sequestration tendency of pedogenic iron oxides to HREEs compared to LREEs led to the smaller potential bioavailability of HREEs and the higher average LREEs/HREEs value of the labile pool of REEs than that of total REEs, especially in B horizons. The results suggested that the geological properties majorly affected the REEs level in the studied benchmark soils in Taiwan, which subsequently dominated the amount of labile pool of REEs throughout soil profiles. Nevertheless, the co-translocation and fixation of REEs with soil colloids from the surface to subsurface horizons weaken the potential risk of REEs in soils.

Key words: *Technology critical elements; Emerging contaminants; Lithology; Pollution indices*

OS3-2

Effects of drip irrigation and nitrogen management on maize yield and soil nitrous oxide emissions under equal nitrogen

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Abstract

Unreasonable irrigation and nitrogen application will cause the decline of crop yield and quality and the increase of nitrous oxide (N_2O) emissions from farmland. In order to obtain a reasonable drip irrigation water and nitrogen management mode for high yield and quality of maize and low soil N_2O emission, and to reveal the soil factors affecting N_2O emission in maize planting soil, field experiments of different drip irrigation water and nitrogen management under equal nitrogen were carried out in a mobile rain-proof shelter. Maize growth, yield and quality of fresh ears, soil N_2O flux, pH, available nitrogen content, enzyme activity and absolute expression of nitrogen cycle metabolism gene were determined, and then the yield of fresh ear, 100 kernel weight, soluble sugar, reducing sugar and crude protein contents and water use efficiency were comprehensively evaluated using principal component analysis to obtain the optimal treatment for coordinating maize yield, quality and water use, and the relationships between soil N_2O fluxes and each soil factor were analyzed. The results showed that: (1) The yield of fresh ears of W_{80} (70%-80% field capacity) and W_{100} (90%-100% field capacity) was significantly higher than that of W_{60} (50%-60% field capacity) under the nitrogen application ratio of F_{55} (50%N fertilizer as basal fertilizer, 50%N fertilizer as topdressing, i.e. basal fertilizer/topdressing ratio of 5:5), which was 22.6%-43.9% and 5.7%-15.4% higher than W_{60}. The optimal treatment for coordinating yield, quality and water use of maize was $W_{80}F_{55}$ (70%-80% field capacity, basal fertilizer/topdressing ratio of 5:5). (2) The peak of soil N_2O flux appeared within one week after urea application, and the soil N_2O flux was higher at the seedling and jointing stages. The cumulative N_2O emission of soil in F_{37} (basal fertilizer/topdressing ratio of 3:7) was higher than that of F_{55} (basal fertilizer/topdressing ratio of 5:5), and the cumulative N_2O emission of soil in $W_{60}F_{55}$ and $W_{80}F_{55}$ treatments was significantly lower than that of other treatments, which was decreased by 5.8%-36.9% and 22.4%-27.5% compared with $W_{60}F_{37}$ and $W_{80}F_{37}$ treatments, respectively.(3) Soil N_2O flux was significantly positively correlated with nitrate nitrogen content (correlation coefficient: 0.433-0.579), nitrite nitrogen content (correlation coefficient: 0.396-0.532), microbial biomass nitrogen (correlation coefficient: 0.332-0.419), nitrite reductase activity (correlation coefficient: 0.320-0.427), hydroxylamine reductase activity (correlation coefficient: 0.546-0.660) and *nirK* gene absolute expression (correlation coefficient: 0.531-0.642). But soil N_2O flux was negatively correlated with nosZ/nirK (correlation coefficient: -0.260 - -0.330) and *nosZ*/ (*nirS*+*nirK*) (correlation coefficient: -0.244 - -0.407). Therefore, under applying pure N of 180 $kg \cdot hm^{-2}$, P_2O_5 of 90 $kg \cdot hm^{-2}$ and K_2O of 180 $kg \cdot hm^{-2}$, the treatment of nitrogen ratio F_{55} (basal fertilizer/topdressing ratio of 5:5) and 70%-80% of field capacity was the water and nitrogen management mode, which was beneficial for improving maize yield, quality, water use efficiency and reducing soil N_2O emission. Soil nitrate nitrogen, nitrite nitrogen, microbial biomass nitrogen, nitrite reductase and hydroxylamine reductase activities and *nirK* gene absolute expression were the main factors affecting soil N_2O emission.

Key words: *N_2O emission; Inorganic nitrogen; Soil enzyme activity; Nitrogen metabolism pathway gene expression*

OS3-3

Nitrogen cycling patterns in tropical forests: A comparative study of Oxisols and Ultisols under similar soil acidity

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Abstract

The nitrogen (N) cycle in tropical forests is characterized by a high rate of supply to the soil through litter, followed by rapid decomposition and subsequent plant absorption. Oxisols (Ox) and Ultisols (Ul), which are typical of tropical forests, have significantly different physico-chemical properties. However, there have been few studies comparing these differences, and many previous studies have treated them as a single category of highly weathered tropical soils. A previous study in Cameroon, comparing these soil types, found that N infiltrated deeper into the sub-surface horizon in Ox than in Ul. This was thought to be due to the higher soil acidity of Ul, which concentrated fine roots in the O horizon and inhibited nitrification. Therefore, this study investigated whether there are differences in N cycling patterns between Ox and Ul, even when soil acidity is comparable. A forest in the central highlands of Vietnam was selected, with adjacent Ox and Ul plots established within a linear distance of approximately 2 km. The surface soil pH was 3.8 for Ox and 3.9 for Ul. Over a one-year period from April 2018 to March 2019, litterfall, precipitation, throughfall, and soil solution at depths of 0 (directly below the O horizon), 15, and 30 cm were monthly collected. Annual N fluxes were calculated based on the product of weight and N content for litterfall, and the product of dissolved N concentration and leachate volume for solutions. N input through litterfall was 73 kg N ha^{-1} yr^{-1} in the Ox plot and 60 kg N ha^{-1} yr^{-1} in the Ul plot. N fluxes in solution were roughly 25 kg N ha^{-1} yr^{-1} at 0 cm for both plots, but decreased gradually to 20 kg N ha^{-1} yr^{-1} and 12 kg N ha^{-1} yr^{-1} at 15 and 30 cm in the Ox plot, while decreasing sharply to 4 kg N ha^{-1} yr^{-1} and 2 kg N ha^{-1} yr^{-1} in the Ul plot. These results suggest that even when soil acidity is comparable, there is open N cycling to deeper horizons in Ox and closed N cycling in the surface horizon in Ul. The distribution of fine roots mainly at a depth of 0-15 cm in the Ul plot, despite high soil acidity, suggests that N absorption is completed in the mineral surface layer. The increase in NO_3^--N flux from 9 kg N ha^{-1} yr^{-1} at 0 cm to 18 kg N ha^{-1} yr^{-1} at 15 cm in the Ox plot suggests that nitrification occurs in the highly acidic surface horizon of Ox. To elucidate the factors behind open N cycling in Ox, further research on the mechanism of nitrification in highly acidic Ox is needed.

Key words: *Nitrogen Cycling; Tropical Forests; Oxisols; Ultisols; Soil Acidity*

OS3-4

Soil correlation for soil properties prediction

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Abstract

The study was carried out to determine and evaluate the correlation of soil characteristics; the applicability of correlations on soil properties in Vinh Long province. The study collected data from 20 soil samples from Vinh Long Department of Natural Resources and Environment with 18 physical and chemical characteristics of soil: %clay, %meat, %sand, pH(H2O), pH($_{KCl}$)), conductivity (EC), organic matter (OM), cation exchange capacity (CEC), total N, total P, available P, total K, exchangeable K^+, Na^+, Ca^{2+}, Mg^{2+}, and Al^{3+}, soluble SO_4^2. The results have identified 30 correlations, showing that some pairs of soil properties have high and very close correlations. For the 1% significance level ($r \geq 0.549$, $n = 19$) consisting of pairs: OM with N totals, available P with Al^{3+}, Mg^{2+} with Na^+, $pH_{(KCl)}$ with $pH_{(H2O)}$, total P with total K, etc. For the 5% significance level ($r \geq 0.433$, $n = 19$) consists of pairs: $pH_{(H2O)}$ with Al^{3+}, $pH_{(KCl)}$ with Al^{3+}, CEC with meat ratio, $pH^{(H2O)}$ with SO_4^{2-} , tc.). It helps to quickly predict and calculate from other data, reducing costs and time in determining soil characteristics when assessing soil quality. More research, specific agreement, and specification are needed, and more sampling points must be arranged.

Keywords*: correlation, soil characteristics, Vinh Long province.*

OS3-5

Overview of soil based-functions in serpentine ecosystem

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Abstract

Serpentine soils have unique biogeochemical characteristics, such as Ca/Mg ratio imbalance and extremely high concentrations of geogenic potentially toxic elements (PTEs) including chromium (Cr) and nickel (Ni). Multi-discipline study on this soil is necessary because of its capacity to promote crop growth and food safety, protect environmental qualities and human health, and sustain natural resources. These attractive issues of serpentine soils are pedogenetic processes, bioavailability of PTEs, hyperaccumulation of PTEs, human health risk from exposure to PTEs, and others. However, the primary application of serpentinophytes is phytoremediation at contaminated sites depending on the uptake ability of PTEs by plants (accumulator/excluder). In addition, bio-ores can be obtained from serpentine soils by phytomining, and agromining provides local communities with an income from cultivating plants on serpentine soils by considering the hyperaccumulator plant as a crop that recovers target metals. Serpentine minerals can be used as lime materials for acidic soils and heavy metals-contaminated soils and with carbonation for carbon dioxide sequestration. However, future research on serpentine soils needs to be conducted with respect to the following: the release of PTEs from soils to the environment when using oxidation treatments for organic contaminants, verification of the geogenic PTEs present, and the environmental effects of applying plant growth-promoting bacteria in serpentine ecosystem.

Key words: *agromining; food safety; phytoremediation; potentially toxic element; carbon sequestration*

OS3-6

Modeling for the smart and rapid screening fertility of serpentine soils in Eastern Taiwan

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Abstract

The deficiency of calcium (Ca) and enrichment of magnesium (Mg) in serpentinite lead to low exchangeable Ca to Mg ratio in serpentine soils, resulting in poor soil fertility. Hence, the evaluation of soil fertility considering the Ca and Mg balance in serpentine soils is important for agricultural use. However, the chemical method for determining the exchangeable Ca and Mg in soils is economic and time-consuming. Proximal soil sensing is an approach to rapidly quantify soil properties by using proximal sensor and machine learning. Thus, this study aimed to estimate the exchangeable Ca to Mg ratio in serpentine soils based on the total content of 16 elements (Al, Ca, Fe, K, Mg, P, Si, Ti, As, Cu, Cr, Mn, Ni, Rb, Sr and Zn) by using portable X-ray fluorescence (pXRF). Totally 56 soil samples from 10 pedons were collected from the serpentine areas in Eastern Taiwan. The soil samples were air-dried, grinded, and passed through sieve (< 2 mm). The exchangeable Ca and Mg of soils were determined by ammonium acetate (pH = 7) method. In addition, the soil samples were filled inside a plastic sampler and analyzed by the pXRF (Olympus Delta Premium 2000) through a 2.5 mm Mylar membrane for above-mentioned 16 elements. Moreover, partial least square regression (PLSR) algorithm was selected to establish the prediction model for exchangeable Ca to Mg ratio based on the total content of these elements. A low root mean squared error and low residual prediction deviation, 0.15 and 1.86, respectively, verified accurate performance of the PLSR model. Furthermore, the Lin's concordance correlation coefficient also confirmed the predictive power. Therefore, the PLSR generated an acceptable model for the prediction of exchangeable Ca/Mg ratios in serpentine soils by total contents. To sum up, pXRF is a promising tool to quantify the ratio of exchangeable Ca and exchangeable Mg through PLSR algorithm.

Key words: *"serpentinite", "serpentine soils", "exchangeable Ca to Mg ratio", "portable X-ray fluorescence", "partial least square regression"*

OS3-7

Effects of AigamoRobo, Automatic Weed Supression Robot, in an organic paddy field

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Abstract

Weeds are the biggest problem in organic rice cultivation. AigamoRobo is a unique robot that automatically navigates the paddy field according to a set track, agitates the paddy water and stirs up surface soil. The suspended soil makes the paddy water turbid, then sunlight hardly reaches the soil surface. The germination and growth of weeds can be suppressed due to insufficient sunlight on the soil surface. This robot is expected to suppress weeds in a labor-saving manner and ensure stable rice production in organic paddy fields. However, researches, which evaluate the effects of introducing this robot to organic paddy fields, are limited. Therefore, we conducted a study on effects of this robot on weeds, growth and yield of rice, and greenhouse gas emission in an organic paddy field located in the cool climate region of Japan. In 2022, immediately after the transplanting of rice plants, an AigamoRobo was introduced to one of organic paddy fields in Kawatabi Field Science Center, Graduate School of Agricultural Science, Tohoku University. The area of this field was 0.12 ha. The robot worked in this field for three weeks. An adjacent organic paddy field was used as a control field, where weeding was carried out three times with a rotary weeder. In the field where the AigamoRobo was introduced as well, weeding was carried out twice with the rotary weeder. The plant height, number of tillers and SPAD value of rice plants were measured during the rice growth period. At the maturity stage, rice plants were harvested and the yield components were investigated. Weed samples were collected at the panicle initiation stage of rice, and the dry weight was measured. Gas samples were collected three times by closed chamber method, and the methane fluxes from the paddy fields were evaluated. AigamoRobo is sensitive to the difference in the level of the soil surface, and frequently stopped by stucking at places with high surface level. This shortened the operation time of the AigamoRobo than expected. Even in the field where the AigamoRobo was introduced, a large amount of weeds was observed, and the dry weight of the weeds at the panicle initiation stage of rice plants was about 100 g m^{-2}. However, compared to the control field without the AigamoRobo, the amount of weeds was reduced by almost half, indicating this robot can suppress the emergence and/or growth of weeds. The plant heights and SPAD values (leaf color) of rice plants in the field where the AigamoRobo was introduced were similar to those in the control field. However, the numbers of tillers and spikelets in the field where the AigamoRobo was introduced was smaller than those in the control field. The cause of decreasing tillers and spikelets may be the physical impact by the AigamoRobo on rice plants. Methane emissions were lower in the field where the AigamoRobo was introduced than those in the control field. The results suggest that agitation of the paddy surface for 3 weeks after rice transplanting has some effect on the soil and methane emission.

Key words: *AigamoRobo; GHG; Weed*

OS3-8

Geochemical Characterization of Soils in the Ophiolite Complex of Eastern Taiwan

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Abstract

The geological setting and landscapes of the ophiolite complex predominantly consist of serpentine and ophiolitic soils, resulting in appreciable variations of soil characteristics. This study determined the pedogenic characteristics of soils in the ophiolite complex from eastern Taiwan. Four pedons were selected along a toposequence of the ophiolite complex to compare with nearby two serpentine-derived soils for elemental characterization. Soil samples were analyzed for general properties, total elemental contents using ICP-MS and XRF, and mineralogical and micromorphological assessment using XRD and polarized light microscope. The mobility of soil elements was quantified using the mass balance model. The experimental results indicated that serpentine group minerals dominated the serpentine soils, but feldspars were the major minerals in the ophiolitic soils. Concentrations of Cr and Ni in the ophiolite soils were lower than those in the serpentine soils. The major elemental compositions in the ophiolite soils were comparable. However, the serpentine soils were characterized with <1.0 Ca/Mg. Significant ($P < 0.05$) and positive correlation between Cr and Ni while negative and poor correlations were observed among the trace metals, pH, and Ca/Mg ratio, indicating that trace metals were concurrently derived during soil formation and soil pH, Ca, and Mg behaviors do not influence the concentrations of trace metals. The enhancement of clay particles in the ophiolite soils was associated with the advanced soil development and the deposition of fine particles. Ca appeared to be the most mobile basic cation compared to Mg. Furthermore, both serpentine and ophiolitic soils show enrichments of Cr and Ni relative to their depth which substantiated the results in clay contents but not Fe; thus, clay particles provided major adsorption sites for trace metals.

Key words: *Chromium; nickel; pedogenesis; ophiolitic soils*

OS3-9

Changing patterns of Ni concentration in soil and rice with water management in serpentinitic paddy soils

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Abstract

Nickel (Ni) is an essential micronutrient but often causes a toxic effect on plant growth when it is excessively present in soil. This study investigated the temporal changes in the phytoavailability of Ni and redox-sensitive species in terraced paddy fields affected by serpentinite, which contains an anomalously higher Ni content compared with other geological materials. In 2022, soils, soil solutions, and rice plants at several different growing stages were collected from three adjacent terraced paddy fields under the same water and fertilizer management in northern Kyoto, Japan. Total elements in soil were determined by XRF. Soils were extracted with diethylenetriaminepentaacetic acid (DTPA) solution, and Ni, Fe, and Mn concentration in the extracts were determined with ICP-AES. Major cationic or anionic species in soil solution was determined by ICP-AES or ion chromatography. Dissolved organic carbon (DOC) content was determined with TOC analyzer. Temporal changes in their elemental compositions revealed that the concentration of Ni in soil solution was much higher during the flooding period compared with the drainage period, which positively correlated with the concentration of Fe, Mn, and DOC. This trend is probably due to the co-solubilization with Fe or Mn oxyhydroxides under low redox potential conditions. The DTPA-extractable Ni content increased at the drainage period, suggesting that a part of the co-precipitated Ni with Fe or Mn oxyhydroxides was available for rice. Interestingly, rice accumulated Ni at a higher rate during the drainage period than in the flooding period in spite of the Ni concentration in the soil solution being lowest in the drainage period. Since the relative concentration to Fe (i.e., Ni/Fe ratio) was much higher than that in flooded conditions, we considered that the phytoavailability of Ni relative to Fe would be a key factor to control the transfer of Ni from the soil to rice in serpentine-affected paddy fields, which largely fluctuated during the growing period.

Key words: *Irrigation water management; Redox-sensitive species; Serpentinite; Soil-to-plant transfer; Terraced paddy fields*

OS3-10

Cross-validation Approaches for Evaluation of Landslide Susceptibility Map Accuracy

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Abstract

The spatial predictability of a landslide susceptibility map depends on its accuracy and reliability. Most studies use simple validation methods to evaluate the reliability of landslide susceptibility maps, which can easily lead to bias or uncertainties. The cross-validation (CV) method has been used to overcome the bias and assess the quality of landslide susceptibility maps and models. However, there has not been a study with a comprehensive quantitative evaluation of cross-validation methods under the same data conditions. So, it is beneficial to work if the overall view of the advantages and limitations of itself or between the existed cross-validation methods in establishing and evaluating the accuracy or reliability of the landslide susceptibility map. Therefore, in this study, we simultaneously tested two sampling methods (namely random selection and clustered selection) for four cross-validation methods: Design-based, Random K-fold CV, spatial K-fold CV, and buffered left-one-out CV method (B-LOO CV) for comparison these methods in assessing the accuracy of landslide susceptibility maps using a random forest model. The results show that random sampling has better results than cluster sampling in terms of the sampling method. For the comparison of cross-validation methods, the design-based non-repeating test method has the best results. The weak predictively occurred in subareas far away calibration points due to the Spatial and B-LOO CV approach results. Both random and spatial cross-validation methods with replacement selection provide uncertainties of map accuracy. Random k-fold and Spatial k-fold present the same trend that is overestimated with random selection while underestimated with clustered selection. Spatial CV strategies are more subjective compared with random CV. Collectively, the choice of sampling method and different cross-validation methods will also significantly affect users' interpretation of the quality and reliability of a landslide susceptibility map.

Key words: *Landslide susceptibility; Cross-validation; Machine learning; Random selection; Clustered selection; Spatial CV; Buffered left-one-out; Design-based, K-folds*

OS3-11

Establishing geochemical baseline and threshold for major and trace elements in Lao Cai agricultural soil

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Abstract

The establishment of geochemical baseline and threshold values of major and trace elements, especially with heavy metals is essential for soil management activities. As a rule, the baseline values are the average contents of elements in natural undisturbed soils, or the threshold values for the study area, obtained by statistical methods. A total of 912 topsoil samples were collected from Lao Cai province. Regional samples were collected at a sampling density of one sample per 16 km^2 (one sample per 4 x 4 km grid square). The major element concentrations were analyzed by X-ray fluorescence and concentrations of trace elements were by ICP-MS. The median element concentrations in the topsoil of the study area were consistent with the world soil average and trace elements in background soils of the protected area (except for some sampling sites with high metal elements such as As, Cu, Pb, Zn, Fe, REE). Using a geochemical approach is not suitable for this dataset because it does not take into account the natural variability of concentrations in different soil types. The "median + 2MAD' and TIF methods for obtaining geochemical threshold values, which different samples with a baseline from those with unusually high element concentrations, are presented. The usage of geochemical threshold values for soil risk assessment is suggested by comparison with national technical regulations on Vietnam's soil quality. Based on geochemical mapping and 90^{th} percentile threshold values, the priority areas for future assessment can be identified.

Key words: *Geochemical baseline; Threshold value; Geochemical mapping; Topsoil; Lao Cai*

OS3-12

World Reference Base for Soil Resources – scientific and educational challenges related to “illustrated” databases

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Abstract

World Reference Base for Soil Resources (WRB) enables exchange of information regarding the soil cover of various regions of the world and the creation of international soil databases. It is also very important as a scientific language that allows scientists exchange information about soils on a global scale. Although this system has been officially implemented in 1998 (first edition), and its fourth edition is currently in use (IUSS Working Group WRB, 2022), the official key for naming soils and creating legends for soil maps poses many difficulties in its implementation - especially in countries where traditional nomenclature and classification methods differ significantly from those used in WRB. Abundantly illustrated soil databases containing examples of soil profiles and their diagnostic features may be tools to facilitate the implementation of the above-mentioned system. The aim of the presentation is to show the various possibilities of scientific and didactic use of the soil databases described in accordance with the WRB nomenclature on the example of the publicly available Soil Sequences Atlas (SSA) series (Świtoniak and Charzyński 2014, 2018a, 2018b, 2019c, 2022). Soil Sequences Atlas series contains description of about 350 pedons (with soil profile photo, description of morphology and laboratory data) grouped into over 60 chapters each representing a different environmental setting specific to very diverse regions from all five continents – North and South America, Africa, Europe and Asia. Each chapter show the typical set of soils (mostly 3-6 profiles) related to a change in one or several main soil-forming factors of a given landscape. At this level, the presented database is a broad comparative study of various types of soil "catenal" systems. From an educational point of view, such sequences can be used to show soil-environment-human relationships expressed in soil names both, locally and in comparison across different regions of the world to raise environmental awarness. At the level of individual soil profiles, SSA can be used as: a) a comparative base of individual Reference Soil Groups (RSGs), b) a resource for creating hypothetical transition systems between RSGs expressed in the variability of qualifiers, c) a database of qualifiers expressed both in laboratory data and morphologically in the soil profile. The above examples demonstrate the significant usefulness of the presented database in the scientific and teaching process. Nevertheless, it is necessary to develop it - especially with examples of underrepresented RSGs and regions of the world.

Key words: *soil classification, catenas**,** soil teaching*

OS3-13

Soil degradation status on different land use types in Can Tho province, Viet Nam

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Abstract

The study aims to assess land types and the current land use status in the Can Tho province and assess changes in soil characteristics of different types of soil degradation for land use types in the study area. The study has collected secondary data on the current land use situation, soil types, and soil characteristics of soil degradation in the study area. It is a premise to evaluate changes in soil properties for different land use types. It uses synthetic data processing, mapping, evaluation, and analysis methods. From there, the results in the study area have 13 main soil types: Sp_2, Sj_1p, Sj_2, Sj_2p, Sv, Pb, Pfb, Pf, Pgb, Pg, Pvb, Pv, Nt. In which the soil type occupying the most extensive area is alluvial soil with a red-yellow layer (Pf) of 47,479 ha, distributed the most in Co Do district (18,264 ha) and the lowest in Thot Not (344 ha). In the area, agricultural soils are concentrated with the largest area of 114,621 hectares, including the following types of land use: Wetland rice-specialized land accounting for 78.25% of agricultural production soil; Annual upland cropland accounts for 1.25%; soils for perennial crops accounted for 20.4 9%; soils for aquaculture accounts for 2.14%. From there, the average index of soil characteristics and the variation of 12 types of characteristics were determined based on each district, land use status, and land type. Through the change in soil properties according to the types of degradation, assess the degree of soil degradation in Can Tho province, which has no degradation by administrative unit and land use type.

Keywords: *Land use; soil degradation; soil type.*

ORAL SESSION 4: MITIGATION AND C-SEQUESTRATION IN SOIL-PLANT SYSTEM; LAND USE TO RESPOND TO CLIMATE CHANGE AND SEA LEVEL RISE

OS4-1

Agroforestry provides long-term income and sustainability over monoculture in Northwest Vietnam

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Abstract

Diversifying planting as in agroforestry were compared with business-as-usual monocultures on sloping land in Northwest Vietnam. Longan+mango+maize+forage grass was compared with maize alone and longan alone. Macadamia+coffee+soybeans was compared with macadamia+soybeans and coffee+soybeans. The soybeans were planted only in the first two years of trials. Maize gave annual income; coffee gave income from the third year; The woody species started bearing fruit from year four and year five for logan and macadamia, respectively. Maize and coffee yields under the agroforestry systems were decreased due to their reduced areas within agroforestry plantings. However, annual incomes under agroforestry were increased above the monocultures, with maize in agroforestry returning $US 1890/ha compared with $US 1030/ha for maize alone; Coffee in agroforestry returning $US 1300/ha compared with $US 1265/ha for coffee alone. The break-even points presented in the second and third years for Longan+mango+maize+forage grass and Macadamia+coffee+soybeans, respectively. The longan and macadamia alone get break-event points in year six. The cumulative benefit reached the level of $US 5472/ha after six years with Longan+mango+maize+forage grass. Double compared with Macadamia+coffee+soybeans, Coffee soybeans and Maize monoculture. The farm-gate nutrient balance was calculated for all systems. The Longan+mango+maize+forage grass shows a deficit of N and K from the second year. All other systems show the surpluses of nutrients. Further study on nutrient balance should be done to support the development of good agricultural practices and reduce emissions from the overuse of fertilizers.

Key words: *"agroforestry, farm-gate nutrient balance, sloping land"*

OS4-2

Roles of Soil Particle and Soil Aggregate Size Distribution on Organic Carbon Sequestration under 46-years Long-term Experiment in Thailand

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Abstract

Enhancing carbon sequestration in agricultural soils is one of the important mitigation options in combating climate change. Under tropical climate, high soil temperature rendering a quick turnover of soil organic carbon (SOC), and intensive agricultural practices usually lead to its limited carbon sequestration potentials. In the current study, we investigated the effects of different long-term agricultural practices (46 years) on soil carbon sequestration. The specific focus is on the relationships among cultural practices, aggregate and particle size distribution and soil carbon sequestration rate. The study was conducted in a long-term experimental site in Lopburi province, Thailand. The plots were cultivated with maize as a main crop and mung bean as a fallow period crop. There were twelve treatments including tillage (both tillage and no-tillage), chemical fertilizer application (NPK), crop residue incorporation, and organic matter (OM) input (rice straw and cow dung). Soil samples were taken from these plots to determine the particle size by sieving. Sand particles were separated into five fractions based on their sizes: very coarse sand (1.00 mm–2.00 mm), coarse sand (0.50 mm–1.00 mm), medium sand (0.25 mm–0.50 mm), fine sand (0.10 mm–0.25 mm), and very fine sand (0.05 mm–0.10 mm). The technique of laser diffraction was used to evaluate the composition of silt and clay content. Four soil aggregate sizes [large macroaggregate (> 2.00 mm), small macroaggregate (0.25-2.00 mm), microaggregate (0.0533-0.25 mm), and silt+clay fraction (< 0.053 mm)] were analyzed by wet sieving. The analysis of soil organic carbon in both bulk soil and soil aggregate sizes was conducted using a CHN analyzer. The results indicate that there was no significant difference in sand fractions, silt, and clay particles among treatments, and the soil texture was loam. Among treatments, only the fraction of microaggregate showed the significant treatment effects. Soil organic carbon content ranged from 0.83 to 1.54%; the highest content was found in treatment of no-tillage with chemical fertilizer and cow dung application. There is a significant positive relationship ($p \leq 0.05$, n=12) between the presence of coarse sand and medium sand in the soil and the amount of SOC. The small macroaggregate fraction had a significant positive correlation with the total amount of carbon in the soil ($p \leq 0.01$, n=12). On the other hand, SOC was negatively correlated with silt and clay fractions ($p \leq 0.01$, n=12). The results indicate that the long-term cultivation practices affect SOC sequestration by increasing SOC stock in the sand fractions and in the small macroaggregate. This is found in the treatments where there is organic material input such as rice straw and cow dung.

Key words: *"soil carbon sequestration, soil particle size distribution, tropical soil"*

OS4-3

Effect of different organic fertilizer on soil organic carbon transformation and soil CO_2 emission

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Abstract

Organic fertilizer from livestock husbandry is widely used in Japan to improve soil organic carbon (SOC) set up an environmentally friendly agro-ecosystem. The present study conducted 91-day incubation experiment to evaluate the impact of different organic fertilizer on the CO_2 emission and SOC transformation. Five treatments were tested: N (no amendment), F (inorganic fertilizer), M (manure compost), S (slurry) and D (anaerobic digestion effluent) with 3 replications. Carbon applications for M, S, and D are 1.69 g, 1.66 g, and 1.05 g, respectively, based on common nitrogen, phosphorus and potassium application rates in grassland in Hokkaido, Japan. Incubation experiment was performed at 25°C and 60% of the field water holding capacity. The gas samples were collected 14 times totally for CO_2 analysis and the cumulative emission was calculated by trapezoidal rule between sampling occasions. CO_2 emission factor (EF_{CO2}) was calculated as [(cumulative CO_2 emission in fertilization treatment -cumulative CO_2 emission of non-fertilization treatment)/applied carbon]. Soil samples were collected 6 times totally for SOC pools including labile organic carbon (LOC), microbial biomass carbon (MBC) and dissolved organic carbon (DOC). Readily oxidizable carbon (ROC) was calculated as [SOC-ROC]. The changes of CO_2 emission (Δg) and SOC pools (SOCe, LOCe, ROCe, DOCe, MBCe) effected by fertilizer were defined as the difference between fertilization and N treatments. Carbon factor (CF_{SOC}, CF_{LOC}, CF_{ROC}, CF_{DOC}, CF_{MBC}) were defined as the ratio of SOCe, LOCe, ROCe, DOCe, MBCe content to fertilizer carbon content, respectively. At the end of the incubation period, cumulative Δg in F, M, S, D were 34.62, 1737.98, 2902.63, 981.54 mg CO_2/kg, respectively. S showed significantly highest Δg followed by M, D and F ($p<0.05$). EF_{CO2} of M, S, D were 28.06%, 45.43%, 25.39%, respectively. The highest EF_{CO2} in S could be explained by the carbon in slurry not being composted or fermented, which is mineralized more easily by microorganisms. At the end of the incubation period, CF_{SOC} and CF_{ROC} of M, S, D were 23.81%, 26.82%, 49.80% and 14.90%, 16.22%, 39.84%, respectively. D showed significantly highest CF_{SOC} and CF_{ROC}. While there was no significant difference in CF_{LOC} between each fertilization treatment, which implies that LOC added from organic fertilizer was mineralized within 91-day incubation. At the end of the incubation period, CF_{DOC} and CF_{MBC} of M, S, D were 0.06%, 0.08%, 0.13% and 0.11%, 0.10%, 0.18%, respectively. The significantly highest CF_{DOC} and CF_{MBC} in D implies that anaerobic digestion effluent are most effective in improving the growth of soil microorganisms. The Δg had significant positive correlation with SOCe, LOCe, DOCe and MBCe in all treatments, while significant negative correlation was observed between Δg and ROCe in all treatments. This result implies that higher LOC content in organic fertilizer increase decomposition, while higher ROC content derived from organic fertilizer decrease decomposition. In conclusion, anaerobic digestion effluent, which showed the lowest EF_{CO2} and the highest CF_{SOC} and CF_{ROC}, is considered to be the most effective organic fertilization on carbon sequestration.

Key words: *organic fertilization, soil organic carbon, CO_2 emission*

OS4-4

Factors affecting the amounts and turnover rates of soil organic carbon fractions in paddy fields across Asian countries

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Abstract

Soil organic matter (SOM) plays important roles: labile fractions are mainly related to soil fertility and persistent fractions are linked with the mitigation of global warming via soil C sequestration. To balance food production and environmental conservation, therefore, it would be necessary to evaluate SOM fractions according to their stabilization mechanisms. This study aimed to evaluate the amounts and turnover rates of SOC in multiple fractions and to elucidate their determining factors using the total of 244 paddy soils across seven Asian countries under different climatic and geological conditions. SOC was fractionated into four fractions based on their physicochemical properties: (1) coarse light fraction (LF) derived from plant residue, (2) coarse heavy fraction (HF) containing stable aggregates, (3) NaClO oxidizable fraction (OxF) and (4) NaClO non-oxidizable fraction (NOxF) associated with fine-textured minerals. The C content of each fraction was determined by dry combustion method and $\Delta^{14}C$ values were measured as indices of turnover rates for some samples. The relationships between the amount of fractionated SOC content and climatic factors plus soil properties were also investigated.
The mean values of total C content were in the order of Japan (26.6 gC/kg, n = 73) > Malaysia (26.2, 40) > Philippines (19.3, 37) > Taiwan (17.0, 30) > South Korea (16.7, 25) > Thailand (16.1, 16) > Nepal (12.5, 23). The mean values and percentages of fractionated C for all the soil samples were OxF (9.0 gC/kg, 44 %) > NOxF (7.0, 31) > LF (3.3, 16) > HF (1.8, 9), showing the predominance of C in fine-grain fractions. The average $\Delta^{14}C$ values of the selected samples were in the order OxF (8 ‰) > HF (-54 ‰) > NOxF (-169 ‰). Relatively high $\Delta^{14}C$ values (i.e., relatively high turnover rates) for OxF imply that repeated puddling in paddy fields might have caused more disaggregation and then reduced C stability. Carbon contents in both OxF and NOxF had significant positive correlation with oxalate-extractable Al (Alo) and Fe (Feo), pyrophosphate-extractable Al (Alp) and Fe (Fep), and, at the same time, showed significant negative correlation with annual mean temperature ($p < 0.01$). These results suggest the influence of volcanic activities and climate. Multi-regression analysis further revealed that roughly 40 and 63% of the C variation in OxF and NOxF were explained by the above variables for all the samples. Removal of Malaysian samples in the same analysis improved the coefficients to 44 and 77%, implying that water conditions may have strong influence on the C accumulation in Malaysia. These results suggest that the soil properties examined in combination with temperature had significant control on the SOC storage in OxF and NOxF. In conclusion, these findings on the distribution of SOC among the fractions and the factors controlling their pool size and stability should be used carefully to manage SOC levels in paddy soils to achieve sustainable food production and environmental conservation.
Key words: *Asia; fractionation; paddy soils; radiocarbon dating; soil organic carbon (SOC).*

OS4-5

Soil Carbon Check: A Tool for Monitoring Soil Carbon Sequestration and Giving Guidance for Soil Health Solutions

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Abstract

Soil organic matter (SOM) plays an important role in integrating many aspects of soil health. Healthy soil is the foundation for profitable, productive, and environmentally sound agricultural systems. In an agricultural context, soil health most often refers to the ability of the soil to sustain agricultural productivity and protects environmental resources. A healthy soil provides many functions that support plant growth, including nutrient cycling, biological control of plant pests, and regulation of water and air supply. These functions are influenced by the interrelated physical, chemical, and biological properties of soil. Thus, increasing SOM content has many benefits including: (1) improving the capacity of a soil to bind, exchange and deliver essential nutrients, (2) increasing the capacity of a soil to bind water, (3) increasing soil biodiversity and thereby the disease suppressiveness against soilborne plant pathogens, and (4) improving soil structure, thus giving plant roots and soil life improved living conditions, and farmers improved soil cultivation conditions. Approximately 50% of SOM contains soil organic carbon (SOC). In 2015, 17 Sustainable Development Goals (SDGs) were approved, including SDG13 – Climate Action, which addresses actions to increase carbon capture (CO_2-C storage) for climate change mitigation. However, no analytical procedures have been defined for quantifying SOC sequestration. This paper presents a rapid tool for guiding farmers and for monitoring SOC sequestration in their fields. The tool consists of multi constituent soil analyses through near-infrared spectroscopy (NIRS) and an SOC mineralisation model. The tool provides forecasts of SOC sequestration over time. Soil analyses by NIRS have been calibrated and validated for farmer fields in European countries, China, New Zealand, and Vietnam. Results indicate a high accuracy of determination for SOC ($R^2 \geq 0.93$), and for inorganic C, soil texture, and soil bulk density. Permanganate oxidizable soil C is used as proxy for active SOC, to detect early management-induced changes in SOC contents, and is also quantified by NIRS ($R^2 = 0.92$). A pedotransfer function is used to convert the results of the soil analyses to SOC sequestration in kg ha^{-1} C as well as CO2. In conclusion, the tool allows fast, quantitative, and action-driven monitoring of SOC sequestration in farmer fields, and thereby is an essential tool for monitoring progress of SDG13 and giving guidance for soil health solutions.

Key words: *carbon sequestration, climate action, SDG13, soil organic carbon, soil testing*

OS4-6

Effect of long-term land management and residue quality on *in-situ* SOC accumulation in Andosols, Japan, by using $^{13}C/^{15}N$-labeled residue

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Abstract

Management of harvested crop residues is an important agricultural practice to maintain soil organic carbon (SOC) for sustainable agriculture and climate change mitigation. Manure application stimulating soil aggregation and high C/N ratio residue application may effectively accumulate residue-derived C in soil. Here, we aimed to quantitively clarify the effect of land management and residue quality on residue-derived C accumulation in Andosols, a major soil type of upland field in Japan. We measured the accumulation of residue-derived C in soil and the incorporation of residue-derived C into soil aggregates in long-term management cropland in Andosols, Japan, using $^{13}C/^{15}N$-labeled residues. We conducted the field incubation experiment at the long-term management cropland (>30 years) in Tokyo, Japan (Andosols). We used three land management soils such as no fertilizer (Ctrl), chemical fertilizer (CF), and cow manure (M), and two types of $^{13}C/^{15}N$-labeled young maize residues, such as leaf (C/N ratio = 15) and root (C/N ratio = 30). The research applied the residues of 2.2 g C kg^{-1} (2 Mg C ha^{-1}) to each soil and mixed, and then put them into the PVC pipes (5 cm * 20 cm). The filled PVC pipes were inserted into the field (15 cm soil depth) with four replications (total of 144 pipes). The pipes were collected at 20, 60, 120, and 450 days after installation. The collected soil samples were fractionated by wet sieving method (macroaggregate (>250 μm), microaggregate (53-250 μm), and silt+clay fraction (<53 μm)), and analyzed the C/N contents and the abundance of $^{13}C/^{15}N$. Residual rates of leaf-derived C were 40%, 34%, 29%, and 23%, and root-derived C was 56%, 43%, 38%, and 29% at 20, 60, 120, and 450 days, respectively, averaging land management. The residual rates were not significantly different between the land management, but root-derived C of soil was 1.2~1.4 times higher than leaf throughout the experimental period. Residue-derived C was accumulated mainly in macroaggregate in all land management, such as M (16.5%) ≒ CF (12.6%) > Ctrl (8.6%) at 450 days. The residual rate in each fraction at 450 days was Leaf (9-17%) < Root (15-23%) in macroaggregate, Leaf (3-10%) ≒ Root (3-11%) in microaggregate, and Leaf (1.6-2.9%) > Root (1.1-2.5%) in S+C fraction. These results indicate that land management and residue quality affect the incorporation of residue-derived C into soil aggregates. Furthermore, we will also present residue-derived C in microbial biomass and discuss microbial mechanisms of SOC accumulation at the conference. We found that 23% of the leaf and 29% of the root residues remained in the soil even after 450 days in Andosols, though land management did not affect the SOC accumulation pattern. We also found that root-derived C accumulated more in macroaggregate and less in S+C fraction compared to the leaf-derived C.

Key words: *Soil C sequestration, long-term experimental site; residue quality; soil aggregates*

OS4-7

Studies on the use of locally available (*Coxs Bazar and Saint Martin*) renewable seaweed wastes as compost organic fertilizer resources

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Abstract

Marine red algae from the Bangladesh Bay of Bengal Hypnea Sp have been used as organic materials due to the presence of a number of plant growth-stimulating compounds. The effect of various seaweed species on plant growth and development with an emphasis on the use of this renewable bio-resource in sustainable agriculture of northern fertilizers raw materials system. Organically made fertilizers play an important role in increasing crop yield and the quality of crops promises improvements considering climate adaptation. Seaweed wastes compost was put in evaluation trials at Sreemangal, Bangladesh to evaluate its efficacy and find out the optimum dose for profitable Betel leaf production. This part of the study is directed toward the analysis of the future trend and performances of composting seaweed wastes. The science of seaweeds explores, how analysis of the future trend and performances of composting seaweed wastes. A field study was conducted at three treatments at khasia farmers of Sreemangal khasia betel leaf cultivation community area of Bangladesh. Seaweed wastes mixed with compost organic fertilizer dose of 50g per support tree . The highest betel leaf yield was obtained from seaweed wastes mixed with compost organic fertilizer applied to plants. Table 1. (2880 leaf). This study suggests that seaweed wastes mixed with organic fertilizer are suitable for betel leaf cultivation. Area-based conservation is a key tool for delivering the Sustainable Development Goal of responsible production and consumption and climate action.

Keywords*: Seaweed, Plant Growth, Organic Material, northern fertilizer, Sustainable*

OS4-8

Carbon sequestration and formation of stable carbon stock depend on some chemical components of soil which can control climate change

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Abstract

In this work an evaluation is done on soil organic carbon and as well as organic matter pool to find out a carbon sequestration index which possess a direct relationship with climate change. Twenty five different soil samples from forest , adjacent deforested and pasture land were analyzed in the laboratory to assess various types of carbon stocks. All these soil samples analyse chemically and various carbon stock like Soil organic carbon, humic acid, fulvic acid, humin was extracted and estimated from these soils and characterizes by various experimental tools. On analysis it was observed that some chemical component enhances the carbon sequestration power of soil . E_4/E_6 value increases where as cation exchange capacity reduces drastically with deforestation. On analysis it was established that molecular weight, aromatic-aliphatic ratio, -COOH, - OH functional groups and total acidity reduces with declining forest. Intense vegetation and some chemical constituent of soil possess more carbon sequestration power with increasing stable carbon stock which is reflected from organic pool analysis is a good index for restoring climate change.

Keywords: *Soil organic carbon, organic pool, carbon sequestration, deforestation and climate change.*

OS4-9

Soil health, Carbon Storage (Topsoil and Subsoil), and Crop Yield Improved by Biochar: A Solution for Carbon Farming

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Abstract

This study evaluate the role of biochar on soil quality, carbon storage, and crop yield (tea and rice) in Northern Vietnam. Three biochars, including wood biochar (WBC), rice husk biochar (RBC), and bamboo biochar (BBC), were produced under limited oxygen conditions using Top-Lid Updraft Drum technology at temperatures around 550^{o}C. After that, the three biochars were mixed well with ratio of weight (1:1:1), and added into FYM (Farm Yard Manure) for composting (05% biochar). Then, the field trials (three replications) were conducted for tea and rice with three treatments including NPK (T1 = control), 80%NPK + 2 tons biochar/ha (T2), and 10 tons compost + NPK (T3). The results indicated that the biochar products had positive impact on soil quality, carbon storage, and crop yield. Particularly, soil organic carbon (SOC) in tea-cultivated soil applied biochar products was increased from 19 to 20% for topsoil (0-20 cm) and 6.41 to 13.16% for subsoil (20-40 cm) comparison to control. Meanwhile, SOC of rice-planted soil applied biochar products was increased from 9.52 to 10.68 % for topsoil (0-20 cm) and 15.38 to 18.92 % for subsoil (20 -40 cm). In addition, crop yield of the treatments applied the biochar products was increased from 10.7 to 17.2% for rice and 33.0 to 48.4% for tea compared to control.

Key words: *biochar, rice, tea, physicochemical characterization, SOC storage, composting, yield*

OS4-10

Stability of organic carbon fractions in soils with different arable land uses in northern Taiwan

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Abstract

Total organic carbon is not equivalent to the long-term stability of carbon storage in soil. The present study focused on the fractionation of soil organic carbon (SOC) with chemical fertilization in three types of arable land use that are upland cropping with *Pennisetum alopecuroides* for 10 months, paddy field with rain feeding, and paddy field with conventional irrigation for 4 months in northern Taiwan. The surface soil samples from the upland were collected at 2-month intervals and those from the paddy field at 1-month intervals. The collected air-dried sample was fractioned by an integrated and sequential physical and chemical procedure. The soil samples were firstly separated into sand, silt and clay fractions. Then the sand fraction was divided into the light fraction (LF) (< 1.8 g/cm^3) and heavy fraction (HF) (> 1.8 g/cm^3) using the sodium polytungstate (SPT). The fraction including silt and clay was further treated by NaClO. Further, the residues were classified as non-oxidizable fraction (NOxF) and the others were oxidizable fraction (OxF). Carbon concentration was analyzed by TOC analyzer for all fractions. The C content in the fractions showed that the HF increased (1.40 C g/kg to 3.53 C g/kg) with time in the upland cropping, while the other fractions slightly decreased. After the paddy rice cultivation, the C content in the HF with rain feeding and conventional irrigation increased, but C in the LF and NOxF decreased clearly. Nevertheless, the C content in the OxF was consistent.

Keywords**:** *Carbon dynamics, carbon fraction, soil carbon storage*

OS4-11

Vietnam's Forest Carbon Pools and Implication for Climate Change Mitigation

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Abstract

Forests play an important role in absorbing greenhouse gases and providing non-carbon environmental services for production and life. Determining the carbon storage of forest ecosystems plays an important role in the country's strategy to reduce greenhouse gas emissions. Vietnam's forests are tropical forests so their carbon absorption ability is high. According to 2022 statistics, Vietnam has 14.7 million hectares of forest, covering 42%, including 10.1 million hectares of natural forests and 4.7 million hectares of planted forests. The forest ecosystem has 5 carbon reservoirs: the reservoir is in the biomass of trees living on the ground, including high-story trees, shrubs and fresh carpet; underground storage tanks mainly live root systems; carbon sink in dead wood; carbon pool in the litter layer and soil carbon. Carbon measurement methods are quite diverse, but mainly focus on direct measurement methods and indirect measurement methods. Research on biomass and forest carbon in Vietnam is quite diverse, focusing heavily on the above-ground carbon pool of forest ecosystems. Carbon stocks vary widely between forest types. Deciduous forests in the Central Highlands are 158.4 tons C/ha, semi-evergreen forests are 179.9 tons C/ha, evergreen broadleaf forests fluctuate from 244 to 282 tons C/ha and other forest types have reserves of carbon from 170 - 200 tons C/ha. Among forest types, natural mangrove forests in Ca Mau store very high carbon, reaching 484 tons C/ha. For planted forests, carbon storage depends closely on tree species, density, age and soil level. A 30-year-old *Pinus massoniana* forest with land level I is 179.4 tons C/ha, a *Pinus merkusii* forest is 148.8 tons C/ha, almost equivalent to deciduous forests in the Central Highlands, a 7-year-old Acacia hybrid forest is 108.6 tons C/ha and eucalyptus forest is 95.6 tons C/ha. Biomass carbon stock of planted mangroves in Can Gio is estimated at 203 tons C/ha. The total amount of carbon in litter and soil compared to forest biomass and total forest carbon as a general rule in tropical forests is not large. Carbon is concentrated in forest biomass. Soil carbon accounts for 30 - 35% of total forest carbon, except for deciduous forests, 41% of which may be due to charcoal because forests are always burned. Including litters, this ratio is 35 - 38%. In many places, mangrove forests in the Mekong Delta contain organic matter that increases with depth, sometimes up to 120 cm, so carbon in the soil accounts for a higher proportion than carbon in forest biomass, accounting for 56.2%. It is estimated that all Vietnamese forests currently store 662 million tons of C (equivalent to 2.2 billion tons of CO_2) and the annual amount of carbon absorbed is about -70 million tons of CO_2. Protecting and developing forests through forestry-based greenhouse gas mitigation solutions plays a significant role in achieving the emission reduction goals that Vietnam has committed and is also an important factor in development. sustainable development and mitigate the impact of climate change.

Key words: *carbon pools, forest carbon, natural forests, plantation, climate change mitigation, Vietnam*

OS4-12

Effects of plant residues quality on C accumulation patterns in the converted cropland soil from lowland paddy field in Japan

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Abstract

In Japan, land use conversion from paddy field to dry cropland field is being promoted as a national policy, and the area of converted lowland cropland field is rapidly increasing. To achieve the sustainable land use, it is important to understand the soil organic carbon (SOC) dynamics. Plant residues quality (e.g., C:N ratio) is considered a key factor affected SOC mineralization and its accumulation patterns. However, effects of plant litters quality on C mineralization and accumulation pattern in this converted field are not fully understood. Here, we applied the C_4 plant residues (maize, sorghum, and miscanthus) with 10 different C:N ratios ranging from 15 to 182 into the C_3 (rice)-domain soil of converted field from paddy. The rate of plant residue application was 2 Mg C ha^{-1} (~1.25 g C kg^{-1} soil). The field-incubation experiment was conducted in the experimental field of Tokyo University of Agriculture and Technology. The concentrations of C and ^{13}C isotope were measured in each soil fractionations (LF <1.7 g cm^{-3}, POC= 53−2000 μm, and MAOC <53 μm) at 30, 90, and 180 days after installation. Results showed that SOC accumulation patterns were strongly affected by plant litter quality. After 180-day incubation, in case of low C:N ratio litter (C:N from 15 to 52), litter-derived C accumulated twice in MAOC compared to POC. In contrast, in case of high C:N ratio litter (C:N from 56 to 187), litter-derived C accumulated more into POC. We also found that low C:N ratio litter-derived C were transferred from POC to MAOC after 90-day incubation. Meanwhile, high C:N ratio litter-derived C were transferred from LF to POC at same time. A total C losses of C_4 plant litter at 180 days was 45% and 53% in low and high C:N ratio litters, respectively. Our findings indicated that the plant litter quality affect the characteristics of C accumulation in various fractions of soil, leading to change in SOC mineralization/sequestration patterns in converted cropland fields.

Key words: *C sequestration; ^{13}C isotope analysis; plant litter quality; lowland soil*

OS4-13

Application of CLUE-Mondo and SWAT models to assess land use and climate change impacts on hydrological process and potential soil erosion in Ba river basin of central highland of Vietnam

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Abstract

Over the last decades, Viet Nam has been facing severe changes in the land use and climate. Climate changes scenarios predict these changes to be amplified in the upcoming decades. Yet, the hydrological response and soil loss to these land use and climate changes remains poorly characterized, which threatens effective soil and water management strategies. To address this, we integrated ground-monitored time series data with CLUE-Mondo and Soil and Water Assessment Tool (SWAT) models to evaluate the effects of current and anticipated land use and climate alterations on hydrological processes and soil erosion in the Ba River basin in the Central Highland of Vietnam. Our findings have significant implications for the formulation of robust land use and water resource planning and management strategies. Notably, the successful application of the SWAT model in simulating stream flow and sediment yield in the Ba River Basin underlines its suitability for addressing these critical issues. Furthermore, the research underscores the impact of various land use change and climate change scenarios on hydrological responses and sediment yield. Specifically, the intensification of the RCP 8.5 climate change scenario has emerged as the most influential factor, leading to elevated surface runoff, river flow, flood occurrences, inundation, sediment yield, soil loss, and landslides in the region. Moreover, different land use change scenarios exhibit varying degrees of influence on hydrological processes and soil loss, with LU Sce3 showcasing potential benefits in curbing surface flow and soil loss while enhancing evapotranspiration, percolation, groundwater, and water yield. In addition, the development of a Web-GIS system has facilitated the visualization of comprehensive results through interactive maps and data distribution, particularly aiding the identification of potential soil erosion risk areas. The use of WebGIS technologies is an evolving area with the potential to surpass current technical limitations in the near future. Based on the study outcomes, we recommend the implementation of spatial strategies at both regional and local levels to allocate diverse land use types effectively. It is crucial to raise awareness among farmers about the detrimental environmental impacts and the importance of soil and water conservation, alongside encouraging the diversification of existing land management practices. Government policies should focus on extending land use rights and providing financial assistance to support sustainable soil and water conservation efforts. This study serves as a crucial step towards enhancing our understanding of the intricate relationship between land use, climate change, and their impacts on hydrological processes and soil erosion, thereby laying the groundwork for informed and effective environmental management policies and practices in the Ba River basin and other similar regions.

Key words: *Climate Variability, Hydrology, Land Use, Sediment Yield, SWAT model, CLUE-Mondo, Ba River Basin*

OS4-14

Carbon sequestration in mangrove plantation sediment in Red River Mouth, Northern Vietnam

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Abstract

Existing along tropical and subtropical coastlines under waterlogging condition, the substrate in mangrove received suspended matters from tidal flushing, the matters in turn provide a special environment for plant development. In this study, the carbon sequestration and relationships between physico-chemical properties of sediment and organic carbon contents were determined. For that, plots were set up in monospecies planted mangrove of *Kandelia obovata* as well as in the adjacent bare land in Red River Mouth, Northern Vietnam. All the sediment samples and roots were treated in situ and in laboratory by standard methods. Sediment characteristics varied considerably among sites, and significant differences ($P < 0.05$) were detected in some sediment properties between mangrove and bare land sites. The results indicated that the total carbon sequestration in bare land and in 20-year-old-planted mangrove sediment were 91,14 ± 6,84 MgC ha^{-1} and 152,31 ± 2,37 MgC ha^{-1}, respectively. The significant positive and linear correlations between silt, clay and sediment water contents with carbon contents at depth and the negative correlations between sand contents with all parameters (except bulk density) were found. The results confirmed that fine particles (clay and silt) can keep water as well as organic carbon in their structure much better than the larger one (sand), and the inundation may act as an essential role in the process of carbon storage in mangrove sediment.

Key words: *mangrove sediment, carbon sequestration, Red River Mouth.*

ORAL SESSION 5: SOIL POLLUTION; SOIL DEGRADATION AND REMEDIATION; RECENT ADVANCES IN SOIL RESEARCH

OS5-1

Sediment microbial fuel cells with iron addition for reduction of phosphorus release in agricultural areas

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Abstract

Sediment microbial fuel cells (SMFCs) are a unique system that harvests energy and improves sediment and water qualities by controlling the redox potential of the sediment. Drainage sediment from agriculture contains high contents of organic matter and nutrients and may cause dissolved oxygen deficiency, followed by phosphorus (P) release under anaerobic conditions. In this study, we applied SMFCs with iron (Fe) addition to agricultural drainages to reduce P release from the sediment. Surface sediment samples were collected from agricultural drainages (paddy, livestock, and pasture areas) in Okayama prefecture, Japan. The sediment samples were repacked in acrylic columns (i.d.: 45 mm, height: 146 mm). For these columns, dual chamber SMFCs were established by placing a graphite felt anode in sediment and a carbon rod cathode in the cathode chamber. For the paddy drainage sediment, we examined the effect of the addition of iron oxide (Fe_2O_3) and amorphous iron oxyhydroxide (FeOOH) to sediment for 17 days. As a result, FeOOH lowered P release from sediment regardless of SMFC operational conditions, suggesting that higher P adsorption by FeOOH may mask the effect of SMFCs, while Fe_2O_3 did not reduce P release from the sediment. On the other hand, P release was not suppressed by the SMFC operation, although SMFCs increased sedimentary redox potential, indicating that organic P would be released by SMFCs from P-rich sediment. For the drainage sediments from livestock (LS) farming and pasture-grown (PS) areas, we determined the effect of $FeCl_3$ addition to the sediment for 98 days. Phosphorus release from LS sediment was higher than from PS, with a lower total P content. SMFCs with $FeCl_3$ addition were effective in reducing P release through Fe precipitation until day 42. Afterward, SMFC operation or Fe addition increased P release from sediment, probably because of organic matter decomposition. Our results suggested that the combination of SMFCs and Fe addition suppressed P release from sediment for a certain period but SMFCs may enhance organic matter decomposition and thereby increase P release from sediment for more extended periods.

Key words: *Organic matter, phosphorus, redox potential, sediment*

OS5-2

Influence of long-term fertilization on clay mineral transformation in variable charge soils areas

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Abstract

The variable charge soils that have been developed in tropical and subtropical zones are unique soils compared with the constant charge soils that have been developed in Europe and North America. Constant charge soils usually have lower weathering indices and lower contents of iron/aluminum oxides, and the 2:1 type minerals are the major clay minerals in these soils. By comparison, variable charge soils have higher weathering indices and higher contents of iron/aluminum oxides. The significant difference between the two abovementioned soil types is mainly attributed to their mineralogical properties. Besides, soil acidification is a natural process, and it is well-known that soil acidification can be accelerated by long-term fertilization. Although the manure application with lime have been shown to significantly mitigate soil acidification, nevertheless, how this acidification occurs and how mineralogy's of the important active clay component in variable charge soil areas respond to the acidification is still less understood. Here, three different long-term experiment samples with manure fertilization were selected, and the effect of manure application on the phase transformation of clay minerals was investigated. Compared with the blank treatment, long-term fertilization treatment of chemical N reduced the total content of iron oxides and the ratio of goethite to hematite, and the transformation of iron oxides and the accumulation of hematite in soil would reduce the buffering capacities of soil onto acidification. Whereas the long-term fertilization treatments with manure presented the opposite trends. The potential acid Al^{3+} ions in soil is reduced through the ionic substitution of Al for Fe in the structure, which may further mitigate the process of soil acidification. On the other hand, the long-term fertilization treatments with manure led to the rapid transformation of soil clay minerals from 2:1 type to 1:1 type in variable charge soil areas, but presented negligible differences in the transformation of clay minerals in the constant charge soil areas, further revealed the zonal characteristic of clay minerals transformation. The stimulatory transformation of clay minerals in such a short geological time (decade-scale) may result from the important contribution of the soil microbial community.

Key words: *Variable charge soils; clay minerals; soil acidification; microbial-mineral interactions; anthropocene*

OS5-3

Enhance the Detoxification and Adsorption Capacity of Thermoacidophilic Microalgae Cyanidiales by Oxidizing Fe(II) under Anaerobic and Acidic Conditions

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Abstract

Over the past few decades, acidic wastewater rich in arsenic (As) is one of the most hazardous types of liquid waste and this type of waste has severely contaminated the environment due to a lack of environmentally safe and economically viable disposal methods. Herein, the approach uses Fe(II) bio-oxidation by 3 species of the acidophilic microalgae species (Cyanidioschyzon merolae (Cm), Cyanidium caldarium (Cc), and Galdieria partita (Gp)) to synthesize into a bio-composite Cyanidiales/Fe(II) adsorbent for As(III) removal. To deeply understand the mechanism of removal the enrichment of As(III), the synchrotron radiation research technology at the molecular level will be used for analysis, including 2D and 3D analysis of metal accumulation on algae by X-ray microscopy (TXM), and use X-ray absorption spectroscopy (XAS) with linear combination analysis (LCF) to qualitatively and quantitatively change the form of As, then, Fourier transform infrared spectroscopy (FTIR) to analyze the structural transformation of polysaccharides on the cell surface and proteins in the cell body. The newly formed complex showed superior absorption of toxic metal As(III) of Cm, Cc, and Gp were 145 mg g-1, 150 mg g-1, and 139 mg g-1 after 6 hours of reaction, respectively. In which, up to 92.7% of the total As was As (III) sorbed on the cell surfaces. In conjunction with the 3D morphology that showed the relatively homogeneous As distribution covering the cell with the consistent proportion of As (III) bonded with Ferrihydrite (III) (82% - 92.7%) and polysaccharide (5.9 - 17%) at pH 5.0. In addition, XAS showed that Cc has a higher absorption capacity due to the special structure of the cell when it is possible to combine Cysteine with As (III) with 3% in the adsorption system. The knowledge provided here could improve the application of the bio-composites Cyanidiales/Fe(II) in environmental remediation as an innovative green technology.

Key words: *Iron, Arsenic, Biocomposite, Cyanidiales.*

OS5-4

Silicon supplementation for sustainable yield of crops in coastal unfavorable ecosystem of Bangladesh

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Abstract

Silicon (Si) is a beneficial plant nutrient element, has enormous capacity to mitigate biotic and abiotic stresses on crops. The coastal region of south and southeast Asia are a prospective region for Si management on account of the range of stresses to which crops are exposed; among them soil and water salinity, excess tidal water flooding, cyclone and storm surges, excess rain in monsoon etc. seriously hampered crop growth and yield. There was no effective way till developed to overcome the problems associated in the coastal region; Si supplementation could be the safeguard in this unfavorable ecosystem. The objective of the study was to evaluate the effect of different sources of Si on crop yield, leaf erectness, and silicon uptake in rice and maize under saline and non-saline coastal soil conditions. A wide range of field and pot experiments were conducted during 2020 to 2023 in south central coastal region of Bangladesh. Field experiments were conducted in Amtali upazila of Barguna district and Dumki upazila of Patuakhali district, Bangladesh. Pot experiments were conducted in the net house of the Patuakhali Science and Technology University, Bangladesh. Silicon effects were tested under saline and non-saline condition in different varieties of rice and maize. In a pot experiment under both 0 and 6 dS/m salinity condition the 2, 4 and 8 mM silicon progressively increased plant height, number of tillers per hill, number of leaves per plant, dry weight of shoot and root, total chlorophyll content of Binadhan-8 over Si control treatment; 8 mM Si had the highest performance. In another pot experiment the rice varieties BRRI dhan76, BRRI dhan77, Moulata and Sadamota recorded shoot dry weight by12.74, 23.00, 26.43 and 8.29 g pot^{-1} in 100 mg Si kg^{-1} soil treatment, which were 26.6, 28.6, 57.3 and 0.12% higher than their respective Si control. Silicon supplementation significantly improves leaf architecture making leaves more erect which facilitate plants receiving more sunlight for photosynthesis. In a field study three sources of silicon including calcium silicate, sodium meta silicate and silicic acid were tested in rice; the three sources recorded grain yield of 4.67, 4.56 and 4.52 t ha^{-1}, respectively where calcium silicate had the best followed by sodium meta silicate and silicic acid. However, 25 kg Si ha^{-1} was the best rate of calcium silicate and sodium meta silicate, and 30 kg Si ha^{-1} for silicic acid at coastal region of Bangladesh. In another field study Si application in maize at a rate of 20 kg Si ha^{-1} with 40, 60, 80, and 100% recommended NPK fertilizers recorded grain yield higher than 6.3 to 28.0% over respective control; maximum cases rate of yield increase by Si was higher in lower rates of NPK fertilizers. Silicon application in soil at a rate of 20-25 kg Si ha^{-1} through calcium silicate were recommended for enhancing yield of crops in coastal unfavorable ecosystem of Bangladesh

Key words: *"Coastal ecosystem; leaf architecture; Salinity tolerance; rice; sources of silicon"*

OS5-5

Application of phytoremediation and chelates to remediate heavy metal contaminated soils in Thai Nguyen mining sites

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Abstract

Phytoremediation can potentially be used for the remediation of areas polluted by metal. This study evaluated the accumulation of heavy metals (As, Cd, Cu, Pb, Zn) in native plants and in the contaminated soils in three contaminated mining sites in Vietnam consist of Ha Thuong lead-zinc mine (HT), Trai Cau Iron mine (TC), and Hich Village Lead-zinc mine (LH) in Thai Nguyen mining sites, Vietnam. The study focus especially to evaluate the phytoremediation potential of native Lau plant (EA) (*Erianthus arundinaceus (Retz.*) and Reed plant (PA), *Phragmites australis (Cav.)* in the three HMs contaminated mining sites in Thai Nguyen province, Vietnam.. EA can naturally survive, grow and produce large biomass in extremely high contents of multiple HMs in soils. EA has the potential for phytostabilisation of Cd-contaminated sites. Moreover, research application of synthetic chelate (EDTA), the natural chelates (EDDS, NTA) to enhance ryegrass (*Lolium multiflorum Lam.*) uptake of the heavy metals (As, Cd, Cu, Pb and Zn) from the contaminated soils in the Thai Nguyen mining sites. The study compares the effects of these chelates (EDTA, EDDS and NTA) on the phytoavailability of heavy metals (As, Cd, Cu, Pb, Zn) using the ryegrass through the single addition and sequential addition methods in contaminated soils in the three different mining sites. The study found that when compared with no EDTA, EDDS or NTA application, the use of EDTA, EDDS and NTA significantly increased the uptake of certain HMs (As, Cd, Cu, Pb, Zn) by ryegrass (*Lolium multiflorum Lam.)* employing the single addition and sequential addition methods. Moreover, the study evaluate the important factors relating to the application of chelates (EDTA, EDDS and NTA) by the single addition and sequential addition methods. The purpose of the chelating experiments was to mobilise the HMs, thereby enhancing the phytoaccumulation of mobilised HMs and their subsequent removal from soil.

Keywords: *Phytoremediation, chelate, contaminated soil, heavy metals, native plant, mining sites*

OS5-6

A novel new T-FACE research platform advancing climate change simulation in paddy fields

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Abstract

This paper introduces an innovative new research platform known as T-FACE (Temperature by Free-Air CO2 Enrichment) for climate change simulation developed by Chinese Academy of Sciences. This T-FACE enables the simulation of future climate scenarios, specifically focusing on the interaction between high CO2 levels and warming within the paddy fields. The elevated CO2 treatment involves maintaining ambient CO2 levels in addition to an increase of 200 ppm, and the elevated temperature treatment includes a 2℃ rise in whole-ecosystem warming (air, water and soil surface temperature increase) compared to ambient conditions. The level of precision and stability achieved in the treatment control is of the first-class level. This is the first platform to explore the interaction between elevated CO2 and whole-ecosystem warming in open ecosystems. It can provide climate change simulation conditions for crop science, soil science, plant nutrition, ecology, environmental science and other related fields. This enables the study of how farmland systems respond, adapt to and address climate change.

Key words: *"Climate Change; Research platform; elevated CO2; Whole-ecosystem warming; Paddy fields"*

OS5-7

Research on measures to reduce soil degradation for vegetable and flower cultivation in ferralitic soil in the Central Highlands region in Vietnam.

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Abstract

The Central Highlands region concentrates on large basalt plateaus with altitudes from 500m or more above sea level, popular perennial crops include coffee, cocoa, pepper, and mulberry. Moreover, ferralitic soil is very suitable for growing vegetables and flowers, solve to increase income for farmers and distribution in Vietnam. The use of fertilizers and pesticides are the causes cropland degradation occurs. The results of research on soil degradation for growing vegetables and flowers on ferralitic soil are mainly a decline in the quality of soil fertility. The reaction of the soil solution (pH) tends to change from slightly acidic to neutral and alkaline. Organic matter in the soil is quite rich due to the use of a lot of organic fertilizers and its humus ability is poor, making it difficult for plants to absorb. Many indicators are abnormally high, such as easily digestible phosphorus, dozens of times higher than the control sample, causing an imbalance in the ratio of N - P and N - K in the soil, reducing the effectiveness of fertilizer use. Soil cation exchange capacity (CEC) is lower than control soil (hills) even though the organic content of cultivated soil is quite high. The composition and population of beneficial soil microorganisms decrease, leading to weak biological activity in the soil. The main reasons are due to the intensity of continuous land exploitation, an average of 3-4 crops/year, in some places up to 8 crops/year, so the land has not recovered. The amount of chemical fertilizer used is high and disproportionate. There is still a lot of untreated manure applied to cropland. The amount of lime used for soil is high to very high, up to 1,000kg-1,500kg/ha, increasing soil pH but reducing the effectiveness of nitrogen due to calcium taking up space in CEC, reducing the density of soil microorganisms, especially strains of bacteria. Antibiotics against fungal pathogens. A large number of farmers use a lot of pesticides on vegetables and flowers during the growing period. Therefore, the proposed measure is to improve degraded soil by advising the farmers not to apply much phosphate fertilizer per crop and to balance the nutritional needs of crops. Increase the use of processed and composted organic fertilizers such as biological organic fertilizers and microbial organic fertilizers with strong antagonistic microorganisms such as *Trichoderma* sp., *Streptomyces* sp., *Saccharomyces* sp., *Bacillus subtilis* against fungi and bacteria that cause diseases in vegetable and flower crops such as *Rhizoctonia*, *Sclerotinia*, *Fusarium*, *Pythium* and *Phytopthora* and some other bacteria. Do not apply lime more than a dose of 500kg CaO/ha for many consecutive seasons and can replace lime by using dolomite to both supplement calcium and magnesium, overcoming the phenomenon of magiesium deficiency. Results when applying measures to treat degraded soil with soil improvement fertilizers: organic fertilizers, biochar, dolomite, nano chitosan 0.3%, microbial compost and at the same time reduce the amount of inorganic fertilizer in a balanced and reasonable. The results showed that some soil physical and chemical properties improved soil fertility compared to pre-experiment soil and traditional farmer's cultivated land. For example, the soil is not compacted (density decreases by 0.29 - 0.36%), organic humus increases by 0.8 - 1.4%, cation exchange capacity increases by 2.8 - 4.7 meq/100g and microflora increases. The antagonistic microflora increased from 1.9 x 10^3 CFU/g. Profits of farmers increased by more than 10% on chrysanthemum and 30% on carrots.

Key words: *soil degradation, nutrient balance, organic fertilizers, antagonistic microorganisms*

OS5-8

Influence of organic amendments on soil properties and bioavailability of heavy metals in the contaminated soil

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Abstract

With economic development and industrial activities frequently, heavy metals, which generated by factories and mining, could enter agricultural soils through rivers and irrigation water, leading to contamination of farmland. Organic amendments included compost, livestock manure, biochar, biosolids, vermicompost, and so on. Several studies had demonstrated that amendment of organic amendments could not only improve soil physical and chemical properties but also have a stabilizing effect on heavy metals. The objectives of this study were to investigate the effects of different organic amendments application (two kinds of chicken-manure-processed organic fertilizers and vermicomposts) on soil properties and the bioavailability of heavy metals at various time intervals in soil contaminated with cadmium and nickel. Experimental results showed that applications of organic amendments not only raised soil pH and electrical conductivity but also increased the concentration of available phosphorus, available sulfur, and exchangeable potassium, calcium, and magnesium in the soil. Besides, organic amendments application increased the concentration of organic matter and wet aggregate stability. In terms of the bioavailability of heavy metals in soil, the application of organic amendments decreased the bioavailability of cadmium, chromium, nickel, and lead in soil, and vermicomposted cabbage treatment induced the lowest concentration of bioavailability. In addition, the additions of organic amendments changed the fractions of heavy metals from acid and exchangeable fraction to oxidizable fraction. Furthermore, at different time intervals, the concentrations of available nitrogen, available sulfur, and exchangeable calcium and magnesium reached their highest values between the 10th and 20th day. On the other hand, the concentration of available phosphorus reached its peak around the 60th to 70th day. As for the results related to heavy metals, the available concentration may change over time due to soil fixation and organic matter mineralization. In summary, amendment of organic amendments could promote soil physical and chemical properties and reduce mobility of heavy metals in soil.

Key words: *chicken-manure-processed organic fertilizers, heavy metal, mineralization, vermicompost*

OS5-9

Water erosion mitigation practices in the agricultural highlands of Thua Thien Hue province

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Abstract

Water erosion has created severe degradation problems in the Thua Thien Hue Province of Vietnam. To support local farmers and the government in mitigating the impact of water erosion, we tested the effect of cassava and Acacia intercropping as well as surface mulching on water erosion reduction. As a result, applying 10 Mg ha-1 of air-dried grass mulch at the time of cassava seeding in early May mitigated more than a quarter of the runoff and three-quarters of the soil loss compared to bare land. The cassava + Acacia intercropping system reduced runoff and soil loss by more than two-fifths compared to bare land after canopy closing in the second year. Based on our results, grass mulching and intercropping were significantly effective at managing water erosion under the specific climatic and soil conditions in this area. However, we must keep in mind that when the mulch had completely decayed, a high risk of water erosion occurred in the mulching plots during the fallow period after harvest. To increase the efficiency of these practical techniques for water erosion mitigation, grass residue should be applied at the same rate twice, once after seeding and again after harvesting. Grass mulching should also be applied to the intercropping system once or twice until the Acacia canopy is closed.

Key words: *Acrisols; sloping cropland; water erosion management; grass mulching; intercropping*

OS5-10

Application of Spent Coffee Grounds Can Increase Soil and Clay Losses

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Abstract

Application of spent coffee grounds (SCGs) for soil is widely encouraged as this practice is greatly in line with current environmental campaigns such as circular economy, net zero carbon esmission. However, negative impacts from this practice were not fully understood. This study aims to present the effect of nanosized SCGs (*n*SCGs) on dispersibility/transportability of a soil clay. *n*SCGs sample was extracted from SCG waste and its effects on the dispersion of clay were tracked over the pH range ~3 to ~9 and ionic strength from 0.001 to 0.1 N by using dynamic light scattering technique and test tube method. *n*SCGs was found to carry negative charges and the presence of *n*SCGs in the suspension of clay resulted in decreases in surface charge (toward more negative) of the clay suspension, particularly at pH < 6. Through providing more negative charges for the clay system, *n*SCGs stimulated and favoured clay dispersion. Herein, edge surface of clay and Fe oxides may play a central role in associating soil particles, but this role was likely declined due to the presence of *n*SCGs. In general, it can be implied that our effort to utilize SCGs may bring adverse impacts such as soil/clay losses or soil structural-induced changes, and these impacts need to be considered.

Key words: *spent coffee grounds; circular economy; nano particles; clay dispersibility; soil loss"*

OS5-11

Effect of rice cultivation on abundance of iron-reducing bacteria in paddy soils

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Abstract

Biological nitrogen fixation (BNF) in paddy soil is considered to provide substantial nitrogen to rice plants. It has been described that BNF activity in paddy soils is mainly contributed by *Deltaproteobacteria*, especially the genera *Anaeromyxobacter* and *Geobacter*. They are also known as iron-reducing bacteria (IRB), which could utilize ferric iron compounds as electron acceptors for respiration. It has also been demonstrated that the addition of metal Fe to paddy soil improves productivity of rice. However, how rice cultivation influences IRB abundance in paddy soils is not clear. In this study, we designed a rhizo-box system for high-throughput screening of abundance of *Anaeromyxobacter* and *Geobacter* in the soil with the cultivation of 143 *japonica* rice cultivars. IRB abundance generally increased in the rhizosphere soil with the cultivation of rice seedlings. Rice genotypes affects IRB abundance. Genome-wide association study was performed to find out the casual genes in rice that may participate in the rhizosphere communication between rice and IRBs. We selected candidate genes and CRISPR-Cas9 has been applied to generate knockout lines of those possible causal genes. This study may reveal a genetic component(s) that influences the abundance of IRB in paddy soils.

Key words: *rice; paddy fields; nitrogen fixing bacteria; genome association study*

OS5-12

Aerobic co-composting degradation of highly PCDD/F-contaminated field soil. A study of bacterial community

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Abstract

Dioxin-contaminated soil has attracted worldwide attention due to its potential negative impacts on human health and the ecosystem. Thus, technological development aiming at high treatment efficiency and low cost for dioxin-contaminated soil is largely needed. This study investigated bacterial communities during aerobic food waste co-composting degradation of highly PCDD/F-contaminated field soil. Aerobic composting was found to be successful in biodegrading dioxin-contaminated soil with a removal efficiency of 81% after 35 days. The highest biodegradation rate was observed during the thermophilic phase, where bacterial activity was at its peak. The presence of dioxins in the compost was also observed to affect the bacterial community structure. Based on the 16S rRNA sequences, the results indicated that *Bacilli, Actinobacteria, Clostridia, Gammaproteobacteria, and Alphaproteobacteria* were the main classes in the bacterial community. Bacterial species containing catechol 2,3-dioxygenase (C23O) and angular dioxygenase encoding genes were searched and identified using BRENDA database and previous studies. These genes code for the key enzymes in dioxin biodegradation pathways. Ten dioxin-degrading species and three potential dioxin degrading species (*Pseudomonas* sp., *Burkholderia* sp., and *Ralstonia* sp.) were identified in our compost. From the phylogenetic tree, candidate bacterial species for future dioxin degradation studies were also identified, with 99% 16S rRNA gene sequence similarities to previously reported dioxin-degrading species. These results provide novel insight into the bacterial community structure in the compost samples and phylogenetic relationship of the dioxin-degrading microorganisms that would be of benefit in pilot-scale composting of dioxin-contaminated soil.

Keywords: *Aerobic food waste co-composting, Next-generation sequencing, 16S rRNA sequencing, Angular dioxygenase, Catechol 2,3-dioxygenase, PCDD/Fs*

ORAL SESSION 6: LAND GOVERNANCE; LAND POLICY AND EDUCATION ON LAND MANAGEMENT

OS6-1

Development of comprehensive soil education package for achieving SDGs

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Abstract

Soils play key roles in achieving SDGs to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity. It is, however, not well understood, known or even aware of by the general public, allowing soil and land degradation to lead us to face a variety of global environmental challenges. On the other hand, based on our questionnaire survey, we found that the kids of elementary school and pre-school age instinctively know how to play with and thus are strongly interested in soils, concluding that the first target or customer in soil education market is those who are in such generation. The objective of this research project is to develop a comprehensive soil education package, particularly for achieving SDGs, to be applicable to those from pre-school children to middle school students in as well as out of doors. The contents of the package include the topics for stimulating the sense of wonder, for providing basic knowledge of soil forming processes and its distribution pattern to understand the principles of soil and land management, nutrient cycling in an ecosystem and various aspect of ecosystems services, and for practical observation, learning and experiments in a field, workshop and laboratories. In each topic the contents are arranged in problem-solving style, i.e., observing the current status of nature, objects or problems first, then raising the question why it is so, and discussing among the learners and finally finding the answer or solution. The contents are built as something like a book chapter in a variety of multimedia format such as video clip, Podcast, E-book, etc. as well as in a classical style of guide book or text book and will be stored and shared by the uses on a digital transformation platform or social media, e.g., You Tube, Instagram, X (formerly Twitter), Tik Tok, etc. We expect that the users could become a contributor as well in the future and then the package will be self-propagated so that more contents could be available to a variety of users such as children and kids, school teachers and the general public at not only school classes but at home, social cultural events, etc. Such new environment with this educational package should enhance the public awareness of soil and soil sciences and help a lot for achieving SDGs more widely and quickly.

Key words: *soil education; SDGs; problem-solving style learning; digital transformation platform*

OS6-2

Determination of Tropical Peat Soils Humification Degree using Field Emission Scanning Electron Microscope equipped with Energy Dispersive X-Ray and Digimizer Software to Supplement von Post Scale Method

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Abstract

The von Post classification system (hand rubbing technique) entails the nature of materials after squeezing and the plant structure. Despite its widespread use, this method provides general information and lacking specificity. Inexperienced use can lead to misleading interpretations of peat humification during field observation. The purpose of this study is to enhance the existing peat humification classification using the von Post Scale, by incorporating the Field Emission Scanning Electron Microscope (FESEM) with Energy Dispersive X-Ray (EDX) and Digimizer software. In this study, peat samples, categorized by the von Post Scale, underwent analysis for physical properties (color, bulk density, water, and fiber content) and chemical properties (organic matter, pH in KCl and water, C/N ratio, exchangeable Ca, Mg, Na and cation exchange capacity) using standard procedures. The microstructure and elemental composition of the peat were determined using FESEM-EDX, respectively, before being quantified using Digimizer software. The findings suggest that the higher the peat humification degree, the darker was the peat soil and this observation was glaring for higher bulk density and lower water content of the peat soil. Also, the peat pH, nutrient availability, CEC, and exchangeable cations increased with increasing humification of the peat whereas the opposite was true for the peat C/N ratio. The peat humification degree (H1-H10) determined using von Post Scale in the field was supplemented with the microstructural image produce using FESEM-EDX and the approximate percentage of degradation from the microstructural image was quantified using digimizer analysis. The results of this study (physicochemical properties and microscopic analysis of peat soils) could be used for determining peat soils' humification level because with the aid of FESEM-EDX, accurate classification of peat soils is possible. In conclusion, the microstructural image of the peat revealed by FESEM provides evidence on the extent of the peat decomposition and this was collaborated with the EDX elemental analysis results; a confirmation being the percentage of degradation in the digimizer analysis. To improve or advance the findings (for example, reliability and validity) of this represent study, large sample size is recommended.

Key words: *humification; microstructural; soil; method; peat*

OS6-3

Assessing current land use of priorities for change in Nam Nan catchment, Lao PDR

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Abstract

Qualitative evaluation of land was carried using modified method following guides of FAO 1976 and FAO 1993 for Nam Nan catchment, Luang Phrabang province, Lao PDR. Briefly, it is to match the qualities of the land with the requirements of the intended land use type. Each Land Use Types (LUTs) is combination of crop and growing season. Additionally, economical factor based on results of semi-structured interviews on 81 household help to assess current LUTs. The results show that all current rice grown in rainy season is suitable at 294,8 ha (S1, S2), and 680,7 ha of double crops: Rainy season rice-Dried season rice is grown suitably (S1, S2). The current LUT of rice-winter crop of 294.8 ha is assessed suitable, equal to area of single-rice grown in rainy season. Total grown area of Job's tear + Cassava + Grass (King grass or Guinee grass) was 3167.3 ha, of which 2950 ha in suitable level and 217.2 ha in marginal or non-suitable level.Considering producer margin, vegetable provided highest return of over 51,01 million Kip/ha, followed by rice 30.5 million Kip/ha, maize at 29.1 million Kip/ha (fixed price in 2022). Job's tear and cassava earned lowest producer margin at 23.33, and 19.1 million Kip/ha, respectively. Although vegetable earned highest producer margin, but its initial investment costed double compared to that of other crops. Vegetable product is perishable, requiring advanced storage and processing facility for large quantity to be transfer to end customers. Further, it is high demanding labor crop, hence difficulty in increasing scale of farm at non-populous area like Nan district. It is suggested that small irrigation systems could be built for an increase of 219.6 ha rice and some land with rainy rice season can be converted into two rice system. On the other hand, some of area with low economic performance can be converted into vegetable or legume (e.g. peanut.) crops. Annual crop such as maize, cassava and Job's tear grown on slopping land being considered prone to soil erosion and soil degradation should be reduced or converted into grass cultivation, unless conservation practice is applied. When prices of commodities (e.g., cassava and Job's tear) fluctuate, shifting from one to another would be considered as a mean to increase producer margin. The study indicated that land use change in area devoted to agricultural cultivation needs to be carried out in a deliberate and throughout plan, under well-coordinated and discussed by land users, agricultural experts, authorities and other stakeholders involved.

Key words: *Catchment study, Land use type, Land use change*

OS6-4

Enhancing Soil Temperature Determination using Novel Remote Sensing Indices

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Abstract

Soil temperature plays a pivotal role in soil management, crop development, and soil - surface - atmosphere interactions, contributing significantly to climate change dynamics. However, the accurate and comprehensive observation of soil temperature is hindered by equipment and budget constraints. This study explores the potential of Landsat 8, with its advanced thermal detection capabilities and high spatiotemporal resolution, to address this limitation. In this study, we introduce a novel index, the "Normalized Difference Soil Temperature" index (NDST), based on the disparity between two thermal bands. Our experiments, conducted using data from agrometeorological stations in various land use and topography settings, reveal strong correlations between NDST and surface and soil temperature ($R^2 = 0.40$). Significantly, for built-up or bare soil areas, the correlation is considerably higher ($R^2 = 0.60$). Additionally, NDST demonstrates a robust spatial correlation with Land Surface Temperature derived from Landsat 8 imagery, with a correlation coefficient of 0.90 or higher. To improve temperature measurement over vegetated areas, we enhance NDST by incorporating the blue band, which effectively distinguishes between bare soil and vegetative cover. This refined index, termed "corrected NDST" (cNDST), demonstrates comparable levels of connection to NDST in bare soil and notably greater correlations in crop-covered land ($R^2 = 0.74$ compared to 0.60). These findings highlight the advantages of our new indices in soil and surface temperature determination and their potential for broad and convenient application in the mapping of temperature patterns over space and time. These innovative indices promise to be valuable resources for soil temperature reporting across a variety of applications, including climate change assessment, soil property studies, and crop protection research.

Key words: *climate change; Landsat 8; Normalized difference soil temperature index; remote sensing; soil temperature mapping.*

OS6-5

Soil topics as a part of geographical education – current state and 'digital natives' generation perspective

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Abstract

One of the challenges of the modern world is to increase social awareness of the environment and geography lessons create an opportunity for transferring the skills of conscious management of the Earth's resources. The research clearly shows that soils topics are underrepresented (Charzyński et al., 2022) and students lack an awareness of threats related to the environment (Urbańska et al., 2022). The awareness of threats related to various Earth spheres is considerably differentiated. Research shows that the soil issues are the least known in this aspect. Soil education is deficient in many countries. In schools, soil topics are usually taught briefly and with little detail. This may result in students' perceiving the pedosphere as less important than the other spheres– "just" 'dirt' we walk on! A proper approach to the issues of sustainable development without an full knowledge of the environmental threats is impossible. How to encourage a "digital native" to understand the soil - something so "down-to-earth"? The best option is to change the way of knowledge transferring to make this process much more attractive for modern generations. There are a lot of possibilities: mobile games related to soil (free game-based learning platforms) or on-line and off-line mobile applications for the soil profile description to combine soil education with ecological issues and edutainment social networking service. This motivational, challenging, and rewarding digital environment helps learners work toward a goal while choosing actions, and experience the competition and consequences of those actions (experience level/ranks/digital rewards/skills badges/points). This kind of interactive competitive game-based techniques in learning process can be a perfect way to increase public awareness of soils. " Learning by doing" or even "learning by playing" is a key aspect of multitasking nature of digital natives as well as the ability to apply the knowledge in practice.

Key words: *soil awareness, soil threats**,** soil education; gamification; edutainment*

OS6-6

Factors affecting the knowledge capacity of cadastral officials in land management in A Luoi district, Thua Thien Hue province

Le Ngoc Phuong Quy[1*], Duong Thi Thu Ha[1], Tran Trong Tan[1], Le Dinh Huy[1], Ton Nu Tuyet Trinh[1], Nguyen Thi Hai[1], Pham Huu Ty[1], Le Viet Linh[1], Ho Thi Tuyet Trinh[1]

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Abstract

The requirement for high knowledge of cadastral officials has played an important role in the efficiency of land management in Vietnam. Therefore, this study aims to determine the factors affecting the knowledge capacity of cadastral officials in land management in mountainous area- A Luoi district. The study focuses on analysing 5 factors to determine the relationship between variables that help explain the compatibility of cadastral officials and their knowledge capacity. Methods such as Cronbach's Alpha, exploratory factor analysis using SPSS software were used to check the correlation between the factors and to draw conclusions about factors affecting cadastral officials'knowledge capacity. A survey questionnaire using semi-structured interviews was administered to 175 respondents representing cadastral officials, local authorities at district and commune levels, and local people. The results revealed that training and professional development activities, salary and bonus payments, management and supervision of staff, working conditions and job characteristics were critical factors that influenced knowledge capacity of cadastral officials. Additionally, the data proved that knowledge capacity was based on regular training activities therefore training and professional development activities had the most positive impacts of cadastral officials' knowledge capacity. Moreover, these results will provide local authorities at commune and district level with a better assessment of how to improve the knowledge capacity of cadastral officials in their land management tasks.

Key words: *cadastral officials; influencing factors; knowledge capacity; land management.*

OS6-7

Situation of land use management in the new rural construction in trang bom district, Dong Nai province

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Abstract

Land plays an important role in planning and building new rural construction. The study aims to assess the current situation and propose solutions for land management to contribute to the basis for the formulation of a land management and use strategy to serve the rural development program in the Trang Bom district. The results of the study show that: Of the total of 25 land use planning indicators, 6 indicators were rated as very good; 7 indicators achieved were good, 2 indicators were at an average level; and 10 indicators were at a low or very low level, accounted for 40%. Of the 10 land use management criteria, 3 were rated as very good; 3 were rated as good; 3 were rated as average; and 1 was rated as low. Based on these findings, the study proposes solutions to improve the efficiency of land management in the construction of new rural areas.

Keywords: *new rural construction, land use management, Trang Bom district*

ABSTRACTS OF POSTER PRESENTATION SESSION 1

	Poster Session 1 (35 Posters) **TNU Convention Centre – Main Hall** **(TNU Area Poster Place 1)**
S1A	**PS1A-1** **Evaluating the Potential of Rice-Based Spent Mushroom Substrate (SMS) Combined with Chicken Manure and Liquid Organic Plant Supplement as Soil Conditioner** Rojales, J.S., Dimaano,V.T. , Allag, D.R., Cortez, L.A., Arciaga, J.P., Samar, E.D and Bautista, K.S.
	PS1A-2 **The development of a national soil health strategy and action plan for Vietnam** Nguyen Dinh Cong, Nguyen Song Ha, Caon Lucrezia, Tran Minh Tien, Tran Minh Thu
	PS1A-3 **Chemical speciation and phyto-availability of legacy phosphorus in rice paddy soils in Taiwan** Huang, Z.L., Wang, S.L.
	PS1A-4 **Agricultural Soil Fertility Assessment Model and Grading** Yoon, Jeong , Jeong , Nam , Lee J.G., Kim, H.S., Kim, M.S. & Yang, J.E
	PS1A-5 **Assessing the potential for sustainable nitrogen utilization in clay-enhanced chicken manure** Chen Ting-Yu and Lai, H.Y
S1B	**PS1B-1** **Potential use of soil improvement microbial preparation for fruit trees** Nguyen Thu Ha, Nguyen Viet Hiep, Dang Thuong Thao, Truong Thi Duyen
	PS1B-2 **Research on methods to produce slow-release N, P, K fertilizers which was using silica-biochar materials from rice straw as a substrate** Nguyen X. Huan, Tran T.M. Thu, Nguyen N. Minh, Tran M. Tien
	PS1B-3 **The effect of composted and pelleted quail manure on soil nitrogen mineralization** Yeh, C.Y. & Lai, H.Y.
	PS1B-4 **The impact of chicken manure processing fertilizers made from chicken manure bedding material with various agricultural byproducts on soil properties and growth of pak choi** Yang, M.Q., Hsu, Y.H. & Lai, H.Y.
	PS1B-5 **Effect of applying organic fertilizer made from chicken manure on soil fertility and the growth of Brassica chinensis L. cv. Wrinkled leaf** Lee, Y.C. & Lai, H.Y

S1C	**PS1C-1** **Short-term impact of agricultural plastic mulches on soil labile carbon and available phosphorus in chilli (Capsicum annuum) cultivation in Sri Lanka** Dias, P.A.M., Gimhani, T.D.M., Chathurika, J.A.S., Ariyarathne, M., Karunarathna, A., Perera, C., Jones, D.L. & Chadwick, D
	PS1C-2 **Effect of decomposer enriched City Waste Compost application on growth and Yield of broccoli** Sabina Devkota and Parbati Adhikari
	PS1C-3 **Effects of continuous application of rice straw and cow-dung compost on soil fertility and rice yield in paddy fields** Yuka Sasaki, Makoto Chuzenji, Nguyen Thanh Tung and Ken-ichi Kakuda
	PS1C-4 **Assessing Land Suitability for Major Crops and Proposing to Convert Cultivation Structure On Agricultural Production Land Area of Nhu Xuan District, Thanh Hoa Province** Nguyen Thi Hue, Ha Manh Thang, Mai Van Trinh
	PS1C-5 **Application of Data Mining Techniques and GIS to Assess Suitable Land for Mango Cultivation in Cho Moi District, An Giang Province** Nguyen Huy Anh, Nguyen Trinh Minh Anh, Nguyen Phu Cuong
S1D	**PS1D-1** **Applying machine leaning to produce Soil Organic Carbon Stock map of Vietnam** Vu Manh Quyet, Nguyen Dan Tri, Tran Minh Tien
	PS1D-2 **Verifying the Semi-quantitative Soil Classification System of Vietnam Based on Soil Monoliths from the Vietnam Soil Museum** Nguyen Thanh Tuan, Ho Quang Duc, Le Thai Bat, Le Anh Tuan & Tran Thuy Chi
	PS1D-3 **Northeast Hilly Land Classification According to Fao-Unesco-Wrb Quantitative Method** Nguyen Van Toan, Nguyen Vo Kien, Duong Thanh Nam, Vu Xuan Thanh, Nguyen Thi Ha, Vu Anh Tu, Vu Xuan Thanh, Nguyen Thi Ha, Duong Thanh Nam
	PS1D-4 **Effects of rice straw mulching on trophic structure and metabolic footprints of the nematode community belowground in an alternative upland-paddy rice system** Sinh, N.V., Brooke, K., Jessica R., Hao, V.A., Thinh, N.Q., Chan, P.B., Thy, C. T. A., Phuong N.T.K., Toyoda, K. & Nghia, N.K.
	PS1D-5 **Effects of cultivation activities on deep earthworm density in the citrus orchards** Nguyen V. Hiep, Nguyen M. Hung

S1E	**PS1E-1** **Heat stress tolerance on Cucurbitaceae plant and biocontrol activity on plant parasitic nematode by endophytic fungus isolated from weeds growing under asphalt conditions** Saya Nakano, Ryota Kataoka
	PS1E-2 **Current situation and solutions to promote digital conversion of land indicators in organic agricultural production** Luyen Huu Cu, Pham Minh Hanh, Le Thai Bat
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PS1A-1

Evaluating the Potential of Rice-Based Spent Mushroom Substrate (SMS) Combined with Chicken Manure and Liquid Organic Plant Supplement as Soil Conditioner

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Abstract

The study aimed to evaluate the efficacy of enriched rice-based spent mushroom substrate (SMS) from *Pleurotus sp*. as a soil conditioner. The SMS contained 70% rice straw and 30% sawdust. Together with chicken manure (CM), the materials were analyzed for % OC, %OM , %N, Available Phosphorus and Exchangeable K content. The rice-based SMS and CM mass ratio used was 90% SMS and 10% CM (4.5:1) with 30:1 initial C/N ratio. Indigenous Microorganisms (IMO) and Oriental Herbal Nutrient (OHN) were prepared in accordance with existing protocol and sprinkled to the SMS/ CM mixture at 60% moisture. Soil conditioner quality in accordance to the Philippine National Standards/Bureau of Agricultural and Fisheries Standards (PNS/BAFS) 183:2020 was determined including microbial population, pH, and temperature. All SMS combinations passed the standard values on % total N-P2O5-K2O, % Organic Matter, % actual moisture content and odor criteria. Among the treatments, SMS + CM attained the highest % total N-P2O5-K2O and % Organic Matter. The heavy metal content of all the rice-based SMS combinations also conformed to the allowable limit set by the PNS/BAFS 183:2020. Fungal population of the SMS soil conditioners increased at Week 3 and decreased until 14 weeks of composting period. Bacterial population was higher in SMS+CM+IMO at Weeks 0, 3, and 5. Lowest bacterial count was observed in SMS Alone. All soil conditioners were within the normal pH range of 6-8 with temperatures ranging from 30-35°C. The formulated SMS were subjected to an efficacy trial using lettuce (*Lactuca sativa*), bush sitao (*Vigna sesquipedalis x Vigna unguiculata*) and pepper (*Piper longum*) at the rate of 5 tons/ha. Plant height, biomass, number of pods (for bush sitao) and weight of fruits (for bush sitao and pepper) were determined. SMS with amendments gave better yield in lettuce and significantly increased plant height of pepper but did not significantly affect the number and weight of pods in bush sitao. Soil chemical properties generally improved with the addition of the rice-based SMS soil conditioners. Results showed that the quality, efficacy and effect of SMS+CM on soil chemical properties were statistically comparable with the rice-based SMS combined with IMO and OHN. It is recommended to explore the long-term effect of the rice-based SMS soil conditioners to the soil at the field level particularly in terms of soil biodiversity and nutrient cycling potentials, organic matter build-up, and soil health improvement.

Key words: *soil conditioner, rice-based spent mushroom substrate; liquid organic plant supplement; indigenous microorganisms; oriental herbal nutrient*

PS1A-2

The development of a national soil health strategy and action plan for Vietnam

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Abstract

Vietnam's agricultural productivity faces challenges arising from soil erosion, nutrient depletion, pollution, and unsustainable practices. These issues are compounded by a lack of comprehensive data and monitoring, which hinders effective management. To help address these issues, the government of Vietnam asked the Food and Agriculture Organization of the United Nations (FAO) for support on developing a National Soil Health Strategy (NSHS) and a National Plan for Soil Health Management (NP-SHM) aligned with the "One Health" approach. The NSHS and the NP-SHM will be prepared considering relevant policies, global frameworks, and best practices, as well as the evolving Vietnamese agricultural sector, its deep integration into global markets, and the threats posed by climate change and technical barriers. The writing and further implementation of these documents is expected to strengthen national institutional capacity of land use systems for soil health management with an integration of food security and safety, biodiversity, climate change mitigation and adaptation. The project is in its initial stage and is currently seeking partners to support three main objectives: (i) developing a NSHS that mainstreams food security, biodiversity, and climate change mitigation and adaptation, (ii) developing a Five-Year NP-SHM integrating food security and safety, biodiversity, climate mitigation and adaptation, and (iii) improving capacity of national trainers to roll out the NP-SHM. With the Soil and Fertilizer Institute as the main implementing partner, the project is set for implementation in 2024-2025. Stakeholder consultations with soil scientists, land management authorities, and practitioners will inform the final strategy and action plan in 2025.

Key words*: soil health, policy, national strategy, food security*

PS1A-3

Chemical speciation and phyto-availability of legacy phosphorus in rice paddy soils in Taiwan

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Abstract

Phosphorus, as one of the macronutrients for plant growth, is often added to agricultural lands in the form of fertilizers to increase crop yields. However, long-term excessive use of phosphorus fertilizers in Taiwan has led to environmental pollution, making the problem of legacy phosphorus soil hardly be ignored. To understand whether legacy phosphorus in the soil is sufficient to supply the nutrients needed by crops without fertilization and in what form phosphorus species are released into the soil, this study conducted measurements of total phosphorus, plant-available phosphorus, pH, and other properties in rice field soils from different regions. Phosphorus speciation was analyzed with X-ray absorption near edge structure spectroscopy (XANES). The results showed that the soils in Yilan, Hualien, and Taitung, which are acidic soils, had lower levels of plant-available phosphorus and total phosphorus. In contrast, the soils in the regions with alkaline soils, including Yunlin, Chiayi, Kaohsiung, and Pingtung, had plant-available phosphorus levels two to three times higher than other regions, indicating regional differences in soil phosphorus content. The linear combination fitting results of XANES showed that the major phosphorus species supplying plant-available phosphorus in the soil were likely calcium phosphate or aluminum phosphate. The findings will contribute to a reevaluation of recommended phosphorus fertilization methods for rice, with the aim to reduce phosphorus fertilizer application to decrease phosphorus mineral consumption and simultaneously lower legacy phosphorus levels in rice paddy soils to mitigate phosphorus pollution.

Key words: *Legacy phosphorus; X-ray absorption spectroscopy; Rice paddy soil; Plant-available phosphorus*

PS1A-4

Agricultural Soil Fertility Assessment Model and Grading

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Abstract

Republic of Korea conducts annual soil analysis to prescribe fertilizers and assess the chemical properties of agricultural soil. The chemical evaluation of agricultural soil is based on individual chemical standards, determining suitability or unsuitability (excessive or deficient). However, there is currently no comprehensive assessment of soil fertility and quality through scoring. This study developed a comprehensive soil fertility evaluation model based on the analysis results of 91,562 soil samples conducted in 2021, attempting to grade soil fertility. Land use types included 50,493 samples for paddy, 27,215 for upland, 9,967 for orchard, and 3,887 for greenhouse. In the fertility assessment model, agricultural land was categorized into paddy and other land uses based on chemical standards in Korea. Soil properties used to assess fertility were pH, EC, organic matter, available phosphorus, and exchangeable cations (Ca, Mg, K). Scoring models for each soil property were selected by referencing appropriate chemical standards and previous research results. 'Optimum is better' models were applied to pH and available phosphorus, 'more is better' models to organic matter and exchangeable cations, and 'less is better' models to EC. The scoring model equations for each soil property allowed expressing soil analysis values as scores from 0 to 1. Soil fertility was determined by applying the average scores for each parameter, and the overall soil fertility assessment categorized fertility scores from 0 to 0.3 as 'low,' 0.3 to 0.7 as 'medium,' and 0.7 to 1.0 as 'high.' The soil fertility evaluation method and grading approach developed in this study are considered to be important resources that can be utilized in the future for transitioning to comprehensive soil management strategies based on soil fertility.

Key words: *Soil fertility; fertility assessment model; agricultural soil; soil chemistry*

PS1A-5

Assessing the potential for sustainable nitrogen utilization in clay-enhanced chicken manure

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Abstract

Soil inorganic nitrogen (N) is divided into non-exchangeable, exchangeable, and water-soluble forms. Release of inorganic N from the mineralization of manures in field frequently leads to low N use efficiency (NUE) since it cannot be uptaken by crops promptly. Previous studies have demonstrated that the utilization of clay minerals aiming to enhance the non-exchangeable ammonium (NH_4^+) and exchangeable NH_4^+ can reduce N loss and facilitate the NUE. However, the mineralization process of manures produced by using clay-rich soils substitutes for clay minerals, with chicken manures, has been still obscure. Hence, the aim of this study was to understand the proportion of soil available N forms transformation under the rich-clay soil additional granulation incubation. Two soil series, Erlin soil (Eh) and Laopi soil (Lo) (sand particles have been removed during the preparation) by which the granular fertilizers were produced in this study, were employed with six addition rates (0%, 2%, 4%, 6%, 8%, and 10% (w/w)) to mix in chicken manures. The produced fertilizers were added to the incubation soils by an application rate of 180 N kg/ha, with a control (no fertilizer application). The results indicated that the incubated soil with Lo addition treatment had a higher proportion of exchangeable NH_4^+-N throughout the incubation period than the Eh granular fertilizer addition treatments due to the higher cation exchange capacity (CEC) of Lo. Furthermore, compared to other application rates, the soil with 10% Lo granular fertilizer addition significantly increased the proportion of exchangeable NH_4^+-N while the water-soluble NH_4^+-N decreased and reached the highest reduction of water-soluble NH_4^+-N by 27.1% during the early stages of incubation. Experimental result of this study reveals that the addition of 10% clay-rich soil with high CEC in chicken manures was potential to mitigate N losses.

Key words: *ammonium; chicken manures; nutrient preservation; nitrogen mineralization*

PS1B-1

Potential use of soil improvement microbial preparation for fruit trees

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Abstract

Biological solution to improve soil fertility, increase soil moisture retention and increase the efficiency of mineral fertilizer use is an issue of current concern. In addition, the use of microbial preparations to increase crop yields and farmers' income is very necessary. Soil improvement microbial preparation (SIMP) contain nitrogen fixing bacteria *Azotobacter chroococcum* (VACC 86), phosphorous solubilizing bacteria *Bacillus megaterium* (VACC 607), potassium solubilizing bacteria *Paenibacillus castaneae* (VACC 509) and slime producing yeast *Lipomyces starkeyi* (VACC 20028). This study was conducted to investigate the potential of using the soil improvement microbial preparation for fruit trees (longan, orange and pomelo tree). Field trial were conducted in the randomized block design with three replications. The control was applied 100% NPK mineral fertilizers and no SIMP was added. Four (4) experimental treatments were added SIMP with an amount of 60 kg/ha and the amount of NPK mineral fertilizers were reduced by 0%, 5%, 10% and 15%, respectively. The results showed that the SIMP has a positive effect in increasing the available phosphorus, available potassium content; beneficial microbial density and moisture of soil. In comparison with control, using SIMP and 100% NPK had increased yields by 12.66-12.74% for longan, 11.39-11.99% for orange and 12.60-13.15% for pomelo, and hence had increased income by 16,22-16,77%, 17,96-18,01% and 16,63-16,90%, respectively. When using SIMP and reducing NPK by 5-15% for longan, orange and pomelo, the yields had still increased by 10,28-12,12%, 10,00-11,35%, 10,05-12,53% and income had still increased by 12,93-14,67%, 15,64 -16,84%, 13,60-15,32%, respectively. This study indicated that SIMP was able to increase NPK uptake up to 15% in fruit trees (longan, orange and pomelo tree) since using SIMP and reducing NPK by 15%, the yields were still higher than control.

Key words: *fruit trees, income, soil improvement microbial preparation, yield.*

PS1B-2

Research on methods to produce slow-release N, P, K fertilizers which was using silica-biochar materials from rice straw as a substrate

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Abstract

Controlled Release Fertilizer (CRF) is recognized as one of four directions for developing new fertilizers which was saving resources and minimizing environmental impacts. CRF in this study was produced by mixing Silica-Biochar (SB), Bentonite (B) and Diatomite (D) at different ratios with N, P, K form customized crystal membrane to control the dissolution of N, P, K into water. Research results show that the percentages of SB and B used significantly affects the pelleting process, decay rate, hardness and air hygroscopicity of CRF fertilizer. The decay rate > 20 % after 13 and 5 days and > 80 % after 17 and 9 days respectively with SB ratio of 30 and 40 %. The maximum hardness of CRF fertilizer was 3.2 kg/cm^2 and the smallest was 1.6 kg/cm^2 respectively with the SB used ratio of 30 and 40 %. The percentage of SB used 30 %, the CRF fertilizer was the smallest hygroscopicity. The percentage B used 5 %, the decay rate of CRF was the smallest. The percentage of B used did not affect the air hygroscopicity of CRF fertilizers. The different percentages of diatomite used did not affect the decay rate, hardness, and air hygroscopicity of CRF fertilizers. Combining Silica - Biochar from rice straw with diatomite and bentonite as a customized crystal membrane in fertilizer for better control of nutrient release was the main method used in this study. CRF1 (using 30 % SB) and CRF2 (using 40 % SB) were produced by this method with total $N_{total} + P_2O_{5\ avail} + K_2O_{avail}$ content of 27.02 and 22.05 % respectively, meeting the standard for mineral organic fertilizers of Vietnam (QCVN 01-189: 2019/BNNPTNT) and the ISO 18644: 2016 standard. Smaller particles have a faster NPK release rate. Particle size ~ 4 mm, the NPK release rate < 75% was from 14 to 28 days with CFR1 and 7 days with CRF2. Particle size ~ 10 mm, the NPK release rate < 75% was after 56 days with CRF1 and after 14 days with CRF2. Temperature was a major influence on the NPK release rate of CRF1 and CRF2. With CRF1, on the first day, the NPK release rate at 40^{o}C was 29.4 times faster than at 20^{o}C. CRF2 was faster than CRF1 of NPK release rate.

Keywords: *Fertilizer; Slow release; Silica - Biochar; rice straw*

PS1B-3

The effect of composted and pelleted quail manure on soil nitrogen mineralization

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Abstract

In recent years, the reuse of agricultural wastes has become more popular. Among the various types of poultry manure, the reuse of quail manure has gained significant attention. Quail manure has more nitrogen (N) than chicken manure; however, there is limited available data regarding the reuse of quail manure. Therefore, the objective of this study is to investigate quail manure's influence on soil N mineralization trends by comparing quail compost and pellet fertilizer. The experiment used different types of organic fertilizers made from quail manure, namely compost (C), pure quail pellet (PQ), and quail pellets mixed with rice husk (P), in comparison with urea. Incubation experiments were conducted at 2 to 4 times the N recommended fertilization rate (180 N kg ha^{-1}). The results indicated a significantly higher available N accumulation in the incubation soils with PQ and P compared to C. This could be attributed to the higher stability of N compounds in quail manure after composting, resulting in lower N release during the incubation experiments. However, when applied at higher rates, PQ and P achieved N release levels similar to chemical fertilizers. Therefore, experimental results reveal that the application of PQ and P enhances soil N mineralization, exhibiting higher rates of available N release during the incubation experiments.

Key words: *compost; pelleting; nitrogen mineralization; quail manure*

PS1B-4

The impact of chicken manure processing fertilizers made from chicken manure bedding material with various agricultural byproducts on soil properties and growth of pak choi

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Abstract

This experiment used chicken manure processing fertilizers made by granulating a mixture of chicken manure bedding material, soybean meal, and coffee grounds or tea residues as the test material. The incubation experiment was conducted to study the release of nutrients after applying these fertilizers to the soil, and a pot experiment was carried out to investigate its impact on soil properties and the growth of pak choi. The results of the incubation experiment showed that the available phosphorus, nitrate nitrogen, and electrical conductivity of the soil increased with the increasing application of organic fertilizers. Among them, the increase in available phosphorus was most significant when using organic fertilizer made from tea residues and double the application amount as compared to chemical fertilizer treatment. In comparison to chemical fertilizer treatment, adding chicken manure processing fertilizer can improve soil aggregate stability, increase available phosphorus content, and also increase copper and zinc content. In terms of crop performance, adding chicken manure processing fertilizer containing coffee grounds and double the application amount of chicken manure processing fertilizer containing tea residues both contributed to an increase in yield of pak choi. However, electrical conductivity is the most critical soil property affecting yield, and under the treatment of double the application amount of chicken manure processing fertilizer containing coffee grounds, high electrical conductivity in the soil can inhibit the growth of pak choi.

Key words: *chicken manure processing fertilizer; coffee ground; pak choi; tea residue*

PS1B-5

Effect of applying organic fertilizer made from chicken manure on soil fertility and the growth of *Brassica chinensis* L. cv. Wrinkled leaf

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Abstract

The nitrogen of chicken manure is lost during the composting process; therefore, farmers commonly apply chicken manure directly to the soil. In Taiwan, processed chicken manure fertilizer (Item No. 5-08) once disappeared from the market due to the possibility of attracting flies and insects or causing environmental and soil pollution after use; however, it has been revitalized with specifications recently such as oven drying to control its moisture content. The application of decomposed livestock manure not only improves the soil fertility, but also provides the nutrients needed for plant growth when applying in the suitable amount and in the right way. But because heavy metals are commonly added to most livestock feeds, this indirectly leads to an increase in the levels of heavy metals in their droppings. In this study, four treatments were tested: no fertilizer (CK), granulated chicken manure processed fertilizer (G508), powdered chicken manure processed fertilizer (P508), and granulated livestock manure compost (G509). Experiment was conducted in the field trial in accordance with the recommended amount of nitrogen fertilizer of Brassica chinensis L. cv. Wrinkled leaf. The effects of various fertilizers on the growth, soil fertility and accumulation of heavy metals in the crops were evaluated. The results revealed that in terms of soil fertility, the concentrations of available phosphorus, exchangeable potassium and exchangeable calcium increased significantly compared with the CK, and the contents of copper and zinc were all within a reasonable range. The enhancing effect of different treatments on increasing the concentrations of nitrogen, phosphorus and potassium was G508 > P508 > G509. Experimental result implying that under the same amount of nitrogen applied, the G508 improved the growth of Brassica chinensis L. cv. Wrinkled leaf the most.

Key words: *chicken manure; heavy metals; organic fertilizer; soil fertility*

PS1C-1

Short-term impact of agricultural plastic mulches on soil labile carbon and available phosphorus in chilli (*Capsicum annuum*) cultivation in Sri Lanka

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Abstract

Within the agricultural sector, there has been a mounting interest in the utilization of plastic mulches to enhance the efficiency of resource utilization. However, the behaviour of plastic mulches in the soil environment and the potential for microplastic pollution has raised concerns about its long-term use from a sustainability perspective. The main objective of our study was to identify the impact of three different types of plastic mulch on the fate of soil labile carbon (C) and available phosphorus (P) in an Alfisol, commonly used for vegetable cultivation in dry zone (average rainfall <1750 mm/year), Sri Lanka. A field experiment was conducted with *Capsicum annuum* (MICH-HY1) at the Field Crop Research and Development Institute, Sri Lanka. Four treatment combinations were used for the experiment with four replicates consisting of T1-no mulch (control), T2-reflective non-biodegradable conventional LDPE plastic film mulch, T3-black non-biodegradable conventional LDPE plastic film mulch, and T4-black biodegradable PLA-PBAT based plastic film mulch. Sampling was conducted at 0, 2, 4, 6, 8 and 14 weeks after transplanting (WAP). Soil labile C and available P was analysed using standard colorimetric based procedures. The data collected was analysed using two-factor factorial design in randomized complete block design (RCBD) using Minitab v-17. Our results showed that soil labile C was not significantly different (p>0.05) under plastic mulch application in both the early stage and end of the growing season. Nevertheless, application of plastic mulches significantly altered soil available P with time. Available P significantly increased (p<0.05) at 6 and 8-WAP. Highest available P values were recorded at 8-WAP; 29.2, 39.3, 36.2 and 31.6 mg/kg in T1, T2, T3 and T4 treatments respectively. Overall, our results indicate that application of plastic mulches influences on soil available P but not soil labile C fraction in short term. Further studies are required to find out the impact of agricultural plastic mulches on the fate of soil major nutrients and soil health over multiple cropping seasons.

Keywords: *Available phosphorus; Biodegradable mulch; Labile carbon; Plastic mulch*

PS1C-2

Effect of decomposer enriched City Waste Compost application on growth and Yield of broccoli.

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Abstract

Waste is a major problem in main city of the Nepal which tends to increase with rapid urbanization, improved living standards and changing consumption patterns. Management of increasing amounts of solid waste has become a major challenge in many cities in developing countries. City compost produced at mechanical composting plants in Asian countries including Nepal are generally low in plant nutrients. Hence enrichment is necessary for improving nutrient status and quality of compost. Considering the nutritional significance, fast decomposition rate and quality of the compost the study was conducted to enrich the city waste compost with waste decomposers. The present study was undertaken to evaluate the decomposer enriched city waste compost on broccoli growth and yield.The study was done in two locations I.e. In Jitpur,Bara and in Malepatan,Pokhara. The study used a Randomized complete block design (RCBD) with eight treatments and 3 replications. Five types of decomposers namely prarambha dhulo, prarambha jhol,jeevatu, Sathi, and Sanjivani were used to decompose the city waste. The treatments were Control, NPK (Full dose of recommended fertilizer), FYM ,Compost 1 (Prarambha dhulo enriched). Compost 2 (Prarambha Jhol enriched), Compost 3 (Jeevatu enriched), Compost 4 (Sathi enriched)and Compost 5 (sanjivani enriched) .The composting time lasted for 40 days.The results showed that , not all waste decomposer enriched compost showed good results .However, most of the waste decomposer enriched compost showed higher yield and other yield attributes as compared with control and chemical fertilizers in both location.

Keywords:

PS1C-3

Effects of continuous application of rice straw and cow-dung compost on soil fertility and rice yield in paddy fields

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Abstract

For sustainable rice cultivation, it is important to know the soil fertility of each field and choose appropriate fertilizer management. Continuous application of organic matter to paddy fields improves soil fertility and rice yield. Rice straw is commonly returned to paddy fields in Japan. Our previous study clarified that the continuous application of rice straw improved paddy soil fertility as same as the application of cow-dung compost, another organic matter commonly applied. Rice straw application, however, often causes soil reduction quickly after flooding and reduces the early growth of rice. This study evaluated how the continuous application of rice straw and/or cow dung compost affects the soil fertility and rice yield of paddy fields to consider appropriate fertilizer management for rice cultivation. The experiment was conducted at the paddy fields in the Field Science Center (FSC), Faculty of Agriculture, Yamagata University, Japan. The treatments of no organic matter (CT), rice straw (RS), cow-dung compost (CP), and RS plus CP (RS+CP) applications had been continued from 2015 until 2021. Chemical fertilizer application and other cultivation practices followed the conventional manners of the FSC. Soil organic carbon and available nutrients were increased by the continuous application of organic matter. The ascending order of the increasing rate of soil organic carbon and available nitrogen were CT, RS, CP, and RS+CP. RS+CP was higher in available phosphorus and exchangeable potassium too. Rice yield was also improved by the continuous application of organic matter in most years. The ascending order of the yield was CT, RS, and CP after the third year. The yield of RS+CP varied from the lowest to the highest, and the years 2017, 2018, and 2021 showed the lowest yield among the treatments of organic matter application.

Key words: paddy *soil fertility; rice yield; continuous application of organic matter; rice straw; cow-dung compost*

PS1C-4

Assessing Land Suitability for Major Crops and Proposing to Convert Cultivation Structure On Agricultural Production Land Area of Nhu Xuan District, Thanh Hoa Province

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Abstract

The research was conducted on 15,944.36 hectares of agricultural land in Nhu Xuan district. The results of land assessment have identified 32 land units and 99 agrochemical codes on 4 types of soil belonging to 2 main soil groups: Ferralsols and Luvisols, of which the area is Ferralsols group is 98.97%. The agricultural land area with poor total nitrogen and total potassium content accounts for about 60%, poor digestible phosphorus and digestible potassium, total organic matter content (OM) and exchangeable absorption capacity (CEC) in the soil are low, pH_{KCl} in soil ranges from moderately acidic to very acidic. Proposing 6 types of crop structures suitable to the agricultural production development orientation of Nhu Xuan district. The climate in Nhu Xuan is suitable for growing 12 main crops, most land plots meet land use requirements for crops; However, the area suitable for land at level S3 (less suitable) is still large due to limited slope, acidic soil, low nutrient content in the soil, and rain-fed farming. The unsuitability level (N) of each crop type ranges from 0.22% - 2.21% of the marrow for each crop type due to the limiting factor of a slope greater than 25 degrees and located in high mountainous areas; Plants are not suitable for growing in areas with soil pH levels that are too low, or low-lying or flooded areas are also not suitable for plants that prefer shallow soil.

Keywords: *soils suitability map, agricultural land, Nhu Xuan district.*

PS1C-5

Application of Data Mining Techniques and GIS to Assess Suitable Land for Mango Cultivation in Cho Moi District, An Giang Province

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Abstract:

The objective of this study is to evaluate the feasibility of using data mining techniques through a decision tree model to assess suitable land for mango cultivation in Chợ Mới District, An Giang Province. Data mining methodology using the decision tree aims to quantify the relationship between land characteristics and crop productivity. The study has established a map of 16 land units in Chợ Mới District based on factors such as soil type, relative topography, mechanical composition, layer thickness, appearance depth of gley, and gley intensity. The decision tree regression model was implemented with the target variable being yield (tons/ha), and predictor variables including soil type, relative topography, mechanical composition, layer thickness, appearance depth of gley, and gley intensity. The research results indicate that the explanatory power of the predictor variables is 78.24%. High adaptability level (S1) covers an area of 17,518.28 hectares, accounting for 47.52%, while moderate adaptability level (S2) covers an area of 4,487.20 hectares, accounting for 12.17%. The findings provide a scientific basis for local authorities to plan mango production in a rational manner.

Keywords: *Data mining, decision tree, land suitability assessment, GIS, mango cultivation*

PS1D-1

Applying machine leaning to produce Soil Organic Carbon Stock map of Vietnam

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Abstract

Soil organic carbon (SOC) is the main key of soil health. The maintenance of soil organic carbon is critical to soil productivity. Therefore, mapping the SOC stock is necessary. Digital soil mapping approaches have been widely applied in predicting the soil property maps, including SOC. In this study, 2661 soil profiles with latitude and longitude coordinates and analyzed soil properties were collected in Vietnam from different soil-related projects carried out during 2000-2022. After quality checking and data cleaning, 2386 soil profiles were used as the observed data and harmonized to create the top soil samples (0-30 cm) for using in digital soil mapping. The Quantile Random Forest model was used to predict SOC stock from observed data and 68 environmental covariates including remote sensing, topographic and climate variables. First, the collinearity of covariates was checked to identify and retain only those relevant features that are uncorrelated and non-redundant in the prediction of SOC stock. Second, the QRF model is calibrated using only the previous selection of covariates and applying 10-fold cross-validation. The data is randomly partitioned into 10 parts, with one part used for testing and the remaining 9 parts used for training the model, and this process is repeated 10 times to enhance the robustness of parameter estimations. The uncertainty was assessed by standard metrics of error estimations including the standard deviation (SD), mean absolute error (MAE), Root Mean Squared Error (RMSE), R-Squared (R^2) for the model residuals. Result showed that the climate variables (mean annual air temperature, mean daily temperature of coldest month, minimum monthly evapotranspiration, evapotranspiration) and topographic variables (elevation, terrain wetness index) were the most important factors in predicting SOC stock. The total predicted SOC stocks of top soil in Vietnam were 16,431,522 t C, and ranged from 10.2 – 183.2 t C.ha^{-1}. The results imply that the combination of different environmental covariates such as climate and terrain data is a feasible way to predict SOC, and the QRF model has the potential in digital soil mapping in general and to predict SOC stocks in Vietnam.

Keywords: *digital soil mapping; machine leaning; organic carbon; QRF; Vietnam*

PS1D-2

Verifying the Semi-quantitative Soil Classification System of Vietnam Based on Soil Monoliths from the Vietnam Soil Museum

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Abstract

Like specimens in museums, soil monoliths in soil museums in the world are their "soul". As a new soil classification system is released, verifying its applicability to rename soils in the museums is scientific and educational, meaning it updates new advantages of soil classification science. The Vietnam's semi-quantitative soil classification system (SCS) was upgraded in 2021. It has not been verified its applicability to remain soils in soil museums in Vietnam. The study aid (1) verify the applicability of the semi-quantitative SCS of Vietnam to identify new nomenclatures of soils in the Vietnam Soil Museum; (2) suggest attention to transferring the old nomenclatures from the old SCS to the semi-quantitative SCS of Vietnam in soil museums as well as other ones in the world. Ten soil monoliths from the Vietnam Soil Museum were renamed according to the semi-quantitative SCS of Vietnam, but only five are illustrated in the study. The results indicate that two soil monoliths VN05 and VN14 do not have enough data to rename the soil group, soil type, soil subtype, and soil variety according to the new SCS. These soil monoliths VN34, VN46, and VN60 are the typical yellowish red soil variety with low base, light loam" (*Vetic Haplic Acrisols (Loamic)*), the red sandune soil variety, very firm (*Rhodic Aeolic Arenosols (Very firm)*), the gleyic soil variety with high base saturation and stagnic, heavy clay (*Stagnic Eutric Gleysols (Clayic)*), respectively. 60% of soil monoliths are renamed successfully, and their FAO-UNESCO-WRB's nomenclatures are similar to those identified before in the museum. To enhance the effects of old soil name conversion, it is necessary to effectively interpret the diagnostic horizons, properties, and materials and add data for diagnostic criteria by analyzing related criteria of soil samples.

Key words: *Soil monoliths, Museum, Verifying, Diagnostic, Vietnam.*

PS1D-3

Northeast Hilly Land Classification According to Fao-Unesco-Wrb Quantitative Method

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Abstract

Northeastern Hilly Area belongs to six provinces namely Cao Bang, Quang Ninh, Lang Son, Bac Giang, Bac Can and Thai Nguyen. It has total natural area of 1,230,175.41 hectares, of which land area is 1,138,336 hectares. Research on soil classification of Northeastern hilly area was conducted to provide basic data for rational land use planning. Study results show that: Soils of Northeastern Hilly Area are very diverse with the appearance of the diagnostic layers such as argic, ferralic, mollic and calcic, etc and gleyic properties. In which, argic layer is formed by clay leaching, what is very common in soils of the studied area. Based on the appearance of the diagnostic layers, properties and material as mentioned above, soils of Northeastern Hilly Area are classified into 9 soil groups, 22 soil units and 86 soil subunits. Acrisols are most common in the area, these cover an area of 859.074 ha, occupies 69.8% of total natural area, next is Anthrosols (7.7%), Ferralsols (5.8%), Leptosols (3.2%), Gleysols (2.7%), Luvisols (2.4%), the rest soil groups such as Phaeozems, Calcisols and Vertisols cover small areas (less than 1%).

Key words: *Northeastern Hilly Area; soil classification; soil groups*

PS1D-4

Effects of rice straw mulching on trophic structure and metabolic footprints of the nematode community belowground in an alternative upland-paddy rice system.

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Abstract

The Mekong Delta of Vietnam is facing serious problems under climate change due to drought and salinity intrusion. A feasible cropping system has been proposed to adapt to adverse conditions to optimize crop production and enhance livelihoods. Upland crops like corn (*Zea mays*), cowpea (*Vigna unguiculata*), and watermelon (*Citrullus lanatus*) have been cultivated in the dry season to replace rice crops in triple rice cultivation systems. Changes in cropping patterns may induce the possibility of changes in soil organisms like nematodes. This study aims to clarify the responses of nematode community composition to soil properties under mulching at 0, 3.5, 7.0, and 10.5 tons ha^{-1} in two paddy rice fields in Long Phu and Lieu Tu, Soc Trang province, ground without mulching or a fallow as a control treatment. A total of 31 and 33 nematode taxa were recorded at the Long Phu and Lieu Tu sites, respectively. Bacterivores was the most dominant trophic structure, followed by herbivores. Among them, *Acrobeloides, Hirschmanniella, Chronogaster, Aporcelaimellus,* and *Prismatolaimus* were the most dominant genera in Long Phu, and *Acrobeloides, Prismatolaimus, Hirschmanniella,* and *Alaimus* were predominant in the Lieu Tu site. A tendency to increase the proportion of omnivores and predators and decrease the proportion of herbivore groups was observed in mulched soils, but not significantly. General linear model analysis showed that mulching at 10.5 tons ha^{-1} increased significantly the total biomass (840-3170 µg $100g^{-1}$), composite footprints (175.2-471.8 µgC $100g^{-1}$), structure footprint (99.12-357.64 µgC $100g^{-1}$), and predator footprint (69.01-276.37 µgC $100g^{-1}$) of the nematode community compared to other treatments, reflecting soil is matured, fertile and moderate in C/N ratio. The functional guild (cp3) in soil having mulching at 7 tons ha^{-1} in Long Phu was significantly higher than that without mulching or mulching at 3.5 tons ha^{-1} in the Lieu Tu site. Our result indicates that the application of mulching at 10.5 tons ha^{-1} enhanced the structure of the soil by enhancing nematodes at higher trophic levels, indicating that management practices associated with growing upland crops and mulching affects soil properties and consequently nematode populations, thus can be proposed for agriculture sustainability.

Key words: *free-living nematodes, soil organisms, crop rotation, sustainability*

PS1D-5

Effects of cultivation activities on deep earthworm density in the citrus orchards (pomelo tree)

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Abstract

Deep-burrowing earthworms play an important role in maintaining a stable soil ecosystem. However, earthworm populations are greatly affected by farming activities: adding organic matter, soil amendments containing calcium, different weed management or applying active irrigation methods... can all affect the density of deep-burrowing earthworms. The research on "Effects of cultivation activities on deep earth worm density in the citrus orchards (pomelo tree)" was conducted over a period of 2 years: from January 2021 to December 2022 on light red yellow soil with lots of gravel. In the first year, the research team conducted a survey of the effects of some factors on the density of deep-burrowing earthworms on NPK fertilization: the type of available organic matter added to the soil, the supply of Calcium-containing soil amendments, active irrigation and non-irrigation, forms of weed management. The results showed that: Among the 08 kinds of organic matter used for the survey, the density of deep-burrowing earthworms in the formula with buffalo dung was the highest, increasing by 78.75% compared to the control formula. Among the 05 kinds of materials used to make lime and provide calcium to the soil used for the survey, applying calcined lime to the soil gave the highest density of deep-burrowing earthworms, an increase of 78.95% compared to the control formula. In the survey types of non-irrigation, micro-irrigation (drip irrigation) and sprinkler irrigation, the density of deep-burrowing earthworms was higher in irrigation treatments compared to non-irrigation (reaching density from 29 to 32 earthworms/m^2, the density of control formula was 18 earthworms/m^2. Thus, there was an increase of 61.11 - 77.77% compared to the control formula). Among the weed management methods surveyed, the formula using chemical pesticides to kill weeds or covering the soil surface with plastic reduced soil earthworm density by 36.18% and 17.47% density of deep-burrowing earthworms, respectively compared to the control formula. Cutting weeds and mulching on the surface helped increase the density of deep-burrowing earthworms by 26.84%. The experimental results of the second year showed that: Using the formula combination: NPK fertilizer according to local recommendations + 12 tons of buffalo manure/ha + 500 kg of calcined lime + drip irrigation + weed cutting and mulching on the surface helped the density of deep-burrowing earthworms reach 49 earthworms/m^2, an increase of 172.22% compared to the control only fertilizing NPK + no irrigation + leaving weeds intact. Thus, using buffalo manure to add organic matter, fertilizing with calcined lime, cutting weeds and mulching on the surface combined with economical irrigation increases the density of deep-layer earthworms in citrus orchards.

Keywords: *density of earthworms, deep-burrowing earthworms, farming activities*

PS1F-1

Spatial analysis of land quality of agricultural land use types in Bac Lieu province

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Abstract

The study aims to assess the soil quality of agricultural land use types spatially and propose spatial development orientations of agricultural land use types in Bac Lieu province. To achieve the project's objectives, the study collected data, map overlay, and descriptive statistical methods to conduct spatial soil quality analysis. After analysis, conduct field testing with 30 survey forms for each land use type. The research results assessed the current status of agricultural land use, including 5 types of land use (81,862 hectares of rice cultivation land mainly distributed in Hong Dan district, 116,813 hectares of aquaculture land distributed broadly in Dong Hai district, 116,813 hectares of aquaculture land distributed broadly in Dong Hai district, 1,537 hectares of salt making land are only distributed in Dong Hai and Hoa Binh districts, 126 hectares of special-use forest land is only distributed in Bac Lieu city and Hoa Binh district; 3,665 hectares of protective forest land is distributed mainly in Hoa Binh and Hoa Binh districts. Dong Hai) and the current land quality situation in 2019 of Bac Lieu province are divided into 02 types: high land quality and medium land quality (according to purpose of use and administrative unit). In addition, the results also evaluate the change in soil quality from 2004 to 2019 for each type of soil through each soil characteristic. At the same time, the development orientation of the above land use types in space has been proposed based on the assessment results.

Keywords: *Spatial analysis, land use type, agricultural land, soil quality*

PS1F-2

Spectroscopy and potential for soil study in the Mekong Delta, Viet Nam

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Abstract

Research aimed at evaluating the development, current application status, solutions, and development orientation of spectroscopy technology in soil research in the Mekong Delta, Vietnam. By synthesizing the relevant secondary data to assess the current status and potential of soil spectroscopy and the proposed solutions and orientations in the region, The results show that the application of spectroscopy technology has contributed to promoting soil research with advantages such as no need to prepare through many steps, no use of chemicals to analyze samples, and no risks to the health of animals. People are also improved, have high flexibility, save a lot of costs, and have a shorter time to return soil sample analysis results. There are still limitations that need to be overcome, such as no fixed data on the accuracy of measurements, updated data from many spectral libraries around the world, and current handheld meters that cannot measure these layers more deeply in the soil. To evaluate and further develop robust and reliable prediction models for soil parameters on a wide scale across diverse soil settings, researchers must collaborate and share spectral information. Spectrum technology development and application is still widespread in the Mekong Delta region.

Keywords*: Mekong Delta, Soil Spectroscopy, Pedology.*

PS1F-3

Use of RothC model to predict the spatial and temporal changes in soil organic carbon sequestration potential in central Taiwan

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Abstract

Farmland plays a crucial role in soil organic carbon sequestration (SOC) wherein the accumulation of soil organic carbon (SOC) can be increased through agricultural management. However, the extent, rate, and controlling factors of SOC sequestration potential under different climates and management methods in a region or country are highly important for policymakers and land managers. Limited information on the future dynamics and spatial distribution of SOC over the coming decades. The objective of this study is to quantify the SOC sequestration potential under both business-as-usual (BAU) and sustainable soil management (SSM) practices during the climate change scenarios from 2021 to 2040. The study focuses on the Zhuoshui River Basin with a resolution of 100 meters, aiming to simultaneously examine the temporal and spatial aspects of SOC sequestration potential in the future. The RothC model is employed in this research to calculate SOC stocks and annual organic carbon input, which is then applied to assess the SOC sequestration potential under climate change scenarios and different SSM methods from 2021 to 2040. Under the influence of climate change and soil management, the average SOC sequestration potential from 2021 to 2040 relative to 2020 ranges from 0.30 to 0.41 t C ha^{-1} yr^{-1}. This study also provides spatial distribution information of SOC sequestration potential, serving as a reference for soil carbon sequestration planning.

Key words: *RothC model; Soil organic; Carbon sequestration potential; Spatial and temporal changes; Sustainable soil management*

PS1F-4

Effect of Rice Straw Compost Treatment Levels on Soil Organic Matter Content and Rice Yield in Long-Term Experiment Paddy Soil

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Abstract

Proper soil management is necessary to produce crops, and long-term repeated experiments are required to determine the effects of nutrients and soil on crop productivity. Therefore, in order to identify changes in the soil environment due to long-term agricultural inputs and to prepare future countermeasures, this study examined changes in organic matter content and rice yield characteristics of paddy soil after long-term application of the same fertilizer. The test plots were paddy plots operated since 1954, and the treatments were no fertilizer, NPK, NPK+compost 7.5 ton ha-1 (NPKC7.5), NPK+compost 15 ton ha-1 (NPKC15), NPK+compost 22.5 ton ha-1 (NPKC22.5), and NPK+compost 30 ton ha-1 (NPKC30). The three-element fertilization rate was 7.5-7.5-7.5 (N-P2O5-K2O) kg 10a-1 from 1954 to 1970, 10.0-7.5-7.5 kg 10a-1 from 1971 to 1978, 15.0-8.6-8.6 kg 10a-1 from 1979 to 1985, and 11.0-7.0-8.0 kg 10a-1 from 1986. The results showed that in the recent 22 years (2002-2023), regardless of rice straw compost input, soil organic matter decreased from 2002 to 2010, but then tended to increase. In addition, soil organic matter increased with increasing rice straw compost input, and the soil organic matter content in 2023 was NPKC30 (48 g kg-1) > NPKC22.5 (44 g kg-1) > NPKC15 (36 g kg-1) > NPKC7.5 (29 g kg-1). We also analyzed the correlation between soil organic matter content and rice yield. The results showed a positive correlation. Rice yield tended to increase with higher rice straw compost inputs and was highest at 7.7 ton ha-1 in the 3-element + 30 ton/ha compost treatment, which had the highest input. In all compost treatments, rice yields were higher than uncomposted (2.7 tons) and NPK (6.2 tons). Compost has been reported to increase yields with long-term application regardless of soil characteristics, timing, and location. However, long-term use of organic matter sources can accelerate salt accumulation in the soil, causing soil properties to deteriorate and negatively affecting water systems, so it is necessary to find the optimal level of soil organic matter input through continuous long-term application experiments and monitoring.

***Key words**: Long-term Experiment; Organic Matter; Rice Straw Compost*

PS1F-5

Greenhouse gas emission from rice cultivation in different soil and ecological conditions in Vietnam

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Abstract

This study was carried out on 3 regions of Red River Delta, Central Coast and Mekong River Delta and 3 dominated soil types of alluvial soils, acid sulphat soil, and saline soil, with the objectives of: Assessing the evolution of greenhouse gas emissions from rice cultivation on different soil and ecological conditions in Vietnam; and Determining the variability of GHG emissions on rice-growing land in ecological regions. Gas sampling taken at 11 points and rice is cultivated by traditional farming methods. The concentration of CH_4 and N_2O was analysed by gas chromatography (Shimadzu GC-2014) equipped with a separate electron capture detector (ECD) and flame ionisation detector (FID). The gas fluxes were calculated using the Smith and Conen (2004) equation. Global warming potential (GWP) over a one-hundred-year period was estimated by multiplying the emissions factor of 25 for CH_4 and 310 for N_2O to convert them into CO_2 equivalents (IPCC, 2013). Yields scaled GWP (kg CO_2-equivalents/ kg of rice grain) was calculated by dividing CO_2-equivalents by paddy grain produced. The results showed that dynamic of methane emissions in the spring/winter-spring season in the three ecological regions increased continuously since the period of rice root development and reached peak emission during the tillering or node elongation period. Then, emissions change depending on the water regime in the field. During the summer/autumn crop, measuring points in the Red River Delta, Mekong Delta, and Central Coast all have a common trend of increasing emissions immediately after transplanting and reaching the peak of 20.36 mg CH_4/m^2/hour during the tillering stage, then emissions gradually decrease until harvest. Particularly for the North Central region, emissions are slightly different as the maximum emission rate is reached later in the flowering stage. Methane emissions dynamic in the spring season in all soil types increased continuously from the time the rice developing new root and reached the peak during the tillering period. Emissions then change depending on the water regime in the field. During the growing season, all measurement points on all soil types have a common trend of increasing emissions immediately after transplanting and reaching peaks of 28 mg CH_4/m^2/hour during the period from tillering to panicle initiation and then emissions gradually decrease until harvest. The dynamics of N_2O emissions in the spring season on different soil types are very different according to growth stages and nitrogen fertilization regimes and emissions reach their peaks during the flowering period with a rate of up to 0.4mgN_2O/m^2/hour. Then emissions gradually decrease until harvest. Total greenhouse gas emissions ranked in ascending order of alluvial soil (13.38 tons CO_2e /ha/year) < saline soil (15.1 tons CO_2e/ha/year) < grey soil (18.71 tons CO_2e /ha/year). The emission intensity increased from saline soil (0.722 kgCO2e/kg rice) < alluvial soil 2 rice (0.823) < gray soil (1.252) for spring rice and from alluvial soil (1,484) < saline soil (1,577) < gray soil (1,789) for summer rice. Total methane emissions in season range from 75 to 360 kg CH_4/ha/season.

Key words: *climate change, mitigation, emission, agro-ecologica region*

PS1G-1

Impact of rice straw Incorporation and Indigenous Microorganisms (IMO) on soil carbohydrate and nitrogen mineralization in a long-term paddy soil

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Abstract

The study assessed the impacts of rice straw, Indigenous Microorganisms (IMO) on the mineralization of carbohydrates and nitrogen in long-term paddy soil in Central Vietnam. Anaerobic incubation was conducted as follows: 30g of soil (Control); Control + 0.6 g rice straw (RS), Control + 50 ml IMO (IMO), Control + rice straw + IMO (Combine) for measurement of carbon and nitrogen dynamics. The results showed that the amount of carbohydrates produced after 4 weeks of anaerobic incubation (145 mg kg^{-1} to 167 mg kg^{-1}) was not significantly different among all treatments. However, carbohydrate-based loss in the RS and IMO treatments increased by 2.5 to 5.3 times compared to the Control treatment. Meanwhile, NO3- and NH4+ amounts ranged from 0.8 mg kg^{-1} to 1.6 mg kg^{-1} soil from 24.7 mg kg^{-1} to 24.5 mg kg^{-1} soil), respectively. Interestingly, rice straw addition treatments tended to decrease both amounts of NO_3^- and NH_4^+ compared to Control and IMO treatments. This led to similar levels of mineralized nitrogen in the Control and IMO (10.0 mg kg^{-1} and 10.4 mg kg^{-1}), significantly higher than those in RS and Combine treatments (min-N $\leq$ 2.1 mg kg^{-1}). The results indicate that IMO supplementation accelerates carbon emission, while straw supplementation promotes denitrification.

Key words: *Carbohydrate; Denitrification; Indigenous Microorganisms (IMO); Nitrogen minveralization; Rice straw*

PS1G-2

Development of calibration curves of SOC stocks for different cropland types with BD expressed in a function of OC

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Abstract

It is essential to delineate the variation in soil carbon stocks under planting different crops for evaluation of carbon sequestering by cropland soils. Calculation of soil organic carbon (SOC) stock is usually based on accompanied measurements of organic carbon (OC) and bulk density (BD). However, soil sampling in field to determine BD includes unexpected errors and variation. By contrast, the variation of OC measurement is less than that of BD measurement. In order to evaluate potentials of soil carbon sequestration under different cropland types, in the study we tried to characterize the relationships between OC and BD to develop the site-specific calibration curves of SOC stock for different cropland types. The relationships between BD and OC for the croplands under planting the lettuce, lisianthus, multigrain, pineapple, tea, and coffee were investigated. And the minimum detectable differences (MDDs) for assessing increases of soil carbon storage in different cropland types also were conducted. The results showed that the relationship between the values of OC and BD was in negative correlation. A continuingly decreasing function of OC could be well fitted to the observations of BD in the croplands' soil. According to the BD was expressed in the OC function, the site-specific calibration curve of SOC stock for each cropland type was developed for assessing increases of soil carbon storage. We found that further OC sequestration to increase stock by 0.4% in a 30-cm depth of soil would more efficiently occur in deeper soil than in upper soil. Current practices for planting lisianthus, tea, and coffee, increasing OC would be more conservational and result in a significantly decreasing BD trend. In contrast, croplands for the cultivation of lettuce, multigrain, and pineapple, which have much less OC saturation, could efficiently increase OCS by 0.4% in a 30-cm soil depth for further OC sequestration. In addition, the lower MDD for the croplands under planting lettuce, lisianthus, multigrain, pineapple suggested more certainly a deviation of SOC stock. However, for planting tea and coffee, the MDD values were relatively high to indicate more uncertainty in finding changes in SOC stock.

Key words: *Pedotransfer function; Soil carbon sequestration; Land use; Crop production; Site-specific management*

PS1G-3

Paddy field irrigation for soil total organic carbon and nitrogen form analysis

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Abstract

Carbon and nitrogen is the essential element for soil, it can provide the necessary nutrient when the plant is growing, the nitrogen mainly comes from the fertilizers in growing, also the nitrogen performs nitrification and de-nitrification in the soil, generally form ammonium, nitrate and nitrite (NH_4^+-N, NO_3^--N, NO_2^--N and hydrolyzable). By measuring the different form of nitrogen, we can understand the current conducting reaction in soil. Recently, the AWD (Alternating wetting and drying) irrigation is widely advocated, because it can decrease the time soil in drowning, mitigating the CH_4 emission, but it can cause N_2O emission. Furthermore, with rice straw return, reduce the chemical fertilizers adding. In order to understand the mechanism in paddy field, collecting topsoil on different growing stage of rice, measuring total organic carbon (TOC), total nitrogen (TN) and different form of nitrogen. Result show that compare with AWD, flooding has more TOC and TN content. In the future, hoping have more detail in carbon and nitrogen mechanism in paddy soil.

Key words: *Paddy soil, Rice AWD, Nitrogen, Carbon*

PS1G-4

Effects of flooding on land resources in coastal areas of Quang Ninh province under climate change conditions and proposed solutions for sustainable land use.

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Abstract

Results of flood assessment on land resources in the coastal area of Quang Ninh province show that statistical data on sea level trends in the coastal area of Quang Ninh province increased at an increase rate of about 2.53 mm/year during the period from 1960 to 2018. Forecasts according to the Climate Change scenario, by the end of the century, sea level will rise about 53 cm with a confidence level of about 32 ÷ 75 cm according to the RCP4.5 scenario and increase to 72 cm with a confidence level ranging from 49 ÷ 101 cm (corresponding to the 5 ÷ 95% percentile) according to the RCP8.5 scenario. Climate change has exposed the risk of flooding due to sea level rise for the province's coastal land resources. According to the RCP 4.5 scenario, by 2030 and 2050, 1.51% and 1.64% of the coastal land area will be flooded, respectively, according to RCP 8.5 scenarios by 2030 and 2050 have 1.52% and 1.67% of coastal land flooded, respectively. Most of the flooding is concentrated in Ha Long City (more than 3.3 thousand hectares), Dam Ha (nearly 1.5 thousand hectares), Van Don (more than 1.4 thousand hectares), Quang Yen Town (more than 1.1 thousand hectares). ha), City. Mong Cai (more than 1.0 thousand hectares); Hai Ha (nearly 0.5 thousand hectares) and districts of Tien Yen, Co To, Cam Pha City was flooded in a small area.

Key words: *land resources, Coastal areas, Climate change, Quang Ninh.*

PS1G-5

Effect of Complex Soil amendment on winter wheat (*Triticum aestivum* L. cv. "Baekkang") Growth In Reclaimed Tidal Land

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Abstract

Saemangeum reclaimed tidal land (RTL) is the largest RTL in Korea with an area of 29,100 ha, out of which 10,360 ha is designated as the agricultural area.Existing RTL is mainly cultivated for rice. However, due to the recent food insecurity and decrease in rice consumption, a plan was established to cultivate only field crops in the Saemangeum RTL. According to a previous study on Saemangeum's agricultural area, EC and Exchangeable Na are low, therefore, salt damage is expected to be small. In addition, fertility such as organic matter, exchangeable cation, and available P2O5 is very low, and biological properties are also very low, so soil amendment is essential to improve its fertility and biological properties. In this study, Pot test was conducted by cultivating winter wheat (*Triticum aestivum* L. cv. "Baekkang") to screen complex soil amendment. The amendment contained compost and phospho-gypsum(PG), biochar, coco peat(CO), black peat(BK), soft rice husk(SRH), brewer's spent grain + rice husk(BRH) furthermore, for physical improvement, zeolite, and hydrogel were used. The pot configuration is control (CON), conventional fertilization(CV), biochar(BC), organic matter(OM), and organic + physical amendment(PS), as shown Table 1. The BC was treated with 100, 200, and 300% (BC 100, 200, and 300) compared to the standard amount of fertilizer in Korea. All pots were treated with N, P, and K(4.48, 12.38, 0.48 g), and all pots except the control group that was treated with biochar and phospho-gypsum. (4, 8 g) Table 1 shows the port configuration using this improver. This study measured dry weight of shoot, root, shoot length, and the weight of an average grain of ear. Compared to control, the dry weight of shoot, CV showed a lower value of -20%, and in BC, BC 100 showed the highest value at 23%. In OM, BRH showed the highest value at 23%, however, in SRH, it showed a low value at -72%. In PS, CO was the highest at 42%. The dry weight of root part, shoot length, and the weight of the ear also showed a similar tendency. To sum up, Putting all the results together, CV showed a value of -28% compared to control, and PS-CO pot showed the highest value at 31%. OM - BRH pots followed with 17%. In BC, the BC 100 that met the standard non-prescription standard was the highest at 12%. Therefore, it was found that the administration of complex improvement agents mixed with CO, BC, PG, and physical amendment was the most effective for crop growth. It is necessary to identify the cause through future soil analysis accurately. Since it is a short-term result, analyzing the improvement effect through fertilization is also necessary.

Key words: *'Saemangeum', 'Soil Physicochemical and Biological Properties', 'Reclaimed Tidal Land', 'Wheat'*

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PS2A-1

Developing land fund for urbanization in the context of climate change in Ho Chi Minh City

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Abstract

Urbanization is an inevitable trend in economic - social - cultural - spatial - environmental transformation associated with scientific and technical progress. Urbanization could promote the division of labor, sustainable socio-economic development, and improving people's quality of life. One of the basic premises for promoting the urbanization process is to improve the efficiency of land fund development. The study aims to summarize the scientific and practical basis for land fund development and propose solutions to develop land funds to serve urbanization in the context of climate change in Ho Chi Minh City. The methods used: collecting secondary documents and data; systematic review; statistical; comparison; analysis and synthesis; expert interview; etc. The results show that the land fund development in Ho Chi Minh City has contributed a lot to its socio-economic development. However, because Ho Chi Minh City is the largest and a urban area in Vietnam, with a very high population density (4,292 people/km2) and complex development characteristics..., the process of developing urban land funds in this city has many problems such as not regularly updating the cadastral database; lack of synchronization between land use planning, urban planning, and construction planning; slow in planning approval; slow in carrying out site clearance; ect. They have limited land fund development and the abilities to exploit "clean land sources" to create development capital. In addition, as one of the top ten cities in the world that could be most seriously affected by climate change, the urbanization process in Ho Chi Minh City faces many difficulties such as increasing mechanical population rappidly, flooding, environmental pollution, traffic jams, complex land fluctuations, lack of land fund to serve the functions of residential and infrastructure development, ect. According to the scenario of climate change and sea level rise, by 2099, the average annual temperature of Ho Chi Minh City will increase by about 1.55oC (RCP 4.5) and 2.65oC (RCP 8.5), the average annual rainfall increased by 15.4% (RCP 4.5) and 21.3% (RCP 8.5); sea level rise due to storms in the coastal area from Ho Chi Minh City to Ca Mau will be more severe (with a possible level of 270 cm). The area risk of flooding due to sea level rise is 209,962 hectares, with a flooding rate of about 9.36-17.15% of the area when the sea level rises 30-100cm, the highest is in Binh Tan (80.35%) and Thu Duc (64.47%). In addition, there is also a quite serious land subsidence with subsidence funnels at a rate greater than 10cm/10 years. Those are the biggest obstacles to developing land funds for urbanization in Ho Chi Minh City. To develop land fund for sustainable urbanization in the context of climate change in Ho Chi Minh City, it is necessary to synchronously implement the following solutions: policy mechanisms, land fiscal, land management, increasing community participation, risk management, and technology solution.

Keywords: *Climate change, Developing Land Fund, Ho Chi Minh City, Urbanization*

PS2A-2

No-tillage paddy rice can significantly reduce fuel consumption and working time but cause a decrease in rice yield.

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Abstract

Greenhouse gases (GHG) emitted from paddy fields and agricultural machines significantly contribute to global GHG emissions. No-tillage (NT) paddy rice offers a solution to this problem because it has been reported to significantly reduce GHG emissions compared to conventional tillage (CT). NT can also reduce fuel consumption and working time, as plowing and puddling processes are eliminated. This is important not only for economic reasons but also for the potential environmental benefits associated with decreased fuel usage. The present study was conducted to investigate on how much NT can reduce fuel and working time compared to CT in paddy rice, as well as to examine the effects of NT on rice growth, yield, and soil fertility. The experiment was conducted in three continuous paddy fields at the Field Science Center, Yamagata University, Japan, during the 2021 and 2022 growing seasons. Both NT and CT were implemented in half of each field. In NT treatment, rice seedlings were transplanted directly into the field without prior soil preparation. In CT treatment, the soil was plowed and puddled two times before transplanting. Fuel consumption and working time were recorded for plowing, puddling, transplanting, and harvesting processes. Growth data, including tiller number, plant height, and SPAD, was recorded every ten days. Rice yield and its components were examined. Soil samples were collected before starting experiments and after harvesting. Fertilizer was applied at the same rate in two treatments. Herbicide was applied at the same rate in two treatments in the first year but higher rate in NT treatment in the second year. The results showed that the NT treatment reduced fuel consumption by 66.7 % (equivalent to 2116 MJ ha^{-1}) and saved 49.1 % of working time (equivalent to 10.6 hours ha^{-1}) compared to the CT treatment. Tiller numbers were lower in the NT treatment in the first year but nearly equal to those in the CT treatment in the second year. Plant height showed no difference between treatments in both years. SPAD values were almost the same between treatments in the early growth stage and slightly higher in the NT treatment at the last stage in both seasons. Grain yield in the NT treatment was significantly lower than in the CT treatment, attributed to weed presence in the first year and the occurrence of weedy rice in the second year. Soil physical properties (soil hardness and bulk density) and chemical properties (total C and N) did not differ between treatments. Further research is needed to examine suitable fertilizer and weed management for NT to improve the grain yield. It is recommended to apply NT in forage rice production, where all straw is removed from the field, enhancing transplanting performance, and weedy rice can be used as feed.

Keywords: *Fuel consumption; no-tillage; paddy rice; working time; yield.*

PS2A-3

Assessment the difference in heavy metal contamination between Geoaccumulation Index and Contamination Index

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Abstract

Heavy metals emitted from industrial complexes can contaminate the soil of nearby agricultural areas, and heavy metals accumulate in the bodies of crops grown in these areas. If ingested by humans, they can adversely affect health and cause various diseases, and it is important to investigate the content of heavy metals in agricultural soils near industrial complexes to prevent them in advance. Therefore, in this study, topsoil (0 - 15 cm) was collected from agricultural fields located within 1 km of industrial complexes in Kangwon and Gyeonggi (300 points in total) to investigate the content of heavy metals. The collected soil was analyzed for As, Cd, Cu, Ni, Pb, and Zn by ICP-OES after decomposition with royal water according to the soil pollution process test method. The results of the soil heavy metal content analysis showed that all analyzed items did not exceed the soil pollution concern standard. After calculating the Geoaccumulation index (I_{geo}) and Contamination index (C_f) using the concentration values of heavy metals at each point and the natural background concentration, I_{geo} was classified into seven grades (0 to 6) and C_f into four grades (1 to 4), and the three grades of I_{geo} corresponding to moderate contamination and the two grades of C_f were compared. In I_{geo}, the heavy metals that exceeded moderate contamination were more than 20% for Cd less than 1% for other heavy metals (Table. 1.). On the other hand, C_f had more heavy metals exceeding moderate contamination than I_{geo}, about 90% for Cd and 5.7 to 11.3% for other heavy metals (Table. 2.). The reason for the different results of I_{geo} and C_f is the difference in the formula for obtaining factor values and the classification criteria, and it is judged that adjustments to the calculation formula are necessary for accurate prevention of damage caused by heavy metals. In addition, intensive monitoring of Cd, which was found to be at a high level compared to other heavy metals, is necessary.

Keywords: *Industrial park; Heavy metal; Geoaccumulation index; Contamination index; Natural background concentration*

PS2A-4

Effects of raw gypsum and its combination with other amendments on the immobilization of As, Cd, and Pb in soil

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Abstract

Remediation of heavy metal(loid)-contaminated soil through metal-immobilizing agents is well-recognized. This study investigates the immobilization of contaminated soil using various amendments, including raw gypsum (RG) and its combinations with rice-husk biochar (RG+B), bone meal (RG+BM), red mud (RG+RM), and steel slag (RG+SS) at a 1% application rate. The experimentation explores the effects on soil pH, dissolved organic carbon (DOC), water soluble-metals, metal uptakes by lettuce, and alleviation of plant stress. Except for RG+RM, all treatments decreased soil pH (by <0.9 pH units). DOC also decreased by 8–13 mg kg^{-1} in every treatment, indicating DOC coagulation by amendments. Raw gypsum and its combinations slightly decreased water-soluble As, Cd, and Pb compared to the control. Meanwhile, all treatments reduced concentration of plant-available As in lettuce compared to the control, with RG+SS being the most effective with 66% reduction, followed by 65% in (RG+BM), 64% in (RG+RM), 49% in (RG), and 46% in (RG+B). For plant-available Cd and Pb, only RG+RM showed reductions of 21% and 85%, respectively. Heavy metal mobility in soil solution is pH-dependent, and lowering soil pH through treatments (except RG+RM) resulted in an increase in the mobility of Cd and Pb at the soil-root interface. As RG+RM reduced plant uptake of every analyzed element in lettuce, it exhibited the lowest malondialdehyde (MDA) concentration compared to those of other treatments and the control (which showed the highest MDA), reflecting decreased phytotoxicity of lettuce. The study suggests that RG+RM is the most effective for the simultaneous remediation of As, Cd, and Pb in contaminated soil.

Keywords: *heavy metal(loid)s, immobilization, raw gypsum, soil amendments*

PS2A-5

Evaluation of Heavy Metal Stabilization in Contaminated Soil by Combined Application of Compost and Phosphogypsum

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Abstract

Compost (COM) can be used as an immobilizing agent in soils contaminated by heavy metals. However, COM increases soil dissolved organic carbon (DOC), which could reduce the immobilizing effects. Phosphogypsum (PG) serves as a DOC coagulator, so combining COM and PG may enhance heavy metal stabilization. This study aims to compare the heavy metal uptake of plants in contaminated soils treated with COM and PG alone or in combination. Heavy metal contaminated soil was mixed with 1% COM, 1% PG, and a combination of 1% COM + 1% PG (COM+PG). Neutralized PG was used in this study (pH 7.85). After two weeks of incubation, lettuce was cultivated for four weeks. After harvest, soil pH, DOC, and plant As, Cd, Pb, and Zn concentrations were analyzed. While COM increased soil pH and DOC compared to the control, PG and COM+PG showed lower soil pH and DOC than the control. The concentrations of As in lettuce were COM (5%↑) > Control > PG (9%↓) > COM+PG (11%↓), in accordance with the result of soil pH and DOC. In addition, Pb concentrations in lettuce were Control > PG (6%↓) > COM (22%↓) > COM+PG (43%↓), indicating that COM+PG exhibited the highest reduction in the Pb uptake. However, Cd and Zn of COM+PG lettuce were slightly higher than those of the control, although they were still lower than those of COM and PG. In conclusion, the combined use of COM and PG can immobilize As and Pb more effectively than the single use of PG and COM. The reduction of plant-available Cd and Zn was marginal, so future studies on Cd and Zn would be needed.

Key words: *Compost; Combined application; Heavy metal stabilization; Immobilizing agent; Phosphogypsum*

PS2B-1

Molybdenum speciation in paddy soils and its uptake and accumulation by rice plants

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Abstract

Elevated levels of Mo have been detected in soils and groundwater near industrial parks in Taiwan, indicating potential discharges from these industrial facilities into the environment. This study investigates the uptake and accumulation of Mo by rice (*Oryza sativa* L.) grown in three soils with varying pH and soil texture. The availability of Mo in these soils is correlated with its predominant chemical species, as determined using X-ray absorption spectroscopy. The investigation delves into dynamic rhizosphere processes, encompassing continuous dissolution/desorption and reprecipitation/re-adsorption reactions. Notably, the higher amorphous Fe oxides content in acidic soils leads to a higher proportion of molybdate sorbed on Fe oxides within the soils and the Fe plaque on rice roots. The results suggest that Mo associated with soil Fe phases, particularly in submerged conditions, could serve as a source of Mo for rice plants. The translocation factors of Mo indicate that soil Mo exhibits a high availability for uptake by rice roots and a pronounced tendency for Mo to be translocated from the roots to the aerial parts of rice plants. Due to the high translocation rates of Mo to the grains, the consumption of rice grains harvested from Mo-contaminated soils poses relatively higher health risks. These findings underline the importance of understanding the complex processes that govern Mo availability to rice plants in paddy soils and underscore the significance of thorough risk assessment for food safety and environmental management.

Key words: *Paddy soil; Molybdenum availability; X-ray absorption spectroscopy; Rhizosphere*

PS2B-2

Effect of combined treatment of red mud and gypsum for metal(loid)s immobilization in acidic and alkaline soils

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Abstract

Red mud (RM) has received attention as a metal-immobilizing agent by absorbing and precipitating heavy metals. However, RM is highly alkaline and increases soil dissolved organic carbon (DOC), which is unfavorable to absorbing anionic metals (such as As) and decreases the effect of immobilization. Meanwhile, raw gypsum (G) decreases soil pH and DOC, so the combined use of RM and G would improve the immobilizing effect. The immobilizing effects could be different by the phyco-chemical characteristics of soils. Therefore, this study examines the combined RM and G effect on heavy metal(loid) immobilization in acidic and alkaline soils. A total of 45 soils contaminated by heavy metal(loid)s were collected from different places (21 acidic and 24 alkaline soils). Each soil was divided into 'untreated' and 'RM+G treated' groups in 5 L pots. After a month of incubation, rice was planted for five months, and harvested. Soil pH, DOC, and rice heavy metal(loid) levels of both groups were analyzed. The soil pH of each soil in RM+G groups was lower than or equal to those of the untreated groups except 3 acidic and 2 alkaline soils. The high alkalinity of RM did not influence soil pH due to the effect of G. In addition, the RM+C treatment decreased soil DOC of most soils except 3 alkaline soils. The heavy metal concentrations of rice were compared with the Korean threshold of rice (As 0.5, Cd 0.2, and Pb 0.2 mg kg^{-1}). In the acidic soils, while the rice exceeding the Korean threshold were 6 for As and 2 for Cd in the untreated groups, those in the RM+C treated groups were 1 for As and 3 for Cd. This result indicates that the RM+C treatment effectively reduced the plant-available As. However, the result in the alkaline soils were different. While the untreated groups showed 13 (As) and 4 (Cd) rice exceeding the Korean threshold, 18 (As), 5 (Cd), and 1 (Pb) rice exceeded the threshold in the RM+C treated groups. Therefore, the combined treatment of RM and G would be effectively used for As-contaminated acidic soils.

Keywords: *Gypsum; Heavy metal contaminated soil; Plant-available heavy metals; Red mud*

PS2B-3

Effects of CO_2 and temperature on the release of arsenic from high arsenic biochar

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Abstract

Rice straw derived biochar has been recently used as a soil additive to improve soil quality and rice yield. However, it may contain arsenic (As) and the biochar-associated As (bAs) can be recycled into soil. To date, little is known about the extent and cycling rate of bAs in the real condition of paddy soil, particularly under the context of climate change (with parallel increases in temperature and CO_2 emission). In this study, we conducted incubation experiments to elucidate the synergistic effects of CO_2 and temperature on the release of bAs. The temperature of the incubation experiments was installed at either 20 or 50°C while CO_2 concentration was kept at 0.04 and 15%. Tomographic analyse revealed the biochar as a composite structure which was built up from black organic matter in the association with silica; and the destruction of this composite structure govern the release of bAs. Temperature was found to stimulate the dissolution/destruction of silica inside biochar, thereby intensifying release of bAs. At elevated CO_2 concentration, the dissolution/destruction of silica inside biochar was prohibited; however, no clear effect of CO_2 on bAs can be warranted. We concluded that application of As-tainted biochar under elevated temperature may lead to large evacuation of As from biochar into soil, and this can generally accelerate As cycle in paddy regions.

Keywords: *arsenic, biochar, rice straw, temperature, CO_2*

PS2B-4

Soil degradation status on different land use types in Can Tho province, Viet Nam

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Abstract

The study aims to assess land types and the current land use status in the Can Tho province and assess changes in soil characteristics of different types of soil degradation for land use types in the study area. The study has collected secondary data on the current land use situation, soil types, and soil characteristics of soil degradation in the study area. It is a premise to evaluate changes in soil properties for different land use types. It uses synthetic data processing, mapping, evaluation, and analysis methods. From there, the results in the study area have 13 main soil types: Sp_2, Sj_1p, Sj_2, Sj_2p, Sv, Pb, Pfb, Pf, Pgb, Pg, Pvb, Pv, Nt. In which the soil type occupying the most extensive area is alluvial soil with a red-yellow layer (Pf) of 47,479 ha, distributed the most in Co Do district (18,264 ha) and the lowest in Thot Not (344 ha). In the area, agricultural soils are concentrated with the largest area of 114,621 hectares, including the following types of land use: Wetland rice-specialized land accounting for 78.25% of agricultural production soil; Annual upland cropland accounts for 1.25%; soils for perennial crops accounted for 20.4 9%; soils for aquaculture accounts for 2.14%. From there, the average index of soil characteristics and the variation of 12 types of characteristics were determined based on each district, land use status, and land type. Through the change in soil properties according to the types of degradation, assess the degree of soil degradation in Can Tho province, which has no degradation by administrative unit and land use type.

Keywords: *Land use; soil degradation; soil type.*

PS2B-5

Application of biochar derived from different agricultural waste to improve soil quality in Thai Nguyen

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Abstract

Soil degradation is a trouble that endangers sustainable development in Vietnam. Biochar is a solid, stable, carbon-rich, and highly aromatic material prepared using different agricultural waste with a rich pore structure, high specific surface area, and high capacity for holding water and nutrients. However, the use of biochar as a soil amendment is limited in Thai Nguyen. This study collected three typical agricultural waste feedstock acacia wood, rice husks, and sawdust, to prepare biochar at 450 °C via a one-step pyrolysis method. The synthesized biochar samples were characterized using scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), and Brunauer-Emmett-Teller method (SBET). After checking the biochar's properties, soil improvement experiments were conducted under different biochar application rates. The prepared biochar was alkaline and contained abundant oxygen-containing functional groups (such as -COOH, -OH,..) and some nutrients. The results showed that biochar application had a significant promoting effect on soil quality, mainly through providing rich nutrient sources (including C, N, P, K, and Ca), increasing the soil cation exchange capacity (CEC), humidity, and therefore the nutrient effectiveness, and enhancing the ability of soil to retain nutrients. This study provides a feasible soil quality improvement plan by using biochar soured from different feedstocks.

Keywords: *Biochar; Pyrolysis; Agricultural Waste; Soil Quality; Nutrients*

PS2C-1

Environmental quality of rice growing land in Bac Ninh province (Vietnam): Current status and some solutions for reasonable use and protection

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Abstract

Land is a special means of production for agricultural production, especially the crop industry. The quantity and quality of soil will greatly affect crop productivity and quality. Bac Ninh is a province with the smallest area in the Red River Delta but is a province with a high population density, ranking third only after Hanoi and Hai Phong. Therefore, the issue of using and protecting agricultural land resources, especially rice land, is extremely important for ensuring food security, food safety and people's health. In recent years, due to the strong impact of vibrant economic activities in this province, the environmental quality of agricultural land in general and rice land in particular has been showing signs of deterioration decline, even in some places rice land shows signs of slight pollution. Faced with that unfavorable situation, analyzing and evaluating the environmental quality of rice growing land in Bac Ninh province, finding the basic causes of deterioration in quality and environmental pollution of rice growing land in the province, therefrom propose some solutions to properly use and protect this type of land is an urgent issue, because it will be a scientific basis for relevant management levels and branches of Bac Ninh province to consider planning production sectors, especially agricultural production, and implementing strategies for rational use of resources and environmental protection in the province.

Keywords: *Rice land; environmental quality; Bac Ninh province; Current Status; solution*

PS2C-2

Evaluation of heavy metals (As, Cd, Cu, Pb, Zn) accumulation in native plants growing on contaminated Thai Nguyen sites, Vietnam

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Abstract

This study evaluated the accumulation of heavy metals HMs (As, Cd, Cu, Pb and Zn) in native plants and factors impact them in contaminated mining sites in Vietnam, specifically three mining sites in Thai Nguyen province, including: Ha Thuong lead-zinc mine (HT), Trai Cau Iron mine (TC), and Hich Village Lead-zinc mine (LH). This study, focus especially to evaluate the phytoremediation potential of Lau plant (EA) (*Erianthus arundinaceus (Retz*.) and Reed plant (PA), *Phragmites australis (Cav.)* in the mining sites. Soil samples were subsequently characterised by XRD, SEM and EDS methods. The research results indicated that soil minerals clearly affected soil pH and HMs contents in the soils. Pearson correlation and linear regression analysis showed that there are clear correlations among the contents of HMs and soil properties, in which soil pH had a significant impact. The contents of HMs were high in stem, leaves and roots, demonstrating the plants' high metal bioaccumulation potential from the soils, which are also high in HM content. Total As, Cd, Cu, Pb and Zn contents in soils varied from 4 to 2605, 0 to 124, 6 to 603, 45 to 5008 and 64 to 31789 mg/kg, respectively, while the corresponding contents in the plants ranged from 0.02 to 300, 0.1 to 33, 3 to 111, 1.19 to 982, 27 to 1346 mg/kg, respectively. The accumulation factor for HMs in roots was higher than that in stems or leaves of the plants for all soils. EA had the ability to naturally survive, grow and generate high biomass in the presence of extremely high contents of multiple HMs in soils. Soil minerals clearly affected soil pH and HMs contents in the soils. Native EA species has the potential for phytostabilisation of Cd contaminated sites. EA and PA growing on the sites have the potential for phytoremediation of the HMs, especially in extremely high contents of multiple HMs (As, Cd, Cu, Pb and Zn).

Keywords: *Accumulation, Contaminated soil, Heavy metals, Metals mining sites*

PS2C-3

Factors affecting the adsorption capacity of Mg/Al layered double hydroxides composite zeolite (Mg/Al LDH-Zeolite) on heavy metals in contaminated soil in Vietnam

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Abstract

This study focuses on evaluating and synthesizing factors affecting the adsorption capacity of heavy metals in contaminated soil when using Mg/Al layered double hydroxides composite zeolite (Mg/Al LDH Zeolite), which was prepared via the in-situ method to enhance the immobility of heavy metals in soil such as Cr(VI), Pb(II) and Cd(II). The Mg/Al LDH Zeolite, as a potential adsorbent material, has attracted interest in soil cleaning applications, especially for soil contaminated with heavy metals in Vietnam. This article analyzes the influence of factors such as soil pH, soil moisture, soil incubation time with adsorbent on the ability to adsorb heavy metals. By synthesizing information from experimental and simulation studies, this paper provides an overview of the performance and stability of Mg/Al LDH Zeolite in the removal of heavy metals from contaminated soils. Understanding these influencing factors will help optimize the effectiveness of modified zeolites in practical applications and support the development of sustainable environmental cleanup methods in the future.

Key words: *Mg/Al LDH Zeolite, Factors affecting, the adsorption capacity, heavy metals, contaminated soil in Vietnam.*

PS2C-4

Screen for stable low-risk rice genotypes for As based on environment-genotype interaction, food quality standard, and health risk assessment

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Abstract

Arsenic (As) accumulation in rice is a global health concern and has been received increasing attentions in recent years. In this study, 12 rice genotypes were cultivated at four As-contaminated paddy sites in Taiwan. According to the crop season and As level in soil, the experimental sites were further divided into 18 environments. Results showed that 67% of the studied environments were likely to represent As contamination in agricultural soils; however, only 50% of the environments having mean As concentration in brown rice higher than maximum permissible concentration (MPC) in rice grains. The analysis of variance over environments indicated that grain As concentration was mainly affected by environments, suggested that there was a remarkable degree of variation across the trial environments. According to the combination of the GGE biplot and cumulative distribution function of order statistics (CDFOS) analysis, five genotypes TCS17, TCS10, TT30, KH139, and TC192 were regarded as stable low-risk genotypes because the probability of grain As concentration exceeding the MPC of these genotypes were lower across the environments. Then, grain As levels in the selected genotypes were applied in assessing health risk of Taiwan residents associated with As exposure through rice consumption. Results showed that the upper 75%-tile values of *HQ* were all less than unity. This result suggested that the health risk was acceptable for most local residents associated with consuming the selected rice genotypes. Furthermore, the TCS17 was recommended to be the most "safe" rice genotype which could be immediately cultivated in local paddy fields for the protection of consumers' health. The comprehensive methodology developed here was also applicable to screen for stable, low-risk rice genotypes of As across multiple field environments in other regions or countries.

Key words: *Arsenic; GGE biplot; human health risk assessment; rank order statistics; rice*

PS2C-5

Assessment Of Soil Pollution In Industrial Zones: Case Study At Industrial And Minerals Exploitation Area In Dak R'lap District, Dak Nong Province, Vietnam

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Abstract

Soil pollution is a global problem that is caused by waste from industrial production in industrial areas as one of the main causes. The concentration of Arsenic (As), Cadmium (Cd), Copper (Cu), Lead (Pb), and Zinc (Zn) in 4 water samples and 12 soil samples collected from drainage ditches and surrounding areas of the industrial zone were used to evaluate the level of soil pollution at industrial and mineral exploitation area in Dak R'Lap district. The analysis results showed that 5/12, 8/12, and 4/12 of the soil samples have As, Cd, and Cu concentrations at near-pollution levels, and 1/4 of the water samples have As concentrations at near-pollution levels. Soil in the areas surrounding the industrial zone has not been found to be polluted. However, there are 417,29 hectares at risk of pollution with As, Cd, and Cu concentrations in soil and water. Some sources of pollution include solid waste from mining activities, water and tailings from mining sites, and waste from workers' daily activities and machinery operations.

Key words: *Soil pollution; Industrial zone soil pollution; Industrial zone; Dak R'lap industrial area.*

PS2D-1

Biodegradation of nitenpyram insecticide by endophytic bacterium *Bacillus thuringiensis* strain NIT-2, isolated from neonicotinoid-treated plant

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Abstract

Nitenpyram, a popular neonicotinoid insecticide, is commonly used in the plant for protecting the crops from pest attacks. In recent days, the accumulation of nitenpyram in soil is found to be higher owing to wide usage. Moreover, due to systemic in nature, plants can easily absorb this insecticide by their roots or leaves and store them for a long time in their edible parts. Thus, control of nitenpyram residue in the environment is essential. However, bioremediation is withstanding for sustainable and environmental friendly technique. Unfortunately, very limited information has been found regarding nitenpyram biodegradation. Therefore, our study was aimed to isolate and identify the bacterial strain, which can capable to degrade nitenpyram. For identifying degradable bacteria, we isolated endophytic bacterial strains from *Brassica rapa* plants which were exposed by different neonicotinoid insecticides. Almost 300 endophytic strains were tested where a bacterium strain, NIT-2 was shown considerable degradation of nitenpyram (about 65%) after 14 days of incubation in potato dextrose broth (PDB) media. The strain was recognized as *Bacillus thuringiensis* bacterium through 16S rRNA sequencing. From our study, we got 95% degradation after 28 days of incubation in PDB media. Bacterial growth ($OD_{600\ nm}$) was higher when the degradation became faster. On the other hand, degradation test in mineral salt media also confirmed that strain NIT-2 used nitenpyram as a sole C and N source during the degradation process. However, CPMF was confirmed whereas CPMA might be formed as metabolites during degradation process. Furthermore, metabolites degradation were run by strain NIT-2 in PDB medium where 71% degradation of CPMF were found. As, CPMA is very sensitive to identify under organic solvent extraction in liquid chromatography, we did not confirm any degradation after 14 days of incubation. As, strain NIT-2 can degrade both nitenpyram and its primary metabolite, *Bacillus thuringiensis* NIT-2 can be used for the bioremediation of nitenpyram-contaminated environment.

***Key words*:** Bacillus thuringiensis *NIT-2; Nitenpyram; Biodegradation; CPMF*

PS2D-2

Predicting ^{137}Cs and ^{90}Sr activity concentrations in brown rice using specific activity ratios of ^{137}Cs/Cs and ^{90}Sr/Sr in the exchangeable fraction of soil

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Abstract

Ceasium-137 and ^{90}Sr are major artificial radionuclides released into the environment through nuclear weapons testing (conducted mainly in the 1950s and 1960s), routine nuclear power plant emissions, and accidental releases from nuclear power reactors. Soil-to-plant transfer of radionuclides plays a crucial role in food contamination. Accurate estimation of radionuclide activity concentrations in crops, especially rice as a staple food in Asian, is vital for assessing internal radiation doses resulting from food ingestion. In this study, soil and brown rice samples were collected from paddy fields contaminated with ^{137}Cs and ^{90}Sr from different sources: Aomori Prefecture (global fallout), Fukushima Prefecture (accidental release), and Ibaraki Prefecture (global fallout and accidental release). The ^{137}Cs activity concentrations in the soil and brown rice exhibited a wide range, spanning 2.5–12,000 and 0.0044–120 Bq kg^{-1} dry weight (DW), respectively. Conversely, the activity concentrations of ^{90}Sr in the soil and rice showed relatively small variations, specifically 0.13–3.2 and 0.0044–2.3 Bq kg^{-1} DW, respectively. Most ^{90}Sr present in Fukushima soils originates from the nuclear weapons testing, with limited release resulting from the 2011 TEPCO Fukushima Daiichi Nuclear Station accident. To estimate the activity concentration of radionuclides in crops, the widely-used soil-to-crop transfer factor (TF) was considered. The TF is calculated by dividing the activity concentration of radionuclide in crops by that in soil (both Bq kg^{-1} DW). The soil-to-rice TF for ^{137}Cs exhibited a wide range of 0.00023–0.060 and decreased as the concentration of exchangeable K increased. Similarly, the soil-to-rice TF of ^{90}Sr was 0.0028–0.081 and decreased with increasing concentration of exchangeable Ca. The specific activity ratios of ^{137}Cs/Cs and ^{90}Sr/Sr in the exchangeable fraction were similar to those obtained in brown rice, allowing for the prediction of ^{137}Cs and ^{90}Sr activity concentrations in brown rice by accounting for changes in exchangeable K and Ca, respectively. Predicting ^{137}Cs and ^{90}Sr activity concentrations in crops using TF values leads to considerable variation, spanning multiple orders of magnitude due to TF fluctuations. However, the accuracy of ^{137}Cs and ^{90}Sr activity concentration predictions in rice can be improved by employing specific activity ratios of ^{137}Cs/Cs and ^{90}Sr/Sr in the exchangeable fraction. Predetermination of stable Cs and Sr concentrations in rice enables rapid and accurate prediction of ^{137}Cs and ^{90}Sr levels, which promotes the assessment of potential contamination in rice.

Key words: *Soil-to-plant transfer; Exchangeable fraction; Paddy field; ^{137}Cs/Cs; ^{90}Sr/Sr*

PS2D-3

Study on the possibility of soil improvement and treatment of heavy metal pollution of elephant grass VA06 growing on land of Lead Zinc mine waste land Hich Village, Tan Long commune, Dong Hy district, Thai Nguyen province

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Abstract

Thai Nguyen province has many mineral exploitation mines, including Hich Village lead and zinc mine. The post-mining waste soil here is highly contaminated with heavy metals, especially Pb, Zn, As. The experiment results of pots growing Voi grass on the waste soil of Lang Hich lead and zinc mine show that Voi grass has good growth ability, high biomass, and high ability to accumulate heavy metals in leaves and roots, achieving 80-90% compared to growing on unpolluted hilly soil. The accumulation of heavy metals in leaves and roots of VA06 grass is also quite high, especially Pb, Zn, As. Pearson statistical analysis demonstrated a correlation between heavy metal concentrations in soil and in plants. This result proves that VA06 grass is a suitable crop for a multi-use biological solution that both improves contaminated soil and serves as fodder for livestock, contributing to livestock development, efficient and sustainable use of waste soil after mining.

Keywords: *Voi grass, mine waste, heavy metals, pollution*

PS2D-4

Assess the current situation, changes and propose solutions for sustainable use of land resources in Ky Anh town, Ha Tinh province

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Abstract

Ky Anh Town is the socio-economic center at the southern gateway of Ha Tinh province with many favorable conditions for socio-economic development such as having a deep-water port, Vung Ang Economic Zone with a road connecting the port to National Highway 1A and going to Lao PDR. Results of assessing land use changes in the period 2005 - 2015, industrial land is the type with quite large fluctuations due to the formation of Vung Ang Economic Zone; The area of agricultural land tends to decrease, forest land increases slightly, the coverage rate compared to the national average is still low. The land use change forecast results indicate that the shift in the economic structure from agricultural production to industrial and service production in Ky Anh town also necessitates attention to issues related to land reclamation, compensation, and the allocation of land for resettlement, housing for experts, and workers. And especially handling environmental issues such as arranging appropriate waste treatment areas, ensuring forest cover rate, and green tree rate in urban areas.

Key words: *Land use change, Sustainable land use, Ky Anh.*

PS2D-5

Application of Gis Technology to Build Land Database for Provincial Planning (An Experiment for The Planning Development of the Urban System in Thai Binh Province)

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Abstract

In compliance with Law on Planning No. 21/2017/QH14 and Document No. 5746/BKHĐT-QLQH, many localities have started to develop provincial planning using an integrated, cross-sectoral approach. The establishment of a comprehensive shared data repository for multiple sectors is essential and contributes significantly to meeting the requirements of digital transformation in land management.The research has applied GIS technology to construct a land database in provincial planning, conducting experiments in Thai Binh Province. The objective is to enhance the effectiveness of provincial planning and, more broadly, state land management. The research has proposed a procedure for building an urban land database. ArcGIS was used to construct the structure and content of the urban land database in Thai Binh Province, consisting of four foundational data groups and four urban land data groups (current land usage at the provincial level, including 10,331 land parcels; provincial land usage projections up to 2030, including 2,343 parcels adjusted to align with land use criteria; current urban system development with 11 urban areas; and future urban system development up to 2030, including 16 new urban areas). These data were packaged in GDB format and presented in *.MXD format. Based on this, several solutions were proposed to improve the effectiveness of GIS application in building land databases in provincial planning, as well as solutions for database exploitation, operation, and management.

Key words: *Database, land management, provincial planning, Thai Binh province.*

PS2E-1

Land policy as part of natural resources management strategy in Viet nam in the period of 2011-2020 and to ward 2030

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Abstract

This paper is an overview study on land policy of Vietnam for the period of 2011-2020 and a vision to ward to 2030. Below are the main points: 1) Communist Party of Vietnam, 2011, Platform for national construction in the transition to socialism (additional development 2011), defining: “Economic development is the central task; carry out industrialization and modernization of the land"; Current legal policy stipulates: "Actively respond to climate change, strengthen resource management and protect the environment". 2) According to the results of land inventory 2019: Vietnam has a total natural area: 33,131,713 ha, including: agricultural land group 27,986,390 ha (84.45%); non-agricultural land group: 3,914,508 ha (11.82 %); unused land group: 1,230,815 ha (3.73%). Land management has contributed to socio-economic development: Agriculture in the period (1986-2016) Vietnam has always maintained an increase of 3.5%/year, reaching 3.76% in 2018. Agricultural export in 2000 reached 4.2 billion USD; 2020 reached 41.3 billion USD; Forestry: prevent forest degradation; increase the coverage from 39.5% in 2010 to 42.01% in 2020. Industry: by December 2020, 575 industrial zones have been planned with an area of 219.5 thousand ha; Industrial parks and economic zones have attracted 10,148 domestic projects and 10,921 foreign-invested projects, with a total registered investment capital of about 2.52 million billion VND and 230.2 billion USD respectively. 3) Challenges for Vietnam's land management in the period (2021-2030): a) Limited land fund, exploited for agricultural and non-agricultural purposes 96.37%; only 3.73% of unused land remains. b) Land quality: The whole country has 11,838.0 thousand hectares of degraded land, accounting for 35.74% of the country's natural area. c) Small-scale, scattered agricultural production (average index of agricultural production land: 0.6766 ha/rural household), little investment, manual labor. Productivity, quality, low output; low land use efficiency. d) Being influenced by many objective factors: i) the impact of globalization; ii) impact of industrial revolution 4.0; iii) impacts of urbanization, iv) impacts of global climate change 4) Vietnam socio-economic development strategy for the period (2021-2030): “comprehensively and synchronously promoting the renovation, industrialization and modernization; firmly build and defend the Fatherland, maintain a peaceful and stable environment; striving by the middle of the twenty-first century, our country becomes a developed country, following the socialist orientation". National land use planning period 2021-2030, vision to 2045 and 5-year land use plan (2021 - 2025): by 2030 Vietnam will put into use 31,663,144 ha (98.48 % total natural area) including agricultural land 27,732. 040 ha (83, 70%); non-agricultural land 3,931,110 ha (14.78%), unused land: 1,634,130 (1.52%). Paddy land of 3.5 million ha, with 42,000,000 tons/year, ensuring national food security, contributing to global food security; Forest land of 15,404,660 ha ensures forest coverage of 46.49%, meeting the requirements of protecting school grounds and biodiversity. Non-agricultural land with an area of 4,896,480 ha (accounting for 14.78%), meeting the demand for land use to realize 10-year socio-economic development goals (2021 - 2030)

Key words: *Policy, strategy, land, natural resources and environment, Vietnam, 2011-2030*

PS2E-2

Geochemical fractionation of nickel and chromium in serpentine-derived paddy soils in the Philippines

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Abstract

The geogenic high levels of Ni and Cr in serpentine soils are well known. However, very few studies have looked into the different fractions of Ni and Cr in serpentine-derived paddy soils that may pose potential health risks to humans due to the consumption of Ni and Cr-contaminated rice. The objective of the study is to determine the lability of Ni and Cr in serpentine-derived paddy soils and to elucidate their relationships to soil's physicochemical properties. A total of sixty surface soils (0-20 cm) were collected, and fractionation (exchangeable- F1; reducible- F2; oxidizable-F3; residual-F4) of Ni and Cr were conducted by sequential selective extraction. Results revealed that Ni (total and all its fraction) and Cr (total, F2, and F4) concentration in paddy soils are directly associated with physicochemical properties such as silt, pH and organic carbon, dithionite- extractable Iron (Fe_d), ammonium-oxalate extractable Iron (Fe_o), total Fe but inversely associated with sand, Si, Al, Ca, and K. The availability of Ni (F1) for plant uptake is strongly related to these properties. In contrast, Cr availability (F1) only showed a direct association with ammonium-oxalate extractable Iron (Fe_o) and an inverse association with total K. Results further revealed that in all soils, the concentrations of Ni fractions in soils are in the order of residual (F4) > reducible (F2) > oxidizable (F3) > exchangeable (F1). On the other hand, the Cr concentrations in the different fractions are in the order of residual (F4) > oxidizable (F3) > reducible (F2) > exchangeable (F4) fractions for Masinloc and Candelaria, whereas for Sta. Cruz the order is residual (F4)> reducible (F2) > oxidizable (F3) > exchangeable (F1) fractions. These results suggest that despite the very high concentrations of Ni and Cr in soils, most of the Ni and Cr are tightly bound to mineral structures, affecting the low bioavailability of Ni and Cr in rice uptake. Our results demonstrate that reactive iron acts as a giant rusty sponge of Cr and Ni in serpentine paddy soils

Key words: *"metal speciation, paddy soils, reactive iron, rice, serpentine"*

PS2E-3

Application of Visible and Near-Infrared Diffuse Reflectance Spectroscopy for Estimating Soil Organic Carbon

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Abstract

Soil organic carbon (SOC) is commonly measured using classic chemical analysis methods, such as the Walkley-Black wet-oxidation method, because of its simple analytical procedure. However, these analyses consume toxic chemicals and potentially cause human health and environmental risks. The issue of reducing chemical waste in science raises the need for safer and faster techniques for quantifying SOC. The multivariate regression model from soil spectral data to evaluate soil properties has recently been applied as an alternative to classical methods. Visible and near-infrared diffuse reflectance spectroscopy (Vis-NIR, 350-2500 nm) has proven to be a rapid, nondestructive, cost-effective, and eco-friendly technique for the prediction of SOC. In this study, the classical wet oxidation and spectral analyses (at the range of 350-2500 nm under laboratory conditions) were compared for 70 soil samples, collected since 2015, from paddy fields in the Red River Delta and Mekong River Delta in Vietnam. The obtained comparative data was used to model spectral-based SOC contents. The model was trained using 80% of the soil samples, and the remaining 20% was used to test the model. Multivariate modelling, such as partial least squares regression (PLSR) and machine learning, are the most common methods for modelling soil properties with spectroscopy. In this study, regression models for estimating the SOC content by the spectral data were constructed using partial least squares regression (PLSR) and principal component regression (PCR). The PLSR showed a better accuracy (coefficient of determination value was 0.88; root mean square error of prediction value was 0.72%; and ratio of prediction deviation value was 2.64). Overall, the findings provide a basis for development of spectral-based techniques for fast and accurate SOC measurements. However, this model still requires more empirical validations.

Keywords: *Soil organic carbon; Visible and near-infrared diffuse reflectance spectroscopy, PLSR, PCR*

PS2E-4

Development of a Model for Predicting Soil Properties in South Korea through Mid-Infrared Soil Spectroscopy

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Abstract

The role and importance of soil are increasing in the face of various challenges such as climate change and food security. Proper conservation and management of soil are necessary to maximize the functions and ecosystem services of soil. In South Korea, a large amount of soil testing (approximately 600,000 points) is conducted annually for reasons such as determining the analysis-based appropriate fertilizer usage, evaluating soil carbon accumulation, and assessing soil resources through monitoring agricultural land. However, the currently commonly used laboratory soil analysis methods are known for their drawbacks, such as being time-consuming, costly, and requiring skilled personnel. To address these issues, rapid soil analysis methods using MIR (Middle Infrared) spectroscopy have been proposed as an alternative. In this study, we aimed to confirm the applicability of MIR near-soil sensing techniques for rapid soil analysis by developing and evaluating models based on MIR spectroscopy. For model development, 1167 soil samples were collected, and laboratory analyses including pH, organic matter (O.M), total nitrogen (T-N), cation exchange capacity (CEC), and others were performed as dependent variables. The MIR spectrum, serving as an independent variable, was analyzed using the MIR spectrometer (Invenio-r, Bruker). Additionally, machine learning models (PLSR, Cubist SVM, MBL) were constructed for MIR near-soil sensing model development, and evaluation was performed using k-fold cross-validation (k=15). The analysis showed that the R^2 values for pH, EC, O.M, T-N, Sand, and CEC were 0.78, 0.88, 0.92, 0.95, 0.82, and 0.89, respectively. The high predictive power of the model was observed in some soil analysis items, such as O.M and T-N, indicating that the MIR near-soil sensing technique using MIR can provide rapid soil analysis compared to traditional laboratory analysis methods. The MIR near-soil sensing technique offers the advantages of low cost, speed, safety, and the ability to perform repeated measurements with minimal soil samples. However, for practical field application, developing a versatile MIR near-soil sensing model through model construction using a large number of soil samples is essential. With these improvements, accurate and rapid soil analysis is expected to be possible.

Key words: *Infrared; proximal soil sensing; Rapid soil analysis*

PS2E-5

Paired Observations of Arsenic Speciation in Rice Grain, Leaf, and Paddy Soil Using High-Resolution X-ray Absorption Near Edge Spectroscopy

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Abstract

Rice provides an average of 20% of globally consumed calories and employs millions of rice farmers. Rice is commonly grown in paddy soils, where anaerobic respiration reduces ferric iron (III) oxyhydroxides, sulfate (SO_4^{2-}) and arsenate (AsO_4^{3-}), increasing dissolved Fe (II) and As (III) concentrations in soil pore water. Rice commonly accumulates this soluble As, potentially posing environmental and health concerns. Understanding how that As accumulates in the grain, and its toxicity to humans and plants, requires detailed knowledge of the oxidation state and coordination environment, collectively called the speciation, of the arsenic in each material. Most previous research examining As speciation in rice chemically extracts As from the soil, plant or grain, then determines speciation using a combination of chromatography to separate species and inductively coupled plasma-mass spectroscopy (ICP-MS) to detect species containing metals. These methods have found that a portion of the As in rice grain is methylated, but it oxidizes As, and it removes the As from its coordination environment, making it hard to see how the As is bound in the plant tissues and soils. Here, we establish the utility of synchrotron-based X-ray absorption spectroscopy for As speciation in rice grain, leaf and paddy soils nondestructively and in situ. Arsenic speciation was determined at the National Synchrotron Light Source-II in Brookhaven, NY, USA for collocated rice and paddy soil samples collected from a wide range of small stakeholder farms in January 2023 in Kandal and Kampong Chhnang provinces of Cambodia. The total arsenic concentration of plant samples was determined by digestion and ICP-MS, while soil As was measured by X-ray fluorescence (XRF). Methylated As was found in soils, leaves and grain. In grain, this method is uniquely able to show that both inorganic As and methylated As species are coordinated to protein. Soil, in contrast, contains primarily arsenate, some of which is methylated, unless collected from fields under sustained flooding, where arsenite, thioarsenate, and dimethylarsenite are also found. Neither speciation or grain concentration was correlated to soil or leaf As concentrations. Arsenic XANES spectra were collected successfully for grains and leaves with less than 50 µg As/kg and soils with as little as 1 mg As/kg. Thus, we demonstrate that As XANES analysis serves as a useful tool to determine the oxidation state and coordination environment of As in impacted agricultural systems. Understanding the speciation of rice arsenic will allow for more productive rice growing methods while mitigating rice As as a major risk to public health and food security.

Key words: *Arsenic; Rice; Soil Chemistry; Spectroscopy; Speciation*

PS2F-1
Effects of Chicken-Feather Hydrolysate on Soil Health

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Abstract

As the global population continues to surge, the demand for food increased fertilizer utilization, primarily for nitrogen (N) supply in soil. However, the excessive use of chemical fertilizers poses threats to soil fertility and the environment. To address this challenge, there is apressing need to reduce chemical fertilizer usage and enhance nitrogen fertilizer efficiency. On the other hand, an enormous amount of chicken feathers is generated globally. Chicken feathers, comprising 92% keratin, can be potentially converted into hydrolysate through subcritical fluid extraction. This hydrolysate, rich in peptides, soluble proteins, and amino acids, holds promise as a sustainable agricultural amendment for soil nitrogen fertilization. This study investigates the transformation of chicken feather hydrolysate (CFH) in soils with varying pH and texture over 60 days and explores its impact on soil health. Our findings reveal that the transformation of CFH into ammonium nitrogen was slower than urea across different pH levels and soil textures. The mineralization of CFH was more prominent in high-clay content soil. The available N release from CFH did not surpass the applied CFH amount, suggesting no significant priming effect. However, CFH treatment led to a decline in total carbon, indicating reduced soil organic carbon (SOC) stability. Our study underscored that CFH can serve as an organic nitrogen fertilizer, offering a sustainable alternative to synthetic nitrogen fertilizers with a lower environmental impact. Despite some challenges, CFH presents a viable solution to both feather waste management and the promotion of sustainable agricultural practices.

Keywords: *Nitrogen Fertilizer; Chicken Feathers hydrolysate; Soil nitrogen speciation*

PS2F-2

Effects of in-season nitrogen application on soybean

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Abstract

Soybean production have been increased over past decades, but there are still an important issues to be addressed for tangible improvement of soybean cultivation. In Korea, in-season nitrogen fertilizer application is common to increase yields, especially in case of paddy field cultivation. However, there is still lacking believe on positive effects of in-season nitrogen application to soybean, though previous studies reported that in-season nitrogen application helps to increase of soybean yield. Despite the effects of in-season nitrogen application on soybeans, there has been no extensive information regarding the effects of in-season nitrogen application. Therefore, this study investigated impacts of in-season nitrogen application on soybean cultivation and production. Soybeans were planted in the paddy field and had the same amounts of pre-plant nitrogen fertilizer for all treatments. Fertilizer applications were categorized into four conditions: $6N \cdot 10a^{-1}$, $4N \cdot 10a^{-1}$, $2N \cdot 10a^{-1}$, and $0N \cdot 10a^{-1}$ (control) based on the amount of fertilizer. In-season fertilizers were treated each at R1 and R3 growth stages. As a result, in-season nitrogen application did not affect the growth characteristics of plant. Yields from 6N condition had the greatest yields when treated in R1 stage. Based on the findings of this study, it can be indicated that application of in-season nitrogen application may help for increasing yields of soybean.

Key words: *soybean; fertilizer; nitrogen; growth characteristics; soybean yield*

PS2F-3

Study on leaf nutrition diagnosis to determine deficiency and use appropriate fertilizer for Ha Giang Sanh orange variety

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Abstract

Research with the aim of determining the current situation and develop the nutritional status in leaves of Sanh orange variety to detect, identify and overcome limiting factors in each specific farming area, contributing to adjusting fertilization regimes, improving productivity, quality and production efficiency. Results of monitoring and evaluating the nutritional status in leaves for the Sanh orange variety (Citrus reticulata x maxima) in Bac Quang, Quang Binh and Vi Xuyen districts of Ha Giang on 90 gardens/householder, carried out continuously during the period 2021 - 2022, applying the Diagnosis and Recommendation Integrated System (DRIS) method in evaluating macro, secondary and micronutrient elements. The results determined the appropriate nutritional classification threshold in leaves for the Sanh orange variety as: N: 2.53 – 2.89%, P_2O_5: 0.12 – 0.16%, K_2O: 1.32 – 1.68%, Ca: 2.59 -3.46%, Mg: 0.23 – 0.41%, S: 0.17 – 0.22%, Cu: 16.22 – 45.59 mg/kg, Zn: 4.70 – 10.56 mg/kg, B: 32.69 – 46.33 mg/kg; the nutritional status in leaves at different levels including: very deficient, deficient, suitable, excess and very excessive; identify common limited nutritional elements in the order Cu>Mg>S>Ca>B>N>P>K>Zn; nutrient balance index (NBI) between gardens ranges from 32 - 94; based on that, we have overcome limiting factors and built a suitable fertilizer regime for the Ha Giang Sanh orange variety.

Keywords: *Sanh orange variety, the nutritional status, nutritional ranges, limiting elements, DRIS*

PS2F-4

Change of soil map in Kon Plong district, Kon Tum province in the 2005 - 2023 period

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Abstracts

This research conducted in the Kon Plong district aimed to assess the changes in soil classification over the 2005-2023 period. The research was surveyed and described soil morphology at 15 different locations. Seventy-one soil samples were collected according to each horizon layer. Twelve soil samples were chosen to analyze for various physical and chemical parameters such as pH, organic matter content, nutrient levels, and soil texture at the Land Resources Laboratory, Can Tho University. The results have identified four main soil groups in the Kon Plong district, including alluvial soil (Py), yellow-red soil (F), red-yellow humus soil on mountains (H), and valley soil due to the condensation product (D). In some areas with high agricultural activities, the soil has changed compared to 2005. In particular, the alluvial soil was significantly changed because the map was conducted at a higher scale level. This research will benefit the agricultural sector and contribute to sustainable development and resource protection in the region.

Keywords: *Highland, soil, soil change, soil classification*

PS2F-5
Solution to enhacne accumulation and concentration of agricultural land in Vietnam

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Abstract

The agricultural sector plays a key role in Vietnam's reform process, creating 85% of jobs for rural residents and being the source of livelihood for more than 65% of the country's population. Since the reform process, Vietnam's agriculture has undergone major changes and achieved many valuable achievements. In particular, in the context of the strong outbreak of Covid-19, agriculture is considered a bright spot and a pillar of the economy. However, agricultural development is still facing many limitations, such as outdated production methods, small production scales, and limited application of high technology. Besides, agricultural land fragmentation causes many difficulties for agricultural production. It can be seen that the accumulation and concentration of agricultural land are essential for ensuring rural development and reducing land fragmentation. In recent years, the state has had specific policies to encourage people and businesses to accumulate and concentrate agricultural land, contributing to socio-economic development and ensuring national defense and security. However, the process of accumulating and concentrating agricultural land is still slow. This paper discusses the limitations of land policies that affect the accumulation and concentration of agricultural land as a basis for proposing policy implications to accelerate the process of land accumulation and concentration in Vietnam.

Keywords: *accumulation, concentration, agricultural land, Viet Nam.*

PS2G-1

Monitor the rice growing season using remote sensing images

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Abstract

The study monitored the rice growing stages, cropping season, and rice sowing progress in serving rice plants' care and health management. Multispectral remote sensing imaging technology with many spatial and temporal resolution levels and significant coverage is suitable for monitoring information fluctuations on the earth's surface at a large scale. Landsat 9 images are used to monitor vegetation coverage with a spatial resolution of 15x30m, with an 8-day cycle, suitable for research on seasonal crops, especially rice. Based on image characteristics (NDVI vegetation index value) that have a relationship with changes in the growth status of rice plants over space and time, it helps determine sowing time and spatial fluctuations. The current status of rice tea and the crop structure of rice growing areas serve well in managing rice plant health. Expected results: Landsat 9 multi-temporal high-resolution satellite images can be used to build a map of the current status of rice tea because it has a close relationship between the vegetation difference index and growth stages of the tree. Therefore, this high-resolution Landsat 9 image can be applied to determine the current status of rice tea based on the correlation between the NDVI index and the development stages of rice plants.

Keywords: Rice; sowing; growing stages; cropping season; remote sensing.

PS2G-2

Study on leaf nutrition diagnosis to determine deficiency and use appropriate fertilizer for Ha Giang Sanh orange variety

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Abstract

Research with the aim of determining the current situation and develop the nutritional status in leaves of Sanh orange variety to detect, identify and overcome limiting factors in each specific farming area, contributing to adjusting fertilization regimes, improving productivity, quality and production efficiency. Results of monitoring and evaluating the nutritional status in leaves for the Sanh orange variety (Citrus reticulata x maxima) in Bac Quang, Quang Binh and Vi Xuyen districts of Ha Giang on 90 gardens/householder, carried out continuously during the period 2021 - 2022, applying the Diagnosis and Recommendation Integrated System (DRIS) method in evaluating macro, secondary and micronutrient elements. The results determined the appropriate nutritional classification threshold in leaves for the Sanh orange variety as: N: 2.53 – 2.89%, P_2O_5: 0.12 – 0.16%, K_2O: 1.32 – 1.68%, Ca: 2.59 -3.46%, Mg: 0.23 – 0.41%, S: 0.17 – 0.22%, Cu: 16.22 – 45.59 mg/kg, Zn: 4.70 – 10.56 mg/kg, B: 32.69 – 46.33 mg/kg; the nutritional status in leaves at different levels including: very deficient, deficient, suitable, excess and very excessive; identify common limited nutritional elements in the order Cu>Mg>S>Ca>B>N>P>K>Zn; nutrient balance index (NBI) between gardens ranges from 32 - 94; based on that, we have overcome limiting factors and built a suitable fertilizer regime for the Ha Giang Sanh orange variety.

Keywords: *"Sanh orange variety, the nutritional status, nutritional ranges, limiting elements, DRIS"*

PS2G-3

Update soil maps of Tan Thanh district, Long An province, Viet Nam

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Abstract

The study aims to correct and update the soil map for Tan Thanh district as a basis for managing, using, and exploiting sustainable land resources. Based on the 2009 soil map of the Department of Land Resources, Can Tho University. The study surveyed 83 soil profiles with a dedicated drill of 2 meters to describe soil patterns and samples and analyze digestive indicators and soil physiology. Then, the soil was classified according to the classification system of WRB/FAO (2006). The results have identified four main soil groups in Tan Thanh district, including gleysols, anthroposols, histosols, and technosols, with eight soil types identified through the diagnostic horizon, properties, and materials. Thus, it also proposes land use suitable for productive and sustainable crops.

Keywords: *Soil map; WRB; Tan Thanh; Long An*

PS2G-4

Pedotransfer function for soil properties prediction: A case in Vinh Long province, Viet Nam

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Abstract

Research is carried out to determine soil properties and their correlation analysis and assess the applicability of correlations on soil properties characterization and prediction in Vinh Long province. The study collected 20 soil samples from the Vinh Long Department of Natural Resources and Environment, including 18 soil physical and chemical properties, including % clay, silt, and sand, pH(H_2O), pH(KCl), electric conductivity (EC), organic matter (OM), cation exchange capacity (CEC), total N, total Pts, available P, total K, exchangeable K, K^+, Na^+, Ca^{2+}, Mg^{2+}, Al^{3+}, SO_4^{2-}. The results have identified 30 correlation pairs. It shows that some soil properties have high and very close correlations. For significance level 1% ($r \geq 0.549$, $n = 19$) between pairs of OM with total N, available P with Al^{3+}, Mg^{2+} with Na^+, pH(KCl) with pH(H_2O), total P with total K, etc. For the 5% significance level ($r \geq 0.433$, $n = 19$), include pairs such as pH(H_2O) with Al^{3+}, pH(KCl) with Al^{3+}, CEC with silt ratio, pH(H_2O) with SO_4^{2-}, etc.) helps to predict and calculate from other data quickly, contributes to reducing cost and time in determining soil properties when improving soil quality. However, more study is needed, specific agreement and specification, and more sampling points must be arranged.

Keywords: *Correlation, soil properties, Vinh Long province.*


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