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**VIRTUAL CONFERENCE 2021**

**“FUTURE OF AGRICULTURE AND ORGANIC AGRICULTURE  
TOWARDS GREEN ECONOMY”**

**BOOK OF ABSTRACTS**

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# KEYNOTE SPEECH

## SHAPING THE FUTURE OF AGRICULTURE: BIOMIMETIC NON-TOXIC SPECIES-SPECIFIC INSECT REPELLENTS FOR AGRICULTURAL PLANTS

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### ABSTRACT

Post-pandemic recovery plans also need to address biodiversity loss (McElwee, 2020). In agriculture, a related major contribution would be to make the transition from chemical, potentially toxic pesticides that affect the target species with intended consequences and that affect further life forms with unintended consequences by physical pesticides that solely repel the target species, without interruptions to other organisms including humans.

Biomimetics is the field of research that investigates living nature by trying to understand its basic principles and transfers them into technology for the development of solutions, products and/or applications. Various plants produce insect repellents based on wax micro- and nanostructures that exhibit specific mechanical and structural properties, such as finely tuned fracture behavior, thereby preventing insect attachment (Borodich *et al.*, 2010). As England and co-workers showed in 2016 surface roughness rather than surface chemistry essentially affects insect adhesion (England *et al.*, 2016). This is an example for the biomimetic principle that in living nature often structure is more important than specific materials to achieve certain functionalities. One further example for this principle are structural colors in various butterflies, where periodic, regular nanostructures yield brilliant, non-bleaching colors that can easily be transferred to technological surfaces via stamping (Zobl *et al.*, 2016).

The keynote presentation will illustrate how the research of specific structures that can be transferred from one successful plant species to others can be a non-toxic alternative to chemical pesticides. In that case physics (structure) rather than chemistry (material) can offer a modern approach for the protection of crops in modern agriculture against harmful organisms and contribute to shaping the future of agriculture towards targeted insect repellents.

# ORAL PRESENTATIONS

[01]

**IMPROVEMENT OF GROWTH AND DEVELOPMENT OF SWEET BASIL  
(*Ocimum basilicum* L.) THROUGH THE APPLICATION OF CHITOSAN AT  
DIFFERENT PLANTS' MATURITY STAGES**

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**ABSTRACT**

Sweet basil is one of the most popular culinary, medicinal and fragrance herbs in Mediterranean, Asian and Western countries. This study was conducted with the aim to increase the growth performance of sweet basil via different concentrations of chitosan which applied at different maturity stages. The study was arranged in factorial Randomized Complete Block Design with four replications. The plants were divided into two growing stages, which were vegetative stage (S1) and reproductive stage (S2). Those plants were then treated with four different concentrations of chitosan (0, 2, 4 and 6 ml L<sup>-1</sup>) either at S1, S2 or S1+S2. The results indicated that plants treated with chitosan at S1 showed greater performance. Chitosan concentration at 4 ml L<sup>-1</sup> produced taller plant height (55.09 cm plant<sup>-1</sup>), bigger stem diameter (11.08 mm) and higher number of leaves (296.57 leaves plant<sup>-1</sup>) in comparison to other treatments. It is also interesting to observe that the lowest concentration of chitosan (2 ml L<sup>-1</sup>) was non-significantly different with 4 ml L<sup>-1</sup> at S1 in some parameters; length of internode, number of branches, total root length, root average diameter, total root volume and total root surface area. Besides, correlations analysis was done and proved that all the mentioned parameters were significantly correlated with each other at positive correlation. This study also revealed that the application of chitosan must be done at vegetative stage rather than reproductive stage. Besides, single application of chitosan was proven to be more efficient than twice application. As the concentration of 4 ml L<sup>-1</sup> showed superior effect, especially on the number of yield, thus it is recommended for growers to apply chitosan at 4 ml L<sup>-1</sup> during S1.

Keywords: chitosan, drenching, physiology, vegetative stage, reproductive stage

[02]

**AGRONOMIC USE EFFICIENCIES OF SOIL APPLICATION OF ZINC NANO FORMULATIONS IN RICE IN RICE-MAIZE CROPPING SYSTEM**Nair AS<sup>1\*</sup> and Padmaja G<sup>2</sup><sup>1</sup>*Kerala State Disaster Management Authority, Government of Kerala, Kerala, India*<sup>2</sup>*Jayashankar Telangana State Agriculture University, Hyderabad, India*[\\*aswathysnair067@gmail.com](mailto:aswathysnair067@gmail.com)**ABSTRACT**

Zinc is one of the micronutrients and its deficiency is widely reported in India. One of the strategies to tackle zinc deficiency is the application of zinc fertilizer. Zinc sulphate and zinc oxide are the conventional zinc fertilizers used in India, but its efficiency is reported to be very less. Introduction of nano zinc fertilizers is one of the new strategies to increase the efficiency of zinc fertilizers. A field experiment was carried out during 2016-17 at college farm, Rajendranagar, PJTSAU, Hyderabad with rice -maize cropping system to find out the effect of zinc nano fertilizers on rice and maize. As a part of the study, agronomic use efficiencies of soil application of different nano formulations along with conventional zinc fertilizers i.e zinc sulphate (21%) and zinc oxide (80%) were calculated. Two sources of nano formulations used in study were bio-Zn (6% Zn) and nano- Zn (3% Zn) supplied from M/S. Prathishta industries, Alwal, Secunderabad. The experiment was laid out in randomized block design with 16 treatments and 3 replications. The study consisted of 11 treatments of soil application of different sources of zinc fertilizers including one control plot. The soil application treatments were T1 (control), T2 (RDF @ N: P205: K2O @120:60:40 kg ha<sup>-1</sup>), T3 (RDF + ZnSO<sub>4</sub> @ 25 kg ha<sup>-1</sup>), T4 (RDF + ZnSO<sub>4</sub> @ 50 kg ha<sup>-1</sup>), T5 ((RDF + ZnO @ 6.25 kg ha<sup>-1</sup>), T6 (RDF + nano Zn as impregnated granules @ 10kg ha<sup>-1</sup>), T7 (RDF + nano Zn as impregnated granules @ 15 kg ha<sup>-1</sup>), T8 (RDF + nano Zn as impregnated granules @ 20 kg ha<sup>-1</sup>), T9 (RDF+ bio Zn @ 12.5 kg ha<sup>-1</sup>), T10 (RDF+ bio Zn @ 25kg ha<sup>-1</sup>) and T11 (RDF+ bioZn @ 50 kg ha<sup>-1</sup>). Among the four different sources of zinc, soil application of nano-Zn recorded highest agronomic use efficacy (2.133). This was followed by soil application of bio zinc @ 12.5 kg ha<sup>-1</sup> (2.06). The agronomic use efficiency recorded with conventionally using ZnSO<sub>4</sub> @ 25 kg ha<sup>-1</sup> was 0.41, while ZnO reported the lowest zinc use efficiency compared to other sources. So, the results showed that nano formulations of zinc has significantly higher agronomic use efficiencies than conventional sources of zinc. Hence, this study gives an indication that nano fertilizers, consists of very low concentration of zinc could be a better alternative to conventional zinc fertilizers.

Keywords: agronomic use efficiency, rice, soil application, nano-Zn, bio-Zn, ZnSO<sub>4</sub>, ZnO

[03]

**EFFECTS OF SALINITY AND CD INTERACTIONS ON CD ACCUMULATION AND TRANSFER TO THE GRAINS OF SALT TOLERANT RICE GENOTYPES**Zaber HM<sup>1\*</sup>, Atikul IM<sup>2</sup>, Azhar IM<sup>3</sup> and Qudrata KK<sup>1</sup><sup>1</sup>*Soil, Water and Environment Discipline, Khulna University, Khulna-9208, Bangladesh*<sup>2</sup>*Environmental Science Discipline, Khulna University, Khulna-9208, Bangladesh*<sup>3</sup>*Forestry and Wood Technology Discipline Khulna University, Khulan-9208, Bangladesh*[\\*zaberhossain74@yahoo.com](mailto:*zaberhossain74@yahoo.com)**ABSTRACT**

Cadmium (Cd) contamination with high salt concentrations in soil has varying consequences on plants growth and development. For this reason, a pot experiment was conducted to assess the effects of salinity problems on soil Cd contamination. agronomic (shoot dry weight, leaf area, straw yield, chl-a), yield attributes (grain yield, 1000 grain weight, harvest index), Cd content, its uptake and transfer factor in three salt tolerant rice genotypes (BRRI 47, BINA8 and BRRI67). Two levels each of Cd (5, 10 mgkg<sup>-1</sup>) and salinity (4, 8 dSm<sup>-1</sup>) were developed in a silty clay loam soil either single or in combination as growing medium. Pots containing no salt or Cd addition were regarded as control. All the pots were arranged in a completely randomized way with three replications. Agronomic characteristics significantly limited due to the application of either Cd or salinity and salinity effects were more noticeable for the reduction. BRRI 47 rice genotype showed greater sensitivity in response to agronomic characteristics among the rice genotypes studied. Yield characters were significantly inhibited by the single application of Cd or salt. However, the co-exposure of two stresses had little effect on BINA8 and BRRI67 than that of BRRI 47. Result indicated the highest Cd accumulation (81.44%) and uptake (77.92 µg/plant) in BRRI 47. The transfer of Cd from soil to the grains was limited by the application of salt. Treatments with salinity-Cd combination did not have any significant effect on Cd transfer. It is concluded that salinity could reduce the transfer of Cd to the grains of the rice genotypes examined. Finally, it is recommended that such genotypes should be planted in Cd contaminated saline soil.

Keywords: salinity, cadmium, rice, agronomic, yield, transfer factor



[04]

**EFFECT OF FOMESAFEN + FLUAZIFOP-P-BUTYL AND IMAZETHAPYR ON  
GROWTH AND PRODUCTIVITY OF RABI GROUNDNUT IN LATERITIC SOIL  
OF WEST BENGAL**

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**ABSTRACT**

Groundnut (*Arachis hypogaea* L.) is the most important oilseed crop of tropical and sub-tropical regions of the world. It is also known as king of oilseeds and commonly referred as poor man's almond. It is also known as unpredictable leguminous crop. The yield of groundnut is lost in various ways, among all, weed infestation is considered as one of the major problem due to the initial slow growth habit of the crop. Weed interference resulted in maximum yield losses between 74 and 92 per cent. Thus, use of herbicides is one of the options left with the farmers to eliminate crop weed competition at early growth stage of crop. A field experiment was conducted during rabi season 2017-18 at the Agricultural Farm, Sriniketan with Groundnut variety 'TG 24' to study the effect of Fomesafen +Fluazifop-p-butyl on weed management as well growth and productivity of Groundnut. The experiment comprising of ten treatments viz. T1-Fomesafen + fluazifop-p-butyl @ 100+100g ha<sup>-1</sup>, T2-Fomesafen + fluazifop-p-butyl @ 125+125 g ha<sup>-1</sup>, T3-Fomesafen +fluazifop-p-butyl @ 150+150 g ha<sup>-1</sup>, T4-Fomesafen + fluazifop-p-butyl @ 175+175 g ha<sup>-1</sup>, T5-Fomesafen + fluazifop-p-butyl @250+250 g ha<sup>-1</sup>, T6-Imazethapyr @100.0 g ha<sup>-1</sup>, T7- Fluazifop-p-butyl + fomesafen@ 125+125 g ha<sup>-1</sup> (Fusiflex), T8-Hand weeding at 15 and 30 Days after Sowing (DAS), T9-Weedy check and T10-Weed free check and replicated thrice. Result revealed that doses of fomesafen + fluazifop-p-butyl at (125+125,150+150, 175+175 and 250+250 g ha<sup>-1</sup>) significantly reduced the weed infestation and registered lower weed density,weed dry weight, higher weed control efficiency and yield attributes and yield of groundnut over T6-Imazethapyr @100.0 g ha<sup>-1</sup>, T7- Fluazifop-p-butyl + fomesafen @ 125+125 g ha<sup>-1</sup> (Fusiflex) and at par with two hand weeding. Weed management had positive and favourable influence in improving plant height, yield attributes like number of podsplant<sup>-1</sup>, number of kernel pod<sup>-1</sup> and 100 kernel weight of groundnut under study. There was no phytotoxicity observed in any of the doses of the testing herbicide in groundnut and its effect on succeeding transplanted rice crop.

Keywords: Fomesafen +Fluazifop-p-butyl, groundnut, phytotoxicity, WCE

[05]

**EMBRACING WATER-SMART AGRICULTURE FOR OPTIMAL  
AGRICULTURAL PRODUCTION IN SELECTED AREAS OF BUSHBUCKRIDGE,  
SOUTH AFRICA**

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**ABSTRACT**

Agriculture plays an important role for income generation, economic growth, and employment for majority of people. Agricultural production has become the very means of alleviating poverty. In the pursuit to meet the growing demand for food to sustain the ever-growing population, the need to salvage farming and farm productions from extreme climate events using water smart practices remains paramount. The conservation of water resources for water-scare country such as South Africa is important for agricultural development. Water-smart agriculture aims at addressing issues associated with water availability, water use efficiencies as well as water conservation for optimal production. The study was conducted in Chochocho, Bushbuckridge Local Municipality, South Africa. The aim of the study was to examine the adoption of water smart agriculture, determine the efficient water practices employed by farmers in the study area. Random sampling method was employed, and data was collected using structured and semi-structured questionnaires and focus group discussion. Furthermore, the descriptive and inferential statistics were used to explain responses from respondents and the Statically Package for Social Sciences (SPSS 27) software were used for the analysis. The study found that farmers' adoption of water smart practices was hinged on several heterogeneous variables. The study recommends amongst others the need to conserve water for agricultural production, and water infrastructural development for local food security must be improved. Additionally, water demand and supply management issues must be addressed.

Keywords: adoption, agriculture, water, farmers, efficiency, and productivity

[06]

**EFFECT OF FOLIAR APPLICATION OF ZINC NANO FORMULATIONS ON UPTAKE OF ZINC IN RICE IN POT CULTURE EXPERIMENT**Nair AS<sup>1\*</sup> and Padmaja G<sup>2</sup><sup>1</sup>*Kerala State Disaster Management Authority, Government of Kerala, Kerala, India*<sup>2</sup>*Jayashankar Telangana State Agriculture University, Hyderabad, India*[\\*aswathysnair067@gmail.com](mailto:aswathysnair067@gmail.com)**ABSTRACT**

Foliar application of zinc is known as an effective way to supplement zinc to rice crop. Zinc sulphate is widely used as a foliar spray for rice crop. Foliar application of nano formulation is being used increasingly in agriculture sector. Pot culture experiment was conducted in green house, Department of Soil Science and Agriculture Chemistry, PJTSAU, Rajendranagar, to find out the effect of foliar application of nano formulation on the uptake of zinc in rice crop. The soil used for pot culture experiment was red soil. The initial characteristics of soil was sandy loam in texture with slightly alkaline texture with zinc content of 0.52 mg kg<sup>-1</sup>. The pot culture experiment comprised of 10 treatments with completely randomized block design with 3 replications consisting of four levels of liquid nano formulations and two levels of zinc sulphate (21% Zn). Two sources of nano formulations used in study were bio-Zn (6% Zn) and nano- Zn (3% Zn) supplied from M/S. Prathishta industries, Alwal, Secunderabad The treatments consisted of T1(Control (RDF + water spray), T2(RDF +0.2% ZnSO<sub>4</sub> spray), T3(RDF +0.5 ml/ l nano-Zn spray), T4(RDF +1 ml/ l nano-Zn spray), T5(RDF +1.5 ml/ l nano-Zn spray), T6(RDF +2 ml/ l nano-Zn spray), T7(RDF +1.5 ml/ l bio-Zn spray), T8 (RDF + 3.0 ml/ l bio-Zn spray), T9(RDF + 4.5 ml/ l bio-Zn spray) and T10(RDF +6.0 ml/ l bio-Zn spray). The spraying was done at three times during the crop growth stage. The zinc uptake was recorded at tillering, at panicle initiation and at harvest stage. The zinc uptake increased from tillering to harvest and recorded highest values with foliar application of 0.2% ZnSO<sub>4</sub> along with RDF (4.26 g pot<sup>-1</sup>) followed by bio-Zn and nano Zn. Considering the different levels of bio-Zn, 3.0 ml/ l bio-Zn spray along with RDF reported highest zinc uptake of 4.01 g pot<sup>-1</sup> followed by T7, T9 and T10. Among the different levels of nano-zinc, RDF +2 ml/ l nano-Zn spray (T6) recorded highest zinc uptake of about 3.66 g pot<sup>-1</sup> followed by T5, T4 and T3. From the study, it is clear that nano formulation at lower concentration did not have any toxic effect on rice and had positive impact on rice in terms of zinc uptake.

Keywords: Foliar application, rice, nano-Zn, Bio-Zn, ZnSO<sub>4</sub>, zinc uptake

[07]

**POVERTY AND VULNERABILITY: A SYSTEMATIC LITERATURE REVIEW**

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Poverty reduction remains the one of the most important development challenges around the world. Poverty is closely related to vulnerability (to poverty), but not exactly the same. Poverty is an ex-post measure of household welfare that recognizes the poor at a point time. However, vulnerability is a forward-looking concept, which is estimated by the dynamics of consumption or income in the past. Besides, vulnerability is an important aspect of poverty analysis, which can be regarded as a dynamic dimension. Specifically, a household may currently face poor, but may escape poor in the near future. On the other hand, a household may not poor today, but may fall into poor tomorrow. Hence, a thorough understanding of the nature of poverty and vulnerability is critical for the formulation and implementation of poverty reduction policies, particularly in developing countries. In addition, a significant number of prior studies only focused on the estimation of poverty and vulnerability, whereas no research have been done on the research dynamics of poverty and vulnerability over the past few decades through the methodology of systematic literature review. The objective of this study therefore is to systematically review the growing body of literature on poverty and vulnerability, and to identify the mechanisms of the relationship between poverty and vulnerability. The findings of systematic review indicated that the Foster-Greer-Thorbecke (FGT) index developed by Foster *et al.* (1984) was a generalized poverty measure. Meanwhile, three principal approaches widely used for estimating vulnerability to poverty were identified as follows: i) vulnerability as expected poverty (VEP), ii) vulnerability as low expected utility (VEU), and iii) vulnerability as uninsured exposure to risk (VER). Furthermore, the findings of this study suggested that there exists a dynamic interaction between poverty and vulnerability. Hence, policy makers and practitioners should pay more attention to this mechanism when formulating and implementing poverty alleviation strategies.

Keywords: poverty, vulnerability to poverty, dynamics, systematic literature review

[08]

## DENITRIFICATION BARRIERS TO REDUCE NITROGEN POINT POLLUTION FROM RURAL AREAS

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### ABSTRACT

In agricultural areas, manure storage locations are easily and inexpensively sited directly on the ground, then they are strong point sources of nitrogen pollution and are not inadequately protected against toxic leaching to groundwater. The present study summarizes our experience in the construction and optimization of denitrification barriers (DBs) for protecting groundwater from mentioned pollution (nitrate and ammonium). DBs as organic manure plates were constructed at manure storage sites in the farms in Central Poland. The main component of vertical and horizontal deposits in these barriers is a mix of carbon substrate: pine sawdust, straw, brown coal and charcoal lime, in the form of a horizontal layer directly under the manure and a vertical layer around the manure. Effective reduction of nitrate and ammonium were compared with water temperature, pH, dissolved oxygen and water table depth. The greatest reduction of mentioned nutrients was observed in DBs with the highest inflow of load of nitrogen compounds demonstrated a 50% reduction of  $\text{NO}_3^-$  (max inflow ~ 600 mg/L), and the reduction of  $\text{NH}_4^+$  30% (max inflow ~ 25 mg/L). Statistical analyses showed that the water table depth in DBs had the most significant effect on nutrients reduction efficiency. The reduction of the monitored nitrogen compounds also occurred in the temperatures below 6°C, due the winter time. Considering the growing interest of decision-makers (responsible for water quality) solutions that are simple, economical attractive and use the natural potential of the environment, the proposed DBs could be a longtime, resistant on low temperature and also drought, protection against a manure as a point source of pollution. Study supported by projects MIKRAZO PBS1/A8/0/2012 and AZOSTOP TANGO2/339929/NCBR/2017

Keywords: manure, nitrate, ammonium, organic plates, water protection

[09]

## ASSESSING APSIM UPLAND RICE, BIOCHAR AND SOIL NUTRIENT MODULES IN THE GUINEAN SAVANNA ZONE (NYANKPALA) GHANA

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### ABSTRACT

The Agricultural Production System simulator (APSIM) is a cropping modeling program that is employed to address research on intercropping systems. We tested it at Guinea Savannah zone to increase nutrient and nutrient use efficiency to alter agricultural practices in rice-based farming system. Our approach was to calibrate and test the models Upland rice-*Oryza sativa* and cowpea-*Vigna unguiculata*. intercrop, the interactions between crop growth and soil nitrogen (N), surface organic matter, biochar and the assessment of model projections against independent data sets. During calibration, parameters for crops and soil were developed to ensure that the model adequately captures soil nutrient dynamics under three different biochar plus half rate of inorganic fertilizer root mean square error (RMSE). Soil inorganic N dynamics RMSE 0.18 and 0.216kg N ha<sup>-1</sup> for 2018 and 2019 respectively, contrasting soil N mineralization patterns under the combination of biochar and inorganic fertilizer applications RMSE 3.86 and 3.18kg N ha<sup>-1</sup> for 2018 and 2019 respectively, straw N uptake RMSE 6.71 and 6.67kg N ha<sup>-1</sup> for 2018 and 2019 respectively, grain N uptake RMSE 478.62 and 605.33 kg ha<sup>-1</sup> for 2018 and 2019 respectively. The calibrated model was evaluated against independent data on grain yield RMSE 315.18 and 460.04 kg ha<sup>-1</sup> for 2018 and 2019 respectively, straw production RMSE 183.64 and 100.08 kg ha<sup>-1</sup> for 2018 and 2019 respectively and with a highly acceptable yield, particularly with respect to return-N relations. APSIM has proven to be a reliable model for research and decision-making to improve production systems in upland rice-cowpea intercrop in Nyankpala.

Keywords: calibration, stimulate, nutrient use efficiency, biochar

[10]

## **INTERDISCIPLINARY FUTURE SCENARIO WITH 100PROSIM: FEWER ANIMAL FOODS PROVIDE SPACE FOR RENEWABLE ENERGY**

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### **ABSTRACT**

The climate crisis combines land scarcity, high meat consumption, grubbing-up and environmental disasters. Agriculture needs land to ensure food security. In addition, much forestland is needed to store the greenhouse gas carbon dioxide. Access to cleaner energy sources and technologies also helps mitigate the climate crisis and the efficiency of wind- and solar-energy-infrastructures is recognized. These energy sources also require land. This raises the question of how land can be used efficiently to ensure food security, forestland and renewable energy in the context of the climate crisis. Scientific approaches are to save land area from animal husbandry by reducing animal products. Meat production is particularly resource-intensive and requires more area than crop products. The project “Future Discourses in Environmental Communication” at Osnabrück University of Applied Sciences addresses different social groups in order to discuss the climate crisis, energy system made of 100% renewable energies and land consumption. For this purpose, targeted workshops are conducted in combination with a simulation tool for 100% renewable energy scenarios. The tool, based on Microsoft Excel, simulates for the participants the potential area for energy production from renewable energies as well as the relationship to energy consumption. The results of the workshops show that participants are increasingly taking up the approach of saving land from animal husbandry by producing and consuming less animal and more vegetable-foods. Consequently, there is enough space for a future based on 100% renewable energy. In general, meat consumption is related to political attitudes. Those who consume less meat are considered more environmentally conscious. The hypothesis could therefore put forward that the participants want to show their climate and energy awareness by criticizing meat consumption.

Keywords: renewable energy, climate crisis, land area, animal food, energy sources

[11]

## APPLICATION OF SILICA NANOMATERIALS FOR MITIGATION OF ECTOPARASITES IN ANIMAL AGRICULTURE

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### ABSTRACT

Ectoparasites on farm animals cause considerable economic loss in animal agriculture. In response, engaging in unsustainable pest management practices as excessive use of chemical pesticides has further aggravated the issue into a global ecological catastrophe. Chemical pesticides not only have introduced artificial selectivity to parasites but also aided severe water and land pollution. Consumption of pesticide-contaminated farm products has resulted in dire health consequences upon consumers. Hence, alternative novel pesticides and dose minimization strategies for available conventional pesticides are encouraged in livestock industry. Recently, nanomaterials, such as polymers, nanocrystals, lipid nanoparticles and nanoporous silicas have been employed to develop nanopesticide formulations for sustained release and enhanced efficacy. Among these nanomaterials, nanoporous silicas have unique properties including high porosity for payload, rigid framework, ease of fabrication and excellent biocompatibility which are ideal for agriculture applications. Silica nanomaterials pose entomotoxicity. It is absorbed to lipid cuticle of insects via physisorption and cause insect death by physical means. Besides, silica nanoparticles also serve as strategic delivery agents for conventional pesticides. Unique morphologies of silica nanoparticles assist the target delivery. For instance, silica nanoparticles with rough surface morphology reported to perform dual adhesion to animal hide and insect surfaces enhancing the insecticidal capability of encapsulated pesticide. Functionalization of silica surface from chemical moieties influence the surface charge of particles and hydrophobicity. Surface functionalization caters the sustained or stimuli-responsive pesticide release from porous silica nanomaterials. Silica nanoformulations reinforce the delivery mechanism of conventional pesticides by overcoming inherent limitations as inadequate rainfastness, rapid UV degradability, low potency and ineffectiveness. As sustainable delivery agents, silica nanomaterials demonstrate promising prospects in extending the product life of conventional pesticides.

Keywords: agriculture technology, porous silica nanoparticles, nanopesticides



[12]

## AGRICULTURAL HERITAGE: THE STATE OF NATIONAL AND INTERNATIONAL PROGRAMS IN BRAZIL AND ITALY

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### ABSTRACT

Agricultural systems should not be characterized only by its agricultural value, as it is inserted in several domains of social, cultural, geological, and historical aspects. This research has been carried out to present and compare the current state of agricultural heritage programs and their development in Brazil, Italy, and the Globally Important Agricultural Heritage Systems (GIAHS) by the Food and Agriculture Organization (FAO). To this end, the history and the extension of these programs and sites were recovered, the agricultural landscape diversity, the development of the regions, along with the communities, entities and government bodies involved were identified. Through the combination and quality of technical assessment and communities description, the analyzed agricultural heritage programs prove to be an endless source of useful information to the definition of policies aimed at rural areas, in addition to serving as a monitoring tool for many issues in regards to cultural landscape (e.g. climate change, geohazards, deforestation, etc.). Moreover, it shows the engagement of these countries in engaging national policies and entities on the promotion of agricultural heritage programs as major steps for investing on the “greening” of agricultural policies at different levels. Ultimately, these programs can certainly be improved, altered and adapted according to their function, context, demands, and public machinery, taking into consideration, that the agricultural systems surveyed do not just favor social and economic equity, but can also work as role models for technological innovations in the future of agriculture. Even further, being replicable in different regions of the world.

Keywords: agriculture, heritage, traditional communities, giahs, landscape, public policies

[13]

## **STRENGTHENING AGRIPRENEURSHIP @ NEW NORMAL COVID-19**

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### **ABSTRACT**

The Indian economy is basically an agrarian economy; it can serve as a platform for agricultural entrepreneurship, food processing and other allied activities. The rapid growth of agripreneurship Post COVID-19 is essential not only for self-reliance but also for meeting the food and nutritional security of the people as well as to reduce poverty and improve the quality of life. The present paper aims to explore the possibilities of agripreneurship for smallholder farmers and strategies for profitable business. The data revealed that agri-business enterprises in the areas of production, processing, marketing, packaging, transportation, wholesale and retail marketing can be established by the farmers as they contribute in different ways to value and supply chain elements and these can increase the income level and provide employment opportunities. Agripreneurs can increase their profits and create value of their enterprise through different strategies, such as (i) diversifying; means increasing the number of products being produced and sold, (ii) lowering cost; includes finding more efficient resources and production systems for increasing volume to reduce the per-unit cost, (iii) growing the size of the business as well as farm; by increasing sales, capacity expansion, replication and modernization, (iv) adding value to the enterprise; means to increase income by adding value to existing products to meet changing market and consumer demands; (v) specializing; being unique to receive the full attention of the market; (vi) differentiating the product from others to find a well-defined market niche; (vii) integration, horizontal and vertical; (viii) stabilizing; strategies involves various ways of maintaining the size and organization of the farm business at its current level. With an aim to boost innovation and agripreneurship, the Government of India has also introduced various schemes and policies. Entrepreneurship in agricultural sector Post COVID-19 can be a key factor for the survival of farming community in this ever-changing global economy.

Keywords: agripreneurship, agri-business, post COVID-19, strategies

[14]

## BIOFILM AMELIORATORS CAN BRING A PARADIGM CHANGE TO AGRICULTURE AND THE ENVIRONMENT

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### ABSTRACT

Excessive use of chemical fertilizers (CF) and greenhouse gas emissions have led to stagnating crop yields and climate changes, respectively. Finding ways to secure foods for increasing population in eco-friendly manner is the need of the hour. Microbial biofilm ameliorators like Biofilm biofertilizers (BFBF) have shown the potential of achieving food security and environmental protection. Present study investigated the effects of BFBF on crop production and soil carbon sequestration (SCS) in large scale rice cultivation in Sri Lanka. Here, the BFBF practice and farmers' current CF alone (FC) practice were compared in 25 different locations in major paddy growing districts during three consecutive seasons. The BFBF application increased crop yields by ca. 20%, while cutting down CF up to ca. 50%. If we could expand the BFBF practice to entire paddy cultivation (i.e. 1 Mha year<sup>-1</sup>) that would bring a paradigm change to agriculture and the environment. This is because microbial effects exerted from the BFBF to the soil largely contribute to increased microbial diversity, soil carbon accumulation and improved nutrient use efficiency. The comparison of costs to the government showed that the BFBF practice is cheaper by Rs. 9,800 ha<sup>-1</sup> than the FC practice. Thus, the increased yield would increase farmer's income over Rs. 50,000 ha<sup>-1</sup> season<sup>-1</sup>. In addition, SCS in the BFBF practice would add another Rs. 1 billion to the country's economy through carbon trading, and the overall contribution of the BFBF practice would be about Rs. 10 billion annually. Environmental benefits like locking toxic compounds and heavy metals in the soil organic matter and reduced N<sub>2</sub>O emissions would also contribute immensely to lower soil and human health costs and to mitigate climate change, respectively.

Keywords: biofilm biofertilizer, carbon trading, climate change, paddy cultivation, rice yield

[15]

## ANALYSIS OF CONSUMERISM ON ENVIRONMENTAL SUSTAINABILITY

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### ABSTRACT

Global environmental sustainability has led people to focus on viable consumption behavior. Problems, such as climate change, ozone layer depletion, exploitation of natural resources, and increasing contamination of air, water and soil, increasing carbon emissions, are a continually growing concern worldwide. All these issues are raising questions regarding protecting the environment and devising sustainable strategies for protecting the environment. The present study focus on the knowledge of the respondents regarding effects of consumerism on environment, causes of environmental degradation, responsibility of consumers and role of organic agriculture in environmental sustainability. The methodology used was quantitative and descriptive, through survey of 240 consumers and correlation analysis relationship between constructs. The results revealed that the major effects of consumption of non-green goods was environmental pollution and global warming reported by 98 per cent of respondents, health degradation by 93 per cent followed by 90 per cent respondents who considered greenhouse gas production, deforestation and waste accumulation on this earth. The respondents were of the opinion that use of energy efficient equipment, organically grown foods, buying green products and changing lifestyle are important for environmental sustainability. They had a positive attitude towards saving the environment and human health by adopting organic products for day to day living but the price of green products was the major factor that affected their buying behavior. The correlation analysis values were significant ( ) which indicate that a positive relationship exist between knowledge, attitude and practice of respondents towards environmental sustainability and green consumerism. Based on the results, it is suggested that organic agriculture, dairy and poultry production and green consumption should be promoted to improve the quality of life and sustainability of the environment. Organic agriculture plays a role towards sustainable utilization of resources in food production as well as help in developing green economy with less pollution and greenhouse gases; ultimately climate change.

Keywords: environment, sustainability, organic consumption, green consumerism

[16]

**A COMPARATIVE STUDY OF ENVIRONMENT RISK ASSESSMENT (ERA)  
GUIDELINES OF DEVELOPING AND DEVELOPED COUNTRIES INCLUDING  
BANGLADESH**

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**ABSTRACT**

Genetically Engineered (GE) plants are the need of time for increased demand of food. According to the report of International Service for the Acquisition of Agri-biotech Applications (ISAAA), a total of 29 countries produced GE plants in 2019. A complete set of regulations need to be followed from the development of a GE plant to its release into the environment. The whole regulation system is categorized into separate stages for maintaining the proper biosafety. Environmental Risk Assessment (ERA) is one of such crucial stage in the whole process. ERA identifies potential risks and its impacts through science based evaluation where it is done in a case by case study. All the countries which deal with GE plants follow specific guidelines to conduct a successful ERA. In this study, ERA guidelines of 4 developing and 4 developed countries including Bangladesh were compared. ERA guidelines of countries such as India, Canada, Australia, the European Union, Argentina, Brazil and US were considered as model to conduct the comparison study with Bangladesh. Initially, ten parameters were detected to compare the required data and information among all the guidelines. Surprisingly, an adequate amount of data and information requirements (e.g. If the intended modification/new traits of interest has been achieved or not, Growth habit of GE plants, Consequences of any potential gene flow upon the cultivation of GE plants to sexually compatible plant species, Potential adverse effects on the human health etc.) matched between all the countries. However, a few differences of data requirement (e.g. Agronomic conventions of non-transformed plants, Applicants should clearly describe experimental procedures followed etc.) were also observed in the study. Moreover, it was found that only a few countries provide instructions on the quality of the data used for ERA. If these similarities are recognized in a more framed manner then the approval pathway of GE plants can be shared.

Keywords: GE plants, ERA, harmonization, ERA guidelines, information and data requirements

[17]

**ASSESSING THE ADOPTION OF CONSERVATION AGRICULTURE TOWARDS  
CLIMATE CHANGE ADAPTATION: A CASE OF NKOMAZI, MPUMALANGA  
PROVINCE**

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**ABSTRACT**

Climate change is a threat to agricultural productivity and the overwhelming effects of climate change hinders the quest for sustainable agriculture, with the aim of satisfying the increasing demands for food and fiber. Adaptation to the ever-changing climate is a necessity for the agricultural sector. The study was conducted in Nkomazi Local Municipality. The study assessed the adoption of conservation agriculture in relation to climate change by smallholder farmers. Focus group discussion, structured and semi-structured questionnaires were used to randomly collect data from selected smallholder farmers. The data was analyzed using the binary logistics regression model to determine adoption behavior of farmers in the use of conservation agriculture. Logistic regression result shows that several predictor variables were found to significantly influence the adoption behavior of smallholder farmers in the area. The study noted the existence of significant variables to include age, education, household size, income, number of children, and adoption of conservation agricultural practice. Furthermore, thoughtful decision process and smallholder farmers' capacity development and training on conservation techniques must be accentuated.

Keywords: adaptation, climate, agriculture, conservation, adoption, decision

[18]

## CHARACTERIZATION OF ROOT GROWTH UNDER DROUGHT STRESS IN RICE CULTIVATION

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### ABSTRACT

Roots play an important role of connecting the plant to the soil and to the atmosphere. The growth and development of plant above-ground parts depends on the acquisition of soil nutrients and water, and so are strongly associated with root morphology and physiology. Root characteristics, particularly the root depth is likely to increase plant water uptake and resist drought. Root growth of lowland rice is generally considered as shallow due to its adaptation to flooded conditions. Despite the genetic variations in root growth, there are different adaptive responses and mechanism of plant roots under extreme environmental conditions. This study was a part of a research based on irrigation in rice cultivation on evaluating the root growth changes of irrigation experiment-studies conducted under different soil moisture stress conditions. All these experiments were designed using Bg300 rice variety and were irrigated based on different soil matric potential threshold levels. One field experiment, a plant house experiment, a pot experiment, and a container experiment were conducted in consecutive years from 2013-2015. Different root growth characteristics, such as maximum root length, root dry weight and total root length were measured. Total root length was measured using Modified Newman method and Image J software. All roots were used in the analysis since root separation was tedious and after careful uprooting, the results were compared. Weekly measurements were taken for the comparison. For wet regimes roots were concentrated at base and had greater horizontal development, whereas in dry regimes, more vertical distribution was observed. There was no significant difference observed in maximum root length measurements, though there is an increasing trend in length variation with drought stress in all treatments.

Keywords: rice, root growth, water productivity, soil matric potential, drought stress

[19]

**SCREENING OF CADMIUM SAFE RICE CULTIVAR IN BORO SEASON IN BANGLADESH**Kibria KQ<sup>1\*</sup>, Atikul IM<sup>2</sup>, Azharul IM<sup>3</sup> and Zaber HM<sup>1</sup>

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**ABSTRACT**

Bangladeshi people consume more rice and hence it is the major route of entry of cadmium (Cd) in human body. Therefore, Cd content in rice grain is very important to regulate this Cd intake. Rice varieties considerably differ in their ability to accumulate Cd in grain due to genetic variations. Hence, screening for Cd safe rice cultivar is one of the effective method to reduce Cd in rice. The main objective of the study is to identify Cd safe rice cultivar in boro season in Bangladesh. A pot experiment was conducted using 8 HYV rice varieties (SL-8, BR-28, BR-58, BR-67, BR-74, BR-82, 1203 and Tej gold) in boro season at control, 5 and 10 mg Cd kg<sup>-1</sup> soil condition. At maturity plants were harvested and agronomic parameters were recorded. Grain and soil bioavailable Cd content was determined in ICP-OES. Soil Cd level variably affect rice plant agronomic parameters that also varied with variety. Soil bioavailable Cd concentration rises with the addition of Cd. Grain Cd content generally increased with increasing soil Cd content. However, grain Cd accumulation noticeably varied among rice varieties. There are about 2.8 fold (lowest 0.285 mg/kg for SL-8 and highest 0.8 mg/kg for BR-82) variations in their grain Cd accumulating capacity among the rice varieties when grown under 10 mg Cd kg<sup>-1</sup> soil condition. At elevated soil Cd, SL-8 variety deposit lowest Cd in grain and hence, this is the Cd safe cultivar. The correlation between grain Cd and soil bioavailable Cd was found high (>0.9). Among the varieties cultivated in boro season in Bangladesh, SL-8 variety may reduce Cd deposition in human body.

Keywords: rice grain, cadmium, bioavailable Cd, safe cultivar, health risk



[20]

## EFFECT OF NUTRIENT MANAGEMENT AND CROP ESTABLISHMENT ON PRODUCTIVITY OF MUSTARD IN LATERITE SOIL OF WEST BENGAL

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### ABSTRACT

Mustard is the second most important rabi oilseed crops in India occupying 6.51 mha acreage, 7.67 mt production and 1179 kg ha<sup>-1</sup> productivity. The productivity is quite lower than other developed countries mainly due to suboptimal application of fertilizers and cultivation on marginal lands. Among the seven edible oilseeds cultivated in India, rapeseed mustard contributes 28.6 per cent in the total oilseeds production and ranks second after groundnut sharing 27.8 per cent in the India's oilseed economy. The gap between production and demand of oilseeds is progressively widening, therefore, the production of oilseed is to be increased for self-sufficiency. Adaptation of system of mustard intensification (SMI) may be one of the ways for increasing productivity for fulfilling the future demand. A Field experiment was conducted during rabi season of 2018-2019 at Agricultural Farm, Palli Siksha Bhavana, Visva-Bharati, Sriniketan, with mustard variety "Divya 33" to study "Effect of crop establishment methods and nutrient management on mustard (*Brassica juncea*) in lateritic soil of West Bengal". The field experiment was carried out in split plot design with three replications in which two crop establishing techniques i.e. Drilling and transplantation and four nutrient managements viz. NM1 = 60:30:30 (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup>), NM2 = 70:35:35 (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup>), NM3 = 80:40:40 (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup>), NM4 = 90:45:45 (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup>). The results showed that establishment method exerted significant influence on all the growth parameters and production on mustard under study. The crop under transplanting method of establishment recorded maximum plant height, leaf area number of leaves, crop growth rate and dry matter accumulation over conventional method of crop establishment. Transplanting method of establishment recorded higher number of leaves plant<sup>-1</sup>, branches plant<sup>-1</sup>, siliquae plant<sup>-1</sup>, seed siliqua<sup>-1</sup>, seed and Stover yield in comparison to those from crops grown under drilling method. Transplanting method of crop establishment recorded maximum gross return, net return and B: C ratio of mustard. The nutrient management showed positive and favorable influence on improving almost all growth and yield parameters of mustard under study. The fertilizer dose of NM4 i.e. 90:45:45 (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup>) exerted significant effect on increasing the growth attributes such as plant height, number of branches plant<sup>-1</sup>, dry matter accumulation, leaf area, number of leaves, crop growth rate, yield attributes such as number of siliquae plant<sup>-1</sup>, number of seeds plant<sup>-1</sup> and test weight, seed and stover yield and economics (gross return, net return and B:C ratio) of mustard. From the present study it may be concluded that transplanting method of crop establishment technique with 90 kg N, 45 kg P<sub>2</sub>O<sub>5</sub> and 45 kg K<sub>2</sub>O ha<sup>-1</sup> may be promoted for improving the productivity of the mustard crop in lateritic soil of West Bengal.

Keywords: nutrient management, mustard, SMI, transplanting, lateritic soil

[21]

## SMARTAGRICHAIN: A BLOCKCHAIN BASED SOLUTION FOR AGRIFOOD CERTIFICATION AND SUPPLY CHAIN MANAGEMENT

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### ABSTRACT

Management of certification issuance and product counterfeit verifications in the Agrifood supply chain are very serious and reaching problems nowadays. The currently existing management systems for this process are either outdated or have significant issues when it comes to security, trust, traceability, management or product certification. The introduction of Blockchain technology, due to its intrinsic properties, has the potential to solve identity, ownership, data temper, traceability and certification issues. This is possible due to the unique identity of each actor and signing verification at each transaction/action. The decentralized nature and constant verification of the chain state also contributes to this security and trust in the system. The proposed solution does not compromise currently existing features, but it will however allow all the actors to take part in the AgriFood supply chain system and constantly monitor its actions. The SmartAgriChain project intends to implement a supply chain and certification system based on Hyperledger Sawtooth that will be capable of identity management, hierarchical users/organizations, significant scalability, low costs, low energy consumption and compatibility with legacy systems. In this article we will explore and explain the system design and architecture in detail as well as a cost projection based on the number of nodes of the distributed system.

Keywords: agriculture, agriFood, certification, sawtooth, supply chain

[22]

## DEVELOPMENT OF ORGANIC FARMING SYSTEMS IN WESTERN INDIA

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### ABSTRACT

Organic agriculture is a holistic production system largely based on principle of optimization of factors production and natural resource management. Development of integrated organic farming systems are important for better productivity, profitability and optimum utilization of resources. In this regard, to study various aspects of integrated organic farming systems, experiments were conducted under ICAR- All India Network Project on Organic Farming (NPOF) during the 2015-16 to 2019-20 at Agricultural Research Station, Udaipu, India. An integrated organic farming system for 0.45 ha consisting of field crops in 0.25 ha (sweet corn + blackgram during kharif and wheat during rabi), fodder crops in 0.05 ha. (fodder maize + fodder cowpea during kharif and berseem in rabi and sesbania green manuring during zaid), vegetables in 0.10 ha (okra and carrot), fruit crop in 0.04 ha (guava) and compost unit in 0.01 ha were evaluated . The total maize equivalent yield of 51496 kg/ha and net return of Rs. 58769/ha was obtained during 2019-20. The total maize equivalent yield of 5917 kg/ha and net return of Rs. 61169/ha was obtained on the mean basis of results during 2015-16 to 2019-20 from the farming system. This was found suitable for recommendation to farmers practicing organic farming in western India.

Keywords: organic farming, farming system, maize equivalent yield, net return, India

[23]

## INNOVATIVE ORGANIC BARRIER FOR REDUCING NITROGEN EMISSIONS FROM ARABLE LAND AND OTHER USABLE AREAS ON THE FARM

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### ABSTRACT

Intensively used farmland and organizational land in the area of the farm where natural fertilizers, silage and feedstuffs are stored, are classified as non-point sources of pollution. From such areas, mainly nitrogen and phosphorus compounds are emitted, which contribute to the outrage of environmental standards and affect to the degradation of water and land ecosystems. The aim of the study was therefore to test the efficiency of an innovative organic barrier, in removal of fertilizers-originated pollutants i.e. nitrogen compounds ( $\text{NO}_3^-$ ,  $\text{NH}_4^+$ ). The organic barrier proposed in agricultural areas consists from generally available organic materials (straw, sawdust, brown coal) and can built highly effective biogeochemical zones. It is also a simple and low-cost solution. This innovative biotechnology is characterized by no interference with the landscape and is highly safe for the environment. The method is ecological and fits in with the idea of circular economy and sustainable development. The research was conducted between November 2018 and May 2020 on a farm located in Łaszczyn in western Poland. Between the arable land and the watercourse, a 100-meter-long organic barrier was built, made of mixed material - straw, sawdust, and brown coal (1: 1: 1). The barrier was about 1.5 m deep and about 1 m wide. Piezometers were installed every 10 meters in front of the barrier, in the middle and behind the barrier, from which groundwater samples were collected for analysis every two weeks. Obtained results showed high reduction of the nitrogen compounds, being: 30% in the case of  $\text{NO}_3^-$  (max inflow – 828, 4 mg/L) and 83% for  $\text{NH}_4^+$  (max inflow – 219, 5 mg/L). These studies have shown that simple organic barriers that are based on natural processes such as anammox, nitrification and denitrification are effective in reducing nitrogen emissions into the environment. Project financed by the European Regional Development Fund under the Wielkopolska Regional Operational Program for 2014-2020, entitled "Development and optimization of an innovative method of reducing significant point dispersed and area pollution in rural areas" (No. : RPWP.01.02.00-30-0010 / 17-00)

Keywords: non-point pollution, diffused nitrogen pollution, ground water protection

[24]

**SIMULATE PLANT GROWTH RESPONSE TO BIOCHAR APPLICATIONS ON  
UPLAND RICE-COWPEA INTERCROP AND INORGANIC NITROGEN AND  
PHOSPHORUS ON A FERRIC LUVISOLS SOIL IN GHANA**

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**ABSTRACT**

A field experiment was conducted on a ferric luvisols in the Guinea Savannah zone, to compare the growth and yield of rice-cowpea intercrop in which three distinct biochar sources (groundnut shells, poultry manure, and corn cobs) was enhanced with inorganic fertilizer to boost their cowpea nitrogen and phosphorus content and were integrated into the soil at a rate of 5t/ha with a depth of 20 cm. It was carried out in 2018-2019 cropping season. A split plot factorial design arranged in a randomized complete block with 4 replications was used. The Agricultural Production Systems Simulator (APSIM) was tested against this dataset. The effect of biochar treatments greatly increases growth of rice. The model performed better in simulating the experimental phosphorus response of the upland rice at high nitrogen levels. The yield of rice was predicted ( $r^2=0.74$  and  $0.85$ ) in 2018 and 2019 respectively. Biochar amendments to input parameters for the phosphorus model, particularly in relation to phosphorus amount and uptake for subterranean soil layers were enhanced and fit between experimental and predicted results. APSIM performed well in predicting the growth of cowpea well-supplied with phosphorus, and the residual biochar and nitrogen benefits to a succeeding upland rice crop, including the response to additional inputs of nitrogen fertilizer.

Keywords: Agricultural Production Systems simulator (APSIM), soil layer, biochar, amendment

# **POSTER PRESENTATIONS**

[25]

**EFFECT OF LCC BASED NITROGEN MANAGEMENT IN MAIZE +  
GROUNDNUT INTERCROPPING AND ITS RESIDUAL EFFECT ON BLACK  
GRAM**

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**ABSTRACT**

Paddy is grown as a major crop not only in Dhenkanal district but also in the entire Odisha. Hence it's a high time to think about the crop diversification as and when possible. Secondly farmers in the rural areas still follow the blanket recommendation of fertilizer application in crops. Therefore, farmers must be taught about the real time nutrient management (RTNM) or site specific nutrient management (SSNM). This experiment comprises of 12 treatments, which are basically a combination of sole maize, sole groundnut, and intercropping of both the crops with Nitrogen application at different critical levels detected by Leaf Colour Chart (LCC) in Kharif. In Rabi we have Black gram in all 12 treatments as a study of pulse growth in residual nutrients which is a common practice in this locality. Hence intercropping, along with temporal arrangement of nitrogen application and inclusion of pulses in the cropping system can be a real time solution for problems like monocropping and excessive use of nitrogenous fertilizer. The experiment was conducted in Kamakhyanagar block of Dhenkanal district, in the two consecutive years i.e 2017-18 and 2018-19. The major objectives were to study the Effect of LCC based Nitrogen management on sole crop, intercrop, sequential crop, crop growth, yield and B: C ratio. In this experiment maize and ground nut were taken as sole crops and as intercrops in 2:1 row ratio (in kharif) and tested N application at full dose (120 kg / ha), no application i.e control plot (0 kg/ ha) and at 3 critical point of leaf colour shade i.e 3,4 & 5. From the statistical analysis, it was observed that, in case of maize, inter cropping was better than sole cropping in growth parameters like plant height, leaf/stem/root dry weight, no of leaves, leaf area, green cob weight, corn weight, dry grain weight per corn. The yield of sole maize at 120 kgN/ha is at par with Maize+ g.nut Ic at 120 Kg N/ Ha. There is a yield advantage in case of g.nut in the second year which signifies the nutrient use efficiency of the system. There is no significant Difference in case of growth parameters in G.nut. Treatments where Black gram followed the sole crop shows the better growth parameters. The yield was not significantly different across all treatments. Hence intercropping should be advised to farmers to have a better cropping system which allow the crop diversification, greater soil health and higher B:C ratio.

Keywords: Intercropping, LCC, market demand, crop diversification, RTNM, SSNM, DFI

[26]

**INVESTIGATION OF TOTAL PHENOLIC CONTENT, ANTIOXIDANT  
ACTIVITIES, AND ELEMENTAL COMPOSITION OF THAI GREEN COFFEE  
BEANS**

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**ABSTRACT**

This study investigates the characteristic properties of single-origin coffee beans from five coffee farms in Thailand (two from Chiang Rai, one each from Phitsanulok, Ranong, and Chumporn). As coffee is widely consumed and is one of the most valuable raw materials in global food trade, identifying the origin of the beans is of high interest for quality assurance and authenticity purposes. To establish baseline data, green (unroasted) coffee beans were used. All five bean samples underwent the washed process, which removed the skin, pulp, and mucilage from the beans. Ground coffee samples were measured for their elemental compositions using X-ray fluorescence, and their water extracts were measured for their total phenolic content and antioxidant activities (DPPH scavenging assay and ferric-ion reducing antioxidant power or FRAP) using UV-vis spectrometry. Whole beans were also measured using XRF for comparison with ground beans. The elemental concentrations were found to change, in different ways for different elements. Potassium and calcium are the most abundant detectable elements in the ground beans. Most element concentrations are non-distinguishable among the two coffee species, except for sulfur which is higher in Robusta than in Arabica. From the spectrometry results, it was established that robusta beans were found to have higher total phenolic content ( $55.33 \pm 4.19$  vs  $38.54 \pm 1.38$  mgGAE/g) and antioxidant activities (DPPH:  $65.23 \pm 3.02$  vs  $48.44 \pm 1.82$  mgGAE/g and FRAP:  $643.09 \pm 41.54$  vs  $427.75 \pm 13.77$  FeSO<sub>4</sub>/g) than Arabica beans. The reported values can be used as a basis for categorizing coffee beans by species and by geographical origins in the future.

Keywords: coffee, provenance, Thailand, antioxidants, elemental analysis



[27]

**RESIDUAL EFFECT OF INTEGRATED NUTRIENT MANAGEMENT IN KHARIF  
GROUNDNUT ON GROWTH, YIELD AND ECONOMICS OF RABI FINGER  
MILLET (*Eleusine coracana* L.) UNDER SOUTH ODISHA CONDITION**

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**ABSTRACT**

An experiment was conducted at Bagusala farm of M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Odisha in 2018-19 and 2019-20 to study the residual effect of integrated nutrient management in *kharif* groundnut on growth, yield and economics of *rabi* finger millet. The soil of experimental site was sandy clay loam, neutral, low in available N, medium in available P<sub>2</sub>O<sub>5</sub> and low in available K<sub>2</sub>O. The experiment was laid out in FRBD with two factors and was replicated thrice. One factor was seed inoculation, comprised of 2 levels, S1: solid carrier based *Rhizobium* and S2: liquid carrier based *Rhizobium*, another factor was integrated nitrogen management with 5 levels, N1: 100% RDN (Inorganic fertilizer), N2: 75% RDN (Inorganic fertilizer) + 25% RDN (FYM), N3: 50% RDN (Inorganic fertilizer) + 50% RDN (FYM), N4: 25% RDN (Inorganic fertilizer) + 75% RDN (FYM), and N5: 100% RDN (FYM). RDF was 20:40:20 kg, N: P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O per ha. The above treatments were given to the proceeding groundnut crop and the succeeding finger millet crop was grown under residual soil fertility status. Two levels of seed inoculation did not show any significant difference on different growth parameters such as plant height, leaf area, CGR and no. of tillers plant<sup>-1</sup> and yield attributes such as 1000 grain weight, no. of ear head plant<sup>-1</sup>, weight of grain plant<sup>-1</sup>. Whereas the level of INM 100% RDN (FYM) recorded highest for all the growth and yield attributes. The highest noted grain and straw yield were 1779 and 2181 kg ha<sup>-1</sup> respectively. But in finger millet cost of cultivation (₹25025/- ha<sup>-1</sup>) was same for all the treatment combinations and the highest recorded gross return (₹64100/- ha<sup>-1</sup>), net return (₹39075/- ha<sup>-1</sup>) and B: C ratio (1.56) from S1N5 and lowest from S2N1.

Keywords: finger millet, groundnut, *Rhizobium*, integrated nitrogen management, growth parameters, yield attributes, yield, net return, B: C ratio

[28]

## ASSESSMENT OF CUMULATED ENERGY DEMAND IN GRAIN MAIZE PRODUCTION IN DIFFERENT TILLAGE SYSTEMS

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### ABSTRACT

Due to the need to protect the environment and preserve natural resources, it is important to find solutions to reduce energy consumption in agriculture. Currently, no-tillage systems are becoming more and more popular in crop production. The aim of the study was to assess the energy use throughout the life cycle of grain maize production in the following soil tillage systems: conventional tillage, reduced tillage and direct sowing. The study was conducted on 30 farms, located in the Wielkopolska region (Poland). Assessment of the direct and indirect energy use in maize production was performed according to the life cycle assessment (LCA) methodology. The study was carried out in from "cradle-to-farm gate", from the manufacturing of means of agricultural production through to the process of crop cultivation and harvesting. The cumulative energy demand (CED) method was applied in order to evaluate the energy use, including energy from both non-renewable and renewable sources. The highest value of CED indicator was found in conventional tillage, and the lowest value was in direct sowing. Among the technological processes in maize cultivation, the largest energy input was related to mineral fertilization. Nitrogen fertilizers are responsible for the greatest environmental impact. Knowledge of factors affecting the CED structure allows better identification of critical areas in crop production processes with high energy consumption. The study was carried out in the frame of the research project funded by the National Science Centre, Poland. Project no 2015/19/N/HS4/03031.

Keywords: Life Cycle Assessment (LCA), cumulated energy demand (CED), environmental impact, tillage systems, maize



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