# ABSTRACT e-BOOK

## National Webinar on
## Sustainable Interventions Towards Resource Conservation and Natural Farming

## 22nd-23rd April 2022




**Editors**

Kaberi Mahanta
Anshuman Kohli
Sontara Kalita
Priyadarshini Bhorali
Naseema Rahman
Sanjay Arora
Atul Kumar Singh



**Organized by**

Academy of Natural Resource Conservation and Management (ANRCM), Lucknow (U.P.)

**In collaboration with**

Assam Agricultural University, Jorhat (Assam)

National Webinar

on

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# Abstract e-book

## National Webinar on

## Sustainable Interventions Towards Resource Conservation and Natural Farming

This edited Abstract e-book includes abstracts of original research works and review articles presented during the webinar to highlight the importance of conservation of natural resources and to popularize the natural farming in the context of present scenario of climate change and degradation of soil and water resources. This abstract e-book is an endeavour of the Academy of Natural Resource Conservation and Management, Lucknow in collaboration with Assam Agricultural University, Jorhat, Assam.

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# THEME - I

## *Conservation of Natural Resources for Food Security and Environmental Safety through Organic and Natural Farming*

# Livelihood Security In Rainfed Areas Through Mixed Cropping Systems

**Meenakshi Gupta, Sarabdeep Kour and Rajeev Bharat**
**Division of Agronomy, FoA, SKUAST-J, Chatha**

An attempt was made to improve production and profitability in rainfed areasof Jammu regionthrough Mixed Cropping Systems.On-farm trial was established from *rabi* 2015-16 to *rabi* 2017-18 in established citrus orchard. A rain water harvesting structure was constructed at the farm,various interventions likegrowing field crops in the inter row spaces of fruit trees, application of recommended fertilizer and manures to the fruit trees as per their age, *etc.*were carried to study the benefits of mixed cropping system. Traditionally, intercropping in fruit orchard was practiced under irrigated situation, but with the harvesting of rainwater it was possible to utilize the land unit efficiently by putting it under cultivation of field crops, which helped in increasing both production and productivity. In general, farmers develop orchards for fresh fruit production and do not consider it for intercropping. The study indicated enhanced yield of citrus fruit trees along with intercrops (wheat and mustard taken in *rabi*season and maize and bajrataken in*kharif*season). The mean increase in fruit yield due to interventions, after three years of study was to the tune of 23.0 percent The production of fruits significantly increased due to intercrops and it was maximum in citrus in association with wheat and mustard (4920 q/ha) during *rabi* 2017-18. Mean yield of inter row crops increased by 33.0 percent for wheat, 32 percent for mustard and 45 percent for maize, due to various interventions. Benefit cost ratio increased to 6.2 after three years of study as compared to 4.68 before interventions. System profitability was also worked out and it was seen that Citrus-Maize-Wheat showed maximum profitability of Rs 414/ha/year, followed by Rs.371/ha/year under Citrus-Bajra-Wheat. It was confirmed that citrus based agri-horticultural systems were effective in bringing about improvement in the soil properties as reflected by the significant increase in organic carbon, available nitrogen, phosphorus and potassium. The study showed that intercrops did not exert adverse effect on the growth and productivity of citrus. The field crops intercropped (raised in the interspaces of the fruit trees) in the orchard provided seasonal revenue to the farm family. Intercropping in citrus was effective in bringing improvement in the soil fertility, leading to a sustainable production system.

***Key words:*** *Agri-horti system, water harvesting, Benefit cost ratio, farm profitability, etc*

# Integrated Nutrient Management In Lakadong Turmeric For Higher Yield In Acidic Soil Of Meghalaya

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Meghalaya is home to a variety of spices of which turmeric (*Curcuma longa* L.) is one of the prominent. The Lakadong one of the finest varieties of turmeric has its uniqueness with a very high curcumin content of about 6-7.5 percent and volatile essential oil (dry) of about 3.6-4.8 percent. The farmers grow Lakadong turmeric traditionally without applying any nutrient sources or sometimes with some household waste and farm yard manure (FYM) resulting in poor rhizome yield. As the organic nutrient sources are limited, it is not possible to meet out the high nutrient demand of the Lakadong turmeric. Use of chemical fertilizers alone may increase the crop yields in the initial years but adversely affects the sustainability at later stage. Integrated use of organic and inorganic fertilizers can improve crop productivity maintaining sustainability. There is an urgent need to develop nutrient management package involving renewable resources of plant nutrients that are locally available to the farmers. Although FYM is commonly used organic manure but is not adequately available. The huge amounts of farm wastes can be recycled effectively by preparing vermicompost (VC). Therefore, the present trial was conducted at School of Natural Resource Management, College of Post Graduate Studies in Agricultural Sciences, Umaim, Meghalaya during 2021-2022 to develop integrated nutrient management package for higher yield of Lakadong turmeric in acidic soil of Meghalaya. The eight treatments *viz.*, $T_1$: 100% N through FYM, $T_2$: 100% N through VC, $T_3$: 75% RDN + 25% N through FYM, $T_4$: 75% RDN + 25% N through VC, $T_5$: 50% RDN + 50% N through FYM, $T_6$: 50% RDN + 50% N through VC, $T_7$: 50% RDN + 25% N through VC + 25% FYM and $T_8$: 100% RDN (120:50:80 kg/ha) were tested in randomized block design with three replications. Significant differences were observed among the various treatments. The maximum plant height, number of leaves and fresh rhizome yield was recorded in $T_7$: 50% RDN + 25% N through VC + 25% through FYM followed by $T_6$: 50% RDN + 50% N through VC. On the basis of results obtained, the farmers of Meghalaya may be advised to practice integrated nutrient management involving 50% RDN + 25% N through VC + 25% through FYM for higher rhizome yield of Lakadong turmeric in acidic soil.

***Keywords:*** *Lakadong turmeric; integrated nutrient management; rhizome yield.*

# Developing Organic Nutrient Management Package for Higher Yield of Black Turmeric in Acidic Soil of Meghalaya

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Organic agriculture is holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. The North Eastern states are by default organic in nature. After Sikkim, the government is aiming to make Meghalaya an organic state, except few pockets where intensive cultivation of vegetables using inorganic fertilizer and chemicals is preferred. Turmeric is an important cash crop in the NEH region and shares about 8.30 per cent of the total production in the country. In Meghalaya, black turmeric is an important cash crop. It has high medicinal values. However, farmers cultivate it without applying any nutrient sources or sometimes may apply some household waste and farm yard manure (FYM) resulting in low yield with poor quality produce. Therefore, the present investigation was carried out at School of Natural Resource Management, College of Post Graduate Studies in Agricultural Sciences, Umiam, Ri-Bhoi district of Meghalaya to develop an organic nutrient management package for getting higher production wherein farm yard manure (FYM), vermicompost (VC) and poultry manure (PM) alone and in different combinations were tested through eight treatments *viz.*, $T_1$: FYM @ 20 t/ha, $T_2$: VC @ 10 t/ha, $T_3$: PM @ 5 t/ha, $T_4$: FYM @ 10 t/ha + VC @ 5 t/ha, $T_5$: FYM @ 10 t/ha + PM @ 2.5 t/ha, $T_6$: VC @ 5 t/ha + PM @ 2.5 t/ha, $T_7$: FYM @ 10 t/ha + VC @ 5 t/ha + PM @ 2.5 t/ha and $T_8$: Control. These treatments were replicated thrice in Randomized Block Design. The soil reaction of the experimental plot was acidic. The results revealed that highest plant height, number of rhizomes and rhizome yield was obtained in $T_7$ i.e., combination of FYM, VC and PM @ 10 t/ha, 5 t/ha and 2.5 t/ha, respectively. Therefore, farmers of Meghalaya may be advised to apply FYM @ 10 t/ha + VC @ 5 t/ha + PM @ 2.5 t/ha for getting higher yield of black turmeric in acidic soils.

***Keywords:*** *Black turmeric, acidic soil, nutrient management, organic sources, rhizome yield*.

# Effect of Organic Sources on Carbon Sequestration Rate Under Different Agro Climate Zones

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Carbon sequestration is a function of several factors like cropping system, management practices, soil types and climatic variables etc. Many soil and crop managing practices have been reported in literature that can enhance soil fertility and carbon sequestration. External application of nutrients either through organic and inorganic sources, integrated nutrient management, organic farming, soil test based fertilizer use. Among these integrated nutrient management practices involving the use of organic and inorganic fertilizer and also greater abundance of crop residue left in the field after harvest which ultimately decompose and a portion of this carbon makes its way into soil organic carbon pool. The long-term fertilizer experiments are being carried in erstwhile Andhra Pradesh and Telangana under four different agro climatic zones, *viz.*, Southern Telangana zone (Rice – Rice and Maize- Onion cropping systems at All India Co-ordinated Research Project on Integrated Farming Systems, Rajedranagar), Northern Telangana zone (Rice – Rice cropping system at Regional Agricultural Research Station, Jagtial), Godavari zone (Rice – Rice cropping system at Andhra Pradesh Rice Research Institute, Maruteru) and Scarce rainfall zone (Groundnut - fallow cropping system at All India Co-ordinated Research Project on Dryland Agricultural Research Station, Ananthapur). Carbon sequestration rate (Mg $ha^{-1}$ $yr^{-1}$) was higher in Godavari zone (-0.02 to 1.04), followed by Southern Telangana Zone (maize-onion) (-0.02 to 0.70), Northern Telangana Zone (0.02 to 0.39), Southern Telangana Zone (rice-rice) (0.03 to 0.16) and Scarce Rainfall Zone (0.01 to 0.13). Among the treatments 50% organic + 50 % inorganic treated plots showed higher sequestration rate than 100% organic and 100 % inorganic treated plots. These results suggest that long-term application of organic manures alone or in combination with recommended dose of fertilizers have resulted in the buildup of soil organic carbon content even under tropical climate. The soils were rich in clay content (Godavari Zone and Northern Telangana Zone) and there was relatively higher soil organic carbon content (Srinivasarao *et al.*, 2009). Fine particles of the soil not only constitute simple (stocking compartment) for carbon (Feller *et al.*, 2001) but also play a very important protective role for soil organic carbon as well as its coarse fraction associated with soil macro aggregates (Chan *et al.*, 2002). With these results, changes in soil inorganic carbon, soil organic carbon, total carbon stock and carbon sequestration rate under long-term fertilizer experiments with various integrated nutrient management treatments.

***Key words:*** *Agro climatic zones, Carbon sequestration rate, Integrated nutrient management*

# Use of Harvested Rainwater in Drip Irrigation for Cultivating Off-Season Polyhouse Crops

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Water is undoubtedly a precious resource used in the agricultural sector. Due to this growing demand for water, there has been a rise in concern over water scarcity and the need for conservation of water. In this regard, rainwater harvesting (RWH) has proved to be a promising solution. RWH is the technology of collecting rainwater during and/or after rainfalls, which can be treated and stored for reuse in various agricultural operations. Furthermore, the climate change era is characterized by intensive rainfall and it can potentially damage agricultural lands. RWH, in this regard, can help to divert heavy rainfall from reaching agricultural lands, protecting crops from damage. Rainwater is a soft form of water and doesn't cause any harm to plants. It is in fact the primary source of freshwater. There are many ways rainwater can be harvested, one of which is by collecting it from the roof. In comparison with other ground catchment methods, this one has the advantage of supplying crops with water that is free of contaminants. An average 100 $m^2$ roof can capture 1000 liters of water in 1cm of rain. Harvested rainwater can also be used in polyhouses. It is possible to reduce the amount of groundwater used for irrigation by collecting rainwater in tanks and then using it for greenhouse/ polyhouse crops. Keeping this idea in mind, an experiment was conducted in the ICR farm of Assam Agricultural University, Jorhat during 2021 for studying the effective use of roof harvested rainwater in cultivating off-season vegetable crops in polyhouse. A bamboo based low cost polyhouse of 100 sq. m (20 m x 5m) was constructed in the experimental farm AICRP on Irrigation Water Management using UV stabilized 200 microns thick polyfilm as cladding material. High value off-season vegetable crops were grown inside the poly house in the sequences of Tomato (February-May) - Spinach (June-July) - Capsicum (September-November) and Cucumber (December-February). The water requirements for the crops grown inside the polyhouse were estimated and the crops were irrigated daily based on water requirement. For irrigating the crops the rain water was collected from the roof top of a farmhouse located adjacent to the polyhouse. The rain water collected from the roof was stored in a concrete tank having a dimension of 7.25 m x 4.5 m x 2 m (Length x Breadth x Height) which can store 65,250 liters of water at a time. The stored rainwater was lifted to a syntax tank from which the poly-house crops were irrigated daily using a gravity-based drip irrigation system. The results based on day to day estimation revealed that during the year 2021 an amount of 1,71,960 liters of rain water was harvested against the requirement of 1,61,640 liters of water for growing polyhouse crops round the year. However, due to paucity of rain during January to Mid-May 2021, an additional source of water was used amounting to 10,450 liters to irrigate the polyhouse crops for 56 days. Nevertheless, 19,665 litres of water remained as balance for the next year.

***Keywords**: Rainwater harvesting, polyhouse, water requirement, drip irrigation*

# Drought-Resistance Turfgrass Management Practices

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Turfgrasses are an essential part of every garden. Supplemental irrigation is frequently necessary to maintain turf growth when rainfall is low and water supplies are restricted. Irrigation of landscape plants such as grass is generally one of the first activities to be put on water consumption limits when there is a lack of rain. Professional turfgrass managers and homeowners are needed to maintain functioning and high-quality turf with less water under such constraints. Leaf wilt (leaf fold and rolling) and leaf flaming (yellowing, tan/brown leaves) are two drought stress indicators that appear as the soil dries up. Leaf wilt is a problem in intensively frequented areas like sports fields and golf greens, where it can cause lasting harm and slow recovery. During a drought, the amount of soil water available for transpirational cooling of leaf surfaces decreases, resulting in greater leaf surface temperatures compared to air temperature. Water conservation strategies such as I incorporating water-efficient plant material into the landscape, (ii) implementing water-saving management practises, and (iii) maximising irrigation efficiency by controlling leaching, irrigation water pooling or ponding, and surface water runoff are all routinely used. Choosing turfgrass species and cultivars with higher drought resistance (deep, healthy root systems and innately low ET) is crucial for supporting growth through transpirational cooling during the summer months, when air temperatures typically exceed this ideal temperature range. On hot summer days, noon watering (about 2 p.m.) can also assist minimise heat stress by reducing transpirational cooling, which is especially beneficial for grass species with low drought tolerance. Mowing at the top of a species' (and cultivars') recommended mowing height range (2 to 3 inches) encourages soil surface shading, deeper roots, and drought resistance. Low to moderate doses of fertilizer nitrogen (with at least 30 per cent delayed release nitrogen) should be used sparingly. During a drought, fertilisation should be avoided on non-irrigated lawn. Avoid high nitrogen levels, which favour fast shoot development (and water utilisation), succulent tissues (which are more drought tolerant), and nitrogen-induced roots depth and number decreases. Dark green is preferable than moderate green since it is healthier. Ensure enough phosphate and potassium levels (based on soil test) over the winter months to aid drought recovery. When there is no indication of a potassium deficit, potassium levels should be between 50 and 75 percent of the nitrogen administered. Water should be used wisely, and water should only be applied as quickly as it can infiltrate the soil surface to reduce surface runoff, and paddling is suggested.

***Keywords:*** *Turfgrass, Drought, Irrigation*

# Direct Seeding of Rice: Boon For Rice Cultivation

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Direct seeding is becoming an important alternative of rice transplanting and spreading rapidly in Samba district, J&K due to labour shortage and escalating cost of production. Present study is an attempt to analyze the economics of direct seeded and transplanted methods of rice cultivation in Samba district. A field study was conducted during Kharif season of 2018, 2019 and 2020, to evaluate DSR with an objective to improve farm productivity and efficiency in Samba district,Jammu. Tillage and crop establishment methods had a significant effect on rice yields. Yield of TPR was significantly higher (2.46 percent) than DSR. Labour and cost saving of 18.45 and 15.56 percent were observed in DSR as compared to TPR. It was revealed that the use of machine labour and irrigation water were saved by 37.88 and 13.77 percent respectively in direct seeded rice as compared to the TPR method of rice production. The B:C ratio was higher in DSR (2.44) as compared to TPR (1.95). The study showed that the TPR could be replaced with DSR to save labour and water.

***Keywords:*** *Direct seeded rice, Transplanted rice Tractor, Water use efficiency, Yield, Benefit cost ratio*

# Soil Microbial Identification And Contribution to Overcome the Stressed Environmental Conditions

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A very important role is played by the microorganisms in the biogeochemical cycles. In order to deal with the accumulation and pollution of organic and inorganic compound, they are therefore attractive candidates for developing new or improving existing biotechnological applications. Microorganisms do have the ability to participate in the bioremediation processes which generally depends on their ability to metabolize toxic substances and to catalyze chemical reactions. Soil microorganisms produce biosurfactants which can have many advantages over the manufacture of chemical surfactants as they are less toxic, more biodegradable, more environmentally compatible, have higher foaming properties, and have specific activity where extreme conditions such as temperature, pH and salinity exist. These soil microbes can be proved to overcome the stressed soil conditions and in response they can help the crops to grow, soil to be enriched again. To study the whole microgenome of soil can lead us to the way in which we can decide what we can do improvise the soil quality and to overcome the stressed conditions creating chaos in the soil. The synergism between the soil microorganisms and the other organisms present in the soil (example; earthworms) can contribute a lot in making up the soil rich. Our research efforts will be directed toward one of the most pressing problems our planet is facing if we can understand and predict how climate change impacts soil microbiomes and ecosystem services. Nutrient cycling and soil carbon may be dramatically affected by changes in the climatic conditions. Climate change and its impacts on soil microbiomes are causing us to gain a greater understanding of how soil microbial capabilities can mitigate the detrimental effects of change. These include manipulating soil microbe communities directly, indirectly through modifying land management practices, and using inoculants as environmental probiotics. A better understanding of how climate change imposes repercussions on the biogeochemical processes that are carried out by the soil microorganisms is essential to allow more accurate predictions of climate impacts to be made and ultimately making it possible to develop microbial strategies to mitigate climate warming and the degradation of soil.

***Keywords:*** *Soil microorganisms, climatic conditions, agriculture.*

# Ratoon Pigeonpea - A Resource Conserving Technique

**Vinay M. Gangana Gowdra[1*] and C. Seenappa[2*]**

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With the escalating scarcity for resources in agriculture it is essential to adopt some of the techniques which are less resource demanding for cultivation of crop. One such technique is ratooning; AsRatooning is helpful in efficient utilization of the resources namely cuts down the land preparation activities, saves considerable amount of labour cost in cultivation of crop and irrigation water required to cultivate the crop. India having a lion share in pigeonpea area as well as production it is having a kind of responsibility to produce more to meet the world's pulse demand. Area under cultivation being diminished year by year and some of the promising results of ratooning in pigeonpea from ICRISAT lead to experiment the potential yielding ability of ratoon pigeonpea under different levels of irrigation, fertigation and mulching levels. The experiment was conducted with twolevels of irrigation ($I_1$: 0.50 CPE and $I_2$: 0.75 CPE), three levels of fertigation ($F_1$: 100% RDF, $F_2$: 75% RDF and $F_3$: 50% RDF) and two levels of mulching ($M_0$: Without mulching and $M_1$: With mulching) under split-split plot designat Zonal Agriculture Research Station, GKVK, Bengaluru. The results revealed that irrigation at 0.75 CPE recorded significantly higher seed yield (611 kg $ha^{-1}$) and stalk yield (2250 kg $ha^{-1}$) compared to 0.50 CPE irrigation level. Among the different fertilizer levels, 50 per cent RDF recorded significantly higher seed yield (515 kg $ha^{-1}$) whereas, 100 per cent RDF recorded higher stalk yield (2108 kg $ha^{-1}$) compared to other fertilizer levels. The plants with mulching recorded higher seed yield (500 kg $ha^{-1}$) and stalk yield (1988 kg $ha^{-1}$) compared to no mulching. Among twelve different treatment combinations, irrigation at 0.75 CPE + 50 per cent RDF + mulching ($I_2F_3M_1$) recorded the higher seed yield (727 kg $ha^{-1}$), water productivity (21.07 kg ha-$cm^{-1}$), gross returns (Rs. 43,591 $ha^{-1}$), net returns (Rs. 27,698 $ha^{-1}$), benefit:cost ratio (2.74) as well as nitrogen, phosphorous and potassium use efficiency (58.12, 29.06 and 58.12 kg $kg^{-1}$nutrient applied, respectively.)than rest of the treatment combinations. Fertigation at 50 per cent RDF recorded higher yield compared to 100 per cent RDF as result of more vegetative growth in 100 per cent RDF which led to imbalance in source to sink relationship and 50 per cent fertigation saves 50 per cent of the nutritional requirement when irrigated at 0.75 CPEalong with mulch.

***Key words**: Drip irrigation, fertigation, mulching*

# Natural Farming: A Sustainable Way to Nurture Soil Health

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The green revolution has helped to feed the world's rising population by dramatically increasing agricultural productivity through the use of fertilizers and agrochemicals during the previous half-century. Green revolution has resulted in increasing the food grain output in India from 115.6 million tonnes in 1960-61 to over 281.37 million tonnes in 2018-19. Widespread use of chemical fertilizers and agrochemicals, which earlier resulted in increased production also has negative environmental concerns such as global warming, water eutrophication, and soil degradation. Soil is a crucial limiting component of agroecosystems that is difficult or impossible to replenish and soil quality is closely related to sustainable crop production. One of the most promising strategy to improve soil health and fertility, conserve soil resources, and establish a sustainable agricultural model, is Natural farming. Natural farming is a form of sustainable agriculture that employs natural sources as inputs, adheres to natural laws, and protects the rights of crops and livestock. This technique works closely with the natural biodiversity of each farmed region, allowing the diversity of living species, both plants and animals,that create each ecosystem to coexist with food plants. Natural farming is resource efficient since it uses less financial and natural resources while generating higher yields.It decouples agricultural production and growth from environmental degradation and biodiversity loss by repairing the quality of soil and water-related ecosystems. Natural farming removes chemical fertilizers and pesticides, reducing ocean acidification and pollution from land-based activities. It might assist to minimize nitrogen and phosphorus leaching from the soil into groundwater degrading the water quality. Rao et al., 2013 conducted a study and revealed that soil organic carbon, available nitrogen, available phosphorus, and available potassium, were all found to be built up to substantial extent with the use of organic manures in maize and sunflower. Soil health could be sustained with organic nutrition due to diversification of soil biota. In topsoil, NF enhanced bulk density, pH, electrical conductivity, urease activity, and nitrate reductase activity; deeper soil showed similar patterns. In comparison to soils under conventional management, NF improved soil physical, chemical, and biological parameters and resulted in a distinctive microbial community structure (Liao et al., 2019). NF positively affects soil health and microbial community composition within sustainable farming system. The widespread usage of NF would aid in the reduction of toxic chemical releases into the air, water, and soil. It will minimize the negative influence on farmer and consumer health, as well as biodiversity. As a response, we must shift our goals away from maximum consumption towards optimum consumption.

***Keywords:*** *Ecosystems, Eutrophication, Soil quality, Sustainable, Leaching, Diversification, Acidification.*

# Traditional Medicinal Practices Used Management of Various Ailments of Livestock by The Farmers of Central Kashmir

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Indigenous Technical Knowledge (ITK) is the knowledge about the local environment that is produced, held and used by indigenous communities and is regarded as part and parcel of their lives. The present study on ITK's was confined to Central Kashmir area that consists of three districts Budgam, Ganderbal and Srinagar of Jammu and Kashmir. From each district two blocks and from each block two villages were selected purposively. From each village 15 respondents were chosen that made a total of 180 respondents for the study. 52 ITK's were documented regarding different disease conditions of the livestock like indigestion, diarrhoea, bloat, mastitis, respiratory conditions, urinary conditions, Foot and Mouth disease (FMD). The ITKs were having higher adoption and awareness levels in each disease condition includes "Solution of tea(Camellia sinensis), salt and sodium bicarbonate" in case of indigestion, "mixture of mustard oil and sodium bicarbonate" in case of bloat, "extract of Shanger (Glycyrhizaglabra),Kahzaban (Arnebiabenthemii), Sepistan (Cordial latiafolia), Dalchini (Cinnamonumzeylanicum), and ginger/Adrak (Gingiberofficinale) in case of respiratory diseases, "feeding of grinded woodworm leaves extract" in case of endo and ectoparasites, "application of red mud and Pambchalan (Rheum webbianum Royle)" in case of abscess etc. The findings of the study revealed that there is wider reliance of the farmers over use of the ITK's for their day to day livestock rearing. An immediate attention is needed from the scientific community and research institutes for extensive and exhaustive research in this widely ignored and unexplored field of knowledge. Also the government and non-government organizations should take effective steps towards the documentation and preservation of this precious indigenous treasure that will be a positive step to preserve the biodiversity, intellectual diversity and will also prevent biopiracy ofindigenousmedicinal techniques.

***Key words:*** *Traditional medicine, documentation, livestock, biodiversity*

# Assessment of Effectiveness And Sustainability of Managed Aquifer Rechargein Sikkim Himalaya: Adaptation to Climate Change

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The main source of water for sustenance of life in the Himalayan region is spring water, which emerges spontaneously from confined and unconfined aquifers and the sustainability of which in current time is threatened by climate change and other natural and anthropogenic factors. According to recent study inSikkim, the maximum temperature in Gangtok has been rising at the rate of 0.2°C per decade and the annual rainfall is increasing at the rate of nearly 50 mm per decade. When long-term meteorological data for Gangtok station (1957–2005) is compared to the trend during the previous few years (2006–2009), these patterns reveal an acceleration, with winters becoming increasingly warmer and drier.Perceptions of the local community captured in recent climate change study in Sikkimover the previous 30 years showed the change in mean temperature and increase in intensity of rainfall. The combined effects of all of these factors are realized in the drying up of a huge number of springs in this region. A survey in Sikkim found that the water production has declined in half of all springs in the State. Thus, various spring shed developmental works has been initiated under schemes like DharaVikasYojna under which 58 springs and two dried hill top lakes has been revived. However, the uncertainties associated with such spring shed developmental work needs to be addressed through systematic assessments of the water balances of artificial recharge schemes in a variety of environments in order to provide guidelines on their effectiveness and sustainability. So, the current study in G.B Pant National Institute Himalayan Environment under Mountain Division Fellowship Program aims to explore good practices of water conservation in Sikkim Himalaya as adaptation to climate change, furthermore, the study focuses on detailed water balance(demand-supply) study and governance for selected spring sheds. Lastly, the study analyzes the cost and benefit of spring recharge activities in order to assess socioeconomic profitability and measure their effectiveness for a long-term solution to water scarcity as an adaptation to Climate Change in the Sikkim Himalaya.

***Key Words:*** *Climate Change Adaptation, Managed Aquifer Recharge, Cost-Benefit Analysis, DharaVikasYojna*.

# Inoculation of liquid plant growth promoting rhizomicroorganisms for the production of quality seedlings in cardamom (*elettaria cardamomum*maton.) Through sustainable practice

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Efficiency of modern agricultural practices are unimaginable without the use of chemical inputs such as pesticides, fertilizers. These practices are creating threat to the environment, soil health, human life etc.To this sustainable agriculture plays a significant role. An experiment was conducted by using microbial inoculantswhich does not useagrochemicalsto evaluate the effect of liquid plant growth promoting rhizomicroorganisms with nine treatments and three replications are maintained at ZAHR, during 2020-21 in cardamom (*Elettaria cardamomum* Maton), Mudigere, Karnataka. Thesemicrobial inoculantsare liquid plant growth promoting rhizomicroorganisms which are special liquid formulations containing not only the desired microorganisms and their nutrients but also special cell protectants or chemicals that promote formation of resting spores or cysts for longer shelf life and tolerance to adverse conditions.The results of study revealed that, combined inoculation of *Azotobacter chroococcum*, *Bacillus megaterium*, *Bacillus mucilaginosus*and vesicular-arbuscular mycorrhizae at 150 days after inoculation in the secondary nursery recordedsignificantly maximum in growth parameters like pseudostem height (63.93 cm), pseudostem girth (5.74 cm), number of leaves (10.33), leaf area (1174.41cm$^2$) per plant, biochemical parameter is total chlorophyll content (2.30 mg/g), root parameters are number of primary (11.30) and secondary roots (78.81), root length (45.39 cm), root thickness (1.71 mm), root volume (13.56 cc) and total dry matter production (5.44 g), quality parameters were tillering percentage (37.1), Dickson quality index (1.26) and volume index (557.17) and microbial population in terms of total bacteria (94.00 *cfu*/g) at $10^{-5}$, fungi (46.00 *cfu*/g) at $10^{-3}$, actinomycetes (23.00 *cfu*/g) at $10^{-2}$ compared to other treatments with conjunctive use of liquid PGPR.

# Curtailing Water Requirement for Makhana Farming: A Case Report

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In view of the economic, nutritive and medicinal importance of makhana (Euryale ferox Salisb.), its seed has been deservedly called as 'Black Diamond'. Makhana has emerged as a super food globally, and given its rapidly rising global demand, the crop holds great promise for eastern India. Makhana farming is many folds more remunerative than the majority of the conventionally grown field crops in India. With increasing realization of its economic prospects, farmers across the country have shown interest in makhana farming. However, the perception of very high water requirement for makhana crop remains a major hurdle for them. Traditionally, it is believed that a water depth of at least 5-6 ft is required for this crop, but recent studies confirm that makhana can be successfully grown in as less as 30 cm (1.0 ft) of standing water; even less (15-20 cm) during the vegetative growth. A farmer in the present case report showed the same. Also, a simple, cost effective and easily applicable technique of "polythene lining of the bunds", substantially reduced the loss of costly irrigation water by lateral seepage through the bunds, reducing thereby the irrigation frequency required for maintaining a minimum-required water depth in Makhana field, particularly before the onset of rainy season (March-May), the water-scare period.

*Keywords: Euryale ferox, Fox nut, Gorgon nut, Polythene lining*

# Crop Waste Biochar Application on Soil Moisture Retention Under Red Gram Crop In Rainfed Agriculture

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The experimental soil of Agricultural Engineering College and Research Institute, Kumulur, Trichirapalli district, Kumulur is under ten years of cultivation of redgram crop, having semi arid climate with annual rainfall of 600mm.The soil is mixed red soils with sandy loam texture and applied with crop wastes Biochar. Biochar is the carbon-rich solid product resulting from pyrolysing of crop biomass in an oxygen-limited environment.. Soil moisture retention studies were conducted with the help of tensiometers /soil moisture meter and gravimetric water measurement. Daily observations on soil moisture percentage were made on surface (S) and sub surface (SS) soils at critical stages of crop under rainfed situation. Monthly rainfall distribution pattern was also recorded. Tensiometer readings were calibrated with the help of gravimetric water content. The rainfall distribution pattern was highly erratic. The total rainfall received during October –November 2017 was 284 mm .The vegetative stage of the crop coincides with that rainfall. The soil moisture % was more in surface soil than in subsurface soil during vegetative stage. At flowering stage, the soil moisture %was more in subsurface soil than in surface soil. This observation was noticed only under biochar applied plots. This showed the higher affinity of biochar for water molecules and also the surface properties of biochar significantly enhance the soil moisture per cent when compared to other non biochar applied plots. Under rainfed condition, if enough soil moisture % was present at subsurface (root zone) crop can deprive soil moisture for its growth thereby surface evaporation loss is minimized. Among the various sources of biochar application cotton stalk bio char @ 2.5 t $ha^{-1}$register highest soil moisture retention % in all the critical stages of crop to the tune of 25-30 % in red soils under rainfed scenario. This indicates application of biochar to soil well served the purpose of soil moisture retention at critical stages of crop growth under rainfed scenario. It needs to be studied for prolonged season.

***Keywords**: Crop wastes Biochar, soil moisture, rainfed*

# Climate Change Mitigation On Agriculture, Ecosystem And Rurallivelihood Of North Eastern Hilly Region

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Globally, climate change is up-to the minute and it creates a great challenge for the local ecosystems of north east hilly region. This region in general is projected to be tremendously disposed to climate change due to its unstable geo-ecological, strategic location, trans-boundary river basins and international borders. Itis an element that affects both socio-economic and cultural life of the people across the world besides influencing only in the ecosystem and environment though with spatially diverse intensity. Changing in the climate is a primarytask for agriculture, food security and rural maintenances for thousands of North East peopleof India. Agriculture is considered as one of the greatest subdivision susceptible to the climate change. More than 60% of the north East hilly population is directly or indirectly depending on agriculture as a basis of livelihood and changing in the climate even now making unpleasantly impact on the lives of the population mainly the poor. In this framework, based on the current signals and scientific hypotheses, recent article offers a logical review of the climate change and its possibly influences on agriculture production, environment and livelihood of human in North East India.

***Keywords:*** *Climate Change, Agriculture, Ecosystem, Livelihood, North East India*

# Soil npk nutrient balance and nutrient uptake in chickpea (*cicer arietinum* l.) As influenced by organic foliar nutrition under rainfed condition

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A field experiment was conducted to study the effect of foliar nutrition in chickpea through organics under rainfed condition in medium black soils at Regional Agricultural Research Station, Vijayapur, during *Rabi,* 2020-21. The experiment was laid out in split plot design with three replications. There were fifteen treatment combinations, consisting five organic sources (vermiwash @ 10%, cowurine @ 10%, jeevamrutha @ 25%, bio digester filtrate @ 25% and urea @ 2%) in main plots and three stage of application (pre flowering, pod initiation and pre flowering + pod initiation) in sub plots. Soil nutrient balances were worked for major nutrients taking the initial soil nutrients status(168N, 31$P_2O_5$ and 342 $K_2O$ kg $ha^{-1}$, respectively), nutrient addition, crop uptake and nutrient left in the soil after harvest. The total uptake of major nutrients N (117.86 kg $ha^{-1}$), P (20.72 kg $ha^{-1}$) and K (72.27 kg $ha^{-1}$) was significantly higher in treatments receiving foliar application of jeevamrutha @ 25% both at pre flowering and at pod initiation as compared to alone application either at pre flowering or at pod initiation stage. The results pertaining to available nitrogen, phosphorus and potassium were substantially superior with foliar application of jeevamrutha @ 25% both at pre flowering and at pod initiation stage (173.38, 33.36 and 344.49 kg $ha^{-1}$, N, $P_2O_5$, $K_2O$, respectively) as compared to other treatments. The maximum gain of NPK nutrients in soil over initial and higher plant nutrient uptake was recorded with the treatment jeevamrutha @ 25% both at pre flowering and at pod initiation stage as compared to other treatments. Further, growing of chickpea had either maintained or enhanced the available nutrients of N, P, and K status in soil.

***Key words:*** *Chickpea, Foliar Nutrition, Jeevamrutha, Organics, Nutrient Balance*

# Assessing Productivity Gap Analysis of Fruit Crops Through Soil Indices for Its Sustainability and Policy Planning

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Soil indices are widely used for evaluation and quantification of soil related constraints on the productivity of fruit crops in any region under similar or diverse agroclimatic condition. Productivity gap analysis is thus crucial for both qualitative and quantitative information generation, possible reasons and revisiting technological hiccup cum breakthrough. Recent data on soil macro and micro indicators was generated from nine mango orchard soils. Indexing of subtropical mango orchards showed low soil available zinc, copper, phosphorus and potassium. The status of soil organic carbon content, soil available manganese and iron was recognized as medium. The maximum nutrient indexing value for zinc (1.30), soil organic carbon (2.44), phosphorus (1.48) and potassium (1.95) was recorded. Interestingly the values of Cu, Mn and Fe were noted as 1.00, 2.00 and 2.00 respectively across all mango growing villages. The distribution pattern of soil organic carbon, available potassium and zinc indicated 19.58, 29.63 and 85.19 per cent in low categories respectively. Soil pH of 7.5 and above was recorded in mango orchards. It was concluded from the recent study that dehydrogenase activity of lower magnitude (<5.0 µg TPF/g/h) in subtropical mango orchard soils while fluorescence diacetate activity was also on lower side i.e. <500µg Fluorescene/g/h sample. Productivity of <20 t $ha^{-1}$ was noted across subtropical mango orchards. Scientific analysis of other field experimentations on mango, guava and other fruit crops over the decades, it was observed that wide yield gap were recorded between existing vs attainable yield. The role of precision farming on improved nutrient management is dominantly playing role in bridging this gap. Functional relationship between soil physical and biological indices was drawn to correlate the soil conditions and further need to improve soil health. Based on field study, it was recorded that highest yield (70.71 kg fruit $tree^{-1}$) was observed in guava cv Shewta and of course improved from other foliar Zn treatments while in another experiment, application of natural resources to guava soil, maximum of 72.5 kg fruit $tree^{-1}$ was obtained. Foliar Zn nutrient spray also enhanced yield 50.72 kg fruit $tree^{-1}$ from 38.32 kg $tree^{-1}$ in 10 yrs old Mango cv. Dashehari. Thus, there was huge scope for further improvement of productivity of fruit crops through better soil and tree health management. The target yield under high density plantations may be put at 55 to 60 t $ha^{-1}$ in mango and guava and efforts should be initiated for production maximization and efficiency. All data set related to productivity gap analysis will be presented in detailed.

***Key words:*** *Productivity, gap analysis, Soil indices, health management policy*

# Characterization Of Gut Microbes Of Greater Wax Moth (*Galleria Mellonella*)

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Greater wax moth (GWM), *Galleria mellonella* (Lepidoptera: Pyralidae), is a highly destructive honey bee pest prevalent throughout the world. It is considered as a major factor to the alarming decline in honey bee population. GWM destroys active honey combs as it feeds on the beeswax, lays eggs in bee hives and the primary food of their larva is beeswax. Beeswax is a polymer composed mainly of saturated and unsaturated, linear and complex monoesters, hydrocarbons etc. The most frequent bond in beeswax is ethene (CH2-CH2) which is also found in the common plastic polyethylene. As wax-digestion is not a common animal character, we hypothesized about an association of GWM gut microflora with this process; which could possibly degrade polymers like polyethylene as well. This study was aimed to identify the GWM gut microflora via culture- dependant approach. We characterized several bacterial species based on the culture characteristics, Gram- reaction and various biochemical tests. Sequencing of 16S-rDNA revealed nine bacterial and one microalgal species from GWM gut. The bacterial species included Gram-positive *Exiguobacterium aestuarii, Bacillus circulans, Microbacterium zaea, Microbacterium sp., Enterococcus faecalis* and Gram-negative *Agrobacterium sp., Sphingomonas pseudosanguinis, Sphingobium yanoikuyae, Acinetobacter radioresistens*; and the microalgae was *Picochlorum oklahomensis*. Some of them degrade polycyclic aromatic hydrocarbon, low density polyethylene and 2-methylphenanthrene. The microalga, *P. oklahomensis* is capable of stealing bacterial genes to adapt themselves in abiotic stress. Although further investigation is necessary to explore the precise details about polymer degrading capabilities of these microbes, this study builds a foundation for elaborate and advanced future research.

***Keywords:*** *Galleria mellonella, Gut microbe, Plastic digestion*

# Agricultural Water Management In The Context Of Climate Change

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Water management for agriculture is becoming increasingly complex. Climate change is expected to intensify the existing risks, particularly in regions where water scarcity is already a concern, as well as create new opportunities in some areas. Worldwide climate change is relied upon to cause continuously expanded recurrence and seriousness of droughts, which further truly limit plant growth and crop yields. The challenges of climate change will have to be met through adaptation.Efforts to develop adaptation strategies for agricultural water management can benefit from understanding the risks and adaptation strategies proposed to date.Irrigated areas will increase in forthcoming years, while fresh water supplies will be diverted from agriculture to meet the increasing demand of domestic use and industry. Furthermore, the efficiency of irrigation is very low, since less than 65% of the applied water is actually used by the crops. The sustainable use of irrigation water is a priority for agriculture in arid areas. So, under scarcity conditions and climate change considerable effort has been devoted over time to introduce policies aiming to increase water efficiency based on the assertion that more can be achieved with less water through better management. Better management usually refers to improvement of water allocation and/or irrigation water efficiency. Water obtained during the sparse and irregular rainfall days are to be conserved in order to make it available during moisture stress period. Water conservation measures are to be given more emphasis. Watershed based approach are viewed as more useful as far as water and soil preservation is concerned. Agricultural practices, such as soil management, irrigation and fertilizer application and disease and pest control are related with the sustainable water management in agriculture and protection of the environment. Socio-economic pressures and climate change impose restrictions to water allocated to agriculture. Sustainable water management in agriculture, which has a multi-functional role, can be achieved by adopting improvements in irrigation application, soil and plant practices, water pricing, reuse of treated wastewater and farmers' participation in water management.

***Keywords:*** *Climate change, Irrigation efficiency, Water management, Water reuse*

# Role of Organics in Improving Productivity of Cluster bean (*cyamopsis tetragonoloba* l. Taub.) In Arid Region

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A field experiment was conducted under loamy sand soil during kharif 2019 at Instructional farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner. The soil of the experimental field was alkaline in reaction (pH 8.1), poor in organic carbon (0.07%), very low in available nitrogen (89.3 kg $ha^{-1}$), low in available phosphorus (19.5 kg $ha^{-1}$) and medium in available potassium (190.4 kg $ha^{-1}$). The experiment was carried out in randomized block design with three replications and thirteen treatments comprised of control, water spray, urea @ 2%, DAP @ 2%, NPK @ 1%, panchagavya @ 3%, panchagavya @ 5%, cow urine @ 5%, cow urine @ 10%, jeevamrut @10%, jeevamrut @15%, cow dung extract @ 5% and cow dung extract @ 10% applied twice as foliar spray at 40 and 55 DAS. The results revealed that application of panchagavya @ 3% significantly increased the growth attributes viz., plant height, dry matter accumulation at 90 DAS and at harvest, chlorophyll 'a', chlorophyll 'b' and total chlorophyll content, pods $plant^{-1}$ and seeds $pod^{-1}$. Significantly higher seed yield (1216 kg $ha^{-1}$), straw yield (2712 kg $ha^{-1}$) and biological yield (3929 kg $ha^{-1}$) were recorded with application of panchagavya @ 3% compared to control and water spray. It was further observed that nitrogen, phosphorus and potassium content and uptake in seed and straw and protein content in seeds of cluster bean also improved with application of panchagavya @ 3%. Economic study of data affirmed that net returns was highly influenced by foliar application of panchagavya @ 3% and accrued ₹29563 $ha^{-1}$ with B:C ratio of 2.38.

***Keywords-*** *Foliar spray, Panchagavya, Jeevamrut, Growth, Yield and Economics*

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# Natural Farming Improves Soil Quality And Restoring The Ecosystem

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Natural Farming is the art, practice and increasingly, the science of working with nature to achieve much more with less. Natural farming has five components viz, *Beejamrit, Jeevamrit, Whapasa*, *Mulching* and *Plant Protection*. Practices like *Whapasa* have a positive effect in improving fertility and improving water retention capacity of soil. Essentially, Natural Farming helps in making soil porous and increases the moisture content in the soil since the amount of water in the air is 10 times that of the amount of water in rivers. Natural Farming can transform agriculture for drought-prone areas in the country. Modern agricultural practices have a major impact on the environment. Climate change, deforestation, genetic engineering, irrigation problems, pollutants, soil degradation and waste are some of the concerns that are connected with agriculture. Natural farming in India is an ideal solution to reducing all these hazards. This sustainable way of farming is also known as 'Do-nothing farming' or 'No-tillage farming'. It was first popularised by Masanobu Fukuoka way back in the 1940s in Japan. The idea is to let nature play a dominant role to the maximum extent possible. The most immediate impact of Natural Farming is on the biology of soil—on microbes and other living organisms such as earthworms. Soil health depends entirely on the living organisms in it. There are no good or bad organisms; all are vital for a balanced ecosystem. In natural farming, decomposition of organic matter by microbes and earthworms is encouraged right on the soil surface itself, which gradually adds nutrition in the soil, over the period and plants, by way of photosynthesis, use $CO_2$ and water to convert solar energy to biochemical energy or food. About a third of the food manufactured by plants is required by the shoot system over the ground, while 30% is used by the roots. Almost 40%, however, is pushed into the soil as root exudates, which feed microbes. These microbes—bacteria and fungi—in a symbiotic relationship, make the nutrients available to plants. The integration of livestock in the farming system plays a important role in Natural farming and helps in restoring the ecosystem. Total area under Natural Farming in India is 6.5 lakh hectare and presently 11 states ( Andhra Pradesh, Chhatisgarh, Kerala, Gujarat, H.P.,Jharkhand, Udisha, M.P. Rajsthan, Utter Pradeshand Tamil Nadu) are practicing Natural Farming .

***Key Words :*** *Natural farming, Soil , Ecosystem*

# Integrated Horticulture Based Farming System: A Review of Farmers Friendly Approach For Efficient Food Production and Environmental Sustainability

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The objectives of the study were to describe the concept of the integrated horticulture based farming system(IHFS), the nature of integration ,components of IHFS ,productivity, problems, and suggestions for improving.Integrated horticulture based Farming System practice is now a day's gaining popularity among the farmers to fetch higher net returns from a limited piece of land. IHFS is a farming system that combines farm enterprises like field crops, vegetables, dairy, poultry and goatry for realizing profitable and sustainable agriculture which is based on the recycling biological concept, and linked of input-output between the mutually commodities which approach of low external input utilization, which is done on the land, through the utilization of crop waste, animal manure, fish waste for the purpose of increasing the production and productivity so as to increase farmer income and can create condition that are environmentally friendly farming. The main thrust is to minimize risks and increase profitability. Thus Integrated horticulture based farming system was a profitable venture and has positive influence on the standard of living and economic status of the farming community compared to Non- Integrated farming system.Integration of different enterprise with crop activity provides ways to recycle products and waste materials of one component as input through another linked component and reduce cost of production of the products which will finally increase the total income of the farm. Farming system represents appropriate combination of farm enterprises viz., cropping system, horticulture, livestock fishery, forestry, poultry and the means available to the farmer to raise them profitability. It interacts with environment without dislocating the ecological and socio economic balance on one hand and attempts to meet the household needs like food, fibre, fodder and fuel as the national goal on other hand, besides increasing productivity of the farm manifold.

# In Vitro Evaluation of Root Endophytic Bacteria Against *Sclerotium Rolfsii* Incitant Of Stem Rot In Groundnut

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Groundnut is important oilseed legume grown under irrigation as well as rainfed crop. India occupies the second position in percent of groundnut production after china. Groundnut crop is facing several threats in production among these the diseases are major contributors for the yield reduction, mainly the soil borne diseases viz., Collar rot, dry root rot and stem rot are most important diseases which infecting the groundnut and leading to yield reduction. Among these diseases the stem rot or pod rot complex incited by the *Sclerotium rolfsii* (Sr) is much important. Thus the management of the stem rot pathogen *Sclerotium rolfsii* is very important to reduce the yield losses caused by it. The management of this pathogen by various agrochemicals and *Trichoderma* spp etc were done in earlier studies. In our present study we were concerning about the use of bacterial root endophytes as biological control agents for management of *Sclerotium rolfsii*. A total of 6 *Sclerotium rolfsii* (Sr) isolates and 23 Bacterial root endophytes (BRE) were isolated covering the three mandals viz., Kadiri, Nallamada and Nallacheruvuru of Anantapur district of Andhra Pradesh. After isolation and purification the pathogenicity test was conducted for Sr isolates viz., Sr 1 to 6 and found Sr-2 is more virulent isolate and it was used for the invitro dual culture studies with BRE. The invitro evaluation by dual culture assay was performed for BRE 1 to 23 isolates in order to know their antagonistic activity against the *Sclerotium rolfsii*. Among the 23 BRE tested the BRE-14, BRE-22, BRE-20, BRE-3, BRE-8 and BRE-13 showed 68.65, 65.29, 51.47, 50.73, 50.35 and 41.77 percent inhibition (PI) respectively against the *Sclerotium rolfsii*. The BRE-14 (68.65 %) showed the highest inhibition percentage whereas lowest inhibition percentage was observed with BRE-13 (41.77 %) compared to the other isolates tested. Hence BRE-14 isolate was found effective against *Sclerotium rolfsii* and it was selected for further studies.

***Key words:*** *Groundnut, Sclerotium rolfsii, Stem rot, Bacterial root endophytes*.

# Effects of Nitrogen Scheduling Along With Zn And Boron Fertilization on Growth And Yield of Indian Mustard (*Brassica Juncea* L)

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Rapeseed and Mustard is the third most important oilseed crop in India after Soybean and Groundnut. In addition to this it produces one of the finest qualities of edible oil along with fodder and oil cake. Being a heavy feeder crop it is demands a RDF of 120:60:20 Kg/ha of N:$P_2O_5$: $K_2O$. AS the initial crop growth is very slow the 50% basal dose of N applied to is not utilized and lost by various means and hence the aim is to increase the fertilizer use efficiency by manipulating the nitrogen schedule. Also an attempt has been made to supplement the growth and yield by Zn and B application. The experiment was laid out in RBD design with 12 treatments and three replications, *i.e.*, different schedules of nitrogen fertilizer, combined with Zinc ($ZnSO_4$) and Boron (Borax) in half of the treatments and rest of the treatments without Zinc and Boron.Statistical analysis of experimental data $T_8$that involves the application of N at 15, 30 and 45 DAS at the rate of 30, 60 and 30 kg/ha, along with Zn and B was found to be the best treatment in terms of grain and biological yield. $T_7$that applied N at 15, 30 and 45 DAS at the rate of 30, 30 and 30 kg/ha, along with Zn and B was found to be the best one in terms of resource saving and economics.

***Key words-*** *Indian mustard, Nitrogen Schedule, Zinc, Boron*

# Hypothesizing Soil Aggregation Characteristics Under Natural Farming

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Soil aggregation is an important mechanism contributing to soil fertility as it reduces soil erosion and mediates air permeability, water infiltration and nutrient cycling. However, the soil management practices such as the use of different tillage systems and fertilizer application affects aggregation, aggregate stability and carbon sequestration. Several researchers have reported that the soil organic carbon and microbial biomass acts as an important binding agent for aggregation. In contrast, conservation tillage practices such as no tillage and reduced tillage have positive effect on aggregates and their binding agents as compared to conventional tillage. Conservation tillage decreases soil disturbance, promotes crop residues retention and slows down residue decomposition which improves aggregation and contributes to soil carbon sequestration and reduces the susceptibility to erosion. These facts lead us to the corollary that under natural farming, where there is no external input and disturbance, there is a far greater potential of soil organic matter build up leading to carbon sequestration in the soil paving way for greater aggregate stability. Soil organic carbon mainly exists in aggregates, which can encapsulate soil organic carbon through its own physical protection to avoid decomposition by microorganisms. The soil organic carbon encapsulated by aggregates can be utilized by microorganisms only after aggregate breakdown. This too comes to an advantage in natural farming, where there is less likelihood of aggregate breakdown and hence reduced rate of decomposition. Similarly, mineral fertilizers (NPK) may enhance soil fertility and crop productivity for a short period. However, long term application of excessive amounts of mineral fertilizers can reduce soil quality, soil organic carbon stabilization, structural damage and hence crop productivity. Some studies have also revealed that a continuous incorporation of mineral fertilizers with organic manure (viz. green manure) enhanced soil aggregation and soil organic carbon stabilization and hence promoting the sustainable development of cropping systems. On the front of mineral fertilizers too, natural farming is aggregate friendly because of greater stability of organic matter. On the whole, soil aggregation is expected to improve with natural farming due to benefits associated with reduction in organic matter breakdown due to reduced tillage intensity, greater surface residues retention and lower use of mineral fertilizers.

# Changes in Alkaline Phosphatase Activities During Decomposition of Crop Residues

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Soil is one of the most precious natural resources of the earth and maintenance of its health is the moral responsibility of mankind. However, the higher quantity of production of food, fuel and feed is causing an irreplaceable damage to its environment. In addition the excessive use of chemical fertilizers and pesticides and modern cultivation practices deteriorate the soil fertility and productivity. Use of organic wastes as soil amendment may hold a good promise for improving the soil health, crop productivity and reduce the waste disposal problem. Agricultural crop residues are generated in large quantities and constitute an abundant but underutilized source of renewable biomass in agriculture. The management of agricultural waste using microbes could also be an excellent option to improve soil health and mitigation of environmental pollution. To address this context an experiment was carried out during 2019 to find out the changes in enzymatic activity during composting of paddy, sesame, redgram stalks and cotton stalks. Microbial consortia of decomposer 1 (*Trichoderma reesi* + Xyline degrading bacterial + PSB + Zinc solubilizing bacteria) and decomposer-2 (*Aspergillus nidulans*+ *Trichoderma viridae* + *Phaenerochete chrysogenum*) were used to facilitate decomposition of selected crop residues along with control. The results of the present investigation revealed that Alkaline phosphatase exhibited highest activity during 30th day of composting for paddy straw (S1) and sesamum stalks (S2) then, the activity was declined up to 120thday of composting Whereas, redgram stalks (S3) and cotton stalks (S4) exhibited highest alkaline phosphatase activity at 60th day of decomposition and later declined up to 120th day of decomposition The production of enzyme depends on microbial biomass, which implies that when this biomass is degraded enzymatic activity decreases. However, the lowest Alkaline phosphatase activity was noticed when all the crop residues were decomposed without any microbial consortia.

***Key words:*** *Crop residues, Soil health, Microbial consortia, Decomposition, Alkaline phosphatise activity, Enzyme activity*

# Soil Microbial Diversity Under Long Term Organic And Conventional Farming: A Review

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Soil microbial diversity offer multifaceted benefits to agricultural crops by their participation in ecosystem processes like nitrogen fixation, insoluble nutrient solubilization, SOM mineralization, etc., which in turn determine plant health, crop yield and productivity (Bastida*et al*., 2021).The belowground microbial communities interact among themselves in various ways and are crucial for plant and soil health, and maintenance of agricultural sustainability as well.There is increasing concern, however, that agricultural intensification alongwith conventional agricultural practices have led to large-scale ecosystem degradation, loss of productivity inlong term and deterioration of soil health (Trivedi *et al*., 2016).Microbial communities show variations in agroecosystems owing to management practices, therefore long-term agroecosystem experiments could provide an indispensable resource for evaluation of effects of farming systems on above and belowground biota, productivityand soil qualityaspects (Armalyte*et al*., 2019). Higher OM input through application of various organic manures under organic farming practices is the key factor in enhancing the enzymatic activities and soil microbial biomass carbon along with higher growth of microbial populations in soil, which are key components of soil biological quality (Sheoran*et al*., 2018). Overall, organic farming practices increasespecies richness, decrease evenness, reduce dispersion and help in shifting the structure of soil microbiota when compared with conventionally managed soils under exclusively mineral fertilization(Hartmann *et al*., 2015).Thus,agro-ecosystems receiving organic fertilizer are characterized by specific microbial guilds known to be involved in degradation of complex organic compounds and improve soil health and productivity compared to conventional farming.

***Key words:*** *Soil, microbial, diversity, organic, conventional, farming*

# Toxicity Mechanisms Of Heavy Metals In Plants

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Pollution of the environment with the toxic heavy metals has become one of the major causes for worry for human health in both emerging and advanced countries. Heavy metal toxicity in plants occurs through four major mechanisms. Induction of oxidative stress and changes in the cell membrane permeabilityand integrity. Manyheavy metals induce the formation of ROS such as $H_2O_2$. ROS inhibits water channel and transporter proteins and enhancing lipid peroxidation. The latter alters membrane fluidity, stability and structure, inhibiting membrane-dependent processes such as electron flow in chloroplasts and mitochondria. Reaction with sulfhydryl groups (–SH), heavy metals have a strong affinity for –SH groups and therefore bind to structural proteins and enzymes containing them. This can prevent correct folding, interfere with catalytic activity, and perturb enzyme-mediated redox regulation.Similarity to biochemical functional groups, As(V) in arsenate ($AsO_4^{3-}$)is an analogue of the micronutrient phosphate ($PO_4^{3-}$) and competes with it in many cellular functions. $AsO_4^{3-}$ displaces phosphate in ATP, leading to the formation of the unstable complex ADP-As that interferes with the energy flows in the cell.Displacement of essential (cat)ionic cofactors in enzymes and signalling components. Metal ions in the active sites of enzymes can be displaced by heavy metal ions resulting in the loss of activity. Therefore, it is well required to intensify the research programs for better understanding of heavy metal toxicity on plants and allied areas to maintain the ecological harmony of the globe.

***Keywords:*** *Heavy metals, mechanism, ROS, sulfhydryl, enzymes.*

# A Review: Zero Budget Natural Farming Feasible To Small Farmers For Food, Nutritional Security And Soil Health

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Agriculture faces many challenges, making it more and more difficult to achieve its primary objectivei.e., to feed the world population. Population growth and changes in diet associated with rising incomes drive greater demand for food and other agricultural products, while global food systems are increasingly threatened by land degradation, climate change, and other stressors. Land degradation is a worldwide challenge, substantially affecting productivity in more than 80 countries and especially serious in developing countries. Land degradation adversely affects the ecological integrity and productivity of about 2 billon ha, or 23 percent of landscapes under human use and up to 40 percent of the world's agricultural land are seriously degraded. India with 2.4% land area supports more than 17% of the world population. Achieving food security under the regime of climate change will require a holistic system approach, incorporating the principles of natural farming or conservation agriculture (CA), and judicious crop rotation.Government has decided to approach 60 lakh (6 million) farming households to adopt Climate Resilient Zero Budget Natural Farming (CRBZBNF) as "a farming practice that believes in natural growth of crops without supplying any chemical fertilizers, pesticides or any other external inputs. The phrase Zero Budget refers to the zero-net cost of production of all crops (inter crops, border crops, multi crops).ZBNF enhance growth and resource-use provides a sustainable livelihood to farmers and allied value chain actors. It has four pillars i.e. Jeevamrutha, Beejamrutha, Acchadana -Mulching. Whapasa–moisture and might help to reduce the leaching of nitrogen and phosphorous from the soil into groundwater or removal of surface water, and eventually into rivers and oceans. Mulching techniques used by ZBNF farmers improve the water retention capacity of the soil, reduce crop irrigation requirements and control the concentration of groundwater contaminants. Through ZBNF farmers get low cost input, high yield, provides food and nutritional security, maintain environmental health, improve soil fertility and developed resilience against climate change.

***Keyword:*** *Agriculture,Sustainable, ZBNF, Soil Health,Crop Residues*

# Rain Water Harvesting-A Simple Method Of Water Conservation

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Water is essential to sustain all living forms on earth-including human, animal and vegetation. Groundwater is the primary source of fresh water that caters to the demand of ever-growing domestic, agrarian and industrial sectors of the country. Where there is no surface water, where groundwater is deep or inaccessible due to hard ground conditions, or where it is too salty, acidic or otherwise unpleasant or unfit to drink, another source must be sought. We cannot generate artificial water and must depend on water sources available on our planet earth. In this context, adopting rainwater harvesting that is collection of rain water and recharging groundwater is one of the simplest and best measures in conserving water globally. Rain water harvesting is a technique used for collecting, storing and using rainwater for domestic, agricultural or any other uses. Rain water is harvested from various hard surfaces such as rooftops, runoff from catchment from streams and water conservation through watershed management or other manmade above ground hard surfaces. Water retention in upland and midland through unlined water harvesting structures improve ground water recharge. The southwest monsoon accounts for nearly 80% of the rainfall in India and its performance from June to September decides the state of agricultural productivity in India, which in turn, decides the state of the economy. These four month are more important to collect runoff may be harvested from roofs and ground surfaces as well as from intermittent or ephemeral watercourses. This simple water conservation method can be a boost to an incredible solution in areas where there is enough rainfall but not enough supply of groundwater. It will not only provide the most sustainable and efficient means of water management but also unlock new vista of several other economic activities leading to the empowerment of people at the grass-root level. Success of rain water agriculture can be ensured with appropriate utilization of every drop of water. In India per capita water availability is declining (1816$m^3$/year in 2001 to 1545$m^3$/year in 2011) over the year due to population pressure, Excessive need of water to suit ever expanding modern life style, agriculture and industrial expansion besides changing climate scenarios. So it is the high time to take different water harvesting measures to increases ground water level. Government should also expand help in grass root level for installation of different water harvesting structure and there by encourage the people to harvest rain water as well as increase ground water level.

***Key words:*** *Rain water, Harvesting, water conservation, ground water.*

# Natural Farming As A New Soil Management Strategy To Improves Soil Quality And Changes Microbial Community

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Natural farming (NF), which is similar to organic farming in terms of environmental friendliness, was created in India. It is a holistic agro alternative that encourages lower production costs while also producing high-quality and yielding products with little or no use of inorganic fertilizers and pesticides. The approaches through which we can achieve the target of soil quality improvement in the natural farming are like as zero tillage, minimum tillage, conservation tillage, use of farm residues after decomposition under natural conditions for nutritional meet of crop plants etc. Introduction of Natural Farming to increase the abundance of good and efficient microorganisms can assist to improve and preserve soil biological, chemical, and physical features, as the approach is closely associated to soil fertility. Because many people are becoming aware of the dangers of consuming foods containing chemical compounds, the use of helpful microbes in Natural Farming is becoming more popular. However, due to the absence of technical understanding in the needed subject, boosting food security using this strategy in India is still a relatively new option. In some soils, a single application may be sufficient to achieve the desired outcomes, whilst repeated applications may be useless in others. The justification behind this is that introduced microorganisms take longer in some soils to adapt to new ecological and environmental conditions and establish themselves as a stable, effective, and dominant portion of the indigenous soil microbes. Overall, we demonstrate that NF has a favourable impact on soil quality and the makeup of microbial communities in sustainable agricultural systems.

***Keywords:*** *Natural farming, Agricultural practices, Zero tillage, minimum tillage, Conservation tillage,*

# Halophilic Microbes For Bio-Remediation Of Salt Affected Soils

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Soil health is one of the key factors for efficient agricultural production. Increased demand for agriculture commodities generates incentives to convert forests and grasslands to farm fields and pastures which results in increase in soil erosion. Among the soil degradation problems, salt-affected soil is one of the serious problems under arid and semi-arid lands. Soil degradation through salinity or sodicity is universal concern. The problem of salinity and sodicity in India is becoming more serious and is a matter of concern because of alarming increase in the area in the country under these soils. The reclamation of these soils requires additional agricultural inputs and practices like amendments, water and infrastructure for drainage, which is costly and resource consuming. One of the cheapest approach for reclaiming the salt affected soils is the use of microorganisms in the form of different formulations. But the microbial strains available as biofertilizers for different crops do not perform effectively under salt stress and their activity decreases when used in salt affected soils due to osmolysis. To overcome this, attempts have been made to develop bioformulation based on halophiles, that can replace regular biofertilizer applications in salt affected soils. Halophiles are salt-loving organisms that inhabit hypersaline environments. A pot experiment was conducted during Kharif season of 2019, at the Division of Soil Science and Agriculture Chemistry to study the efficacy of halophilic biofertilizers *i.e.* Halo-*Azotobacter*, Halo-Phosphate Solubilizing Bacteria (Halo-PSB), Halo-Zinc and Halo-Mix on the soil health as well as growth and productivity of paddy (PR-113). Regular biofertilizers are ineffective under sodic soils owing to the inability of microbes to tolerate salt stress. Biological parameters such as, microbial biomass carbon, dehydrogenase activity, alkaline phosphatase activity and bacterial count were also increased significantly in sodic soil over corresponding control values. However, microbial biomass carbon, dehydrogenase activity and bacterial count also increased significantly in normal soil, respectively, while there was no significant difference observed in soil alkaline phosphatase activity in normal soils treated with various bioformulations. The soil fungal colonies remained significantly higher in normal soil as compared to sodic soil, even after the application of these bioformulations. Both dehydrogenase activity and phosphatase activity were affected by the type of soil and application of halophilic formulations. In sodic soils, the quantum of increase in enzymatic activity was, however, higher and significant, upon application of bioformulations. Microbial count for both bacteria and fungi were significantly higher in normal soils as compared to sodic soils, as evident from overall mean values. Bacterial count was significantly higher in inoculated sodic soils over un-inoculated sodic soil.In nutshell, it was observed that Halotolerant strains of bio-fertilizers viz. Halo-*azotobacter*, Halo-phosphorus solubilizing bacteria, Halo-zinc and Halo-mix (combination of all three) were found to be effective in sodic soils. Application of multi-strain bacterial growth consortia could be an effective approach and need to be further explored.

***Keywords:*** *Halophiles, Halo-Azo, Halo-Phosphate Solubilizing Bacteria (Halo-PSB), Halo-Zinc and Halo-Mix, Microbial Biomass Carbon, Dehydrogenase activity, Phosphatase activity.*

# A Review: Organic Farming For Sustainable Agriculture In North East India

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Advancement of organic farming is possible in the North East Region of India. Low and minimal use of chemical fertilizers and synthetic compound are common in hilly ecosystems, despite inherent nutrient deficits and supplementing these to harness higher land, water and crop productivity. Currently, organic farming is gaining momentum as a sustainable crop and soil management practice specially for the small and marginal hill farmers by helping in enhancing soil health and carbon sequestration, providing multiple ecology services including mitigation of climate change. Integrated organic farming system will not only encourage organic food production but also decrease need on exterior resources through efficient recycling of on-farm biomass and additional resources particularly disease management. So, traditionally, bulky organic manure [farmyard manure] has been replaced through integrated organic nutrient management method by merging application of mixed compost, vermicompost, poultry manure, pig manure, in addition of in-situ and ex-situ bio-mulches and alley-cropping approach. Genuinely, marketing and value additionof organic products place a vital part of concern. So, certifying of organic products by the resource poor farmers is also another challenge for hilly farmers. With the policy support, farmers can be group and achieved certification in a cost-effective manner for their sustainable livelihood development.

***Keywords:*** *Organic farming, sustainable, hilly region, farmers, livelihood*

# THEME - II

## *Conservation Agriculture, Carbon Sequestration, Nutrient Management and Biodiversity Conservation in the Context of Natural and Organic Farming*

# Crop Diversification In *Adsali* Sugarcane Under Natural, Organic And Conventional Farming Practices

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A field experiment was carried out at Agricultural Research Station, Hukkeri (Dist. Belagavi) during 2019-20 on medium black clay loam soil to study the effect of different farming practices, spacings and intercropping systems on performance of adsali planted sugarcane. Experiment was laid out in split-split plot design with eighteen treatment combinations. The main plot consists three farming practices viz., $M_1$: Recommended package of practices (RPP), $M_2$: Organic farming (OF) and $M_3$: Natural farming (NF); in sub plots two spacings viz., $S_1$: 60-180-60 cm × 60 cm and $S_2$: 240 cm × 60 cm and in sub sub plots three intercropping systems viz., $I_1$: Sugarcane + soybean fb chickpea fb turmeric, $I_2$: Sugarcane + onion + cowpea + coriander + green chilli and $I_3$: Sole sugarcane were taken. Among the farming practices, RPP recorded significantly higher cane yield (137.8 t $ha^{-1}$) and net returns (₹ 317423 $ha^{-1}$) as compared to organic and natural farming. Row spacing, $S_1$: 60-180-60 cm × 60 cm recorded significantly higher cane yield (136.5 t $ha^{-1}$) and net returns (₹ 284511 $ha^{-1}$), respectively as compared to $S_2$: 240 cm × 60 cm. Among the intercropping systems, sugarcane + soybean - chickpea - turmeric registered significantly higher sugarcane equivalent yield (160.0 t $ha^{-1}$) and net returns (₹ 260258 $ha^{-1}$) as compared to sole sugarcane, but it was on par with sugarcane + onion + cowpea + coriander + green chilli with respect to net returns.

***Keywords:*** *Adsali sugarcane, intercropping systems, natural farming, organic farming, sugarcane equivalent yield*

# Isolation And Identification Of Microorganism Decomposer From Sugarcane Trash

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Cellulose is a world's most abundant polymer on Earth and is an important structural component of the primary cell wall of green plants. Cellulose should be degraded and converted to into soil and recycled through the activity of microorganisms. Bacteria play important role to degrade cellulose for their energy requirements to sustain their life. Therefore, the aim of the study is to isolate cellulose degrading microbes from soil samples collected from different Sugarcane farm of IISR and to identify cellulose degrading microbes. 20 Soil samples after appropriate dilutions were spread on CMC (Carboxy methyl cellulose) agar medium, colonies were purified by repeated streaking. Screening was done utilizing Congo red & verification was done after development of microbes into the medium that contain CMC. Assessment of bacteria ability in cellulose degradation was performed via estimation of transparent zone around the colonies. The apparent area around the colony was a sign of good cellulose decadence activity of bacteria. The highly cellulolytic bacteria were identified on the basis of Gram staining; morphological cultural characteristics; analysis of collected samples for physio, chemical and morphological properties; biochemical tests; compatibility assay; extracellular enzyme production and waste degradation potential. The study highlights the extensive and unexplored structural diversity of enzymatic systems in cellulolytic soil bacteria and indicate the roles of multiple abundant bacterial taxa in the decomposition of cellulose and other plant polysaccharides.

***Key Words:*** *Cellulose degrading bacteria, Gram staining.*

# Soil Carbon Sequestration Through Different Management Practices

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Climate change is one of the most serious issues in the twenty-first century, with enormous implications for ecological sustainability, the environment, and human health. The reason behind climate change is global warming which is a function of increase in atmospheric concentration of carbon dioxide ($CO_2$), methane ($CH_4$,), and nitrous oxide ($N_2O$). Contribution of carbon dioxide (16%) found highest followed by $CH_4$ (6.2%), $N_2O$ (2%)and fluorinated gas (F-gas) towards total GHGs emissions. Agriculture being a predominant global land use is a significant contributor to anthropogenic global warming. Judicious management of agricultural land is one of the key strategies to promote carbon sequestration. Carbon sequestration in agricultural land is capable of removing excess carbon di-oxide from the atmosphere and also improving soil health and productivity resulting in a win-win situation. C sequestration in various agro-ecosystems through appropriate management methods is an essential alternative for combating climate change. Agricultural soils have the capability for sequestering carbon up to 1.2 billion tonnes per year. Arable lands with sound management methods have been determined to be capable of sequestering 0.90–1.85 Pg C $year^{-1}$ (0.56–1.15 t C $ha^{-1}year^{-1}$), which is 26–53 percent of the "4p1000 Initiative: Soils for Food Security and Climate" target. The ability of soil to behave as a source or sink for atmospheric carbon dioxide is entirely dependent on management techniques. Conservational tillage (minimum tillage and zero tillage) in combination with residue management and surface mulching not only facilitates soil C storage but also improves soil health. Under zero tillage, several researchers showed a percent increase of 5.8 to 32.14 in TSOC stock in comparison to a conventional tillage system. Legume-based cropping system and cover cropping influence soil aggregation and hence SOC storage. The use of biochar has been demonstrated to help increase soil C stock and promote soil aggregation.Despite the numerous benefits, there are several barriers to adopting such sustainable management strategies, including a higher initial investment for conservation agriculture, a lack of knowledge, insufficient flexibility and creativity among farmers and extension personnel, and limited research on biochar, particularly in developing countries. However, careful monitoring of present SOC status, as well as future forecast, is required before implementing such management systems for increasing SOC contents.

***Keywords:*** *Climate change, Green house gases, Carbon sequestration, Conservation tillage, Biochar, Cover cropping*

# Changes In Soil Fertility And Productivity Of Rice-Wheat Cropping Sequence After Twenty Years Effect Of Inorganic And Organic Fertilizers In Northwestern India

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The long-term nutrient management experiment on rice-wheat cropping system has been in progress since 1999 at Research Farm, Department of Soil Science, PAU, Ludhiana. The experiment aimed to study the long-term changes in soil fertility and crop productivity under combination of chemical fertilizers and organic manures. The experiment was conducted in randomized block design (RBD) with 12 treatments, replicated three times. After 20 croppingcycles, surface soil samples were collected for examining the changes in soil fertility and crop productivity. The intensive cultivation of rice-wheat system under balanced fertilization with FYM significantly improved the organic carbon content from 0.24% at the start of the experiment to 0.58% in 2019. Incorporation of FYM along with NPK sequestered significantly higher C as compared to the application of NPK fertilizers alone. On the other hand, continuous application of fertilizers resulted in a decline in soil pH. The continuous application of inorganic fertilizers conjunctively with FYM significantly enhanced available N, P and K status. The positive effect of fertilizer application on grain yield of rice and wheat was observed compared to no fertilizer application (control). Application of organic manures like green manure, straw incorporation and farmyard manure in addition to recommended fertilizers further improved grain yield of rice and wheat. The grain yield of rice and wheat in 100%NPK+FYM treatment was 20% and 15% higher than 100% NPK treatment, respectively. The study indicates that long term application of balanced fertilizer and organic manure improved soil fertility and productivity of rice-wheat system.

# Resource Management Through Foliar Feedingfor Increasing The Productivity of Blackgram Intercropped in Coconut Gardens

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India, the largest producer and consumer of pulses in the world, have an area of 29.4 mha with an annual production of 19.5 mt and productivity of 664 kg $ha^{-1}$ (DPD India, 2018).Among pulses, blackgram (*Vigna mungo* (L.) Hepper) also known as urd bean is a much preferred short duration crop as it survives better in all seasons either as sole crop, intercrop or catch crop accounting for 13 per cent of the total pulse area and 10 per cent of the total pulse production in the country (MoA and FW, 2021). An investigation was conducted at Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala during summer 2020 and Rabi 2020-21 for increasing the productivity of blackgram intercropped in coconut gardens. The experiment was laid out in split plot design with five varieties ($v_1$ -Sumanjana, $v_2$ -DBGV 5,$v_3$ -VBN 5,$v_4$ -VBN 6,$v_5$ -CO 6) as main plot treatments and six foliar sprays of nutrients and plant growth regulators as subplot treatments ($f_1$: 19:19:19 (1%) at 45 and 60 DAS, $f_2$: SOP (0.5%) at 45 and 60 DAS, $f_3$: NAA 40 mg $L^{-1}$ and salicylic acid 100 mg $L^{-1}$ at pre-flowering (30-45 DAS) and 15 days later, $f_4$: $f_3$ + $f_1$, $f_5$: $f_3$ + $f_2$ and $f_6$: Control - KAU POP-20:30:30 kg NPK $ha^{-1}$).Coconut gardenwith palms of uniform age (45-50 years old)and experiencing a light intensity of 48.6-56.2 flux was selected for conducting the experiment. Two meter radius was left from the base of coconut palms to avoid interruption from coconut roots so that growth and development of intercrop was unaffected. Main plot of 3m x 6m were taken and were divided into sub plots of 3m x 1m.Crops were given irrigation during critical stages and harvesting was done 90-100 days after sowing (DAS). Among the treatment combinations, Sumanjana ($v_1$) with $f_4$ produced taller plants at two months after sowing, higher number of branches and leaves per plant during summer and Rabi. Leaf area index, number of nodules and dry weight of nodules at flowering were also higher for $v_1f_4$ followed by $v_2f_4$. The variety Sumanjana with $f_4$ produced superior number of pods per plant (30.24 and 29.40) and hundred seed weight during summer and Rabi. A higher seed yield was realized in $v_1f_4$ (1750 kg $ha^{-1}$) which was on par with $v_2f_4$ (1713 kg $ha^{-1}$) during summer. Seed yield was the highest (1700 kg $ha^{-1}$) in $v_1f_4$ during Rabi. It can be concluded that, growing of shade tolerant varieties viz., Sumanjana and DBGV 5 with recommended dose of nutrients as per KAU package supplemented with foliar spray of 19:19:19 (1%) at 45 and 60 DAS + foliar spray of NAA 40 mg $L^{-1}$ and SA 100 mg $L^{-1}$ at pre-flowering (35 DAS) and 15 days later could be suggested as a better resource management strategy for increasing the productivity of blackgram intercropped in coconut gardens.

***Key words:*** *Blackgram, Coconut gardens, Foliar spray, Resource management, Yield*

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# Conservation Agriculture For Enhancing Pulse Production

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Pulses are an important group of food crops that can play a vital role to address national food and nutritional security and also tackle environmental challenges. Pulses are second only to the cereals as human food. They are most important sources of vegetable proteins, also rich in fibre, iron, potassium, folate etc. in addition to antioxidants; they are free of cholesterol and gluten. Besides improving soil fertility and physical structure, pulses fit well in mixed/inter-cropping systems, crop rotation and dry farming, provide green vegetable and nutritious fodder for cattle as well thereby contributing to a more sustainable food system. India is the largest producer (25 % of global production), consumer (27 % of world consumption) and importer (14%) of pulses in the world. Even being the largest producer of pulses, it contributes only around 7-10 % of the total foodgrains production in the country. The persistent and growing demand-supply gap is putting pressure on prices and this good source of vegetarian protein is turning inaccessible to the poor. Attaining food security for a growing population and reducing poverty while sustaining agricultural systems under the current scenario of depleting natural resources, negative impacts of climatic variability, increasing cost of inputs and volatile food prices are the major challenges. Therefore, an ideal shift in farming practices through eliminating unsustainable parts of conventional agriculture is crucial for future productivity gains while sustaining the natural resources through conservation agriculture. Conservation Agriculture is a farming system that promotes maintenance of a permanent soil cover, minimum soil disturbance and diversification of plant species. Pulses are considered as hardy crops which can thrive better than many crops under adverse conditions, thus have immense value in Conservation Agriculture and fitted well in all the three principles. Inclusion of pulses in cereal based cropping system enhances inputs use efficiencies and hence considered as one of the resource conservation technologies. The basic principles of Conservation Agriculture such as least disturbance of soil, retention of organic cover on soil surface and crop rotation are met while bringing legumes in production system.

***Keywords:*** *Conservation agriculture, Crop rotation, Food security, Intercropping, Pulses*

# $NH4^+$ - Fixation In Soil As Influenced By Addition Of Mustard Cakevis-A-Vis Humic Acid

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Addition of organic matter plays an important role in improving soil physical, chemical and biological properties. Mineralization of added organic matter releases N with time.It is well known that $NH_4^+$ produced through mineralization of organic matter takes part in clay fixation process. The relative release of $NH_4^+$ produced through mineralization of organic matter vis-a-vis humic acid and its participation in the fixation process is not well understood. A laboratory experiment was, therefore, conducted with mustard cake vis-a-vis humic acid extracted from it in presence and absence of inorganic N. Results of the investigation revealed that addition of mustard cake and humic acid enhanced accumulation of exchangeable $NH_4^+$ and soluble $NO_3^-$ – N with significantly higher amount of exchangeable $NH_4^+$ under humic acid added inorganic N.On the other hand, mustard cake in presence of inorganic N showed significantly higher amount of soluble $NO_3^-$ followed by soils treated with mustard cake.Irrespective of treatments, fixed $NH_4^+$ decreased with increase in the period of investigation. Results further showed that mustard cake treated soil in presence or absence of inorganic N showed significantly higher order of fixed $NH_4^+$ over the corresponding humic acid added systems. The result thus pointed out that decomposition of mustard cake is faster than humic acid showing comparatively higher amount of fixed $NH_4^+$ in mustard cake than humic acid treated soils.

***Key words:*** *Exchangeable $NH_4^+$ -N, Soluble $NO_3^-$-N, fixed $NH_4^+$-N,Mustard cake and Humic acid*

# Carbon Sequestration Under *Brideliaretusa* (Asana) Based Agroforestry System In Konkan

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The study was conducted during 2018 to 2020 at the Research Farm of *AICRPonAgroforestry,Dr.BSKKV, Dapoli,* on "Carbon sequestration under *Brideliaretusa* (Asana) based agroforestry system in Konkan".The carbon sequestration under agroforestry systems were noted highest (7.32 t/ha) in $T_6$- Asana + Jam (*Syzygiumsamarangense*) followed by $T_5$- Asana + Karonda (Carissa carandas) (5.76 t/ha), $T_7$- Asana + Seedless Lemon (*Citrus latifolia*) (5.75 t/ha) and $T_4$- Asana + Mulberry (*Morusalba*) (5.59 t/ha) than other. The above ground biomass (AGB) and below ground biomass (BGB) were recorded significantly higher by $T_6$- Asana + Jam (*Syzygiumsamarangense*) than other treatments.Similarly, higher soiltotal carbon, plant carbon stock, soil carbon stock, plant carbon sequestration as well as soil carbon sequestration and total carbon sequestration with its rate per years were recorded by $T_6$- Asana + Jam (*Syzygium samarangense*) as compared to other agroforestry systems. Overall higher growth performance and carbon sequestration was recorded by $T_6$-Asana + Jam (*Syzygium samarangense*) followed by $T_4$- Asana + Mulberry (*Morusalba*) than other system inKonkan.

***Keywords:*** *Agroforestry system, AGB, BGB, carbon sequestration.*

# Application Of Organic Manures and Biofertilizers In Turmeric

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Turmeric is a SouthEast Asian spice. It is grown on thousands of hectares in India. In dia produces roughly 20% of the overall consumption and imports the rest.As a result , turmeric cultivaton should be prioritised. Turmeric reacts well to nutrition because i t is a longterm (89 months) crop. As a result, getting the right amount of nutrients is c rucial for a healthy output. Chemical fertilisers, herbicides, and pesticides used in agr iculture to increase yield and control weeds and crop pests can pollute water, air, and food, reduce soil fertility, impede soil microorganism growth, and provide a health ri sk to humans (Parr et al., 1991). This detrimental impact of agricultural methods coul d be mitigated by proper use of manures and/or crop leftovers within the farm.farmin g strategy with or without organic fertiliser (Mandalet al, 2007). Aside from that, it's a good idea to use organic manure in agriculture to see how different organic manure s affect turmeric development, yield, and other characteristics. The use of various org anic manures has been shown to have a positive impact on vegetative, yield, and qual ity characteristics. All of these variables combined to generate the greatest estimated fresh rhizomes yield and cured rhizomes yield, respectively. The highest cure % (20. 28) was found, though. Increasing the productivity of problem soils, lowering the use of chemical fertilisers, increasing farm efficiency, and reducing environmental issue s are all goals. Organic farming is gaining traction around the world as a means of en suring turmeric's longterm viability and improving quality. Organic manures' contrib ution to improved soil structure and fertility.Organic manures improve soil texture an d structure, as well as water holding capacity and drainage, which aids in the growth and development of rhizomatous crops such as turmeric (Kale et al., 1991). Given the economic importance of turmeric and the environmental issues associated with chem ical use, it is critical to plant turmeric with organic fertiliser. Distinct organic manure s have different effects on turmeric productivity and quality. Poultry excrement, cow dung Mustard cake and Neem cake are the best organic manures for turmeric and gin ger cultivation.Along with organic manures, biofertilizers (Trichoderma viridae, Pseu domonas fluorescence, Azotobacter, VAM, and others) play an important role in incr easing turmeric and ginger productivity, yield, and quality.Apart from that, biofertiliz ers have the ability to minimise rhizome rot in turmeric and ginger. Rhizome rot caus es considerable harm to the rhizome development, resulting in a significant loss in pr oduction and negative impact on the quality of the output.

***Key Words:*** *Turmeric, organic manures, Biofertilizers, Curcumin, Yield*

# Impact of Permanent Manurial Experiment on Crop Yield And Soil Health Under Maize - Sunflower Cropping Sequence

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A Permanent Manurial Experiment (PME) was started in the year 1909 and being maintained at Tamil Nadu Agricultural University, Coimbatore. It is the oldest one having historical importance in India as it has crossed 111 years of continuous experimentation to study the long term effect of continuous application of manures and fertilizers either singly or in combination and with or without organic manure on crop productivity and soil quality. The experiment was conducted using non-replicated trial in red sandy loam soil (*Typic Haplustalf*) under Sunflower – Maize cropping sequence was followed with high yielding varieties/ hybrids and fertilizer dose of 60:90:60 and 250:75:75 kg NPK $ha^{-1}$, respectively. The treatment comprises of control, N alone, NK alone, NP alone, NPK, PK alone, K alone, P alone, NPK blanket, NPK+FYM, Farmers; practice, No manure no crop, STCR-IPNS, FYM (NEB), poultry manure (NEB), Residue mulching, FYM every year and FYM even year. From the result revealed that application of 100% NPK+FYM@ 12.5 t $ha^{-1}$ recorded the highest grain yield of maize (7725 kg $ha^{-1}$) and sunflower (2347 kg $ha^{-1}$) during 2020-2021 when compare to NPK treatment and absolute control (maize 910 kg $ha^{-1}$ and Sunflower seed yield 769 kg $ha^{-1}$). Continuous adoption of 100% NPK+FYM@ 12.5 t $ha^{-1}$ enhanced the soil OC status from 3.2 g $kg^{-1}$ during 1974-79 to 9.10 g $kg^{-1}$ during 2021. INM (100% NPK+FYM) practices showed the positive nutrient balance in soil. Balanced fertilization maintained the soil nutrient status whereas continuous addition of single nutrient alone depleted nutrients from soil.

***Key word:*** *NPK, FYM, Organic carbon and Yield*

# Organic Farming, Conservation Agriculture Carbon Sequestration And Biodiversity Conservation In Natural Farming

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Natural Farming is an agriculture practice which promotes neither chemical nor organic fertilizers are added to the soil. Natural farming benefits the farmer by the restoration of soil fertility, Environmental health and reducing the input cost on land which profits the farmer in term of economy. Government introduces *Zero Budget Natural Farming (ZBNF)* it is a method of chemical free agriculture drawing from traditional Indian practices. *ZBNF* helps to break the debt cycle for many small farmers. *ZBNF* promotes the application of *'jeevamrutha'– a mixture of fresh desi cow dung* and *aged desi cow urine, jaggery, pulse flour, water* and *soil* on farmland. This is a *fermented microbial culture* that adds nutrients to the soil. In Natural Farming use of*vermicomposting*is avoided, which is main backbone of nutrients in organic farming. *'Eiseniafetida'*the most common composting warms which absorb toxic metals and poison from soil are used in Natural Farming *carbon sequestration*, the long-term storage of carbon in plants, soils, ocean and other artificial means. Growing concerns about climate change mitigation result in increased Carbon di oxide concentration in the atmosphere. Hence, it is important to increase the rate of carbon sequestration through changes in land use and forestry. *Climate change mitigation* involves reduction in human emissions of greenhouse gases as well as activities that reduces their concentration in the atmosphere. Conservation agriculture promotes maintenance of a permanent soil cover (*mulching*), minimum soil disturbance (*notillage*), and *diversification of plant species*. It enhances *biodiversity* and natural biological process above and below the ground surface which contributes to increase water and nutrient use efficiency and to improved and sustained crop production. Conservation agriculture facilitates good agronomy, such as timely operations and improves overall land quality for rainfed and irrigated production. It also includes the useof*quality seeds* and *integrated pest, nutrients, weed* and *water management*.

# Screening of *Azotobacter* Species For Plant Growth Promotion in Sugarcane

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*Azotobacter* is an important free living nitrogen fixing bacteria and a potential bacterial biofertilizer due to their various plant growth promoting traits. These bacteria with the ability to grow on nitrogen free media and with nitrogenase activity are isolated from 20 different soil samples. These rhizospheric soil samples are collected from different sugarcane fields of IISR, Lucknow. In order to isolate *Azotobacter* preliminary enrichment is carried out in nitrogen free Mannitol agar whose pH is adjusted to 8.4. Firstly, these soil samples are serially diluted and using $10^{-2}$ and $10^{-3}$ dilution media plates are inoculated using spread plate technique, later incubated at $25^{0}$C for 2 to 4 days. The bacterial cultures are repeated for three times to obtain purity of the cultured isolate of bacteria. The colonies formed are slimy, semi-opaque and pale yellow in colour. These isolates will be subjected to cultural, morphological and biochemical characterization. Later, biological nitrogen fixing traits of *Azotobacter* will be examine followed by compatibility assay among potential *Azotobacter* spp. The purpose of this study is to understand its nitrogen fixing ability and its significance in promoting growth of sugarcane crops.

***Keywords:*** *Azotobacter, Nitrogen fixing, Mannitol agar and biochemical characterization.*

# Impacts of Different Nutrient Management Strategies on Arecanut Yields in Uttara Kannada District of Karnataka

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Nutrient management plays a crucial role on yield and quality of horticultural crops. In Uttara Kannada, a traditional area for areca, we see areca cultivation with pure organics (Organic); combination of fertilizers and organic manures (INM); and zero budget natural farming (ZBNF). A study was carried out to compare the three strategies on available nutrient status and corresponding areca yields. Twenty representative areca gardens, with minimum 5 years of nutrient management practices, were chosen from each category. The questionnaires were used to quantify amount of nutrients added and the soils were analysed individually for nutrient status. The study indicated that the NPK nutrients applied by INM famers were substantially higher while, least amounts of nutrients were supplied in ZBNF areca gardens. The total NPK nutrients applied by three groups were in the order - INM>organic>ZBNF. In terms of nutrient availability, higher nutrient contents were recorded in INM areca gardens while, lower nutrient contents were noticed in ZBNF areca gardens. The soil nutrient status was just similar to nutrient applications. Finally, the arecanut yieldsamong three different categories varied significantly and recorded in the order of INM > Organic > ZBNF areca gardens with respective arecanut yields of 3245 kg $ha^{-1}$, 1920 kg $ha^{-1}$ and 1137 kg $ha^{-1}$. Thus, the INM practicesin areca garden were found better and important to achieve higher yields and maintain good soil fertility.

# Effect of Conservation Agriculture on Organic Carbon Changes Over Time In Foothill Shivaliks

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Soil organic carbon is an important component of the ecosystem from the viewpoint of soil fertility as well as its potential to sequester atmospheric carbon. It is especially important because it is more vulnerable to climatic change and disturbance and play vital roles in nutrient cycling. Since the very labile pool only consists of a small part of total SOM, and the highly recalcitrant organic matter is resistant to decomposition and has a turnover time of thousand years, the response of an intermediately labile pool of carbon, between the very labile pool and the highly recalcitrant pool, will determine soil C balance. As organic carbon is highly sensitive to the farming practices, the persistent use of conventional farming practices based on extensive tillage combined with in situ burning of crop residues has magnified its losses. So, identifying rapidly changing SOC might be more informative to assess soil quality and allow early management decisions and quick remedial action. A study was, therefore, conducted to assess the effect of conservation agricultural practices organic carbon changes over time under maize crop. The field experiment was conducted during at Advanced Centre for Rainfed Agriculture, Dhiansar. Geographically the experimental site is located at 32°39′ N latitude and 74°58′ E longitude at an elevation of 332 meters above the mean sea level in the Shivalik foothill plains of North-Western Himalayas. There were 10 treatments with 3 replications each laid out in Randomized Block Design (RBD). CA practices included following interventions: i) soil disturbance: comparison of minimum tillage (single tillage), zero tillage and conventional tillage, ii) soil cover: impact of mulching and iii) cropping systems: sole maize as well as its combination with black gram (mash). The soil samples were collected initially at the time of sowing, 30 days after sowing (DAS), 60 DAS and at harvest and were analyzed for Oxidizable organic carbon (OC). As a general trend among all the treatments, OC slightly increased from before crop sowing to 30 DAS, then decreased at 60 DAS and then more or less levels of OC towards the harvesting stage. But, there was no significant difference between the treatments. Seasonal changes in mineralizable C of this soil illustrated the dependence of seasonal nutrient dynamics on short-term substrate availability from crop roots, rhizosphere products, and crop residues. As compared with initial organic carbon in soils i.e. after the preceding crop of wheat, the soil OC was lower after the maize crop which could be due to increased temperature and optimum moisture conditions during the monsoonal period resulting in faster rates of organic matter decomposition as compared to the winter season.

***Keywords:*** *organic carbon, conservation agriculture, conventional farming*

# Nutrient Management In Organic Aromatic Rice

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A field experiment was conducted at Instructional-cum-Research Farm, Assam Agricultural University, Jorhat during 2018-19 and 2019-20 in factorial RBD with three replications to evaluate the effects of organic nutrient management on growth, yield attributes and yield of aromatic rice. The experiment consisted of three aromatic rice varieties viz., Kola joha ($V_1$), Keteki joha ($V_2$) and Chakhao poireiton ($V_3$) and five organic nutrient management practices viz., control ($N_0$), vermicompost @ 40 kg N $ha^{-1}$ ($N_1$), vermicompost @ 30 kg N $ha^{-1}$ + in situ green manuring with Sesbania aculeata ($N_2$),vermicompost @ 30 kg $Nha^{-1}$+ in situ green manuring with Sesbania aculeata + seedling root dip treatment with Azospirillium and PSB @ 3.5 kg $ha^{-1}$ each ($N_3$) and vermicompost @ 20 kg N $ha^{-1}$ + in situ green manuring with Sesbania aculeata + seedling root dip treatment with Azospirillium and PSB @ 3.5 kg $ha^{-1}$ each ($N_4$). The growth, yield attributes and yield of aromatic rice was significantly influenced by the varieties and different organic nutrient management treatments. Among the varieties, most of the growth parameters viz., plant height , LAI, root dry weight, root length and root volume, dry matter production at different stages were observed to be significantly higher in Chakhao poireiton**.** However, the highest leaf number and panicle number $m^{-2}$ was recorded in Keteki joha. The highest grain yield was recorded in Keteki joha which was found to be statistically at par with Chakhao poireiton. The highest pooled grain (27.46 q $ha^{-1}$) and the straw (78.80 q $ha^{-1}$) yield were recorded with Keteki joha and Chakhao poireiton, respectively.The highest panicle numbers viz., 264.93 $m^{-2}$ in 2018 and 271.40 $m^{-2}$ in 2019 were recorded in Keteki joha with the $N_3$ treatment.The $N_3$ treatment was found superior in respect of almost all the studied parameters which was found statistically at par with the $N_2$ treatment for most of the parameters. The $N_3$ treatment registered the highest pooled grain (31.42 q $ha^{-1}$) and straw (67.48 q $ha^{-1}$) yield. The interaction effects between the varieties and organic nutrient management practices were found not significant except for the panicle numbers. N, P and K contents and their uptake by grain and straw were significantly influenced by the varieties and the highest uptake of N (92.7 kg $ha^{-1}$), P (20.78 kg $ha^{-1}$) and K (91.98 kg $ha^{-1}$) were recorded in Chakhao poireiton. All the organic nutrient management practices recorded significantly higher nutrient content and uptake as compared to the control and the highest values were recorded with $N_3$ treatment. The difference in organic C due to organic nutrient management practices was found significant and the $N_3$ treatment recorded the highest build up of organic C. The highest net return and B:C ratio was achieved with the $N_3$ treatment in Keteki joha.

**Key words:** Aromatic rice, organic nutrient management, yield attributes, yield, organic carbon

# Conservation Agriculture In India

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Conventional agricultural production systems are characterized by repeated tillage operations, monocropping or fixed crop rotations, clean cultivation, greater dependence on chemical fertilizers and other agro-chemicals, and flood irrigation in most areas. Adoption of these so called modern cultivation practices coupled with introduction of dwarf-statured high-yielding varieties of cereal crops has led to increased productivity and also profitability during the first 2-3 decades of green revolution. Subsequently, the production costs started increasing due to high energy requirements for tillage, fertilizer, pesticides, ground water and other resources. Further, there were also reports of degradation of natural resources of soil, water, environment as well as the quality of produce. All these led to a change in thinking and reorientation of crop production practices for achieving higher productivity while ensuring ecological sustainability. Conservation Agriculture (CA) is an ecosystem approach to regenerative sustainable agriculture and land management based on the practical application of locally-adapted three interlinked principles: (i) continuous no or minimum mechanical soil disturbance (notill seeding/planting and weeding, and minimum soil disturbance with all other farm operations including harvesting); (ii) permanent maintenance of soil mulch cover (crop biomass, stubble and cover crops); and (iii) diversification of cropping system (environmentally and socially adapted rotations and/or sequences and/or associations involving annuals and perennials, including legumes and cover crops), along with other complementary good agricultural production and land management practices. These production systems are considered to be more innovative, knowledge-intensive and resource-use efficient, and help in overcoming the problems associated with conventional systems.

**Keywords:** *Conservation Agriculture, Cropping system, Land management and Sustainable agriculture*

# Effect of Biochar And Pig Manure on Performance of Ricebean [Vigna Umbellata (Thunb) Ohwi And Ohashi] And Soil Properties In Dystrudepts

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A field experiment was conducted during the *kharif* season of 2018-2019 in the Department of Agricultural Chemistry and Soil Science to study the effect of biochar and pig manure on performance of ricebean [ *vigna umbellata* (thunb) ohwi and ohashi] and soil properties in dystrudepts. The treatment consist of 2.5 t $ha^{-1}$ wood and bamboo biochar, 5.0 t $ha^{-1}$ of wood and bamboo biochar, 2 t $ha^{-1}$ pig manure and 20 kg N, 40 kg $P_2O_5$ and 30 kg $K_2O$. The study revealed that application of wood biochar @5 t $ha^{-1}$ along with @ 2 t $ha^{-1}$ of Pig manure and recommended dose of fertilizers enhanced the growth characters which increased the grain yield and stover yield. It was also observed that there was a slight increase in pH from 5.2 to 5.4 due to biochar application.

***Keywords:*** *Biochar, Pigmanure, Ricebean*

# The Benefits Biochar In Agriculture

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Biochar is a sterile, solid carbon-rich by-product of biomass pyrolysis produced under low or anaerobic conditions, with the potential to ameliorate climate change through carbon sequestration. B A material must have a long residence time and be resistant to chemical processes such as oxidation to CO2 or reduction to methane in order to sequester carbon. The above requirements are met by using biochar as a soil amendment. Annually about 500 Mt crop residues are generated in India, out of which 141 Mt is surplus and around 92 Mt of residues are burnt every year. With the advent of farm mechanization, the residues generated are less reliable as livestock feed. But the farmers are in a hurry for quick disposal of these residues to reduce the turn over period for sowing the next crop. So, the farmers are burning the crop residues which are detrimental to environment as well as human health. In this case, biochar production from crop residues can be a viable option.Apart from carbon sequestration and mitigation of greenhouse gas emissions, biochar has multiple benefits. Due to its large specific surface area and high porosity, the biochar enhances the soil physicochemical and biological properties like water holding capacity (WHC), soil structure, cation exchange capacity (CEC), nutrient adsorption and creates suitable micro-environment for the growth of soil micro-organisms which in turn increases the crop yield and productivity. Biochar can also be used as a soil amendment for the reclamation of problem soils and remediation of toxic chemicals and pollutants in the soil.

***Keywords:*** *Biochar, carbon sequestration, crop residues, soil amendment*

# Impact of Organic Matter on Soil Biological Properties And Soil Quality

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Organic matter, also known as organic material or natural organic matter, is a large source of carbon-based compounds found in natural and engineered, terrestrial and aquatic environments (Moharana*et al*. 2017). Soil organic matter consists of a variety of components. This includes, in varying proportions and many intermediate stages, an active organic fraction including microorganisms (10-40 percent) and resistant or stable organic matter (40-60 percent) referred to as humus (Mohammadi *et al*. 2011). In a study, Koishi*et al*. (2020) reported that among all the organic amendments, cereal straw, farmyard manure, and cattle slurry promoted a higher SOC content and a lower humification index due to an increase in SOC in the clay-size fraction. Mohammadi *et al*. (2011) also noted that incorporation of organic amendments to soil influences soil enzymatic andmicrobial activities in the soil. They reported that application of FYM + compost + chemical resulted in maximum MBC (691.2 µg) but FYM + compost enhanced protease (110.3 µg), acid phosphatase (226.6 µg) and urease (49.8 µg) as compared to other treatments. Mankindi*et al*. (2011) reported that application of kola pod husk and FYM (75:25) significantly enhanced uptake of N (22.36 mg $kg^{-1}$), P (6.25 22.36 mg $kg^{-1}$), K (34.66 22.36 mg $kg^{-1}$), Ca (10.60 22.36 mg $kg^{-1}$) and Mg (10.80 22.36 mg $kg^{-1}$) as compared to control conditions. On the otherhand, Yongnyu-Phom *et al*. (2018) concluded that application of NPK along with FYM was found to be more beneficial and significantly improved soil, growth and yield of Potato. Maximum available nitrogen (246.0 kg $ha^{-1}$), phosphorous (22.96 kg $ha^{-1}$) and potassium (172.0 kg $ha^{-1}$) was noticed with 100% NPK+ 50% t $ha^{-1}$ FYM).

***Key words:*** *Organic inputs, Soil properties, Nutrient uptake and Soil quality*

# Conservation Agriculture- A Route Towards Sustainability

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Lately, to satisfy the demands of increasing population intensive farming methods are being employed which many a time are correlated with many detrimental implications on soil and environment. In light of those consequences sustainable way of agriculture has been popularized. Sustainability is the ability to meet our present day needs and maintaining them without compromising the requirements of future generations.Conservation agriculture has been featured as a fundamental access to sustainable agriculture. Conventional agriculture is realized to be unsustainable environmentally, ecologically insensitive and economically unsound. Traditional till farming has posing several ill effects on soil physical, chemical and biological properties such as decrease of soil organic matter content, drop in soil biota, enhanced soil degradation, reduced nutrient use efficiency, lowering ground water tables, enhancing waterlogging and salinization, threat of ground pollution and air pollution due to the large discharge of greenhouse gases which in turn responsible for global warming. All these negative effects can be minimized by resorting to sustainable farming practices under conservation agriculture. Hence Food and Agriculture Organisation (FAO) and many others commenced to encourage soil conservation practices under the title ‘conservation agriculture’. It basically relies on three principles viz. no or minimum soil disturbance, maintaining continuous soil cover with the close growing cover crops or by addition of crop residual mulches and the crop rotation.Conservation agriculture is said to be executed only when all the three above ideas are carefully applied. Farmers are followingthose practices from the long time before the term was actually introduced. Sustainable farming approach is not only directed towards conserving soil and water but also improves resource use efficiency by combined management of water, soil nutrients and other biological resources. On account of its numerous benefits, it is widely being practiced and adopted by the farmers and now accounts over 180 M ha all over the world.

***Keywords:*** *sustainability, traditional till farming, resource use efficiency, crop rotation, greenhouse gases.*

# Organic Farming: A Path For Eco-Friendly Sustainable Agriculture

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In recent years, organic farming as a cultivation process is gaining increasing popularity. Organically grown foods have become one of the best choices for both consumers and farmers. Organically grown foods are part of go green lifestyle. Organic farming has been a long way of life and a tradition in our Indian farming system for centuries, it's not a new concept. the Green Revolution was important then but now Organic Revolution is vital. Organic farming is nature's own system following the rules of nature for self-sustainability and the principles in organic farming are the principle of health, ecology, fairness and care i.e., with the concept of 'live and let live' showing a positive effect on the ecosystem. Organic farming among all different kinds of farming systems is gaining more attention due to the positive effect on the ecosystem. Also, organic farming is labour intensive, this increases rural employment and long-term improvement in the quality of the resources.The threat to chemical farming has shed light on the direction of organic farming and is the best natural tool to fight it. Organic farming is nature's way of farming with the adoption of our non-synthetic traditional agricultural knowledge. This farming method can overcome the ill effects caused by the adoption of chemical farming and it shall increase agricultural production and productivity in a healthy way without affecting the ecosystem balance of the growing population. The basic principles of organic farming are the principle of health, ecology, fairness and care. The advantages of organic farming are: it creates a natural level of resistance to plant pests & disease, gives an opportunity for specialization, supports healthy soil and pollinators.

***Keywords:*** *Organic Revolution,Farming systems, Ecosystem&Go -green lifestyle.*

# Cropping Systems, Effect on Soil Physicalproperties and Carbon Sequestration

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Soil properties mainly depends on the response of soil to different crops grown and to the cropping systems adopted. Effect of these cropping systems on soil properties provides an opportunity to evaluate sustainability of cropping systems and thus the soil and crop management must be given high research priority. The climate and soil of a region have a great bearing on availability and degree of decomposition of organic material in soil while the cropping patterns adopted significantly influences the soil organic carbon content. Soil organic carbon (SOC) storage in different cropping systems is critical to maintenance of soil fertility and productivity and reduction of $CO_2$ losses in the atmosphere. The use of different soil management practices enhances soil carbon sequestration and its distribution in the soil profile to mitigate the green-house effect. Soil organic carbon (SOC) is considered as the largest global terrestrial carbon pool which can stock about 1500-2000 Pg C in various organic forms to a depth of 1m. An understanding of the effect of cropping systems on soil physical properties and soil carbon sequestration is of paramount importance for framing strategies for soil quality management in the present context of increasing atmospheric $CO_2$ concentration. A study was thus conducted in Mid-hills of Jammu to assess the effect of cropping systems on physical properties as well as on carbon sequestration of soil. Four cropping systems, namely agroforestry, cereal, horticulture and vegetable were considered for the study. The soil carbon sequestered in 0.5-m soil depth was determined under different cropping systems. Agroforestry based cropping system recorded maximum porosity (49.60 per cent), water holding capacity (42.54 per cent) and infiltration rate (5.93 cm $hr^{-1}$). While, bulk density (1.29 g $cm^{-3}$) and penetration resistance (0.17 MPa) were recorded lowest in agroforestry and highest in cereal-based cropping system. The mean weight diameter of surface soils was highest for agroforestry (2.17mm) and was lowest for cereal (1.22 mm) based cropping system. Water-stable macro-aggregates (>0.25mm) were abundant in agroforestry (84.83 per cent) while, water stable micro-aggregates (<0.25mm) were abundant (70.01 per cent) in cereal-based cropping system. The total carbon sequestered in 0.5-m profile was highest in agroforestry (102.8 Mg $ha^{-1}$) and lowest in cereal (77.4 Mg $ha^{-1}$) based cropping systems. Surface layer recorded highest carbon sequestered in agroforestry (32.9 Mg $ha^{-1}$) and lowest in vegetable (28.3 Mg $ha^{-1}$) based cropping systems. Sub-surface layers recorded highest carbon sequestered in agroforestry and lowest in cereal based cropping system. The results of the study revealed a direct and profound effect of different cropping systems on soil physical properties and carbon sequestration.SOC gains could be enhanced by improving carbon sequestration through best management practices (BMPs) and suitable cropping systems.

*Keywords:Mid-hills, Soil carbon sequestration, Soil organic carbon,Cropping system, Carbon pool, Physical properties, Bulk density, Porosity,Penetration resistance, Micro and macro aggregates, Mean weight diameter, Infiltration rate, Water holding capacity*

# Low Carbon Emissions From Agriculture: An Approach To Combat Climate Change

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Greenhouse gases (GHGs) are released in the atmosphere due to the natural changes and perturbations produced by human activities. Many adaptative approaches have been used to reduce GHG emissions, mainly $CO_2$, in order to achieve the goal of low carbon emission in agriculture in near future under the changing climatic conditions. Climate-smart agriculture through resource conservation has developed a new dimension in the transition from traditional farming operations to smart farm approaches in a region-specific manner. As a result, the scientific community has placed a premium on low carbon emission solutions in order to meet the COP26 aim of zero carbon emissions by 2070. Hence, focus should be given on effective techniques or methods in the agricultural system to mitigate the climate change issues. More emphasis should be given on improving soil health in the direction of carbon sequestration potential.

***Keywords:*** *Climate change, climate-smart agriculture, mitigation, low carbon emission*

# SHORT-Term Effect of Tillage Practices And Mustard-Based Cropping Systems on Soil Quality in Drylands of India

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Soil is a valuable natural resource and soil quality is a key element that determines the crop productivity and sustainability. Unfortunately, with the adoption of green revolution, soils are being degraded at an alarming rate which led to a substantial increase in environmental degradation which includes soil salinization, waterlogging, depletion of underground water-table, soil erosion, and decline in soil fertility etc. Therefore, the need to devise strategies to combat the problems in the existing agriculture production system is the need of the hour. Several research publications have addressed the importance of conservation agriculture practices in preventing soil degradation and restoring the features of soil quality.Therefore,a short-term experiment was conducted with the objective to assess the impact of tillage practices and mustard-based cropping systems on soil quality in dryland area. The study was conducted in already existing permanent experimental plot after four years of field experiment using split plot design in northern India under mustard-based cropping system. The strip constituted three tillage systems: conventional tillage (CT), raised beds (RB) and zero tillage (ZT) in the main plot and four mustard-based cropping systems i.e., mustard-green gram, mustard-pearl millet, mustard-sesamum, and mustard-maize arranged in sub-plots. The experiment had been laid at advanced centre for rainfed agriculture since rabi season of 2016-17 and for this study, soil samples were taken from two depths i.e., 0-15 and 15-30 cm after rabi crop of 2019-20 and were analyzed for physical, chemical, and biological parameters. Soil quality index (SQI) using principal component analysis (PCA) and linear scoring functions were calculated. Among the 12 treatments, the SQI ranged from 0.26 to 0.31. The highest SQI was obtained in ZT (0.31) followed by RB (0.30), while the lowest was under CT (0.26). The key indicators, which contributed considerably towards SQI, were soil microbial biomass carbon (SMBC), clay content, pH, and silt content. On the average, the order of relative contribution of these indicators towards SQI was: SMBC (40.03%), clay content (13.22%), pH (11.16%), and silt content (7.63%). Among these treatments, ZT not only had the highest SQI, but also the most promising from the viewpoint of sustainabilityas well as soil quality in Inceptisols.

***Keywords:*** *Soil quality assessment; Soil quality indicators; Inceptisol; Tillage; Croppingsystems; India*

# Response of microbial inoculants and split application of vermicompost on wheat (*triticum aestivum* l.) Production

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Microbial inoculants and split application of vermicompost enhance yield trend and economics of wheat (*Triticum aestivum* L.) crop were studied for two consecutive *Rabi* (winter) seasons during 2017-18 and 2018-19 at the Agronomy Farm of RCA, Udaipur, Rajasthan. Treatments included microbial inoculants and vermicompost. The seeds inoculated with microbial inoculants increased all characters examined in the study. Two years data indicate that combined applications of microbial inoculants as $B_5$ were obtained significantly higher plant height (101.09 and 102.90 cm), total tillers (90.57 and 92.99), effective tillers (76.77 and 79.00), grain yield (4502.51 and 4626.99 kg/ha), straw yield (6527.0 and 6686.3 kg/ha), biological yield (11029.55 and 11313.30 kg/ha) and B:C ratio (1.92 and 2.24) of wheat over rest of the treatments except $B_4$. Further results observed that split application of vermicompost as $V_3$ significantly improved plant height (100.21 and 102.94cm), total tillers (91.04 and 93.54), effective tillers (75.72 and 77.86), grain yield (4525.66 and 46.48.83 kg/ha), straw yield (6548.1 and 6748.9 kg/ha), biological yield (11073.80 and 11397.68kg/ha) and B:C ratio (1.88 and 2.19) of wheat crop over rest of the treatments except $V_4$. Studies on the use of such beneficial microorganisms and split application of vermicompost are necessary for a sustainable and ecological agricultural wheat production.

***Keywords:*** *Microbial inoculants, sustainable, vermicompost, yield, wheat*

# Characterisation of The Power Loom Dye's Effluent Water In Nagari Division of Chittoor District of Andhra Pradesh

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An investigation was carried out to know the impact of power loom dye's effluent waters as the properties of soil, plant and water in Nagari division of Chittoor district of Andhra Pradesh. For this textile effluent water samples were collected from four different sources namely near the power looms, after entering into the first reservoir, after entering into the second reservoir and release of waste water to the agricultural soils. The power loom effluent water samples were analyzed for physico-chemical and chemical properties. The highest pH value of 9.50 was observed in water collected at near textile units,where as the least pH value of 7.96 was reported in effluent collected at the second tank. The pH of the effluent water samples was medium to high. The EC of the effluent samples was low to medium (0.29 to 0.79 dS $m^{-1}$). The biological oxygen demand (BOD) of the textile effluent was reported to be sufficient and deficient. The highest nitrogen values of 48.52 mg $L^{-1}$ were detected in effluent collected from nearby dyes factories whereas the least nitrogen value of 20.8 mg $L^{-1}$ was distinguished in water collected from the fuel effluent liberated to the agricultural fields. The nitrogen content of the water samples was medium to high (20.89 to 48.52 mg $L^{-1}$).The phosphorous values of effluent collected from the nearby power looms units, from the first reservoir, from the second reservoir and release of effluent to the agricultural fields were ranged from 2.58 to 4.39 mg $L^{-1}$, 2.23 to 3.21 mg $L^{-1}$, 1.98 to 2.98 mg $L^{-1}$ and 1.05 to 1.25 mg $L^{-1}$ respectively. The study revealed that all the effluent water samples collected for phosphorous were reported to be low (1.05 to 4.39 mg $L^{-1}$). The study exhibited that effluent samples collected for potassium were medium to high. The calcium and magnesium values of effluent collected from the four different sources were found to be low to medium. The sodium of the effluent samples was said to be medium to high (385.24 to 543.68 mg $L^{-1}$).The micronutrients such as copper and manganese were above the permissible limits in water samples except iron, which falls within the permissible limits. The zinc level in contaminated water samples was observed to be sufficient and deficient. The heavy metals such as cadmium, chromium and nickel were above the saturated limits in water samples collected from different locations. Effluent water samples collected for lead were reported to be lower than and higher than the permissible limit.

**Keywords:** *Permissible limits, Textile effluent water, Sufficient, Power looms.*

# Effect of organic nutrients on quality of cashew (*anacardium occidentale* l.) Value added product cv. BPP-8

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The present investigation entitled "Effect of organic nutrients on quality of cashew (Anacardium occidentale L.) value added product cv. BPP-8" was carried out at Cashew Research Station, AICRP on Cashew, Ranasinghpur, Bhubaneswar under Odisha University of Agriculture and Technology during the year 2020-21. The experiment was laid out in Randomized Block Design (RBD) with three replications and eight treatments including different source of organic nutrient along with control i.e. $T_1$-100% N as FYM, $T_2$-100% N as FYM + Bio-fertilizers consortium @200 g tree/year), $T_3$-50% N as FYM + Bio-fertilizers consortium @200 g tree/year), T4-100% N as Vermicompost + Bio-fertilizers consortium @200 g tree/year), T5-Recycling of organic residue with the addition of 20% cow dung slurry (20% weight of organic residue as cow dung), T6- In situ green leaf manuring to meet 100% N, T7-25% N as FYM + Recycling organic residue + In situ green leaf Manuring+ Bio-fertilizers consortium @200 g/tree/year), T8-Recommended Dose of Fertilizer (500:250:250g/plant) + 10kg FYM as control. The result revealed significantly positive effect of different organic source of nutrients on RTS prepared treatment$T_8$ (Recommended Dose of Fertilizer (500:250:250g/plant)+10kgFYM as control) exhibited better over all acceptability among the test edtreatment sunder both ambientandrefrigeratedstoragefollowedbytreatment$T_4$(100%NasVermicompost+Biofertilizersconsortium@200gtree/year).Amongthetreatments,$T_8$(RecommendedDoseofFertilizer(500:250:250g/plant)+10kgFYMascontrols)scoredhighestinoverallacceptabilitycomparedtotherestoforganictreatments.However,treatment$T_4$canalsoberecommendedfortheпreparationofRTSbeverageinamongorganic treatments.

***Key word:*** *Cashew apple, BPP-8, organic nutrients, RTS*

# Efficacy of weather based agriculture under changing climatic context in the Kannauj and Bulandshahr districts of Uttar Pradesh

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Weather is one of the most important factors that determining success or failure of agricultural output. It effects on every phase of growth and development of plant. Any changes in weather patterns during the crop season will affect crop development and ultimately yield quality and quantity of crop. Although it is impossible to completely eliminate all agricultural losses due to weather, they can be reduced to some extent by making modifications based on early and accurate weather forecast information. Weather-based agriculture assists farmers in enhancing their productivity and profitability by recommending appropriate management strategies depending on weather conditions. Keeping in view, the Ministry of Earth Science, Government of India (GoI) taken an initiative to establish a scheme namely Gramin Krishi Mausam Sewa (GKMS) with the primary objective. of issuing Medium Range Weather Forecast (valid up to next 5 days from date of issue) inclusive of all-weather parameters and increased Agromet Advisory Services (AAS) at the level of Agro-climatic zone to the local farmers. During the Rabi 2019-20, 2020-21, and 2021-22 seasons, a research was conducted to assess the influence of weather-based agriculture. Farmers who practice weather-based agriculture and farmers who do not practice weather-based agriculture were chosen from different villages of Kannauj and Bulandshahr district in Uttar Pradesh to analyze the impacts of weather-based agriculture. In comparison to farmers who did not practice weather-based agriculture, the results showed that farmers who practiced weather-based agriculture were able to significantly reduce input costs and increase net profit. Weather based agriculture helps to increase agriculture production, increase efficiency in the use of water, reduce costs of inputs, labor, energy, reduce losses, risks, reduce pollution and improves quality of yield with judicious use of agricultural chemicals. Increased yield and reduced cost of cultivation, led to increased net returns. Thus, weather based agriculture based on current and forecasted weather is useful for enhancing the agriculture production and income of farmers by reducing the farm input cost by doing crop and pest management in appropriate time.

***Key words:*** *Agriculture, weather, changing climatic context*

# Conservation Agriculture: A New Technique For Sustenance of Agriculture and Natural Resources

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India is an agrarian country with majority of the population depending on agriculture as their main occupation. To cater the needs of increasing population many developments had been occurring in Indian agricultural system over the decades like developing and using of HYV, fertilizers, tillage operations, farm mechanization etc., which has been successful in attaining the self-sufficiency in the food grains production with increased yields in the country. Even though, India somehow attained self sufficiency goal in agricultural production, it is facing diverse problems relating to the depletion of natural resources and environmental degradation. So, conservation agriculture is gaining wide popularity these days all over the world as a new way of technique in attaining sustainability in agricultural production besides being environmental friendly by conserving the nature resources. This new approach uses three main principles viz., minimum disturbance of the top soil, permanent soil organic cover and crop rotation practices which contribute to increased water and nutrient use efficiency, increased sustainability in crop production and conservation of nature resources by rejuvenating soil fertility, increased soil infiltration rate, maintaining proper soil temperature, aggravating growth and biological activity of soil micro and macro organisms and reducing soil erosion. Combination and coordination of institutional and technological innovations and know how is needed for the sustainable agriculture through conservation agriculture technique.

***Key words:*** *conservation agriculture, sustainable agriculture, natural resources.*

# Conservation Agriculture for Sustainability Through Land Configurations and Mulching Techniques in Chickpea

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Sustainability in agriculture could be attained through efficient use of technical practices that would conserve and give opportunity of recycling resources on field. Employing the land configuration techniques and applying the biomulching treatments are such alternatives that would lead to the conservation of resources especially the *in situ* soil moisture, which is most important constraint in crop productivity. A field experiment was conducted at Agricultural College, Jagtial, PJTSAU, during *rabi*, 2019-20 regarding influence of land configurations and mulching in chickpea on growth and yield. The experiment was laid out in split plot design with three land configurations ($M_1$- Flat bed, $M_2$- Ridge and furrow, $M_3$- Broad bed and furrow) as main plots and four mulching treatments ($S_1$- Control, $S_2$- Sesamum mulch, $S_3$- Gliricidia mulch, $S_4$- Paddy straw mulch) as sub plots, where mulch material was applied @ 10 tonnes/ha after the germination. Significantly better plant stand (90.12 %), plant height (47.49 cm at harvest), dry matter accumulation (851.62 g $m^{-2}$ at harvest) and higher seed yield (1444.3 kg $ha^{-1}$) was recorded with broad bed and furrow, followed by ridge and furrow method and the least plant stand, plant height and dry matter accumulation was recorded under flat bed cultivation. Among different mulching treatments, significantly better plant stand (92.16 %), plant height (48.80 cm at harvest), dry matter accumulation (856.72 g $m^{-2}$ at harvest) and higher seed yield (1365.8 kg $ha^{-1}$) was recorded with gliricidia mulch, followed by paddy straw mulch and sesamum mulch, least performance of the plants to plant stand, plant height, dry matter accumulation and seed yield was observed in control treatment. Land configurations and mulching had exceptional role in improving the *in situ* soil moisture conservation, weed control and fertilizer use efficiency and thus resulted in better performance of growth parameters and yield of chickpea.

***Key words:*** *Sustainability,Conservation agriculture, In situ soil moisture, Weed control, Fertilizer use efficiency, Biomulching and Land configurations.*

# Conservation Agriculture for Sustainable Soil Management and Improve the Livelihood People in India

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Conservation agriculture (CA) technologies require minimum soil disturbance, permanent soil cover through crop residues or cover crops, and crop rotations for attaining higher productivity. In India, efforts to develop, improve and transmit conservation-based agricultural technologies have been progress for nearly two decades and made significant progression since then even though there are several constraints that affect adoption of CA. The adoption and uptake of CA by Middle Eastern farmers has been slow but it is nevertheless occurring gradually. CA represents a fundamental change in production system thinking and is capricious novel and knowledge intensive. the policy-makers and institutional leaders, transformation of tillage systems to CA systems requires that they fully understand the large economic, social and environmental benefits CA offers to the producers and the society at large. Collection of information and research parameters related to agricultural practices are needed for designing a suitable soil and water conservation program for sustainable production intensification. The greater impact that can result from the adoption of CA as a matter of policy and good stewardship is that agriculture development in the Mediterranean region will become part of the solution of addressing regional and global challenges including resource degradation, land and water scarcity, climate change. adopting CA as a basis for sustainable agricultural intensification ecosystem management. The technologies of CA provide opportunities to reduce the cost of production, save water and nutrients, increase yields, increase crop diversification, improve efficient use of resources, and benefit the environment. The benefits include: higher factor productivity, yield and income; improved soil properties; climate change adaptation, including reduced vulnerability to the erratic rainfall distribution; and reduction in machinery, fuel and labour costs.

***Keyword:*** *Sustainable, Conservation, diversification*

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# Conservation Agriculture: A Practice for Soil Carbon Sequestration

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Increase in human populations and the emerging challenges of climate change mean that the world's agricultural systems need to produce more food in an environment that is variable and quality of our natural resource base is declining. Conservation agriculture based on minimum soil disturbance, adequate surface cover, and complex crop rotations is an alternative system to conventional agriculture soil organic carbon (SOC) concentration is a strong determinant of soil physicochemical and biological activities, carbon sequestration in agricultural soils requires changes to management practices.. While the effects of CA on SOC worldwide are variable, with both increases and decreases observed, in regions where soil and climatic conditions are favorable for biomass production and where the system does not negatively impact yield, then CA can lead to higher amounts of SOC relative to conventionally managed systems, particularly in the surface of the soil profile.Harshness of arid and semiarid climate exacerbates the risk of soil degradation by depleting SOC stock and increasing risks of erosion and salinization. Widespread adoption of CA can reduce the cost of farm operations including fuel consumption, while conserving soil water, improving soil functions, controlling erosion, and sustaining productivity. Where greater SOC occurs, these are also often accompanied by improvements in soil structure, water infiltration and soil water storage, plant nutrient availability, microbial biomass and diversity, and yield.Conservation agriculture may be considered as one of the better practice for soil carbon sequestration.

***Keywords:*** *carbon, sequestration, conservation agriculture.*

# Effect Of Different Indigenous Breeds Of Poultry Layers On Productionand Morphological Egg Quality Traits In Western U.P.

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The present investigation was carried out to see the effect of indigenous poultry layers on egg quality traits and production at Poultry Research and Training Centre, SardarVallabhbhaiPatel University of Agriculture &Technology, Meerut. Total 300 poultry layers of three breeds Aseel, Kadaknath and Rhode Island Red in four nests were observed. The traits were age at sexual maturity, body weight at sexual maturity, annual egg production, egg weight, shape index, shell weight and shell thickness. The data were analyzed by using CRD. The age at sexual maturity was as 176.48±1.38, 182.54±0.15 and 187.09±0.16 days, body weight at sexual maturity were as 1330.15±8.7, 1287.93±0.48 and 1441.74±0.58 gm, annual egg production was as 139.36±7.1, 108.32±0.27 and 87.14±0.14 eggs. The egg weight was as 47.37±0.27, 52.43±0.10 and 47.09±0.12 gms, egg shape index 74.67±0.15,75.01±0.109and 75.64±0.12 percent, shell weight 7.07±0.01, 5.74±0.008 and 6.8±0.019 gms and egg shell thickness were as 0.32±0.001, 0.33±0.001 and 0.32±0.001 mm in Rhode Island Red, Kadak nathand Aseel respectively. The analysis of variance showed highly significant differences among breeds for most of the traits except egg shell weight and egg shell thickness. The result shows that the age at sexual maturity and annual egg production traits have high heritability so selection for these traits may results better and these breeds can be used for back yard poultry keeping.

***Keywords:*** *Layers, Egg quality traits and Production*

# Plant Growth Enhancement With Phosphorus-Solubilising Microorganisms And Biochars: A Review

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Phosphorus (P) is the second most limiting soil mineral nutrient and one of the most important macro-elements in plants. It is necessary for crop development and production.

PSBs play an important role in plant P nutrition because of their impact on soil P dynamics and subsequent P availability to plants through solubilization and mineralization processes. The addition of biochar to a soil amendment boosts microbial activity and biomass.Phosphate-solubilizing microorganisms (PSMs) in the soil release organic acids and other enzymes that make the unused phosphate available to the plant.Phosphate-solubilizing bacteria (PSB), such as *Pseudomonas* sp., *Bacillus* sp., and *Agrobacterium* sp., are often found in the soil rhizosphere.For increasing soil biological qualities as well as yield attributes in safflower, using cow dung biochar together with phosphate solubilizing microorganisms, notably mycorrhiza species, is advised. Only phosphate-solubilizing bacteria can dissolve the fixed P in soil (PSMs).Different forms of organic acids were released into the soil by these bacteria, making P soluble and accessible to plants.PSB and biochar have the potential to be a promising alternative to traditional techniques for boosting plant growth and nutrient absorption in semiarid soils, and when used combined, they showed more growth and nutrient concentration than biochar and bacterial treatments alone.It was concluded that PSM, in combination with biochar, had a wide spectrum of plant growth-promoting characteristics that can benefit plants directly or indirectly.

***Key Word**: Biochar, Phosphorus solubilising microorganism, phosphorus- dynamics*

# Rsponsee of Varying Level of Inorganic Fertilizers Farm Yard Manure and Rhizobium Inoculation on Soil Health and Yield Attributes of Blackgram (*Vignamungo*L.) var. Shekhar-2

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A field trial was carried out during kharif season of 2021 to evaluate the "Response of varying level of inorganic fertilizers (N P K & Zn) farm yard manure and rhizobium inoculation on soil health and yield attributes of blackgram(Vignamungo L.) var. Shekhar-2" in sandy loam soil. The experiment was laid down in randomized block design comprised three fertility levels (control, @ 100% RDF, @50% Zn, @ 100 % FYM) and three levels of farm yard manure (control, @ 50% FYM, @ 100% FYM) replicating thrice and rhizobium inoculation. Amongst the fertility levels, the application of @100 % RDF, (20 kg N $ha^{-1}$ 60 kg $P_2O_5$ $ha^{-1}$ 20 $K_2O$ $ha^{-1}$), 100% Zn (25 kg Zn $ha^{-1}$) and 100% (10 t FYM $ha^{-1}$) significantly increased seed yield of black gram. Although, the seed yield in 100 % RDF, 100 % Zn, 100 % FYM and in 50 % was at par with 100% RDF. Similarly, seed inoculation with Rhizobium significantly increased seed yield over the remaining treatments. The interaction effect of fertility levels and biofertilizer significantly influenced the yield and of black gram maximum being with 100% RDF, Zn, FYM& Rhizobium combination.

***Key words:*** *Soil parameters, inorganic fertilizer, Biofertilizer, Blackgram, FYM & Yield*

# Effect Of Long Term Inm On Yield And Soil Properties Under Finger Millet Based Cropping System In *Alfisols* Of Eastern Dry Zone Of Karnataka

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Crop rotation and integrated nutrient management are important practices in present situation of agriculture for maintaining good soil properties and sustainable crop production. A field experiment was conducted in 46 year old long term fertilizer experimental unit, AICRP for dryland agriculture, College of Agriculture, GKVK, Bangalore, with Finger millet as test crop and RCBD design, to know the impact of long term integrated nutrient management and different cropping system on finger millet yield and soil properties. The experiment consisted of two organic source of nutrient FYM and maize residue, along with 0%, 50% and 100% of recommended dose of fertilizers and two cropping systems - finger millet monocropping or finger millet – groundnut crop rotation system. Purely 100 % organic and purely inorganic treatments were also included in the experiment. Results confirmed that integrated nutrient management FYM @10 tonns $ha^{-1}$+ 100% NPK showed 55.7% higher finger millet yield than application of maize residue @ 5 tonns $ha^{-1}$+100% NPK. Finger millet - groundnut crop rotation registered higher finger millet equivalent yield (1991 kg $ha^{-1}$) compared to finger millet monocropping (1169 kg $ha^{-1}$). Higher economic return was associated with the application of FYM @ 10 t $ha^{-1}$ + 100% NPK with net return (Rs 81434 $ha^{-1}$) and B:C ratio (3.28). Different organic residues showed no significant difference in soil Bulk Density (BD) and Particle Density (PD), but significantly influenced Maximum Water Holding Capacity (35.25% and 32.02% respectively) and FYM + 100% NPK showed highest MWHC (41.44%) than any other treatments. FYM as organic source showed significant difference with respect to pH and EC (5.09 and 0.119 dSm-1 respectively) over maize residue as organic source (4.76 and 0.036 $dSm^{-1}$ respectively). Higher organic carbon content was incase of FYM source (0.37%) compared to maize residue (0.33%) with significant difference. Application of organic residue along with 100% NPK showed 177.94 kg, 25.11 kg and 122.48 kg per hectare more nitrogen, phosphorus and potassium than the absolute control. Higher Exch Ca (3.16kg $ha^{-1}$), Exch Mg (1.21kg $ha^{-1}$) and available S (15.97ppm) was noticed in organic residue + 100% NPK than other treatments. Enzyme activity was more better with the application of FYM (28.03 µg NH4-N $g^{-1}$soil $h^{-1}$Urease, 13.86 µg PNP $g^{-1}$soil $h^{-1}$ Acid Phosphatase and 5.07 µg TPT $g^{-1}$ soil $h^{-1}$ Dehydrogenase) than maize residue (25.92 µg NH4-N $g^{-1}$soil $h^{-1}$ Urease, 13.40 µg PNP $g^{-1}$soil $h^{-1}$ Acid Phosphatase and 5.04 µg TPT $g^{-1}$ soil $h^{-1}$ Dehydrogenases. The results highlighted that crop rotation along with integrated nutrient management is better option for sustaining soil properties and crop yield.

***Key words**: Long term, crop rotation, INM, organic source*

# Micronutrient Status In Paddy Fields of Valley Districts of Manipur

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An investigation was carried out in paddy fields of four valley districts of Manipur to study the distribution of micronutrients and some soil physico-chemical properties as well as their correlation. Results revealed that most of the studied samples (71.15 per cent) belonged to clay texture and were acidic in reaction ranging from 4.9 (very strongly acid) to 6.6 (slightly acid). The soils were low in electrical conductivity varying from 0.05 to 0.26 $dSm^{-1}$ and rich in organic carbon (0.79 to 5.82 %) with CEC value ranged between 7.9 to 27.3 meq/100 gm. Higher value of CEC might be due to close positive association between clay content and CEC. Available nitrogen, phosphorus and potassium content of the samples varied from 150.53 to 614.66 kg $ha^{-1}$, 10.80 to 27.89 kg $ha^{-1}$ and 106.60 to 630.45 kg $ha^{-1}$, respectively with more than half of the studied samples medium in available nitrogen content; 53.85% low and 46.15% medium in available $P_2O_5$ content and 51.92% medium in available $K_2O$ content. Soils contained high DTPA-Fe (18.21 to 75.63 mg $kg^{-1}$), DTPA-Cu (0.94 to 2.90 mg $kg^{-1}$), DTPA-Mn (12.37 to 58.24 mg $kg^{-1}$) and most of the soils were deficient in DTPA-Zn (0.08 to 0.79mg $kg^{-1}$). Correlation studies revealed that DTPA-extractable Fe showed a positive and significant correlation with OC (r= 0.281*), DTPA-Zn with EC (r=0.602**) and DTPA-extractable Mn with pH (r= 0.286*) and clay (r= 0.279*). However, there was a negative and significant correlation with sand (r= -0.467**) in case of DTPA-extractable Mn.

***Keywords:*** *Soil, clay, Organic carbon, CEC and Micronutrients*

# Effect of Urea And Organic Manure on Changes In Inorganic And Organic Nitrogen In Paddy Soil

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Nitrogen (N) is one of the most important plant nutrient required by plants for growth and metabolic activities. Its presence in soil mostly comes from natural sources and applied fertilizers. Nitrogen transformation in submerged soils are markedly different from those in drained, aerated soils. These differences affect the prevalent soil microorganisms and microbial activities and turnover, availability and losses of nitrogen.A field experiment was conducted to investigate transformation of different inorganic and organic forms of nitrogen in paddy soil fertilized with different organic manures (vermicompost, poultry manure and FYM) and urea at different growth stages of rice.Treatments consisted of addition of different organic manures *viz*., vermicompost, poultry manure and FYM applied at 100% RDN and combination of above organic manures @75% and 50% RDN along with urea @25% and 50% RDN, respectively, 100% RDN as urea and control. Results revealed that inorganic N ($NH_4^+$and $NO_3^-$) in soil was higher at the start of the growing season and decreased with crop growth. Higher values of $NH_4^+$ and $NO_3^-$in soil were observed in plots which received both organic manures and urea compared to their individual application. Irrespective of different treatments, different organic forms of N *viz*., amino acid N and hexosamine N increased with crop growth. Whereas, total N and total hydrolysable N including hydrolysable ammonium N and unidentified hydrolysable N gradually decreased with crop growth indicating that these fractions mainly contribute to mineralization. Greater amount of different inorganic and organic forms of nitrogen in soil were recorded in singly or combined treated plots of organic manures and urea over control. Organic manures amended soil also resulted in higher build up of different fractions of N over urea alone. The different forms of N were more under vermicompost amended soil followed by poultry manure and FYM. Results further revealed that the addition of organic manures and urea either singly or in combination significantly improved rice yield over control. Moreover, higher rice grain yield (5.55 t $ha^{-1}$) and straw yield (7.23 t $ha^{-1}$) were recorded in 50% RDNvermicompost + 50% RDN urea treatment which was at par with soil treated with 50% RDN poultry manure + 50% RDN urea and 100% RDN urea but superior to rest of the treatments. Application of urea N in combination with organic manures could be considered more effective in rice production for reducing N-losses, conserving-N and increasing the efficiency of applied nitrogen.

***Key words:*** *Exchangeable $NH_4^+$-N, Soluble $NO_3^-$-N, organic N, urea, manure*

# Integrated Farming Systems Under Resource Poor Conditions- An Analysis of Constraints

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With increased inclination towards achieving sustainability in agriculture, it is being channelled towards Conventional farming techniques like natural farming,organic farming. But it wins hands down either on a global scale as it couldn't match high-yield muscle of big agriculture or at a farmer's scale,in terms of economics. In the contemporary situations, a quick return to traditional practices could be dangerous. There is a middle ground, which is an integrated agricultural strategy that is both commercially and environmentally viable. Integrated Farming Systems, like any other farming operation, has its own set of constraints. It is a useful tool, but it has limitations in terms of acceptance at the field level, necessitating farm-level study.Hence, the study's goal is to better understand the barriers to IFS adoption in resource-constrained conditions.The study was undertaken in rainfed area of Southern Telangana Zone i.e., Mahbubnagar district using multi-stage sampling technique. Garrett'sranking technique was employed to analyse constraints of Integrated farming systems. According to the findings, farmers' main difficulty was insufficient rainfall, which hampered their efficient management of integrating activities and ranked I with a Garrett mean score of 77.89. The second biggest limitation, with a Garrett score of 60.36, was a lack of sufficient cash. Farmers regarded labour scarcity as the third most significant barrier to adopting various farming ventures, with a Garrett score of 54.5. The IV major limitation identified by the farmers was higher maintenance costs, with a Garrett score of 53.96. High initial investments &low net returns, Risky & laborious nature of integrated practices,inadequate farming experience and lack of interest in diversification are in the ranking order of V, VI,VII &VIII. Small land holdings,low educational level,and lack of technical advice were ranked IX, X, and XI, respectively, by farmers. Their XII restriction was social issues such as community-based livelihood enterprises, alcohol usage, and other social expenditures.All of these implications, when formulated into policies, can help farmers solve certain issues, bringing benefits to the farming community in terms of both economics and sustainability, which can be achieved more easily with IFS than with other conventional farming techniques that place a greater emphasis on sustainability.

# Organic Farming For Soil Sustainability And Food Production Challenges

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As a completely natural and sustainable farm management practice, organic farming is based on unique values. In other words, organic farming is not only a farm practice but also a philosophy of working together with nature. As a holistic farm management approach, organic farming aims to create a socially, environmentally, and economically sustainable food production system.More precisely, organic farming is based on managing the agro-ecosystem rather than relying on external farming inputs, such as pesticides, artificial fertilizers, additives, and genetically modified organisms. The chemical use is hitting the soil sustainability and decreasing its potency. Applying organic inputs is thesolution to improve the soil health. Organic farming can maintain soil quality as well as without adversely affecting the soil health and environment, can give quality food. However, there is a concern that whether organic farming can full fills the food demands for India's large population in the future or not. Soil sustainability and food production in organic farming is reviewed with regard to sustainable agriculture in India.

**Key words:** Organic farming, soil sustainability, soil quality, sustainable agriculture, food production and demands

# Influence Of Vermicompost And Inorganic Fertilizer On Microbial Biomass And Fertility Status In Incubation Soil

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Soil health act as soil indicator for fertility status as well as microbial growth and proliferation in soil. Heavy use of fertilizer alone can lead to decline in soil fertility and less biodiversity of soil microbes in soil. Soil fertility leads to increase crop production and productivity. Organic matter act as subtract for microbial growth and its higher number count in soil. Integrated application of organic vermicompost and inorganic fertilizer (Recommended Dose of Fertilizer) helps in buildup of organic matter in soil as well as nutrient solubilization in soil which in turn increase the soil fertility level with higher microbial profiles in soil that can lead to the microbial biomass source in soil. Higher dose of vermicompost and full dose of fertilizer application in incubation soil for 0-115 days and after that period analysis of soil sample showed higher amount of available nutrients such as nitrogen, phosphorus and microbial biomass of carbon, phosphorus in soil. The nutrient content in soil increased from initial stage of incubation towards completion of incubation period. The microbial biomass phosphorus increased 40.63% over control in incubation period. The positive correlation among factors of vermicompost and fertilizer showed significant increase over control.

***Keywords-*** *Vermicompost, Fertilizer, Biomass, Fertility*

# Natural Farming – A Frostering Solution to Modern Agriculture in India

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Agricultural production has been increased globally by huge consumption ofinorganic fertilizers, chemicals/pesticides, growth regulators which accounted for depletion of natural resources, environmental deterioration, poor soil quality and loss of crop diversity. These effects shows that modern day agriculture cannot sustain human lives in the long run, to over the ill effects of modern agriculture, natural farming is a sustainable form of agriculture to satisfy the changing needs of humans by addressing all the problems. It not only emphasizes on conservation of natural resources but also manages environment effectively. It is a balanced management system of renewable resources including soil, forest, crops, fish, livestock, plant genetic resources and ecosystems without degradation. It also endeavours to provide food, livelihood, for current and future generation maintaining and improving productivity and ecosystem services of these resources. Natural Farming (NF) is one such low-input, climate-resilient farming that inspires farmers to use low-cost and locally-sourced and available inputs, eliminating the use of artificial/chemical fertilisers and industrial pesticides. Principles of natural farming depends on Bijamrutha, Jeevamrutha, Mulching and WAAPSHA. NF has been emerged as a farming model for small and marginal farmersto overcome the farming distress and sustaining the livelihood and keeping the health of family on top priority.It reduces farmers' costs through eliminating external inputs and utilising in-situ resources to rejuvenate the soil, simultaneously increasing incomes, restoring ecosystem/soil health and climate resilience through diverse, multi-layered cropping systems.

***Keywords:*** *Bijamrutha, Fertilizers, Natural Farming, Pesticides, Sustainability*.

# Carbon Capture Through Geologic and Biologic Sequestration

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Now-a-days amount of carbon dioxide ($CO_2$) in atmosphere is increasing due to rapid development of industries and misuse of natural resources. As per the global emission of forecast there is huge increase of $CO_2$ in environment around 43.08 billion MT by the end of 2050 Where, major emission take place in burning of oil, gas, coal and industries. To controlemission of $CO_2$from industries has to synthesis by carbon capture and sequestration through geologic and biologic. Geologic is the capture of $CO_2$ at point of emissions that store in deep underground geologic formations. Physical geologic mechanism is trapping $CO_2$ in cavity of rocks and chemical geologic mechanisms are binding chemical with another substance by dissolving and decomposing of $CO_2$. Other suitable geologic formations for Storage are salt caverns, Oil and gas rich organic shale, oil and natural gas reservoirs and deep aquifers. Biologic is removal of carbon dioxide from atmosphere by micro-organism and plants through soils, grasslands, forests and peatlands. Agriculture carbon sequestration has high potential to sustain global impacts by sequestration of carbon dioxide usually soil contain more amount of carbon then the atmosphere by following cultural practices like conservation tillage, cover cropping and cop rotation helpful to enhance the sequestration in soil it will increase soil quality. Forests are more extensive role for carbon sequestration 80% of their total carbon store in soil as dead organic matter. However, geologic techniques having good potential for $CO_2$ sequestration and by developing new techniques and monitoring of $CO_2$ emissions in industries can overcome the future challenges of Carbon Capture Sequestration approaches.

***Keywords:*** *Carbon Capture, Soil quality, Geological and Biological Sequestration*

# Effect of integrated nutrient management on growth, yield and yield attributes of finger millet (*eleusine coracana* (l.) Gaertn) in the southern laterites of kerala

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Finger millet (*Eleusine coracana* (L.) Gaertn.) is the staple food for people in the dry areas and is cultivated by farmers on marginal lands with limited resources.The crop has extraordinary potential to adapt itself to multiple stresses encountered in rainfed to dry areas. Finger millet is a principal tropical millet with adaptations to survive drought and nutrient deficiencies in the dry and semi-dry regions of India. A field experiment was conducted in the sandy clay loam soils of the Southern Laterites in the Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India, during the summer season of 2020-2021, to assess the effect of integrated nutrient management on the growth and yield of finger millet. The treatments comprised 10 combinations of five levels of nutrientsubstitution*i.e.*, $s_1$(100 % recommended dose of fertilisers (RDF) as inorganic), $s_2$ (75% recommended dose of nitrogen (RDN) as inorganic + 25% RDN through vermicompost), $s_3$ (50% RDN as inorganic+ 50% RDN through vermicompost), $s_4$ (25% RDN as inorganic + 75% RDN through vermicompost) and an completely organic treatment,$s_5$ (100% RDF asorganic), and two levels of biofertilizer *i.e.*, $b_0$(without PGPR Mix I) and $b_1$ (with PGPR Mix I). The findings revealed that $s_1$and $b_1$resulted in the tallest plants at 30 DAS (58.03 cm,54.68 cm), 60 DAS (87.33 cm,86.03 cm) and at harvest (97.73 cm,93.25 cm). At 30 DAS and 60 DAS, $s_1$ remained atpar with $s_2$.The treatments $s_1$and $b_1$resulted in significantly more number of tillers per plant at 30 DAS (2.13,2.16), 60 DAS (3.12,3.31) and at harvest (4.67,4.49). At 30 DAS and 60 DAS the tiller count recorded by $s_1$ and $s_2$ were comparable. Total dry matter production wassignificantly higher in $s_4$ (4270 kg $ha^{-1}$) and with$b_1$(3975 kg $ha^{-1}$).Among the treatments $s_1$and $b_1$resulted in significantly higher leaf area index (LAI) at 30 DAS (0.542, 0.515), 60 DAS (3.187,3.039) and at harvest (4.087, 3.986).The treatment combination, $s_1b_1$ recorded superior LAI, while at harvest, $s_2b_1$was found to be comparable.The treatment $s_2$and $b_1$was observed to have the most productive tiller count (2.22,2.11). The number of fingers per ear was significantly more with treatment $s_2$and $b_1$(8.73,8.47).Grain yield per plant was superior with $s_2$(6.18 g)and $b_1$ (6.08 g).Grain yield $ha^{-1}$ was significantly higher with $s_2$(1381 kg $ha^{-1}$), $b_1$(1389 kg $ha^{-1}$) and $s_2b_1$(1504 kg $ha^{-1}$) and was at par (1332 kg $ha^{-1}$) with $s_4$. The treatment $s_4$, resulted in significantly higher straw yield (3693 kg $ha^{-1}$) and it was comparable with $s_2$ (3382 kg $ha^{-1}$).The present study revealed that application of 75% of the recommended dose of fertilizers as inorganic along with 25% as vermicompost on nitrogen equivalent basis, supplemented with the biofertilizer consortium PGPR mix I could improve the growth and yield of finger millet in the sandy loam soil of the Southern Laterites of Kerala.

# Conservation Agriculture - A Sustainable Agricultural Production System

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The world population is expected to increase from 7.7 billion at present to 9.7 billion in 2050. In order to feed these extra people, it will obviously be necessary to boost world food production, particularly in developing countries where the greatest rates of population growth currently occur. This too, in a world where the opportunity to expand the area utilized for agriculture is limited and our ability to increase production on existing agricultural land is threatened by land degradation, water resource scarcity,increases in the climate variability and extreme events associated with climate change. Thus, agricultural systems worldwide need to evolve to produce more food, with greater sustainability. One agricultural system that has been often regarded as capable of achieving the sustainable intensification required to meet world food demand is conservation agriculture (CA). CA is defined as a system that combines minimum or no tillage (NT) with permanent soil cover (that leaves at least 30% of the soil covered between harvest and planting) and diversified crop species that include legumes. Other companion practices, such as integrated pest and nutrient management, are also often incorporated into the CA system on a site specific basis to help ensure its success. Overall, CA is a farming system designed to enhance the sustainability of agricultural production by conserving and protecting soil, water and biological resources so that external inputs can be kept to a minimum. The characteristics of CA can vary regionally and can include small landholder systems that use direct planting with hand tools, through to large scale mechanized systems that use tractor mounted direct seeders.CA and its components have been associated with many benefits including greater soil water storage, improved soil quality, decreased erosion and in some instances, greater yield and net farm income. These benefits have led to the identification of CA as an important tool to help ensure future food production and help buffer agricultural productivity against extreme climate events, which are likely to increase in frequency under climate change. One of the key drivers of the improvements observed under CA is the greater soil organic matter (SOM), particularly at the surface of the profile, and the associated improvements in soil structural stability, fertility, and biological diversity relative to conventional agricultural systems.

***Keywords:*** *Conservation agriculture, Farming system,Soil organic matter,Sustainable*

# Effect of lime and fym on growth, yield and quality of soybean (*glycine max* l. Merrill)

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A field experiment was conducted during the *kharif* season of 2016 with the purpose of studying the "Effect of lime and FYM on growth, yield and quality of soybean". The experiment was laid out in factorial Randomized Block Design (RBD) with three replications and seven treatments. The treatment comprised of four levels of lime *viz.* $L_0$- without lime, $L_1$-lime @ 200 kg $ha^{-1}$, $L_2$-lime @ 400 kg $ha^{-1}$, $L_3$-lime @ 600 kg $ha^{-1}$, $L_4$-lime @ 800 kg $ha^{-1}$ and organic manures *viz.* $F_0$- without FYM and $F_1$- FYM @ 2.5 tonnes $ha^{-1}$. The study showed that application of lime recorded significantly higher plant height, number of leaves $plant^{-1}$, number of root nodules $plant^{-1}$, pods $plant^{-1}$. Application of lime @ 800 kg $ha^{-1}$ increased the seed yield and stover yield by 79.42 % and 38.37 %, respectively, and also there was significant increase in pH from 4.68 to 5.20. Application of FYM was found superior than without FYM in terms of growth and yield attributes. Seed yield increased by 32.86 % and stover by 14.97 % with the application of FYM over control. The combination of lime @ 800 kg $ha^{-1}$ with FYM @ 2.5 kg $ha^{-1}$ recorded significant increase in seed yield by 100.57 %. However there was no interaction between lime and FYM on stover yield. With the application of lime and FYM, available nitrogen in soil increased by 24 % and potassium by 65.34 %. Nutrient uptake by plant was also recorded to be significantly higher over control.

***Keywords*****:** *Soybean, Lime, FYM, Growth, Yield, Quality.*

# Carbon Sequestration

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One of the main options for greenhouse gas (GHG) mitigation identified by the IPCC is the sequestration of carbon in soils. The term ‘‘soil C sequestration’’ implies removal of atmospheric $CO_2$ by plants and storage of fixed Carbon as soil organic matter. Since the breaking of agricultural land in most regions, the carbon stocks have been depleted to such an extent, that they now represent a potential sink for $CO_2$ removal from the atmosphere. Improved management will however, be required to increase the inputs of organic matter in the top soil and decrease decomposition rates. The strategy is to increase Soil Organic Carbon density (SOC) in the soil, improve depth distribution of SOC and stabilize SOC by encapsulating it within stable micro-aggregates so that Carbon is protected from microbial processes or as recalcitrant Carbon with long turnover time. Judicious nutrient management is crucial to soil organic C (SOC) sequestration in tropical soils. Adequate supply of nutrients in soil can enhance biomass production and SOC content. Use of organic manure and compost enhances the SOC pool more than application of the same amount of nutrients as inorganic fertilizers. It is, however, argued that SOC sequestration is a major challenge in soils of the tropics and sub-tropics, where climate is harsh and resource-poor farmers cannot afford the input of organic manure and crop residues. The rate of Carbon mineralization is high in the tropics because of high temperature and the humification efficiency is low. Several researchers, especially those in the National Bureau of Soil Survey and Land Use Planning and the International Crops Research Institute for Semi-Arid Tropics monitored the changes in soil organic (SOC) and inorganic (SIC) carbon as influenced by land use in the Indo - Gangetic Alluvial Plains and black soil regions between 1980 and 2005. The results showed an increase in SOC stocks due to turnover of greater plant biomass into the soil. Long-term fertilizer experiments with rice-based double or triple cropping systems indicate soil’s capacity to store greater Carbon, and maintain higher Carbon in passive pools and that active fraction of soil Carbon can be used as an indicator of soil health. The inclusion of active pool/ labile SOC is expected to improve the performance of Century eco-system model in predicting SOC changes under different climatic conditions. It is thus envisaged that the present SOC stock can further be increased by the use of recommended improved seeds, NPK fertilizers, micronutrients, FYM, and the inclusion of legumes in cropping systems.

***Key words:*** *Green house gases, Soil organic carbon, Long term fertilizer*

# Conservation Agriculture Techniques For Sustainable Agriculture

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The green revolution has increased food grain production by four-fold since 1950 – 51 with the adoption of HYVs, intensive input use, and extensive tillagepractices. The intensive cultivation has led to the degradation of natural resources.Cereals are highly-nutrient exhaustive crops. Their intensive cultivation has resulted in deterioration of overall soil health, including the nutrient and moisture-holding capacity of the soil. The deterioration in soil fertility has forced the farmers to use more and more chemical fertilizers per unit area to realize higher productivity of crops. Conservation agriculture is a concept for resource-saving agricultural crop production with high and sustained production levels.The most important principles of CA are minimum mechanical soil disturbance, permanent organic soil cover,and diversified crop rotation. RCTs like zero tillage, precision farming, GPS and GIS systems, Site-specific nutrient management, Integrated farming systems, Rainwater harvesting, System of Rice Intensification, contour farming, strip cropping, etc.CA is a site, crop, and environmental specific, hence large-scale testing of novel methods is required. The fundamental agricultural issues of today include resource exhaustion, which is characterized by decreased factor productivity, dwindling human resources and growing expenses, and societal changes. As a result, there is an urgent need for energy, water, and a labor-saving alternative method that helps to preserve soil and environmental quality while producing more at a lower cost.

***Keywords:*** *Precision farming, Zero tillage, Integrated farming system.*

# Effect of Biochar on Soil Organic Carbon Content

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Biochar is a porous, carbon-rich product derived from the thermochemical conversion of biomass in an oxygen limited environment. Biochar has piqued the interest of scientists and policy makers due to its potential role in climate change mitigation, carbon sequestration, contaminant management, renewable energy, soil improvement, and so on. The current study was carried out with the objective of studying the effect of biochar on soil organic carbon content. Bulk soils of clay, clay loam and sandy clay loam texture were collected from Titabor subdivision of the Jorhat district and were incubated with biochar derived from three different feedstocks (rice husk, rice straw and ipomoea) at four different levels (1, 2, 3 and 4%) in a completely randomized design. The incubation was carried out for 90 days at 60% FC. The results showed that biochar significantly altered the organic carbon content of the soils and that increasing rate of application of biochar significantly increased the soil organic carbon content. The application of rice husk biochar at the rate of 4% resulted in the highest increase (1.41%) in the soil organic carbon content. Biochar, being a carbon-rich material, has a positive effect on the organic carbon content of the soil.

***Key words*****:** *Biochar, Carbon sequestration, Soil improvement, Incubation, Soil organic carbon content.*

# Effect of Zinc Application on Biofortofication in Rice Crop

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This review revealed the effect of soil and/or foliar Zn fertilizer application on grain yield and grain Zn concentration of rice. Zinc (Zn) deficiency is a well documented public health issue and an important soil constraint to crop production. Also, there is a close geographical overlap between soil and human deficiency of Zn and Fe indicating a high requirement for increasing concentrations of micronutrients in food crops. Zinc (Zn) biofortification through foliar zinc application is an attractive strategy to reduce human zinc deficiency. However, little is known about the biofortification efficiency and bioavailability of rice grain from different forms of foliar zinc fertilizers. According to current study ZnSO4 are recommended as excellent foliar zinc forms to ongoing agronomic biofortification.

***Keywords-*** *Zinc, Biofortification, Foliar, Rice*

Conclusions Foliar Zn spray offers a practical and useful means for an effective biofortification of rice grain with Zn. This practice consistently and significantly contributed to increases in grain Zn of rice irrespective of cultivars, environmental conditions and management practices

# Agricultural Practices To Improve Carbon Sequestration For Mitigation Of Climate Change

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The need to stabilize the greenhouse gas concentrations of the atmosphere is the great environmental challenge of this century. To control these concentrations, humanity can reduce fossil fuel emissions and identify mechanisms to remove greenhouse gases once they have been emitted. Therefore, carbon capture is vital to reduce release of carbon emissions and other green house gases to the atmosphere thereby mitigating global warming. Carbon sequestration is the process of removing carbon from the atmosphere and depositing it in reservoirs. Basically it is the process of capturing of atmospheric carbon dioxide and storing it to mitigate global warming and climate change. Recommended agricultural management practices like conservation tillage, crop rotation, residue management and integrated nutrient management have good potential in improving soil carbon sequestration. Efficient use of agricultural inputs would reduce greenhouse gas emissions and result in carbon sequestration. Sequestration of carbon in soil can improve soil health which will help in improving input use efficiency in agriculture.

***Key words:*** *Carbon sequestration, greenhouse gases, conservation tillage, crop rotation, residue management*

# Impact of Resource Conservation Techniques on Soil Properties in Lower Shivaliks of Jammu

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In India land degradation is a common problem in the lower Shivaliks of Jammu, extending from district Kathua in the southeast to Rajouri in the northwest. It is a dry semi-hilly belt, locally known as kandi. Increased human and cattle population pressure and decreased the size of land holdings in the area have resulted in the indiscriminate felling of trees, removal of bushes and grazing and browsing. It has led to unabated soil loss and land degradation**.** So an experiment was laid out to compare the impact of resource conservation techniques on the runoff and sediment yield in two different catchment areas (one with sandy loam texture and other with clay loam texture) in lower *shivaliks* of Jammu. The slope of the catchment areas varies from 3-6%. From the studies it was concluded that besides controlling runoff and sediment yield, the resource conservation techniques were also effective in improving the various physico- chemical properties of the soils. The highest value of runoff (55.10 $m^3 ha^{-1} yr^{-1}$ in sandy loam and 53.00 $m^3 ha^{-1} yr^{-1}$ in clay loam) and sediment yield (9.17 $t\ ha^{-1} yr^{-1}$ in sandy loam and 7.36 $t\ ha^{-1} yr^{-1}$in clay loam ) in both the catchments were recorded in overgrazing prevention and lowest in cover crop.. The quantification of nutrient losses in both the soils revealed that the losses of total nitrogen (24- 26 kg $ha^{-1} yr^{-1}$ in sandy loam & 8.2–14.0 kg $ha^{-1} yr^{-1}$in clay loam), phosphorus (29.0 – 30.0 kg $ha^{-1} yr^{-1}$ in sandy loam & 16.0 – 24.0 kg $ha^{-1} yr^{-1}$ in clay loam) & potassium (23.0 – 29.0 kg $ha^{-1} yr^{-1}$ in sandy loam &8.0 – 10.42 kg $ha^{-1} yr^{-1}$ in lay loam) were maximum in overgrazing prevention and minimum in cover crop. Various physico-chemical properties of the soil influenced the runoff & sediment losses. In sandy loam (7.3 Mg $ha^{-1} yr^{-1}$) and clay loam (7.0 Mg $ha^{-1} yr^{-1}$) cover crop has the highest value of soil loss tolerance limit. The water yield (mm) was highest in overgrazing prevention *i.e.* (370 mm-$I^{st}$ year and 292 mm-$II^{nd}$ year in sandy loam) and (350 mm-$I^{st}$ year and 285 mm- $II^{nd}$ year in clay loam) and lowest in cover crop (140 mm-$I^{st}$ year and 92mm-$II^{nd}$ & 120 mm--$I^{st}$ year and 64 mm-$II^{nd}$ in sandy and clayey soils, respectively). From the above study we can conclude that resource conservation techniques are very effective in controlling soil and water losses due to runoff and sediment yield and therefore are required here to adopt these practices in sub montane *shivalik*.

***Keywords:*** *resource conservation techniques, runoff, sediment yield, nutrient quantification, water yield*

# Influence of Graded Levels of Sulphur on Growth, Yield and Nutrient Uptake of Different Sesame Varieties

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The present experiment was conducted during summer 2019 on sandy clay loam soils of wet land farm of S. V. Agricultural College, Tirupati, Acharya, N. G. Ranga Agricultural University. The main objective of this investigation is to study the effect of varied levels of sulphur on growth, yield and nutrient uptake of different sesame varieties. The experiment was laid out in factorial randomized block design (RBD) with four varieties (YLM-66, YLM-17, YLM-11 and Madhavi) and four levels of sulphur (0, 20, 40 and 60 kg S $ha^{-1}$).The experimental results revealed that the sesame variety YLM-66 was shown to be more responsive to the sulphur treatment than the investigated varieties. Higher leaf area index, drymatter production,seed yield, stalk yield and nutrient uptake (N, P, K and S) were found with the sesame variety YLM-66 while their lowest was recorded with Madhavi. Among all the sulphur levels tested, higher leaf area index, drymatter production, seed yield, stalk yield and nutrient uptake (N, P, K and S) were with the application of 60 kg S $ha^{-1}$. The interaction between sesame varieties and sulphur levels in influencing all the above parameters were found to be non-significant. In conclusion, the present experiment revealed that YLM-66 with the combination of 60 kg S $ha^{-1}$produced higher growth, yield and nutrient uptake of sesame.

***Key words:*** *sesame, varieties (YLM-66, YLM-17, YLM-11 and Madhavi), yield and nutrient uptake*

# Influence of Crop Residues and Bio- Decomposer on Soil Physico-Chemical Properties, Growth and Yield of Maize (*Zea Mays* L.)

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A field trial was carried out during kharif season of 2021 to evaluate the Influence of crop residues and bio- decomposer on soil Physico-chemical properties, growth and yield of Maize (Zea mays L.) var. K-25(Kanchan) in sandy loam soil. The experiment was laid down in randomized block design comprised three fertility levels (Control, @ 50 % RDF, @ 100 % RDF), Crop residues (Wheat and Mustard ) treated with and without Bio-Decomposer replicating thrice. Various treatments doses RDF (N 120 kg $ha^{-1}$, $P_2O_5$ 60 kg $ha^{-1}$,$K_2O$ 40 kg $ha^{-1}$), Wheat and mustard crop residue 5 t $ha^{-1}$ and bio-decomposer 20g/acre. The best treatment was $T_9$ (Wheat residue and mustard residue treated with bio-decomposer + RDF @ 100 %) that showed the highest yield and gave the best results with respect to highest grain yield 37.78 q $ha^{-1}$. In post-harvest soil properties the important parameter on Physico -chemical properties on maize crop. B.D. 1.323 Mg $m^{-3}$, P.D. 2.656 Mg $m^{-3}$, pH 7.74, EC 0.263 dS $m^{-1}$ is found Non-significant and Pore space 51.50 %, water holding capacity 55.59 %, Organic Carbon 0.579 %, Available Nitrogen 243.99 kg $ha^{-1}$, Phosphorus 30.52 kg $ha^{-1}$ Potassium 128.62 kg $ha^{-1}$ was found Significant.

***Key words**: Crop residue, bio-decomposer, Maize, Soil properties.*

# Micro Nutrient Status of Soils Under Different Land Use Systems of Somawarpet Taluk, Kodagu District, Karnataka

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A study was conducted to assess the impact of different land use systems on micro nutrient status of soils under different land use systems of Somawarpet taluk, Kodagu district. Soil samples were collected from five different land use systems *viz*., natural forest, sacred groves, coffee based agroforestry indigenous, coffee based agroforestry exotic and agriculture lands with five replication at 0-20 cm, 20-40 cm, 40-60 cm and 60-80 cm depth. The present investigation revealed that pH was acidic in all the land use systems and electrical conductivity was normal. The highest mean value of available nitrogen was observed under coffee based agroforestry - indigenous and highest mean value of available phosphorous and available Sulphur was observed in natural forest. Natural forest soils shown the highest mean value of DTPA- Fe (32.28 mg $kg^{-1}$), followed by sacred groves (29.61 mg $kg^{-1}$) and the lowest mean value was noticed in paddy land use system (16.82 mg $kg^{-1}$). Coffee based agroforestry - indigenous shows the highest mean value of DTPA- Zn (2.92 mg $kg^{-1}$) and which is followed by natural forest (1.65 mg $kg^{-1}$) and the lowest mean value was observed in paddy land use system (0.64 mg$kg^{-1}$). Coffee based agroforestry - indigenous show the highest mean value of DTPA- Cu (2.64 mg $kg^{-1}$) which is followed by coffee based agroforestry - exotic (2.42 mg $kg^{-1}$) and lowest mean value was observed in paddy land use system (1.33 mg$kg^{-1}$). Natural forest shows the highest mean value of DTPA- Mn (27.25 mg $kg^{-1}$) and followed by sacred groves (26.76 mg $kg^{-1}$) and the lowest mean value was observed in paddy land use system (19.67 mg $kg^{-1}$). All the DTPA-extracted micronutrients were found sufficient in surface soils of all land use systems. It was observed that there was a decrease in the content of all the micronutrients with increase in depth.

***Key words:*** *Land use systems, DTPA extractable and agroforestry*

# Organic Farming: Its Scope And Possibilities In Telangana

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The green revolution has helped the country to achieve self sufficiency in food production, but, it left with infinite problems like decline in soil fertility, environmental pollution, depletion of natural resources, emergence of micronutrient deficiencies and super weeds, increased cost of production, increased emission of green house gases, loss of biodiversity and climate change. Increased consciousness towards food safety among people due to serious health hazards and environmental issue caused by the chemical fertilizers and pesticides has given a thought to the safe and healthy food. This increasing demand for healthy food has taken back farming to traditional, old practices with new name organic farming. Organic agriculture is defined as farming devoid of chemical fertilizers, pesticides, genetically modified organisms, hormones for the sustainability of our ecosystem. The methods like crop rotation, crop diversity, weed management and usage of natural predators, organic fertilizers, soil micro-organisms which increases soil biological activity are the key features of organic farming. The Organic farming in India received more attention after launching of National Project on Organic Farming (NPOF) in 2004-05. Area under organic farming was 42,000 hectares during 2004-05 which had increased to 4.33 hectares by 2020-21 eventually and area under wild forest cover is 1.60 million hectares. The state of Telangana has also formulated a favourable organic farming policy. This is aimed at strengthening the production systems, supply chain and marketing systems through development of proper infrastructure, regulation and providing incentives. Telangana is highly monocropped with paddy, cotton and maize which occupy 80% of total cultivated area. Crop rotation to reduce monocropping, reducing the usage of chemical fertilizers and pesticides, usage of organic manures, natural predators etc are the important methods to be practiced in Telangana. The success stories of Enebavi village (first organic village in India) of Jangoan dist. and Punukula village of Bhadradri district in Telangana are practical experiences of organic farming. Thus there is much scope for organic farming in Telangana.

# Effect of organic nutrients on quality of cashew (*anacardium occidentale* l.) Value added product cv. BPP-8

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The present investigation entitled "Effect of organic nutrients on quality of cashew (*Anacardium occidentale* L.) value added product cv. BPP-8" was carried out at Cashew Research Station, AICRP on Cashew, Ranasinghpur, Bhubaneswar under Odisha University of Agriculture and Technology during the year 2020-21. The experiment was laid out in Randomized Block Design (RBD) with three replications and eight treatments including different source of organic nutrient along with control i.e. $T_1$-100% N as FYM, $T_2$-100% N as FYM + Bio-fertilizers consortium @200 g tree/year), $T_3$-50% N as FYM + Bio-fertilizers consortium @200 g tree/year), T4-100% N as Vermicompost + Bio-fertilizers consortium @200 g tree/year), T5-Recycling of organic residue with the addition of 20% cow dung slurry (20% weight of organic residue as cow dung), T6- *In situ* green leaf manuring to meet 100% N, T7-25% N as FYM + Recycling organic residue + *In situ* green leaf Manuring+ Bio-fertilizers consortium @200 g/tree/year), T8-Recommended Dose of Fertilizer (500:250:250g/plant) + 10kg FYM as control. The result revealed significantly positive effect of different organic source of nutrients on RTS prepared treatment $T_8$(Recommended Dose of Fertilizer (500:250:250g/plant) + 10 kg FYM as control) exhibited better overall acceptability among the tested treatment sunderbothambi entand refrigerated storage followed by treatment $T_4$ (100% N as Vermi compost + Bio fertilizers consortium @200gtree/year). Among the treatments, $T_8$(Recommended Dose of Fertilizer (500:250:250g/plant) + 10 kg FYM as controls) scored highest in overall acceptability compared totherest of organic treatments. However, treatment $T_4$ can also be recommended for the preparation of RTS beverage in among organic treatments.

***Key word:*** *Cashew apple, BPP-8, organic nutrients, RTS*

# Organic Agricultural Strategies For Feeding The World More Sustainably

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Organic agriculture is proposed as a promising approach to achieving sustainable food systems, but its feasibility is also contested. We use a food systems model that addresses agronomic characteristics of organic agriculture to analyze the role that organic agriculture could play in sustainable food systems. Here we show that a 100% conversion to organic agriculture needs more land than conventional agriculture but reduces N-surplus and pesticide use. However, in combination with reductions of food wastage and food-competing feed from arable land, with correspondingly reduced production and consumption of animal products, land use under organic agriculture remains below the reference scenario. Other indicators such as greenhouse gas emissions also improve, but adequate nitrogen supply is challenging. Besides focusing on production, sustainable food systems need to address waste, crop–grass–livestock interdependencies and human consumption. None of the corresponding strategies needs full implementation and their combined partial implementation delivers a more sustainable food future.

***Key Words:*** *Organic agriculture, consumption, sustainable, implementation.*

# Climate Change Mitigation, Carbon Sequestration In Organic Farming

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The global agricultural food production system is principally climate-driven. India hasa total geographical area of 328.73 mhaconsistingof 142.02 mha net sown area and 63.26 million hectares net irrigated area. Climate change adaptation and mitigation strategies vary from place to place even within the same. One of the main effects of climate change is an increase in uncertainties, both for weather events and global food markets. Organic farming as a systematic approach for sustained biological diversity and climate change adaptation through production management, minimizing energy randomization of non-renewable resources, careful management of nutrients, and carbon sequestration The purpose of potential organic farming is therefore to attempt a gradual reversal of the effects of climate change for building resilience and overall sustainability by addressing the key issues. The mitigation strategies used included afforestation and reforestation programs, avoiding veld fires, and preservation of wetlands. Crop rotation brings biodiversity, it is mandatory on organic farms and is stated as a method to maintain and increase the fertility and biological activity of the soil, and means the prevention of damage caused by pests, diseases, and weeds. The seed bank is more strongly influenced by soil characteristics, such as the percentage of organic carbon and percentage of total nitrogen than by management. Conservation tillage is a term that embraces zero- and minimum tillage combined with the use of organic soil covers. The potential of organic agriculture in climate change mitigation depends on its ability to reduce emissions of GHGs (nitrous oxide, carbon dioxide, and methane). Research is needed on yields and institutional environment for organic farming, as a mitigation and sequestration potential.

***Keywords:*** Organic farming, Climate change mitigation, Crop rotation, biodiversity.

# Phosphate Solubilizing Microbes As Promising Biofertilizers

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Phosphorus (P) is a vital plant nutrient, available to plant roots only in soluble forms that are often in short supply in the soil. In fact, P can be tightly bound with soil cations, particularly calcium, iron, or aluminum, leading to precipitation of P in the soil. It has a critical role in plant metabolism and other activities such as cell division, development, photosynthesis, breakdown of sugar, nutrient uptake, nuclear transport within the cell, plant disease resistance and regulation of metabolic pathways. Therefore, despite P being widely and abundantly distributed in the soil in both its inorganic and organic forms, it is not easily accessible for plant growth. Phosphate solubilizing microbes (PSMs) are a group of beneficial microorganisms capable of hydrolyzing organic and inorganic insoluble phosphorus compounds to soluble P form that can easily be assimilated by plants. Microorganisms present in soil plays a major role in enhancing the plant growth. Thus, phosphate solubilizing bacteria (PSB) play an important role in reducing P deficiency in soil through transforming insoluble phosphate to available, soluble phosphate. Phosphate solubilizing microorganisms (PSMs) are group of beneficial microorganisms capable of hydrolyzing organic and inorganic phosphorus compounds from insoluble compounds. Among these PSMs, strains from bacterial genera (Bacillus, Pseudomonas,and Rhizobium),fungalgenera (Penicillium and Aspergillus), actinomycetes, and arbuscular mycorrhizal (AM). Soil is a natural basal media for microbial growth. Mostly, one gram of fertile soil contains $10^{1}$ to $10^{10}$ bacteria, and their live weight may exceed 2,000 kg $ha^{-1}$ . Among the whole microbial population in soil P, solubilizing bacteria comprise 1–50% and P solubilizing fungi 0.1 to 0.5% of the total respective population. PSMs are ubiquitous, and their figures differ from soil to soil. Most PSMs were isolated from the rhizosphere of various plants, where they are known to be metabolically more active. Apart from those species, symbiotic nitrogenous rhizobia, and nematofungus *Arthrobotrys oligospora* have also shown phosphate solubilizing activity. Although several mechanisms may be involved, the main one is through the production of organic acids. Many PSMs are proved to be effective biofertilizers or biocontrolling agents. Since many farmers cannot afford to use P fertilizers to reduce P deficits, alternative techniques to provide P are needed.

# Biofertilizer –A Good Organic Source For Sustainable Plant Nutrition

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The excess uses of chemical fertilizers in agriculture are costly with adverse effects on physico-chemical properties of soils. Therefore, in the recent years several organic fertilizers have been introduced that act as natural stimulators for plant growth and development.Biofertilizers are natural fertilizer which is living microbial inoculants of bacteria, algae; fungi alone or in combination and they augment the availability of nutrients to the plants. Biofertilizer is a substance which contains living microorganisms which applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the availability of primary nutrients to the host plant. They improve soil fertility by fixing the atmospheric nitrogen and solubilizing insoluble phosphates and produce plant growth-promoting substances in the soil (Mazid and Khan 2015). The worldwide increase in humanpopulation raises a big threat to the food security of each people as the land for agriculture is limited and even getting reduced with time. Therefore, it is essential that agricultural productivity should be enhanced significantly within the next few decades to meet the large demand of food by emerging population. Exploitation of microbes as biofertilizer is considered to some extent an alternative to chemical fertilizers in agricultural sector due to their extensive potentiality in enhancing crop production and food safety. The benefits of using biofertilizers includes cheap source of nutrients, excellent suppliers of micro chemicals and micronutrients, suppliers of organic matter, secretion of growth hormones, and counteracting negative impact of chemical fertilizers (Gaur 2010). Bio-fertilizer contains microorganisms which promote the adequate supply of nutrients to the host plants and ensure their proper development of growth and regulation in their physiology. The production of bacterial bio-fertilizer essentially requires the selection of appropriate strains for a particular crop in a given agro-climate. Leguminous crops have the ability to fix nitrogen (N) biologically from the atmosphere. This can benefit not only the legumes themselves but also any intercropped or subsequent crops. Successful nodulation of leguminous crops by Rhizobium largely depends on the availability of compatible strain for a particular legume. In agricultural settings, perhaps 80% of this biologically fixed N2 comes from symbiosis involving leguminous plants and αproteobacteria, order Rhizobiales, family Rhizobiaceae, including species of Rhizobium, Bradyrhizobium, Sinorhizobium, Azorhizobium and Mesorhizobium. The role of biofertilizers in agriculture assumes special significance, particularly in the present context of increased cost of chemical fertilizer and their hazardous effects on soil health. At present times, there is a growing concern about environmental hazards and threats to sustainable agriculture. In view of the above stated facts, the long term use of bio-fertilizers proves to be economical, eco-friendly, more efficient, productive and accessible to marginal and small farmers over chemical fertilizers. The need for the use of biofertilizer thus arises primarily for two reasons.

***Keywords:*** *Biofertilizer, nitrogen fixation, Crop production, Ecosystem and Sustainable agricultur*

# Effect of integrated nutrient management on soil health, growth and yield of black gram (*vignamungo* l.) Var. Indra urad-1

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The present study was entitled on "Effect of integrated nutrient management on soil health, growth and yield of black gram (VignamungoL.). The field experiment was conducted during kharif season of 2021-22 at the NAI, SHUATS in randomized block design with three replications, nine treatments with control. Based on the mean performances $T_9$ [100% Neem cake + 100% RDF] was found the best for plant growth and yield. Observations were recorded on growth parameters such as plant height (cm), plant population, number of leaves plant$^{-1}$ and yield attributes (number of pods plant$^{-1}$, pod length and seeds pod$^{-1}$, biological yields of black gram. The maximum values of these parameters was recorded in the treatment with $T_9$-100% Neem cake (organic) + 100% RDF followed by $T_7$- 100% crop residue + 100% RDF An application of recommended dose of fertilizer @100% gave maximum plant height 57.37cm at 60 DAS, number of leaves 26.60 plant$^{-1}$ and number of pods plant$^{-1}$19.54 in treatment $T_9$ as compared to others. The biological yield was maximum in $T_9$ of 3498 kg ha$^{-1}$ was recorded significantly. Interaction effect of Integrated Nutrient Management was significant for all characters. Thus, it indicates that the process of Integrated Nutrient Management is the better option for physical and chemical Analysis of Soil to achieve with growth and yield attributes of Black gram.

***Keywords:*** *Integrated nutrient, rhizobium, Black gram, Soil Health, Grain yield etc*

# Role Of Organic Farming For Sustainabe Environment

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India 30 per cent of total organic producer in the world, but accounts for just 2.59 per cent of total organic cultivation area of 57.8 million hectares.In the modern era of agricultural sector organic farming is most important and oftmost necessity.It is very old and relevant agricultural practice.The role of organic farming has risen considerably due to rises environmental concerns in modern agricultural practices. Organic farming is type of sustainable farming system which produces healthy crops without causing damage to the environment.On the other hand, sustainable agriculture is one which produces abundant food without depleting environmental resources.Organic farming relies on three principles, principle of inter-dependency, diversity and recycling.The system helps in maintaining soil fertility and control of pest-diseases by enhancing natural processes.Due to its role in enhancing natural health of environment organic farming is in direct relationship with environmental sustainability.Organic farming provides a natural way of crop cultivation by using environmental friendly, plant nad animal based organic resources that are highly rich in nutrients which are required for crops.

***Keywords:*** *Organic farming, Sustainable development, Agriculture, Environment.*

# Effect Of Inm On Soil Health And Productivity Of Maize And Residual Effect On Chickpea

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Maize (*Zea mays* L.) is a multi-faceted crop grown for food, fodder, feed and industrial purpose globally. Evaluate the residual effects of preceding maize hybrids, plant population and fertility levels on succeeding chickpea in maize-chickpea cropping sequence. Data on available soil nitrogen, phosphorous and potassium status after maize harvest revealed that, a clear-cut nutrient gradients were formed due to different treatments imposed to the preceding maize. Hence, varied response of chickpea was observed in the succeeding season. Continuous use of only chemical fertilizers in intensive cropping system is leading to imbalance of nutrients in soil, which has an adverse effect on soil health and also on crop yields. The integrated plant nutrient supply system, by which we can apply the nutrients in balanced form, is emerging as the most logical concept for managing and sustaining long term soil fertility and productivity. INM, which entails the maintenance of soil fertility to an optimum level for crop productivity to obtain the maximum benefit from all possible sources of plant nutrients both organics as well as inorganic in an integrated manner. Continuous use of only chemical fertilizers in intensive cropping system is leading to imbalance of nutrients in soil, which has an adverse effect on soil health and also on crop yields. On the other hand, continuous use of organics helped to build up soil humus and beneficial microbes besides, improving the physico-chemical properties of soil.

# Soil Health – The Foundation for Life

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Soil health can be described as "the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation".A healthy agricultural soil is one that is capable of supporting the production of food and fiberto a level, and with a quality, sufficient to meet human requirements, and to continue to sustain its functions. Some important healthy soil functions related to crop production are infiltration and storage of water, retention and cycling of nutrients,pest and weed suppression, detoxification of harmful chemicals, sequestering of carbon, production of food and fiber. There is a need to assess the soil health to manage the soil for sustainable productionbut there is no direct method to judge the status of soil health. However, it is possible to measure specific soil properties to detect whether a soil is healthy or not. The measurements that make up the minimum data set are called soil quality indicators or soil health indicators. Soil health can be measured with the use of physical indicators like soil compaction level, bulk density, aggregate stability, water holding capacity and with the use of chemical indicators by estimating nutrient content, salinity, sodicity and pH and with the help of biological indicators like soil organic matter, total microbial biomass and microbial diversity index. Different factors that lead to decrease the soil health are aggressive tillage, annual or seasonal fallow, mono-cropping, annual crops, excessive inorganic fertilizer use, excessive crop residue removal, broad spectrum fumigants or pesticides andherbicides. Hence there is a need to manage the soil health for sustainable production. Basic Soil health management principles are to minimize soil disturbance it means to reduce or minimize soil tillage, maximize soil cover by means of improve mulching, maximize biodiversity and maximize continuous living roots. The management practices that tend to improve the soil health are no till or conservation tillage which is a tillage system that conserves soil, water and energy resources through the reduction of tillage intensity and retention of crop residue. It involves the planting, growing and harvesting of crops with limited disturbance to the soil surface. By adopting crop rotation which is the practice of growing a series of different types of crops in the same area in sequential seasons. Growing cover crops or by practicing mulching to control the soil erosion. Use of organic amendments that help in build up the soil organic matter and consequently improve the overall soil quality. Adopting integrated pest and weed management practices which help in reduce the use of chemicals.

***Keywords:*** *soil health, soil quality indicators, conservation tillage, cover crops, crop rotation*

# Studies On The Effect Of Iron And Zinc Nutrition On Quality And Yield Of Linseed (*Linumusitatissimum* L.)

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A field experiment was conducted at College of Agriculture, Vijayapura during *rabi* 2020-21 to study the effect of iron and zinc nutrition on quality and yield of linseed as the iron and zinc content in the soil at College of Agriculture is below the critical limit. The experiment was laid out in randomized complete block design with ten treatments and three replications. The treatments included RPP (Recommended package of practices) and application of ferrous sulphate @ 5, 10 and 15 kg $ha^{-1}$ and zinc sulphate @ 5, 10 and 15 kg $ha^{-1}$ in various combinations along with RPP (Recommended package of practices @ 40:20:20:3000-N:$P_2O_5$:$K_2O$:FYM kg $ha^{-1}$). The results of the experiment revealed that, the application of iron and zinc in combinations resulted in significant increase in yield attributing character, yield, quality parameters and BC ratio by linseed over RPP alone. Among the different treatments RPP + 15 kg $FeSO_4$ $ha^{-1}$ + 15 kg $ZnSO_4$ $ha^{-1}$ was resulted in the higher seed weight per plant (4.00 g),seed yield (800 kg $ha^{-1}$) and stalk yield (1312 kg $ha^{-1}$) and higher oil content (40.3%) and protein content of linseed (20.6 %) and higher benefit cost ratio (2.76) were recorded. These results were on par with the application of RPP + 15 kg $FeSO_4$ $ha^{-1}$ + 10 kg $ZnSO_4$ $ha^{-1}$ and lower values were recorded in the treatment that received RPP alone. Finally it could be concluded that the application of fertilizers containing iron and zinc helps to improve yield, yield attributing characters, oil and protein content in linseed crop. Thus, on the basis of the present investigation it can be concluded combined application of these micronutrients (iron and zinc) along with RPP was found to be a better means of balanced nutrition for linseed crop to ensure higher productivity. Therefore, soil application of RPP+15kg$FeSO_4$$ha^{-1}$+10kg$ZnSO_4$$ha^{-1}$ is recommended for linseed production for the benefit of farming community.

# The Role Of Potassium in Biotic Stress Resistance

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Increased evidence has shown that crop production is significantly restricted by biotic stresses. It was estimated that weeds produce the highest potential loss, followed by animal pests, fungi and bacteria and viruses. These numbers reflect the total attainable production for eight major crops (wheat, rice, maize, barley, potatoes, soybeans, sugar beets and cotton). In many cases, K-deficient plants tend to be more susceptible to infection than those with an adequate supply of K. For example, the rate of rice borer infestation was greatest when there was no supply of K, but decreased rapidly as the K concentration increased. It was also reported that increased K fertilizer significantly reduced the disease incidence of stem rot and aggregate sheath spot, and negative correlations were found between the percentage of K in leaf blades and disease severity. K fertilizer application decreased the incidence of diseases in most cases, but sometimes had no effect or even the opposite effect. Strawberries that were grown with excess K were very susceptible to infection by the anthracnose pathogen, *Colletotrichum gloeosporioides*, but its resistance was greatly enhanced when no K was supplied. This result was observed because the low plant K status induces the synthesis of molecules, including reactive oxygen species and phytohormones, such as auxin, ethylene and jasmonic acid, as a result of its enhanced plant stress tolerance. The higher K+ concentrations decreased the internal competition of pathogens for nutrient resources. This nutritional status enables plants to allocate more resources to developing stronger cell walls for preventing pathogen infection and insect attack and to obtain more nutrients to be used for plant defense and damage repair. During airborne pathogen infections the stomata were able to function properly when there was sufficient K, thus preventing pathogen invasion by rapid stomata closing. K is also essential to the performance of multiple plant enzyme functions, and it regulates the metabolite pattern of higher plants, ultimately changing metabolite concentrations. In a K-sufficient plant, the synthesis of high-molecular-weight compounds was markedly increased, thereby depressing the concentrations of low-molecular-weight compounds, in the plant tissues. These low-molecular-weight compounds are important for the development of infections and insect infestations, so lower concentrations, thereby, leave plants less vulnerable to disease and pest attacks in K-sufficient plants. Adequate K increases phenol concentrations, which play a critical role in plant resistance. Furthermore, it was concluded that less pest damage in higher K plants can be attributed to a lack of pest preference under sufficient nutrient concentrations, as well as the synthesis of defensive compounds leading to higher pest mortality.

***Keywords:*** *Potassium, Stress, Resistance, Biotic*

# Use of Selenium in Crop Production

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The agronomic and genetic bio fortification of crops with selenium are novel strategies to improve the nutraceutical quality of staple crops. Selenium stimulates the synthesis of proteins, amino acids, nitrogen secondary compounds, phenolic compounds, likewise increases antioxidant activity, and it is associated with the prolongation of the shelf life of horticultural products. Bio fortification with selenium in agricultural crops is increasingly becoming a solution to improve the problem of trace element deficiency in the human population as well as to increase the content of bioactive compounds. It was suggested that soil Se fertilization can be an accurate and efficient technique for improving the overall performance of plants including drought tolerance, which was accompanied by action of several antioxidant enzymes, ascorbate peroxidase. The application of Se also increased accumulation of carbohydrates in the young leaf surfaces of potatoes. Salinity harms agricultural production because it inhibits plants growth and yield. A significant finding was that supplementation of Se enhanced the salinity tolerance of maize at the reproductive phase more than at the vegetative stage. Several experiments were conducted to determine the significant function of Se for enhancing plant drought tolerance and drought resistance. Abiotic stress is a significant constraint on the productivity of modern agriculture. Exogenous stress protectants are becoming increasingly popular as means of increasing stress tolerance. Besides improving the photosynthetic activity, increasing the direct quenching of ROS, and upregulating both the enzymatic and non-enzymatic parts of the antioxidant defense system. Se can helps to decrease lipid peroxidation and tocopherol levels, but also, in particular, glutathione peroxidase activity, which ultimately results in cell death. This contributes to the systemic defense against the tissue-damaging effects of ROS.

***Keywords:*** *Selenium, Productivity, Sustainability*

# Growth, productivityand quality of pearlmillet (*pennisetumglaucum* l.) As influenced by different landconfiguration and nutrient management practices in aridwestern rajasthan

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The productivity of arid region is much lower and resource degradation is much fastercomparatively other ecosystem due to aberrant climatic conditions and anthropogenic activities.Lower production in arid region is due to lower nutrient and water holding capacity of soil, erraticrainfall pattern and inappropriate crop management practices. Therefore, present study wasconducted with six planting techniques and four nutrient management practices in split plot designand replicated thrice, to find outsuitable land configuration/planting techniques and nutrient management practicesand their influence on growth, productivity and quality of pearl millet in arid western Rajasthan. Results of study revealed thatpit planting techniquerealized significantly higher growth parameters *viz*. plant height, number of leaves plant$^{-1}$, relative growth rate, chlorophyll content and yield attributes namely effective tiller plant$^{-1}$, weight of earhead, and test weight and protein content in grain and stover as compared ridge planting and direct seed sowing(flat bed).Though ridge planting techniques $PT_2$ and $PT_3$ recorded significantly highest crop growth rate as compared to rest all planting treatments but remained statistically at par with each other during both the years. Moreover, growth parameters, yield attributes and grain yield of pearlmillet also increased with increasing dose of nutrients from $NMP_1$ to $NMP_3$ over control ($NMP_0$). Highest plant height, dry matter accumulation plant$^{-1}$, crop growth rate and relative growth rate at different intervals and grain yield were recorded maximum in $NMP_3$ treatment during both the year of study.

***Key Words:*** *Flat bed, Growth rate, Nutrient,Pearl millet, Pit technique, Ridge and furrow,*

# Impact of Long Term Organic Manure Application on Zinc Status of Soil

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Soil organic carbon plays an important role in improving physical, chemical and biological properties of soil.With the application of organic material reduction of free micronutrient cation concentration in soil solution occurs due to formation of organometallic complexes which enhance phyto-availability, and control mobility of micronutrients in the soil profile. This study was conducted with the objective to see the effect of long term application of organic matter on DTPA extractable micronutrients in soil having varying levels of organic carbon content. A long term experiment was initiated in 1967 at the experimental farm of Department of Soil Science, CCS Haryana Agricultural University, Hisar, India,consisting of 3 levels of FYM (15, 30 and 45 Mg $ha^{-1}$ till 2007-08) and 5, 10 and 15 Mg $ha^{-1}$ from 2008-09 onwards. A control without FYM was maintained. The treatments which show wide difference in organic carbon content after 52 years were selected (0.49, 0.95, 1.40, 1.62, 1.78 and 1.96%). From the study it was observed that the DTPA extractable Zn content increased with increasing levels of organic carbon content during this study in 2019 surface soil after $52^{nd}$ crop cycle DTPA extractable Zn content varied from 0.96 mg $kg^{-1}$ to 1.14 mg $kg^{-1}$ from Soil 1(0.49%) to Soil 6 (1.96%). On comparison of data in long term a decrease in DTPA extractable Zn was observed from 2002 to 2019. Albeit in case of control plot concentration of DTPA extractable Zn increased by 41.17% but after that Zn content decreased in all soils. R**e**sults of different pools of Zn *i.e.* Water soluble and exchangeable (Ws+Ex-Zn), Carbonate bound (Carb-Zn), Iron and Mn oxide bound (Fe-Mn-Ox-Zn), organically bound ( OM-Zn) and Residual (Res-Zn) were affected by long term application of organic manure in a pearl millet – wheat rotation differently.

***Keywords:*** *Micronutrients, Organic carbon, long term FYM application*

# Vertical Distribution of Soil Available Phosphorus in Paddy Growing Alluvial Soils of Tamil Nadu

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Soils are diverse widely in their capacities to supply phosphorus (P) available to crops at different growth stages and it is an important element for crop growth. However, very limited information is available on the vertical distribution of soil available phosphorus in the soil profile. The present study assessed the vertical distribution of soil available phosphorus in paddy growing alluvial soils of Tamil Nadu. Profiles were dug up to 2m or to the depth of parent material whichever is earlier in different landforms of alluvial plains and horizon-wise soil samples were collected for laboratory analysis. The available phosphorus content ranged from 0.9 to 59 kg $ha^{-1}$ and it was decreasing with depth. The soil available phosphorus was having significant negative correlation with soil pH (-0.264**) and clay content (-0.149**). Whereas, the correlation between soil available phosphorus and organic carbon (0.552**), copper (0.586**), iron (0.425**), and zinc (0.360**) was significantly positive. Principal component analysis revealed that the first three components explained 62 percent of the variance with available phosphorus, SOC and copper in one cluster. Thus, the surface horizon showed a different trend compared to subsoils because of the high accumulation of SOC in the surface horizons. The study results highlights the importance of SOC in chelation of available phosphorus and could be useful to improve our comprehension of organic manures on soil available phosphorus in paddy growing alluvial soils, which is vital for optimum P fertilizer application and paddy yield.

***Keywords:*** *Soil available phosphorus, Paddy growing area, Alluvial plain, Principal Component Analysis, Soil profile*

# Influence of Germination on The Nutrients And Bioactive Compounds and Their Health Benefits

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FAO points out that there are more than 50,000 edible plant species across the world. But only a very few species are nutritionally important food sources. Cereals and legumes are the important one with good protein, fiber, vitamins, minerals and constitute an important source of various nutrients to the body. Consumption of both grains and pulses together plays a significant role in improvement of protein quality by supplementing lysine for lysine deficient grains. Germination is an incredible event that signals the birth of new life. It is a process that involves various steps associated with uptake of water by the dry seed and initiate the elongation of embryonic axis. During germination, to support growth, a high amount of nutrients is prepared for this process. All the dormant enzymes are activated during the germination and provide best nutrition to the sprout. So, the amount of available nutrients is greatly increases. Germination is the major biological processing method in the field of nutrition. It is the most dynamic process during the plant growth and is also considered as an important step for improving the nutritional value and reducing the antinutritional content. Many studies have reported that, apart from increasing the availability of the body, germinations also increase the bioactive compounds such as GABA (γ-amino butyric acid), vitamins and a variety of polyphenol compounds which can be used as food antioxidants. The α-Galactosides content, oligosaccharides that produce flatulence and trypsin and chymotrypsin inhibitors, which affect the digestion of proteins, can be reduced during germination. The digestibility of proteins increases during germination and the emulsifying capacity of legume proteins also increases Antioxidants are required for the body to protect from the oxidative damage and a number of degenerative diseases. Currently, there is an increased demand for the germinated foods because of various physiological benefits. Germinated brown rice has resulted the positive effect in reducing the blood pressure, lipids and so, it has potential to treat metabolic syndromes. Consumption of brown rice many physiological benefits such as it prevents complications of life, anticancer, stimulate osteoblastogenesis, regulate emotions and memory. The consumption of plant-based food is increasing markedly due to the improvement of people's awareness of well-balanced nutrition. A wide range of food products are developed by using germinated seeds to improve the functional and nutritional quality of the food products. Germinated seeds are used in the food sector as a substitute in bakery and beverage industry and also used in many infant foods to combat protein energy malnutrition. It is also used as a supplement to prevent many non-communicable diseases. Development of germinated seeds based functional foods is the valuable research hotspots in the present and the future.

***Key words:*** *Germination, GABA, legumes, value added products*

# Predicting the current and future potential distribution of the *myrica esculenta* buch.-ham. Ex d. Don (myricaceae) in hindu-kush himalaya

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Mountainous ecosystems throughout the globe are sensitive to climate change. This is considerably more detrimental in the Hindu-Kush Himalayan region where the elevation dependent warming rates and retreat rate of glaciers is higher than other parts of the world. Such changes are leading to increase the vulnerability of plants, especially threatened species of Himalayan region, which are be at greater risk of local extinction. In this study, we modeled the current climatically suitable areas of a economically and medicinally important tree species, *Myrica esculenta* across Hindu-Kush Himalaya and predicted its possible range shifts under future climate. Anthropogenic disturbance along with changing climatic conditions cause rapid decline in its natural population. Maximum Entropy Modeling (MaxEnt) approach with bioclimatic data from WorldClim was used to construct the climatic niche of *M. esculenta* in present condition and predict the potentially suitable habitat areas for 2050 and 2070 under four representative concentration pathways (RCPs) scenarios (RCP RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5) by integration of five general circulation models. Furthermore, we predicted and calculated the elevational and latitudinal specific range shifts in response to changing climate under the future scenarios. The study revealed that, precipitation of warmest quarter and wettest quarter, mean diurnal range temperature and mean temperature of coldest quarter potentially influences the distribution of *M. esculenta*. The MaxEnt model predicted ~2.88% of the geographical area ranging elevation 900 to 2100m, is currently suitable for the species in Hindu-Kush Himalaya. These results highlights that the distribution of species would shift their range upward in high elevation and north-eastern wards in latitude under a wide range of future climatic scenarios. The application of predictive Maxent modelling approach with simple inventory data (such as the occurrence of the species) may provide academicians and conservationists a useful information for the prediction of future distribution, both at local and regional scales, of medicinally and threatened plant species and its effective restoration and conservation actions.

***Keywords:*** *Climate Change, MaxEnt, Range shifts, Myrica esculenta, Himalaya*

# Climate-Smart Agriculture: Ensuring Food Security Amidst Climate Change

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With the ever increasing population and feeding mouths, Food and Agriculture Organization (FAO) estimates that by 2050, 60 percent of the agricultural production will have to be increased to meet the expected demands. With the evidently alarming climate change these days globally things are getting more complicated due to its adverse effects on agriculture directly. Therefore, concerning food and nutrition security while addressing the climate change impacts, simultaneously preserving our natural resources needs just a different approach, keeping the natural way of farming in view, that can guide us through to make the necessary changes in our current agricultural systems and hence, Climate-smart agriculture (CSA) comes into play. CSA integrates economic, social and environmental developments altogether in a sustainable manner. Sustainable increase in agricultural productivity and incomes, adaption and building resilience to climate change and reduction of greenhouse gas (GHG) emissions are the three pillars of CSA that can address us at this hour of distress and do full justice to mankind in securing a sustainable future for the planet.

***Keywords:*** *Climate-smart agriculture (CSA), productivity, incomes, resilience, climate change, greenhouse gases (GHGs)*

# Effect of Organics in Cultivation of Banana

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Organic farming is a type of farming that minimises or eliminates the use of toxic chemical fertilisers while emphasising the use of natural resources. In most cases, farmers use a chemical fertiliser as the primary fertiliser for their crops' growth, or combine it with organic fertilisers. Chemical fertiliser application yields a high yield; yet, the environment deteriorates, soil becomes infertile, farmers' health suffers, and production costs rise, making them unworthy of their investment. Farmers' debt accumulates over time. The usage of organic fertiliser, on the other hand, aids in soil improvement.It also aids in enhancing the physical, chemical, and biological soil aspects that are conducive to long-term plant growth, as well as lowering production costs and adhering to the sufficient economy principle. Organic fertiliser could reduce the usage of chemical fertiliser, making it more environmentally friendly, healthier for farmers, and safer to consume. Farmers are currently experiencing a variety of issues in growing the emperor banana due to soil deterioration and soil infertility as a result of over use of chemical fertiliser to improve production.As a result, management in the use of various organic forms will play an essential role in solving many problems such as soil improvement, reduction in the use of chemical fertilisers, lower production costs, and increased product quality in accordance with market demands. Animal manure, compost, green manure, and other organic compounds are among the organic substances used to improve soil. Farmers can choose from these organic fertilisers based on their plant appropriateness or the usage of readily available local ingredients. Apart from delivering nutrients to plants, it also serves as a source of hormones, pesticides, and insecticides.

# Effect of Combined Application of Mineral Fertilizers and Organic Manures on Yield And Nutrient Concentration in Fruit of Tomato Crop

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Tomato (*Lycopersicon esculentum* Mill) is one of the important vegetable grown in developed and developing countries, and consumed as ingredient of the human diet contain ascorbic acid, sugar, calcium, and vitamins. Recommended dose of inorganic fertilizer with certain organic manures, such as farmyard manure and pressmud compost provided an opportunity to enhance the yield and nutrient concentration in tomato. Keeping this in view, the present field experiment was conducted to assess the effect of combined use of mineral fertilizers, farmyard manure (FYM) and pressmud compost on yield performance and nutrient concentration in fruit of tomato at Vegetable Research Farm, Bihar Agricultural University, Sabour, Bhagalpur. This study was done using split plot design with two main plots (farmyard manure and pressmud compost) and five subplot levels of treatment (0, 5, 10, 15, 20 MT $ha^{-1}$ organic manure along with 100% NPK) replicated thrice. Results revealed that the concentration of nitrogen and phosphorus was found to be highest in treatment $T_4$ ($T_0$+ 20 MT $ha^{-1}$ organic manure) which was at par with treatment $T_3$ ($T_0$+ 15 MT $ha^{-1}$ organic manure). The Potassium concentration in tomato fruit was found to be non-significant effect of applied organics along with recommended dose of fertilizers on fruit potassium content. However, the treatment $T_4$ contained higher potassium than all other treatments. The use of graded dose of organic manures in soils resulted into considerable increase in nutrient content in fruit of tomato plants due to micro flora activation. Study also showed that in case of organic level, the pressmud compost treated plot leads to be slightly higher fruit potassium than farmyard manure treated plot. Overall, it can be concluded that combined application of recommended dose of inorganic fertilizers and organic manure at the rate 15 MT $ha^{-1}$ can improve the tomato yield, nutrient concentration in tomato crop and soil quality.

***Keywords:*** *Tomato, Farmyard manure, Pressmud compost, Organic manure, Nutrient Content*

# Conservation Agriculture, Improving Soil Quality For Sustainable Production Systems Under Climate Change

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Climate-resilient agriculture (CRA) is an approach that includes sustainably using existing natural resources through conservation agriculture to improve soil health, achieve long-term higher productivity and farm incomes under climate variabilities.This practice reduces hunger and poverty in the face of climate change for forthcoming generations. CRA practices can alter the current situation and sustain agricultural production from the local to the global level, especially in a sustainable manner. Conservation tillage is a widely-used terminology to denote soil management systems that result in at least 30% of the soil surface being covered with crop residues after seeding of the subsequent crop. To achieve this level of ground cover, conservation tillage normally involves some degree of tillage reduction and the use of non-inversion tillage methods. The technologies of Conservation Agriculture provide opportunities to reduce the cost of production, save water and nutrients, increase yields, increase crop diversification, improve efficient use of resources, and benefit the environment. Collection of information and research parameters related to agricultural practices are needed for designing a suitable soil and water conservation program for sustainable production intensification. Conservation agriculture improves soil aggregation compared to conventional tillage systems and zero tillage (ZT) without retention of sufficient crop residues in a wide variety of soils and agro-ecological conditions. yield increases, reduced risks and environmental sustainability can only be achieved through conservation management practices under the scenario of climate change.

***Key words:*** *Sustainable, Soil health, CRA and ZT*

# Enhancing drought stress tolerance in summer rice using beneficial root endophyte Piriformospora indica

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Agricultural yield gap due to climate change is the major trouble facing the world now. Uncertainty in rainfall during cropping seasons has led to water stress situations in critical stages of crop. Researchers have identified a beneficial root endophyte Piriformospora indica, a member of the Sebacinales in Thar desert, India (Verma et al., 1998). P. indica enhanced nutrient uptake, helped plants to survive in extreme drought, temperature and salt conditions, exhibited systemic resistance to toxins, acted as bio-fertilizer, bio-protector, stimulator of growth, increased seed production, and played a key role in increasing the tolerance to insects (Bagde et al., 2011). In this scenario, the present study was conducted in Kerala Agricultural University to assess the performance of P. indica in water deficit situation of summer rice. In this work, the irrigation was given at IW/CPE ratios of 1, 0.85, 0.75, 0.50, 0.43, 0.38 to both P.indica colonized and non-colonoized rice plants. The colonized / noncolonized rice seedlings were transplanted to the field after 14 days and uniformly irrigated till 10 days after transplanting. Crop was raised as per the KAU package of practices recommendation for short duration rice (KAU, 2016). P. indica colonized plants irrigated to IW/CPE ratio 1.00 was found to be significantly superior with 275.00 productive tillers $m^{-2}$, higher filled grains per panicle (111.33), lowest sterility percentage (8.80) and superior grain yield (2698.56 kg $ha^{-1}$). Plants under severe moisture stress (IW/CPE ratio of 0.38) on colonization recorded 73.88 and 18.80 per cent improvement in number of productive tillers and filled grains per panicle over non-inoculated plants experiencing the same stress. LAI was found to be significantly superior at all growth stages for colonized plants which helped to promote higher photosynthesis even in water stress condition. Sterility percentage was decreased by 22.74 per cent in colonized stressed plants over control stressed plants (irrigation interval at 40 mm CPE to a depth of 1.5 cm). Under severe stress condition (IW/ CPE of 0.38), colonization resulted in yield improvement of 37.03 per cent over uncolonized plants. Colonized rice plants showed 15.53 and 26.13 per cent longer rooting depth over non-colonized rice plants at IW/CPE of 0.38 at 30 and 60 DAT respectively facilitating higher water and nutrient absorption from deeper layers of soil by the plant to mitigate water stress situation. Colonized plants under ideal IW/CPE ratio of 1.00 recorded the highest WUE (3.47) than non-colonized plants (2.96) irrigated at the same frequency which could be attributed to the higher water and nutrient uptake made possible through the extensive root surface which

ultimately resulted in high economic yield eventually leading to high WUE. Similar results were reported by Ahmadvand and Hajinia (2018) and Jolly et al. (2019).

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# THEME - III

## *Agro-Forestry, Joint Forest Management and Holistic Agro ecosystem Management for Livelihood Security in the context of Natural Farming*

# Foliar nutrition of water soluble fertilizers for enhancing yield and quality of bhendi (*abelmoschus esculentus* l. Moench)

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A field experiment was conducted during Rabi, 2020 in sandy clay loam soils at farmers' holding at Vellanaipatti, Kalapatti, Coimbatore with TNAU Bhendi Hybrid (COBhH-4). The present study aimed to study the effect of foliar nutrition of water-soluble fertilizers for enhancing yield and quality of Bhendi. The experiment consisted of sixteen treatments that include- Absolute control, 100% RDF combined with commercially available 19:19:19 and TNAU WSF 19:19:19, liquid multi micronutrient @ 1% and 2 % which is foliar fed either alone or in combination depending upon the treatments. The experiment was laid out in a randomized block design (RBD) replicated thrice using COBhH-4Bhendias a test crop. The results revealed that foliar feeding of Bhendicrop with different water-soluble fertilizers had a marked promotional effect on growth and yield of Bhendi. The results of the field experiment showed that the growth parameters *viz*., plant height, no. of leaves per plant, LAI and Chlorophyll content of bhendi was significantly influenced by the WSF and multi micronutrients at almost all stages. Among the two WSF imposed, the treatment $T_{15}$ (TNAU WSF 19:19:19 @ 2% + TNAU Liquid Multi Micronutrient @ 1% - FS) and $T_{13}$TNAU WSF 19:19:19 @ 1% + TNAU Liquid Multi Micronutrient @ 1 % - FS) recorded higher DMP of 4456 and 4348kg $ha^{-1}$ respectively which were comparable with each other and highly significant than other treatments. The commercial WSF produced significantly lower DMP at 1% and 2% concentration with or without liquid MNS compared to TNAU WSF.The $T_{15}$ treatment (TNAU WSF 19:19:19 @ 2% + TNAU Liquid Multi Micronutrient @ 1% (FS) recorded the highest fruit yield of 24.80 t $ha^{-1}$ followed by $T_{13}$Commercial WSF 19:19:19 @ 2% + TNAU Liquid Multi Micronutrient @ 1% (FS) (24.66), $T_{14}$ TNAU WSF 19:19:19 @ 1% + TNAU Liquid Multi Micronutrient @ 1% (FS) and $T_{11}$ Commercial WSF 19:19:19 @ 1% + TNAU Liquid Multi Micronutrient @ 1% (FS) which were on par with each other. The yield increase over the recommended dose as per the HPG ($T_1$) was calculated and it ranged from 7.73 to 37.02 %. The WSF treatments had a marked influence in yield increase which ranged from 14.25 to 21.22 per cent. However when the WSF was combined with TNAU Liquid Multi micronutrients, the yield increase was still higher ranging from23.20 to 37.02 per cent. Whereas the increase in per cent yield for the application of TNAU Liquid Multi micronutrients alone was lower from 9.17 to 11.93. The $T_{15}$ and $T_{13}$ treatments recorded a higher per cent yield increase of 37.02 and 36.24, respectively over $T_1$ treatment.The treatment $T_{13}$ (TNAU WSF 19:19:19 @ 1% + TNAU Liquid Multi Micronutrient @ 1 % - FS) recorded the highest mucilage, TSS, ascorbic acid and crude protein content of Bhendi fruits followed by $T_{15}$TNAU WSF 19:19:19 @ 2% + TNAU Liquid Multi Micronutrient @ 1% (FS) which were comparable in their effect. The lowest crude fiber content was recorded by the application of TNAU WSF 19:19:19 @ 1% + TNAU Liquid Multi Micronutrient @ 1 % (FS) (8.94) which was highly significant than others followed by $T_{15}$ - TNAU WSF 19:19:19 @ 2% + TNAU Liquid Multi Micronutrient @ 1% (FS) with a value of 9.08 per cent.

***Keywords:*** *Water soluble fertilizers, foliar nutrition, growth, yield, quality parameters, bhendi*

# Influence of foliar spray of bio-stimulants on post-harvest and vase-life of tuberose (*polianthes tuberosa* l.) Cv. Suvasini

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The experiment was conducted at College of Horticulture, Mojerla, Wanaparthy, SKLTSHU. Statistical design was Contrast Factorial Randomized Block Design (FRBD with Control) with two factors (Bio-Fertilizers and Bio-Stimulants) with three and eight levels respectively replicated thrice. Tuberose bulbs Cv. Suvasini were treated with Bio-Fertilizers (Phosphate Solubilizing Bacteria (PSB @ 200g/l), Azospirillum (AZO @ 200g/l), Phosphate solubilizing Bacteria (KSB @ 200g/l)) and were sown in the filed with ridges and furrow method of plots. 20 days after sowing when the bulbs were sprouted, they are foliar sprayed with Bio-Stimulants (Gibberellic acid ($GA_3$), salicylic acid (SA), cycocel (CCCC), Humic acid (HA) each at 200 ppm and 400 ppm). After harvest of the spikes the post-harvest studies were done such as vase life, transpiration loss, water uptake. Among the treatments PSB in Bio-Fertilizers, $GA_3$ 400ppm in Bio-Stimulants while in the interaction effect of Bio-Fertilizers and Bio-Stimulants PSB + $GA_3$ 400 ppm resulted best.

***Keywords*** *: Tuberose, Bio-Fertilizers, Bio-Stimulants.*

# Agroforestry Systems As Land Use System

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A series of survey was conducted in fifteen districts of Assam to understand the structure and function of existing agroforestry system in. farmer's field. Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. Agroforestry is relatively a new term coined for a traditional land use practice carried out by millions of farm families' throughout the globe. Diversified cropping systems involving crops, fruit trees, pasture, agroforestry, animals as an alternate land use system and practices have to be surveyed to catogerise the ecological, social, cultural and political environments in which these systems operates. Surveys was conducted extensively in Kamrup Metro, Kamrup Rural, Baksa, Udalguri, Darrang, Nalbari, Barpeta, Chirang, Bongaigaon, Goalpara, Dhubri, Kokrajhar, Morigaon, Nagaon and Hojai districts of Assam. Depending upon the characteristics with regards to composition and design, the agroforestry systems have been categorized in different zones like Compost Heap, Admixture of Fruit Zone and Forest Zone etc. Number of zones varies widely from homestead to homestead. Different agroforestry systems identified are: Agri-Horticulture, Agri-Silviculture, Agri-Horti-Silviculture, Aqua-Agri-Horti-Silvi-Pastoral, Aqua-Horticulture, Aqua-Silviculture, Aqua-Horti-Silviculture, Horti-Horticulture, Silvi-Pastoral, Silvi-Silviculture and Homestead. In several locations there is popularity of horticulture as monoculture, horticulture of mix species, plantation crop as monoculture, plantation crops of mixed species, silviculture as monoculture, silviculture of mixed species and apiculture with trees. Homestead is the most pervading agroforestry system observed in the state. Integrated Baree is a very common system in most of the homestead. Integrated Baree, Palm baree were also found. In Agri-Silviculture and Agri-Horti-Silviculture systems boundary plantation of tree species is the most common. In Horti-Horticulture system intercropping of dwarf species with tall fruit/nut crop is the most common design. Traditionally, the most important horticultural species are Banana, Pineapple, Assam lemon among the fruit species; and Arecanut and Coconut among nut species. Among the forestry species, the most popular species is Bamboo followed by Teak, Gomari, Sisu, Titachapa etc. Tea, Rubber, Cocoa and Cashew nut among plantation crops; and Teak &Gomari among forestry species found in different districts. The survey will help during planning for intervention needed in the existing agroforestry system of the surveyed area in order to maximize the output as well as maintenance of the eco-system.

***Keywords:*** *Agroforestry, Land Use sytem,Agri-Silviculture, Mono culture*

# Nature-Based Climate Adaptive Strategy For Developing A Climate Resilient Agricultural System In Sikkim Himalaya, India

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The Himalayan region is subjected to the impacts of Climate Change, which has in turn led to significant impacts on ecosystems, agricultural systems, biodiversity and well being of Himalayan communities. These communities have been coping with such change over decades through traditional and modern techniques. The rampant change in precipitation patterns associated with other anthropogenic activities has led to an increase in the number of drying springs, species migration, etc., in this region. With the increasing water security challenges, agricultural productivity in this region has been greatly impacted. Thus, building ecological and social resilience becomes important. This study primarily identifies water as a major challenge for ensuring climate adaptive agricultural systems. In addition, Nature based Solutions such as agroforestry practices aided with traditional farming systems can pave a way forward to climate resilient agricultural systems. The highest impact of Climate Change is recorded in declining production of some of the cereal crops, oil seeds, cash crops and on the discharge of springs of the southern part of Sikkim. The production of the agricultural and horticultural produce in Sikkim is fully dependent on organic compost and herbicides since 2016. Thus, the potential of traditional agroforestry practices as a solution to emerging climate change challenges is high. Furthermore, this paper proposes a conceptual framework of Water-Energy-Biodiversity (W-E-B) nexus as a possible solution to food security for a climate resilient agriculture in Sikkim Himalaya.

***Keywords:*** *Climate Adaptive Agriculture, Nature-based Solutions, agro-ecological food production systems, Water-Energy-Biodiversity (W-E-B) nexus.*

# Monitoring Forest Cover Change In Kerala Using Google Earth Engine

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Forests play an essential role in regulating the climate on a global scale. They are also a part of global carbon cycle. Destruction of forest through deforestation is a global issue. It can be caused by manmade and natural causes. Manmade causes are due to demand of population for forest resources and land. Kerala is located on the southern Malabar coast of India, bordering the Arabian Sea. The geographical area of the State is 38,852 sq km, which is 1.18% of the geographical area of the country. The State lies between 8°17'N to 12°47'N latitude and 74°52'E to 77°24'E longitude. According to survey conducted by Forest survey of India (2019), the state is ranked third in top five states in terms of increase forest cover. The study aims to estimate changes in forest cover of the state using satellite data. The study exploits the ability of Google earth engine cloud computing platform for mapping and quantifying the forest cover over a period of 2001 to 2020.Landsat based forest datasets are used for the study. It was found that around 825.67 sq km area was lost and 2017 is the year having more area lost. Major loss is seen in the upper part of the state specifically in Kollam and Idukki districts of Kerala. Monitoring the forest cover is important for the proper management of our forests.

***Keywords:*** *GEE, Forest cover, Landsat, Remote sensing*

# Quantifying The Contributions Basin And Climate Characteristics To Water Yield Across Spatio-Temporal Scales In Upstream Teesta River Basin, Sikkim

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The identification of climate and basin characteristics which plays a key role in determining water yield is of paramount importance. In addition to these, quantifying each parameter's contribution to water yield would aid policy makers in better understanding the water balance as well as in effective water resources management within the watershed. However, because to enormous complexity involved in hydrologic cycle, it is an immense challenge for hydrologists to isolate contribution of each parameter to water yield. To overcome this, an attempt has been made to quantify the contributions of each variable on water yield by using Boosted Regression Trees (BRTs).In this study, the Soil and Water Assessment Tool (SWAT) model was adopted to simulate water yield and its results were employed in BRTs to analyse at spatio-temporal scales in upstream Teesta river basin to understand how water yield varies with different scales. The input parameters used are precipitation, baseflow, maximum and minimum temperature, actual evapotranspiration (ET), snowmelt, normalized difference vegetation index (NDVI) and enhanced vegetation index(EVI).The results showed that on an average, precipitation and baseflow plays a vital role in determining water yield followed by minimum temperature and maximum temperature, while NDVI, EVI and ETwas found less significance with respect to its contribution towards water yield in all aspects.The proposed methodology involving coupled hydrological model and statistical tools can be helpful in describing complex interactions of basin and climate variables with reference to water yield. The result of this study could help inform and support policy makers in effective water resources management strategies.

***Keywords-*** *Spatial and temporal scales, Soil and Water Assessment Tool (SWAT), Boosted Regression Trees (BRT), Teesta riverbasin, Water yield, Water resource management.*

# Jackfruit Conservation Under Natural Farming For Quality Food And Micronutrient Nutrition

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Biodiversity conservation is an important aspect for securing food to growers, small and marginal rural farmers and human cultural diversity. The management of biodiversity is equally essential and mandatory for a country in order to safeguard the eminent fruit biodiversity. In this direction, Jackfruit plays immense importance to provide nutrients as vegetable and ripen fruits to the society as potential benefits. In many states of country, farmers follow natural farming and resource conservation practices to grow, manage and harvest fruits from trees. Jackfruits from different Indian states showed variable shape and size. The recent information on maximum micronutrient content (Zn, Cu, Mn and Fe) in seed, bulb and epicarp was estimated as 41.4, 26.60, 32.9, 485 mg/kg; 36.5, 42.5, 37.33, 487.5 mg/kg and 88.5, 28.0, 57.0, 611.0 mg/kg respectively. The highest content of major nutrients like N, P, K, Ca and Mg were estimated as 4.03, 0.43, 2.24, 0.68 and 0.29 per cent in epicarp across jackfruit accessions. Likewise, the maximum values of major nutrients in seed and bulb was also recorded as 3.75, 0.47, 1.91, 0.89, 0.26 and 3.62, 0.34, 1.97, 0.99, 0.03 per cent respectively. Histographic analysis showed widespread variability of major nutrients in seed, pulp and bulb of Jackfruit germplasms. Similarly, distribution pattern of micronutrients across jackfruit germplasms showed highly variable in nature. Such scientific analysis ensures about the nutrient contents in Jackfruit grown in different Indian soils under various natural farming and with natural resources. The current nutrient content may not be the best for its use. Hence, scientific efforts are indeed needed for systematic conservation and management of jackfruits. The role of soil, kinds of water and climate do have impacts on the jackfruit growth and thus development. Therefore, it is the priority of scientific community to improve the available nutritional content in jackfruit for better sustainable utilization and nutrition to human population.

***Key words:*** *Jackfruit, nutrient contents, histographic analysis, natural farming*

# Predicting the current and future potential distribution of the *myrica esculenta* buch.-ham. Ex d. Don (myricaceae) in hindu-kush himalaya

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Mountainous ecosystems throughout the globe are sensitive to climate change. This is considerably more detrimental in the Hindu-Kush Himalayan region where the elevation dependent warming rates and retreat rate of glaciers is higher than other parts of the world. Such changes are leading to increase the vulnerability of plants, especially threatened species of Himalayan region, which are be at greater risk of local extinction. In this study, we modeled the current climatically suitable areas of a economically and medicinally important tree species, *Myrica esculenta* across Hindu-Kush Himalaya and predicted its possible range shifts under future climate. Anthropogenic disturbance along with changing climatic conditions cause rapid decline in its natural population. Maximum Entropy Modeling (MaxEnt) approach with bioclimatic data from WorldClim was used to construct the climatic niche of *M. esculenta* in present condition and predict the potentially suitable habitat areas for 2050 and 2070 under four representative concentration pathways (RCPs) scenarios (RCP RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5) by integration of five general circulation models. Furthermore, we predicted and calculated the elevational and latitudinal specific range shifts in response to changing climate under the future scenarios. The study revealed that, precipitation of warmest quarter and wettest quarter, mean diurnal range temperature and mean temperature of coldest quarter potentially influences the distribution of *M. esculenta*. The MaxEnt model predicted ~2.88% of the geographical area ranging elevation 900 to 2100m, is currently suitable for the species in Hindu-Kush Himalaya. These results highlights that the distribution of species would shift their range upward in high elevation and north-eastern wards in latitude under a wide range of future climatic scenarios. The application of predictive Maxent modelling approach with simple inventory data (such as the occurrence of the species) may provide academicians and conservationists a useful information for the prediction of future distribution, both at local and regional scales, of medicinally and threatened plant species and its effective restoration and conservation actions.

***Keywords:*** *Climate Change, MaxEnt, Range shifts, Myrica esculenta, Himalaya*

# Fruit Crop Germplasm: A Source For Sustaining Productivity

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Fruit crops known to impart nutritional security, earn foreign exchange, maintain ecological sustainability. The north eastern region of India has significant fruit crop diversity. This diversity can be utilized as cultivars or root stock to improve the quality and impart tolerance to different stresses. Considering this,twenty-five (25 nos.) fruit crops germplasm i.e. plum (02 nos. IC: 0632362-63); peach (04 nos., IC: 0632364-67); *Pyrus pashia* (02 nos. IC: 0632368-69); lemon (13 nos., IC: 0632370-77 and 0635710-14); acid lime (02 nos., IC: 0632378 and 0635715) and Soh-shang (02 nos. IC: 0635716-17) were collected from the region were characterised and evaluated for different traits. At humid tropics of NE India, fruit cracking and maturity during rainy season i.e. May-June is concern among the peaches and plum growers. Thus, local RC Peach-1 rootstock has been identified to hasten maturity and reduce the fruit cracking in peach and plum varieties. Similarly, in cashew reduction in quality of cashew kernels has been observed due to harvesting time of nuts coincides with rains in April at production belt Garo Hills of Meghalaya. Thus, two high yielding and early bearing (Feb-March) genotypes i.e. RC Cashew-1 and RC Cashew-2 has been identified. Region is well known for lemon cultivation and juicy seedless varieties with good yield potential during summer season has high market realization. Considering this, promising lemon genotype i.e. RC-JL-1 (flower have jasmine flower aroma) and RC-EL-1 (fruits have cardamom aroma) has been identified and found suitable for quality lemon production during summer season and also at kitchen garden. The above indigenous fruit genotypes can successfully use for crop improvement and adoption to natural farming practices.

***Keywords:*** *Germplasm; fruit crops, productivity*

# Studies on Effect of Pre Sowing Treatments on Germination of *Carissa Carandas*

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The present experiment was carried out in nursery of Department of Silviculture and Agroforestry, College of Forestry, Sirsi during the year 2021-22 with the objectives to study effects of different pre-sowing treatments on germination and growth parameters of kavale*Carissa carandas*. The Experiment was laid out in completely randomized design involving seven different seed treatments *viz.*, Cow dung slurry treatment (24 hours), Cow urine treatment (24 hours), Water soaking for 12 hours, hot water soaking for 10 minutes at $50^0$ C, KNO3 2% Soaking (2hr), GA3 50ppm for 1hour and control. Among various treatments applied after 90 days, seeds soaked in cow urine for 24 hours recorded significantly higher seed germination (29.5%), followed by cow dung slurry (28.2). The similar trend was observed in plant growth parameters and total biomass of the plant.

# Soil Amendments For Resource Conservation And Sustainable Crop Production Indegraded Ecosystem of Chambal Ravines

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Soil amendments have positive impact on soil properties, crop productivity and on environment, thus could be a viable technology for restoring degraded lands. Limited studies are available on the application of gypsum, crop residue as soil amendments on tablelands for reducing soil and runoff and sustaining crop productivity under rainfed ecosystem. Various combinations of treatments were T1-Control (without fertilizers and amendments); T2-Recommended Dose of Fertilizer (RDF) for soybean; T3-RDF + Gypsum; T4-RDF + mustard crop residue (CR); T5 -RDF+ Gypsum+CR. Highest soybean yield was recorded in RDF+ Gypsum+CR (1.2 t $ha^{-1}$) followed by RDF+CR (0.98t $ha^{-1}$) and lowest without amendments in control (0.54t $ha^{-1}$). Comparing the effect of amendments on runoff and soil loss, it seems that relative to control and T2 (RDF), gypsum applied solely (T3) and combined with CRs (T6) was effective in reducing runoff and soil loss. Pooled analysis showed that average runoff percentage ranged between 16-25% and soil loss varied from 2-4.2 Mg $ha^{-1}$among various treatments. Significant reduction in runoff with sole and combined application of CR and gypsum was observed as compared to control treatment. Magnitude of reduction in runoff and soil loss was 10-37% and 18-52% respectively after three years of soil amendment application in soybean crop. Positive effect of reduction in soil erosion visualized with improved soybean grain yield that varied significantly across the treatments. Application of soil amendments like gypsum improved sulfur availability for oilseed crops increased available nitrogen, phosphorus and exchangeable K content in soil.

***Keywords:*** *Runoff, soil loss, gypsum, crop residue, soybean*

# Phosphorus Utilization And Response Of Red Gram Cultivars To Phosphorus In Alkaline Calcareous Soils Of Madurai District, Tamil Nadu

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In vitro and in vivo studies through incubation study and two culture experiments were conducted in the alkaline calcareous soils of Madurai district, with redgram genotypes to assess the status of different fractions of inorganic phosphorus, to evaluate the P utilization pattern of phosphorus by different varieties of pigeon pea and to optimize the levels of phosphorus for pigeon pea in alkaline calcareous soils. Incubation study was conducted in an alkaline calcareous soil of Katrampattii village of Thirumangalam block ,Madurai district of Tamil Nadu for duration of 90 days with different levels of P viz., 0,30,60, 90 ppm and 120 ppm.The P fixing capacity of experimental soil was 27.50 ppm with 18.5,15 and 88 ppm of Al-P, Fe-P and Ca-P respectively. The available soil P was 12.50 Kg $ha^{-1}$.The P release pattern and P fractions of the experimental alkaline calcareous soil was monitored at 15 days interval up to 90 days. The available P increased with levels, while a decline was observed over the period of time. With respect to P Fractions, Al-P increased with levels and declined over a period of time. The Fe-P and Ca-P fractions increased up to 90 days. Al-P increased with addition of P, while it decreased over a period of time. Al-P ranged from 16.0 to 29.75 ppm, Fe-P ranged from 15.0 to 49.75 ppm. Ca-P recorded an increase with levels of P and time of incubation and was higher in alkaline calcareous soil. Pot culture experiment was conducted in an alkaline calcareous soil of pH 9.2, $CaCO_3$ of 7.5 % and sandy clay loam in texture from Katrampattii village of Thirumangalam block, Madurai dt. with three redgram varieties viz., APK 1, VBN 3 and CO (Rg)7 of TNAU, Coimbatore and four levels of P (0,25,50, and 75 Kg $ha^{-1}$ of $P_2O_5$. The biometric observations, yield parameters, grain and stalk yield were recorded. Among the three fractions studied, Ca-P was higher in alkaline calcareous soil. Application of 50 Kg $P_2O_5$ $ha^{-1}$ recorded maximum plant height at all stages of crop growth in all the three varieties. Among the varieties, APK 1 recorded maximum plant height followed by VBN 3 and CO (Rg)7 and maximum number of branches was recorded in CO (Rg) 7.APK 1 recorded maximum number of pods at 50 Kg $P_2O_5$ $ha^{-1}$ followed by CO (Rg) 7.The number of pods decreased with increase in P levels to 75 Kg $P_2O_5$ $ha^{-1}$.Application of 50 Kg $P_2O_5$ $ha^{-1}$ recorded maximum grain yield of 1370 Kg $ha^{-1}$ with APK 1 redgram followed by CO (Rg)7 (1281 Kg $ha^{-1}$ ) and 1123 Kg $ha^{-1}$ in VBN 3 during the first experiment.During the second pot culture experiment, a similar trend was observed with APK 1 recording an higher grain yield of 1325 Kg $ha^{-1}$ with the application of 50 Kg $P_2O_5$ $ha^{-1}$.The grain yield increased upto 50 Kg $P_2O_5$ $ha^{-1}$ and declined with increase at 75 Kg $P_2O_5$ $ha^{-1}$. Among the varieties, APK 1 of 90 days duration could be recommended for cultivation in an alkaline calcareous soil with 50 Kg $P_2O_5$ $ha^{-1}$.

***Keywords:*** *phosphorus, redgram genotypes, alkaline calcareous soil*

# Effect of Integrated Nutrient Management In Rice For Availability of Different Potassium Forms And Crop Yield

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One field investigation was carried out to assess the effect of imposed treatments on the dynamics of the soil potassium and yield attributes of rice in an Inceptisol of North East India. Treatments consisting 10 treatments combinations of different doses and methods of application of chemical fertilizers and organic manures (enriched compost and vermicompost) and also biofertilizer as source of potassium in 3 replications were laid out in Randomized Block Design. The treatments comprised of $T_1$ - Absolute control, $T_2$ - Microbial consortia (Azospirillium + PSB + KSB) @ 4 kg/ha, $T_3$ - RDF (60:20:40:: N: $P_2O_5$: $K_2O$), $T_4$ - $T_3$ + KSB @ 4 kg/ha, $T_5$ - ½ RDF of K as basal + ¼ at 40 DAT + ¼ at 60 DAT, $T_6$ - Potassium nano-fertilizer @ 100 ml/1.2 L of water (10ml/100g), $T_7$ - $T_6$ + 50% RDF of K as top dressing at 40 DAT, $T_8$ - ½ RDF of K as basal + Spraying 3% K solution at maximum tillering and PI stage, $T_9$ - INM Package (50% NP + Full K + 5t/ha Enriched Compost), $T_{10}$ - INM Package (50% NP + Full K + 5t/ha Vermicompost). In all treatments N and P was applied as per recommendation except control. The experimental findings showed that amongst the applied treatments, where 100% K fertilizers were applied alone or in combination with INM components for 2 years continuously observed an increase in total K, highest being observed in $T_{10}$ = 100% NP + Full K + 5 ton/ha Vermicompost) (11015.50 mg $kg^{-1}$). Water soluble K in general, was higher in the treatments receiving INM package and 100% K fertilizer doses alone or in combination with KSB. Exchangeable K corresponded to the amount of chemical K fertilizer applied and also to the INM package including microbial consortia. Lower values of non-exchangeable K were recorded in all the treatments with different levels of potassium as compared to initial (1.020 mg kg-1) in the field experiment. Highly significant positive correlation values among various forms of K implied the existence of dynamic equilibrium. Grain yield was significantly affected by various treatments with the highest yield in $T_{10}$ which received 100% NP + Full K + 5 ton /ha vermicompost. Finally, the study revealed that INM Packages were found to be better for maintaining available K status, K release from none available pools and the resultant crop yield compared to inorganic treatments.

***Key words:*** *INM, potassium forms, rice yield*

# Effect of Foliar Application of Different Nano Fertilizers on Growth and Yield of Finger Millet

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Green revolution has led to the increased consumption of chemical fertilizers which has not only resulted in the higher productivity on one hand, but also has caused environmental hazards. To overcome all these drawbacks in a better way, nanotechnology is serving as a ray of hope. Nano fertilizer is an important tool in agriculture to improve growth, yield and quality of the crop with increased nutrient use efficiency, reduction in wastage of fertilizers and cost of cultivation. Apart from soil applications, foliar spray of nutrients has been proved to be a practical means of replenishing the nutrients in the leaves. A field experiment was conducted at Dryland Agriculture project, UAS, GKVK, Bengaluru during *Kharif* 2021, to study the effect of foliar application of different nano fertilizers on growth and yield of finger millet. Experiment consisting of 18 treatments was laid out in RCBD design replicated thrice on red sandy loam soil which was slightly acidic in pH (5.15), low in organic carbon (0.40 %), low in available nitrogen (256.08 kg $ha^{-1}$), high in available phosphorous (128.40 kg $ha^{-1}$) and medium in available potassium (146.34 kg $ha^{-1}$). Application of 100 per cent N + recommended PK + spraying of nano - N and nano- Zn twiceat 25 and 45 DAS recorded higher grain yield (3487 kg $ha^{-1}$) and straw yield (4831 kg $ha^{-1}$) and was found to be on par with the application of 75 per cent N + recommended PK + spraying of nano-N and Nano Zn twice. Yield parameters *viz.*, number of productive tillers per hill, ear heads per hill, fingers per ear head and ear length was higher with the application of 100 per cent N + recommended PK + spraying of nano – N and nano- Zn twice (12.72, 7.04, 7.47 and 7.40 cm, respectively) and was on par with application of 75 per cent N + recommended PK + spraying of nano-N and Nano Zn twice (12.07, 6.89, 7.40 and 7.33 cm, respectively). However, imbalanced nutrient application of only recommended PK resulted insignificantly lower grain, straw yield and yield attributes. With only nano nitrogen spray, among the different levels of fertilizers, 100 per cent and 75 per centrecommended nitrogen along with recommended PK recorded the additional yield of 542 and 296 kg $ha^{-1}$ over RDF. Furthermore, an additional returns of Rs. 6952 $ha^{-1}$ was fetched with the application of 75 per cent N and two sprays of nano nitrogen. Overall it wasconcluded that the application of 75 per cent N + recommended PK + spraying of nano-N and Nano Zn twice was productive and feasible for finger millet.

***Key words:*** *Nano technology, nano fertilizer, foliar spray, yield attributes*

# Assessment of Cost And Returns of Banana Cultivation in The Goalpara District of Assam

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Banana is commercially the most important tropical fruit and one of the most widely cultivated cash crop in the world. The study attempted to analyse the cost and returns of banana cultivation in the Goalpara district of Assam which is a leading banana producing district in the state. The findings of the study revealed the overall total cost per ha as ₹225149.50, with ₹227727.99, ₹225072.30, ₹224309.46, and ₹222470.18 for marginal, small, medium and large category respectively. The productivity of banana was found highest in case of marginal farms category (2179.77 bunches/ha) and lowest in large farms category (1933.83 bunches/ha). In other words, marginal farms category allocate and manages their resources efficiently as compared to other categories. The gross return per hectare of marginal, small, medium and large farms were found as ₹502209.09, ₹476748.80, ₹429408.67, ₹408310.60 respectively with an overall gross return of ₹457565.14. Benefit-cost ratio was calculated as a measure of profitability. The Benefit-cost ratio was found to be highest in marginal farms (2.20) and lowest in large farms (1.84) category. Therefore, marginal farmers generate a gross return of Rs 2.20 by investing Rs 1. The benefit- cost ratio for small and medium farms were 2.11 and 1.91 respectively.

***Key words:*** *Productivity, Gross Return, Benefit- Cost Ratio.*

# Yield And Economics of *Olitorius*jute At Different Plant Densities And Topping Practices

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A field experiment was conducted in *olitorius* jute at Agricultural College Farm,Bapatla during *kharif*,2019 with three plant densities [1.66 lakh plants $ha^{-1}$ ($D_1$), 2.2 lakh plants $ha^{-1}$ ($D_2$) and 83,333 plants $ha^{-1}$ ($D_3$)] and four topping practices [$T_1$ ( No topping), $T_2$ (topping at 30 DAS), $T_3$ ( topping at 45 DAS) and $T_4$ (topping at 60 DAS)] in a randomized block design with factorial concept and replicated thrice. Highest seed yield, stalk yield, gross returns, net returns and BC ratio were obtained in crop sown at (60 cm x 20 cm) with a density of 83, 333 plants $ha^{-1}$($D_3$), which was significantly superior over (30 cm x 20 cm) with 1,66, 666 plants $ha^{-1}$($D_1$) and it was on par with 45 cm x 10 cm $ha^{-1}$($D_2$). Topping at 45 DAS ($T_3$) recorded highest seed yield, stalk yield, gross returns, net returns and BC ratio and it was on par with topping at 30 DAS and 60 DAS, which was significantly superior over no topping ($T_1$).

***Key words:*** *Jute; Plant density; Topping practices; Capsules;Gross returns; Net returns; BC ratio*

# Impact of *Dendrocalamus Stocksii* Munro Based Agroforestry System on Growth Performance And Yield of Crops

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A study was conducted during 2021-22 at the Research Farm of *AICRPonAgroforestry, Dr.BSKKV, Dapoli,* on"Impact of *Dendrocalamusstocksii* Munro based agroforestry system on growth performance and yield of crops". The experiment was laid out in Split plot design (SPD) with two factor and four replications. Main plot treatment : 1) 8 m x 4 m i.e. plot size 32 m x 16 m, 2) 8 m x 6 m i.e. plot size 32 m x 24 m and 3) 8 m x 8 m i.e. plot size 32 m x 32 m, and Subplot treatments : 1)Turmeric (*Curcuma longa*), 2) Ginger (*Zingiberofficinalis*), 3) *Alpinia*spp. (*Alpiniagalanga*) and 4) Finger millet (*Elusinecoracana*).Significantly maximum height (6.23 m) and culms/bamboo (21.33) were observed at 8 x 8 m, whereas maximum yield of Turmeric (21.23 q/ha),Ginger (19.77/ha), Alpinia (15.91 q/ha)and Finger millet (16.26 q/ha) were observed at 8 m x 8 m spacing than other. Among the agroforestry based land use systems, bamboo based turmeric agroforestry system growing at 8 x 8 m spacing may be used for getting higher yield of crops.

***Key words:*** Bamboo, Turmeric, Alpinia, Ginger, Agroforestry.

# Development of Physical, Biological and Economic Resources in Karma Micro-Watershed in Eastern Plateau of India Under Integrated Watershed Management Programme: A Case Study

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Land, water and vegetation are the most prime natural resources in the earth. The efficient and economic utilization of these resources determine the agricultural productivity and environmental sustainability.The Integrated Watershed Management Programme was implemented in the Karma micro watershed under semi-arid region of the western West Bengal belonging to the eastern plateau of India since 2010-11 to 2014-15 to develop the area with the soil and water conservation measures. A questionnaire survey based on 40% of the total respondents (126) was carried out in 2017-18 to assess the desirable changes in respect of physical, biological and economic resources in the watershed. The results revealed that the location-specific soil and water conservation practices increased the surface (pond) water resources which helped the resource poor farmers to increase the irrigated area by 46.94% for kharif, 30.53% for rabi and 33.33% for summer season. The crop productivity index (CPI) was increased from prevalent 96.79 to 98.54% for aman paddy and prevalent 80.61 to 94.77% for maize. The benefit-cost ratio for aman paddy was increased from 1.20 (before programme) to 2.41 (after programme). The improvement in soil, water and crop productivity and income gains and thus, the employment opportunity was possible due to the combined adoption of land remediation, renovation of water resources, crop diversification, resource mobilization for cultivation and capacity building of the farmers.

***Keyword:*** *Karma micro watershed, Soil and water conservation, Crop productivity, water productivity, Benefit-cost ratio*

# Agroforestry for Livelihood Security in Natural Farming

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Agroforestry systems are an ancient practice in Indian. Agroforestry deals with the combination of tree species with apiculture, sericulture, animals, lac cultivation, gum and resin, medicinal and aromatic plants and it is based on the principle of optimum use of land. Agri-horticulture, silvi-horticulture, horti-pastoral, and silvi-pastoralas systems are diversified land use options for agroforestry in the plain region. Planting trees in agricultural lands not only generates income in the form of timber and non-timber produce, but also makes treasured ecosystem services. Agroforestry has an vital role in reducing pressure on natural forest, surface run off, nutrient leaching and soil erosion and increasing an output of food, fuel wood, fodder, timber and buffering households against climate related risks. It can also uphold or rise the basis of ecosystem services – water, soil health and biodiversity, especially under a changing climate, that will continue to support social, industrial and ecosystem services. There are many opportunities which can be unified with agroforestry to ensure livelihood security in rural areas, such as apiculture, sericulture, lac cultivation, bamboo, wax, gum and resins, medicinal and aromatic plants, provides picnic resorts and opportunities for sport like hiking trekking, wild life watching, bird watching and industries development like paper pulp, rayon grade pulp and hard board etc.

***Keywords:*** *Agroforestry, apiculture, plants, ecosystem.*

# Impact of Covid-19 Pandemic on Air Pollution in the Delhi Region, India

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Due to Covid-19 lockdowns, most industries, factories, and so on were entirely shut down, human mobility was restricted, and transportation was extremely limited. Due to these unforeseen activities there were several long term and short term effects on the earth's environment. There were drastic reduction in Air quality parameters i.e. PM2.5, PM10, SO2, CO, CO2 content etc due to lockdowns during the pandemic. In the present study, qualitative and quantitative impact of the lockdown on the regional air quality is studied. The Delhi region has been chosen as the study area because Delhi is capital of India and has the greatest number of air quality meter around the state, so study can be done more precisely due to availability of AQI (Air Quality Index) parameter's data over past few years at various points across the city. The daily AQI data for past years were taken from AQICN website and used for the study. The Inverse Distance Weighted (IDW) and Voronoi Tessellation (VT) method were used to do spatial interpolation of daily AQI over the city. The IDW method enforces the condition that estimated value of a point is more influenced by nearby known points compare to those that are further away. When comparing the Lockdown months of March to June, the monthly average AQI found in 2020 was 34.8 percent lower than in 2019 and 44 percent lower than in 2018. Similarly, the average annual AQI was estimated to be 10.6 percent lower in 2020 when compared to 2019 and 19.6 percent lower when compared to 2018.The result suggested that due to COVID-19 pandemic prevention and control action i.e. lockdown, the air quality of the Delhi region improved significantly. This gives impact of humans and their activities on our environment and this can be used further to make long term action plan to manage overall air quality across the region.

***Keywords:*** *Covid-19 pandemic, AQI, Inverse Distance Weighted, Voronoi Tessellation, India*

# Anti-Nutritional Factors and Micro Nutrient Content of Locally Available Tree Fodders And Shrubs In Southern Kerala

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India ranks first in global livestock production and it is an important subsidiary enterprise that support more than 75 per cent of the rural community. But fodder production is not well practiced in our country and animals generally consume naturally grown grasses and shrubs which are of low quality in terms of protein and available energy. Hence, there is an urgent need to look for new fodder resources that are sustainable in nature and cover our fodder deficit. Keeping the above in view, the present study has been proposed to evaluate anti-nutritional factors and micro nutrient content of locally available tree fodders and shrubs in Southern Kerala. The study was conducted in College of Agriculture, Vellayani, Thiruvananthapuram during January-September, 2020. Ten different fodder trees and shrubs which are locally fed to the cattle Viz., Sesbaniagrandiflora, Erythrinaindica, Moringaoleifera, Cocosnucifera, Glyricidiamaculata, Terminaliaelliptica, Leucaenaleucocephala, Manihotesculenta, Musa acuminata and Mangiferaindica were selected and analysed for micro nutrient content (Fe, Zn, Mn and Cu) and anti-nutritional factors (oxalate and nitrate).The results revealed that mean values of iron, zinc, manganese and copper content were of the range 136.45±18.55, 20.59 ±3.62, 30.16±6.48 and 11.75±0.91 respectively. The study also revealed that, both Sesbaniagrandiflora and Glyricidiamaculata have negligible amount of nitrate. Remaining all tree fodders have nitrate in the range of 2.72±1.02. Whereas oxalate content in all tree leaves ranged from 1.43 to 2.97 per cent, with a mean value of 2.93± 0.16 per cent. Therefore the present study concluded that Banana (Musa acuminata) is nutritionally superior with respect to micro nutrients such as iron, zinc, manganese and copper. But the high content of oxalate may limit its utility as a fodder. Whereas agathi (Sesbaniagrandiflora) can be recommended as the best top feed due to negligible content of anti-nutritional factor, viz., oxalate and nitrates. Nevertheless, all the ten different top feed are very good source of micronutrient and can be used for livestock feeding in scarcity zones of Kerala.

***Key words:*** *Anti nutritional factors, micronutrients, nitrate, oxalate, tree fodder*

# Determination of Suitable Extractant and Risk Assessment of Arsenic in Rice

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A study was conducted to assess the suitability of the extractants for determination of soil available Arsenic (As) and risk assessment by solubility Free Ion Activity Model(FIAM) under rice (variety: Sushk Samrat). Soil in bulk was collected from six locationsvarying in physicochemical properties to conduct the pot experiment using five doses of As 10, 10, 20, 40 and 80 mg $kg^{-1}$. Six extractants namely 0.2(M) $NH_4$-Oxalate, 0.05 (N) HCl+0.025 (N) $H_2SO_4$, 0.5 (M) $KH_2PO_4$, 0.5 (N) $NH_4F$, 0.5 (M) $NaHCO_3$ and 0.5 (M)EDTA were used. The effect of these graded of Arsenic was seen on yield attributing characters and yield of rice like tiller number $pot^{-1}$, SPAD, tiller height, grains $panicle^{-1}$, yield and dry matter weight and was observed that all these agronomical parameters decreased with increasing doses of arsenic. The correlation studies revealed that 0.5 (M) $KH_2PO_4$ gave the best correlation with the soil properties and crop uptake and has an edge over all the extractant used and proved to be the suitable extractant. Regardless of the As dose and the soil type used, in rice tissue As concentration followed the order root > straw > leaf > grain. The predictability of solubility Free ion activity model (FIAM) in terms of Hazard Quotient(HQ) also supported the fact that 94% variation of As content in rice grain can be explained when 0.5 (M) $KH_2PO_4$ is being used as an extractant for determination of soil available As.

***Keywords:*** *Arsenic, extractant, correlation studies, Hazard Quotient, Free Ion Activity Model*

# Impact of Tillage and Crop Establishment Practices on Soil Fertility Under Rice-Wheat Cropping System In An Inceptisol

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The present study was carried out under field conditions during the year 2018-19 and 2019-20 with 6 treatments. CE1-CTR-CTW (RR), CE2-CTR-CTW (RR+RI(MB)), CE3-CT DSR-ZTW (Partial CA; anchored residue of rice),CE4-CT DSR-ZTW (Partial CA; anchored residue of rice+ RI(MB)),CE5-ZT DSR- ZTW (Full CA; anchored residue of rice & wheat,CE6-ZT DSR- ZTW ( Full CA; anchored residue of rice & wheat + RRT (MB).In post-harvest experimental plots, soil samples were collected from each crop season and analysed for macro (N, P & K), micronutrients (Fe, Mn, Zn & Cu) following the recommended procedures. Data recorded in various aspects were statistically analyzed by using the Randomized Block Design (RBD). The pH of the soil in 1st rice and wheat ranged between 8.09 to 8.18 and 8.09 to 8.19, respectively. The lowest pH of the soil was recorded with the treatment of full conservation tillage with residue retention in 1st rice and wheat. The pH of the soil (8.19 Mg m-3) was obtained with CE1 in post-harvest soil of 2nd-year rice and wheat, which was non-significantly higher than the rest of the other tillage and crop establishment treatments. The electrical conductivity was recorded from 0.26 to 0.29 dS m-1 in 1st-year rice whereas 0.27 to 0.29 dS m-1 in 1st-year wheat. The lowest value of electrical conductivity of soil was recorded in the field with the treatment of full conservation tillage. Whereas during the 2nd year, the highest electrical conductivity of soil was obtained with CE1 in post-harvest soil of rice field and In wheat crop, the highest electrical conductivity of soil obtained same value in CE1 to CE3. In rice crop, the highest value of soil organic carbon obtained under the full conservation tillage with residue retention (CE6) and lowest in the convention tillage plot during both the years.Similarly, the soil organic carbon was recorded 0.45 and 0.48% soil under CE6, which was statistically higher than conventional tillage without residue in 1st and 2nd years wheat, respectively. Soil available nitrogen in post-harvest soil of 1st-year rice and wheat ranged between 192.19 to 215.09 and 192.21 to 222.75 kg ha-1, respectively, with the highest value obtained under the full conservation tillage with residue retention (CE6) and lowest in the convention tillage plot (CE1). During the 2nd year, soil available nitrogen in post-harvest soil with full conservation tillage without residue retention treatment (CE6) was recorded significantly higher as compared to conventional tillage without residue (CE1) in rice and wheat crops. The full conservation tillage without residue retention treatment (CE6) recorded significantly higher soil available phosphorus as compared to conventional tillage (with and without residue) and partial conservation tillage without residue in rice. While in wheat crops, it was significantly higher as compared to conventional tillage (with and without residue)during both years. Soil available potassium in post-harvest soil was obtained 191.36 and 192.03 kg ha-1 under full conservation tillage without residue retention treatment (CE6) recorded significantly higher as compared to conventional tillage in 1st-year rice and wheat. Soil available potassium in post-harvest soil of second-year rice and wheat was observed 192.25 and 192.85 kg ha-1, respectively, with the highest value obtained under the full conservation tillage with residue retention.

# Influence of Tillage on Peanut Growth, Yield and Resource Use Efficiency In Arid Soils of Rajasthan

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Arid regions of Rajasthan province of India have very low productivity and due to hungry and thirsty soil.Crop yield is further affected by continuous and inappropriate tillagepractices. This posing a serious threat to the sustainability of peanut cultivation in these degraded soils of arid region.Tillage, undoubtedly, is one of the most crucial practices to ameliorate crop productivity and also maintain soil health. The growing concern for food security through improved soil management techniques demands identification of an environmental friendly and crop yield sustainable system of tillage.A two year study was piloted to explore the efficient tillage practices and their influence on crop and water productivity and nutrient uptake in peanut. The experiment was planned with three tillage practices in main plots and six fertilizer management options in sub plots, and replicated four times. Deep tillage (DT) (25 cm) contributed significantly higher pod (2.98 Mg ha$^{-1}$),kernel (2.16Mg ha$^{-1}$),protein (0.24 Mg ha$^{-1}$), and oil (0.91 Mg ha$^{-1}$) yield which were respectively 13, 26, 26 and 28% higher over the minimum tillage (MT). DT also recorded higher water productivity and crop profitability by 12.2 and 13.3% compared to MT.MT recorded the high energy use efficiency (EUE) by 10.2% and energy profitability (EP) by 12.5% compared to DT, respectively. Among nutrient management options to peanut: (20kg N +32 kg P+ 15 kg K ha$^{-1}$) (RDF) along with seed inoculation with arbuscular mycorrhizal fungi (AMF) and phosphorus solubilizing bacteria (PSB) recorded significantly higher pod (3.50 Mg ha$^{-1}$), kernel (2.59 Mg ha$^{-1}$), protein (0.29 Mg ha$^{-1}$), and oil (1.11 Mg ha$^{-1}$) yields compared to RDF without seed inoculation (respectively, 2.86, 2.12, 0.24 and 0.89 Mg ha$^{-1}$). Also recorded the maximum water productivity (8.27 kg ha$^{-1}$), EUE (10.89 MJ ha$^{-1}$), and EP (0.18 kg MJ$^{-1}$) over rest nutrient management practices. Thus, deep tillage along with RDF + PSB + AMF (2 kg ha$^{-1}$) enhanced peanut pod, kernel, protein and oil yields as well as peanut water productivity under arid region of Rajasthan. The conventional tillage (CT) practices resulted in losses of soil, water and nutrients in the field, and degraded the soil with low organic matter content and a fragile physical structure, which in turn led to low crop yields and low water and fertilizer use efficiency. Tillage impact on crop yield is related to its effects on root growth, water and nutrient use efficiencies and ultimately the agronomic yield. It is therefore essential to select a tillage practice that sustains the soil physical properties required for successful growth of agricultural crops. CT is particularly important in arid and semi-arid zones, where water is the limiting factor for crop development and thus correct management of crop residues is essential to achieve sustainable yield.

***Keywords:*** *Peanut, Tillage, Pod yield, Quality, Energy use*

# Climate-Smart Agriculture: Ensuring Food Security Amidst Climate Change

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With the ever increasing population and feeding mouths, Food and Agriculture Organization (FAO) estimates that by 2050, 60 percent of the agricultural production will have to be increased to meet the expected demands. With the evidently alarming climate change these days globally things are getting more complicated due to its adverse effects on agriculture directly. Therefore, concerning food and nutrition security while addressing the climate change impacts, simultaneously preserving our natural resources needs just a different approach, keeping the natural way of farming in view, that can guide us through to make the necessary changes in our current agricultural systems and hence, Climate-smart agriculture (CSA) comes into play. CSA integrates economic, social and environmental developments altogether in a sustainable manner. Sustainable increase in agricultural productivity and incomes, adaption and building resilience to climate change and reduction of greenhouse gas (GHG) emissions are the three pillars of CSA that can address us at this hour of distress and do full justice to mankind in securing a sustainable future for the planet.

***Keywords****: Climate-smart agriculture (CSA), productivity, incomes, resilience, climate change,greenhouse gases (GHGs)*

# Phosphorus Management Strategies In Low Ph Soils of Karnataka

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Deficiency of phosphorus is severe and widespread in southern Karnataka. Nearly half of the soils in the region belong to acid soils and laterite and lateritic soils. The soils, formed under humid tropical conditions, are intensively weathered and exhibit low base saturation values. Thus, the soils are moderate to extremely acidic in nature. In such low pH soils, activities of both Fe and Al remain high due to increased solubility of sesquioxides. Hence, the phosphorus use efficiency is likely to be less and it ranged from 60 per cent in agricultural systems to as low as 10 per cent in some perennial horticultural crops. Direct application of rock phosphate and its indirect use through P-enriched composts increased crop yields by 20 to 45 per cent among agricultural crops *viz.*, paddy, finger millet, cowpea, blackgram etc. Reclamation of acid soils also recorded higher crop yields by reducing P-fixation. Application of lime at 45 % BSP was found much superior over other lime requirement methods. Direct use of rock phosphate is recommended for perennial plantation crops *viz.* coffee, tea and areca in acid soils over conventional fertilizers. In areca gardens of hilly and coastal zones (Zone 9 and 10), use of P-enriched compost is in practice. Band application of P-fertilizers and use of microbial consortia are some other recommended P-management strategies. Recent studies suggest that application of Na or Ca silicates will also enhance P-availability in acid soils. Increase in crop yields could be attributed to higher phosphorus availability in treated plots compared to respective controls. Thus, phosphorus management plays an important role in low pH soils to achieve higher yields by enhancing P-use efficiency.

# THEME - IV

## *Ecological Pest Management in the Context of Increasing emphasis on Natural Farming*

# Title: Eco-Friendly Management of Invasive Pest, Rugose Spiralling Whitefly With Isaria Fumosorosea And Encarsia Guadeloupae

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Control of *rugose spiralling* whitefly, *Aleurodicus rugioperculatus (Hemiptera: Aleyrodidae)* with biological agents like *entomopathogenic fungi, Isaria fumosorosea* (NBAIR- Pfu 5) spraying with the introduction of exotic natural enemy, *Encarsia guadeloupae* parasite. Field evaluation of *Isaria fumosorosea (*NBAIR- Pfu-5) @ 2 x $10^8$ spores/ ml (5 g/litre of water) two sprayings at one month interval was found effective in reducing rugose spiraling whitefly intensity by 58.1 to 97.03 % in coconut orchards during 2018-19. Noticed the establishment of Isaria fungus on whitefly population showing mycelial growth on eggs, nymphs and mummified adults. Similar results observed in 2019-20, I. fumosorosea two sprays at 15day interval with release of exotic natural enemy, E. guadeloupae parasite for augmentation after first spraying of Isaria fungus effectively controlled rugose spiralling whitefly intensity by 71.01 to 75.5%. Interestingly, well establishment of parasitoid, E. guadeloupae was observed in coconut plantation with banana as intercrop which was inoculated after first spraying of Isaria fungus. The population of rugose spiralling whitefly in coconut orchards was reduced significantly with two sprays of I. fumosorosea (NBAIR- Pfu5) with one inoculative release of parasite, E. guadelouape. Coconut farmers lead to the establishment of model biological control system for the farmer level production of I. fumosorosea with the efforts of AICRP on Biological Control, ANGRAU centre and ICAR-NBAIR, Bangalore.

***Keywords:*** *rugose spiraling whitefly, Isaria fumosorosea, Encarsia guadeloupae, coconut*

# Bio -Intensive Approaches Against Major Insect Pests in Aromatic Rice

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The aromatic rice of Assam is a unique Sali rice variety traditionally known as 'Joha' which is known for its aroma, superfine kernel, good cooking qualities and excellent palatability and has a tremendous scope as a cash crop for earning foreign exchequer. In Assam, rice fields are mainly monoculture and the lack of ecological diversity could be the major cause of pest occurrence, because the food, hosts, prey and overwintering sites of most of the natural enemies of the pests are reduced, thereby limiting natural biological control. Excessive and irrational use of pesticides has become a major obstacle to sustainability and threatens environment and human health. As an alternative to chemical control, bio-intensive approaches have been gained momentum in managing the rice insect pests in recent years which help in bio-ecological conservation. The field experiment was laid out in the rice field of Regional Agricultural Research Station, Assam Agricultural University, Titabar, Assam taking the variety Keteki Joha, which is a prominent aromatic rice variety in Assam. Seeds were sown after treatment by soaking the seeds in a solution of Pseudomonas florescense prepared @10g/litres of water per kg of seed for 12 hours. The thirty days old seedlings were transplanted into the main field in two blocks, Biointensive pest management (BIPM) and Farmers' practices (FP) block. The seedlings were transplanted in BIPM block after root dipping in a solution containing Azospirillum and Phosphate solubilising bacteria (PSB) @10g /litre of water. Vermicompost @2.5 tonnes and 300 kg mustard oil cake per hectare half as basal and half as top dress at active tillering stage were applied in BIPM block of the main field. Mass trapping of stem borer by placing pheromone traps @20 Nos/ha was retained throughout the crop season by replacing 3-4 times @5mg lure at 20 days interval. The tricho cards of Trichogramma japonicum card and T. chilonis @5cc egg/ha were placed six times weekly from first week after transplanting. The arahar plant and marigold were planted in the rice bunds of BIPM plot to attract natural enemies and pollinating agents. Neemazal 1% EC was applied when the insect pests attained economic injury level. The pest incidence was significantly lower in BIPM plots compared with FP block. The silver shoot (4.3%) and dead hearts (3.2%) were significantly lower in BIPM plots as compared to FP plots (15.33% silver shoot and 16.56% dead heart respectively).The per cent leaves damaged by whorl maggot (4.75% and leaf folder (4.76%) were also significantly lower in BIPM than that of FP plots (16.43 and 16.75% respectively. Higher yield (4.4t/ha) was recorded in BIPM than FP block (3.2 t/ha) and there was also 20 % increase in straw yield. The population of natural enemies was significantly higher in BIPM block as compared that of farmers' practices.

***Key words:*** *Aromatic rice, Bio-intensive pest management, Farmers' practice, dead heart.*

# Field Evaluation of Pongamia Oil Soap on Whiteflies, *Bemisia Tabaci* of Eggplant at Kasargod, Kerala

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The whiteflies, *Bemisia tabaci* is one of the major pests of vegetable crops causing considerable damage to vegetable growers. As conventional control method are results in resistance, pollution, health hazards of farm workers, undesirable effects on non-target organisms and contamination of products, pongamia oil soap was applied on eggplants to test its efficacy against whiteflies at 4 concentrations. The number of nymphs and adults from five leaves (one top, two middle and two lower) from five tagged plants were counted to calculate the average population density of whiteflies. Observations were recorded one day before, 1, 3, 5, 7 and 14 days after imposing the treatments. After a day of spray application, minimum population of whiteflies recorded in pongamia oil soap @ 3 per cent (0.80 whiteflies/ 3 leaves) which was statistically on par with pongamia oil soap @ 2 per cent (0.93 whiteflies/ 3 leaves) and 1 per cent (1.20 whiteflies/ 3 leaves). Pongamia oil soap @ 0.6 per cent (1.60 whiteflies/ 3 leaves) and neem oil soap 0.6 per cent (1.67 whiteflies/ 3 leaves) gave statistically similar population density of whiteflies followed by chlorantraniliprole 18.5 SC (standard check) (3.60 whiteflies/ 3 leaves). Observations of third day, fifth day and seventh day after spray revealed that pongamia oil soap @ 3% was significantly superior over others. On fourteen day of spray, pongamia oil soap @ 3%, neem oil soap @ 0.6%, pongamia oil soap @ 2%, 1% and 0.6% were on par with each other with 1.47, 2.27, 2.93, 3.53 and 3.73 whiteflies/ 3 leaves respectively. Control plot recorded maximum population of 7.40 whiteflies/ 3 leaves followed by soap solution and chlorantraniliprole with 7.33 and 7.27 whiteflies/ 3 leaves respectively. Hence, soap formulation of pongamia oil was found to lower the whitefly infestation on brinjal and its long term effects and safety also desired.

***Key words:*** *pongamia oil soap, biopesticides, Bemisia tabaci, IPM tool, brinjal pest*

# Field Evaluation of Biopesticides Against Rugose Spiraling Whitefly *(Aleurodicus Rugioperculatus)* in Oilpalm Crop

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*A. rugioperculatus* (RSW) was observed in several coconut farms in the Pollachi area of Coimbatore district, Tamil Nadu and first reported in Kottayam from Kerala during July –August 2016 (Sundararaj and Selvaraj, 2017). Where as in Andhra Pradesh this pest has been recorded from Kadiyapulanka nurseries in Coastal Andhra Pradesh during October-November, 2016 (Chalapati rao *et al*., 2018), now it has spread to all parts of the state, signaling a serious threat to guava, coconut, oil palm and various ornamental crops. Farmers and traders are being worried about the current status of the RSW in South India and its management. Since the emphasis is shifting towards the development of eco-friendly techniques for managing insect pests at the farmer level, there is a need to establish eco-friendly control strategies. Incase of field evalution of different biopesticides; population counts(no/leaf) were taken at different intervals *i.e.,* 24 hrs before treatment application, 24 hrs after, 3 days after, 5 days after, 10 days and 15days after treatment application respectively (Boopati *et al.,* 2015). Among the biopesticide evolution 7 treatments were tested against nymphs and adults, *Isaria fumosorosea* ($2X10^9$ conidia/ml) @5ml/lit with 92 percent pest population reduction was significantly superior over other treatments followed by *Lecanicillium lecani* ($2X10^9$ conidia/ml) @5ml/lit with 79 per cent pest population reduction at 15 days after application.

***Key words:*** *A. rugioperculatus, biopesticides, Isaria fumosorosea.*

# Diversity And Phylogenetic Analysis of Endosymbionts Associated With *Bemisia Tabaci* Species Complex

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The whitefly, *Bemisia tabaci* (Gennadius, 1889) (Hemiptera, Aleyrodoidea) is a cryptic species complex composed of 46 cryptic species. They cause damage to several crops by means of direct feeding, secretion of honeydew, inducing phytotoxic disorders, and by transmission of more than 300 plant viruses. Similar to other sap sucking insects, *B. tabaci*, feeds on the phloem sap of plants enriched in carbohydrates, but deficit in essential amino acids. These lacking nutrients are supplied by the group of bacteria residing in them. In addition to the supply of nutrients, these bacterial endosymbionts exhibit wide range of effects on their hosts, like increased resistance to parasites, high thermal tolerance, ability to transmit virus and contribution towards sexual selection of insect hosts. By means of molecular analysis of GroEL and 16S/23S rRNA genes from B. tabaci populations, two types of endosymbionts are identified. Primary (P) endosymbiotic bacterium, *Candidatus Portiera* aleyrodidarum, is present in all *B. tabaci* populations and supplies essential nutrients to them. Seven secondary (S) endosymbionts like Rickettsia, Wolbachia, Hamiltonella, Arsenophonus, Cardinium, Fritschea, and Hemipteriphilus are also identified. Phylogenetic analysis based on 16S rRNA and gltA genes discovered the seventh endosymbiont "*Candidatus Hemipteriphilus asiaticus*" which is closely associated with *Candidatus Portiera aleyrodidarum*. Increased availability of sequence data for *Bemisia tabaci* species complex and its bacterial endosymbionts is important for developing sustainable pest management strategies which are based on the global diversity of pest and its bacterial endosymbionts.

***Keywords:*** *Bemisia tabaci,* endosymbionts, 16S/23S rRNA genes

# Susceptibility of The Fall Armyworm, *Spodoptera Frugiperda* to Entomopathogenic Nematodes

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The fall armyworm, *Spodoptera frugiperda*, is the serious pest of maize crop. This highly invasive pest species originated in the Central and South America and has recently spread fast to over 100 nations around the world including India. Because of its quick spread and unique capacity to cause significant damage across numerous crops, it poses a major danger to food security in a number of poor countries. In many regions of the world, chemical insecticides constitute the primary management technique for controlling fall armyworm, particularly in newly invaded areas of Africa and Asia. Concerns about the negative impacts on the environment and humans, as well as the emergence of insecticide resistance, have driven efforts to create alternatives that are both effective and low-risk, as well as cost-efficient. Given that entomopathogenic nematodes are usually regarded as desirable biocontrol agent, they are being studied at all stages of development, with a particular focus on their efficacy against fall armyworm. Our research adds to the body of knowledge about EPNs that can be used in the field to combat the fall armyworm.

***Key words:*** *Spodoptera frugiperda, entomopathogenic nematodes, biocontrol agent*

# Efficacy Of Eco-Friendly Pesticides Against two Spotted Spider Mite, *Tetranychus Urticae* Koch on Carnation

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Of the more than 1,200 species of spider mites described, two-spotted spider mite (TSSM) Tetranychus urticae Koch (Acari: Tetranychidae) is the most economically important phytophagous mite pest in the world. T. urticae infestation in carnation grown under polyhouse resulted in yellowing and bronzing of leaves, stunted growth and reduction in yield and quality of marketable flowers. Indiscriminate use of pesticides has led to development of resistance of T. urticae to acaricides, affected human health, destroyed natural enemies and caused environmental pollution. To avoid long term adverse effects of these chemicals, the determination of safer and more cost effective and eco-friendly alternative approaches for the management of this pest is desirable. One of the best available options to be exploited is the use of eco-friendly pesticides viz., botanicals and acaropathogenic fungi. In this context, an experiment was laid out to evaluate the efficacy of eco-friendly pesticides against T. urticae on carnation under protected cultivation at Kothagiri. The treatments include viz., $T_1$-azadirachtin 10000 ppm @ 2ml/lit, $T_2$-Beauveria bassiana formulation 3ml/lit, $T_3$-Hirsutella thompsonii formulation 3ml/lit, $T_4$-fenazaquin 10 EC @ 1.5 ml/ lit, $T_5$ -propargite 57 EC @ 2 ml/lit, $T_6$ .azadirachtin 10000 ppm @ 2ml/lit + fenazaquin 10 EC @ 1.5 ml/ lit, $T_7$-azadirachtin 10000 ppm @ 2ml/lit + propargite 57 EC @ 2 ml/lit and $T_8$ untreated check. Two rounds of spray applications were given at fortnightly interval. The experiment was conducted in RBD with three replications. The population of eggs, nymphs and adults of mites were assessed in the top, middle and bottom leaves of ten randomly selected plants at 0, 3, 7, 10 and 14 days interval after each spraying. Flower yield was recorded at each plucking. Cumulative mean of first and second spray revealed that, least mite population of 11.05 nos/ leaf in plots treated with propargite @ 2ml/lit with 65.40 per cent reduction followed by fenazaquin @ 1.5ml/lit treated plots (11.54 nos/leaf) with 63.91 per cent reduction in mite population over control. However, spraying of biopesticide, azadirachtin 10000 ppm @ 2ml/lit twice at 15 days interval resulted in 54.29 per cent reduction in mite population followed by acaropathogenic fungi, B. bassiana @ 3ml/lit (39.46 %) and H. thompsonii @ 3ml/lit (36.92 %). Carnation flower yield was the highest in propargite 57 EC @ 2ml/lit. (92333 no. of flowers/ 0.5 ac) followed by fenazaquin 10 EC @ 1.5ml/lit. (92166 no. of flowers/ 0.5 ac) and azadirachtin 10000ppm plus acaricide, the benefit cost ratio was also found to be high in the above said treatments.

***Key Words:*** *Two spotted spider mite, carnation, eco-friendly pesticides, protected cultivation*

# Seasonal Fluctuations In The Population of Phytonematodes Associated With Kinnow In Haryana

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The study on the seasonal fluctuation of Phytonematodes is essential for developing effective management strategies. In the present study, seasonal fluctuations of plant-parasitic nematodes (PPNs) were recorded in Kinnow orchards during the year 2020-21. Populations were in November (2020), March (2021) and July (2021), at four different locations selected in Hisar district *viz.*, Arya nagar, Nangthala, Malapur and at CCSHAU Hisar, research farm. Soil samples were drawn at 15-30 cm depth around the tree with help the of auger and processed with Cobb's sieving and decanting technique. At Arya Nagar and Malapur two genera *Tylenchulus semipenetrans* and *Hoplolaimus indicus* were present. Highest population of *T. semipenetrans* (2676 $J_2$ /200 cc soil) and *H. indicus* (265 $J_2$ /200 cc soil) at Arya Nagar was in November while lowest was in July, 1485 $J_2$ /200 cc soil and 112 $J_2$ /200 cc soil, respectively. At CCSHAU, Hisar was selected; at this location orchard was infested *T. semipenetrans* and *Helicotylenchus* spp. The population density of *T. semipenetrans* was more as compared to *Helicotylenchus* spp. and population of both genera was highest in November (2877 $J_2$ /200 cc soil and 603 $J_2$ /200 cc soil, respectively) and lowest in July. At Nangthala, two genera, *T. semipenetrans* and *Pratylecnhus* spp. were found associated with this orchard. Maximum population of *T. semipenetrans* (492 $J_2$ /200 cc soil) and *Pratylecnhus* spp. (2028 $J_2$ /200 cc soil) was recorded in November followed by March and July. At Arya nagar and Hisar, *H. indicus* and at Malapur and Nangthala *Pratylenchus* spp. were the other major PPN along with citrus nematode.

***Keywords:*** *Phytonematodes, Population density, Tylenchulus semipenetrans, Hoplolaimus indicus and Pratylecnhus spp.*

# Harnessing Root Endophytes From Wild Banana Germplasms Against Fusarium Wilt of Malbhog Banana

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Malbhog banana, native to Assam and growers' most preferred variety suffers serious loss due to Fusarium wilt caused by *Fusarium oxysporum* fsp. *cubense* (*Foc*). Some of the wild germplasms with luxuriant growth exhibit resistance or tolerance against the pathogen and it is hypothesized that besides the genetic make up for resistance, these germplasms may have coevolved with some beneficial microbes and harbor them as endophytes which subsequently contributes in disease suppression. In this study we explored wild banana germplasms as a probable source of aggressive endophytes. A total of 21 endophytes were recovered with distinct morphology and subjected to preliminary screening against Foc *in vito*. Three (3) bacterial and one (1) fungal isolate showing more than 50% inhibition of Foc were carried forward for further identification and screening for antagonism and PGP activity. Morpho-cultural, biochemical and molecular characterization revealed identity of endophytes as *Enterobacter* sp., *Bacillus amyloliquefaciens, B. vallismortis* and *Trichoderma harzianum*. *In vitro* evaluation of endophytes showed maximum inihibition by *B. vallismortis* (79.8%) followed by *B. amyloliquefaciens* (75.6%), *Enterobacter* sp. (61.0%) and *Trichoderma harzianum* (57.3%). Endophytes also showed positive results for Ammonia, HCN and Siderophore production confirming their role in suppressing pathogens as well as growth promoting ability. *In planta* evaluation of endophytes for their PGP activity demonstrated all the four endophytes as PGPMs with enhanced growth in terms of plant height, leaf diameter, girth and no. of new root emergence. Our study amply demonstrates the prospects of these root endophytes as a potential solution to Foc in malbhog plantations in Assam as well as growth promoter.

***Keywords:*** *Bacillus spp, Fusarium wilt, malbhog banana, PGP activity, root endophytes*

# Comparative Study of Weed Management on Growth And Yield of Summer Groundnut (Arachis Hypogaea L.)

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The field experiment entitled **"effect of weed management on growth attributes and yield of summer groundnut (*Arachis hypogaea* L.)"** was conducted during summer season of 2018 & 2019 at farmers field, village Retikhurd and Chandauli, district Raebareli. The soil was sandy loam in texture and slightly alkaline in reaction with pH 8.1 and EC 0.37 dS $m^{-1}$. The soil was low in available nitrogen (234.0 kg $ha^{-1}$), medium in available phosphorus (21.6 kg $ha^{-1}$) and high in potassium (284.0 kg $ha^{-1}$). Total three treatment combinations *viz.*, weedy check ($T_1$ ), hand weeding twice at 20 and 45 DAS ($T_2$) and Quizalofop-*p*-ethyl @ 0.04 kg $ha^{-1}$ as POE at 20 DAS + 1 HW at 45 DAS were tested in randomized block design (RBD) with three repetitions. The crop was sown in 30cm × 10 cm spacing with seed rate of 120 kg/ha. The variety ICGV – 93468 (Avtar) was sown on 18$^{th}$ February and recommended dose of fertilizer was 25-50-50 N-P-K kg $ha^{-1}$ and all other recommended practices were adopted according to as per need of crop requirement. It was observed from two years experiment that highest pod yield 22.40 q/ha was obtained from hand weeding twice at 20 and 45 DAS ($T_2$) which is followed by treatment ($T_3$) Quizalofop-*p*-ethyl @ 0.04 kg $ha^{-1}$ as POE at 20 DAS + 1 HW at 45 DAS ie. 21.60q/ha whereas lowest yield was obtained from weedy check ($T_3$) that is 9.30q/ha. Based on the results of two year experimentation, it seems quite logical to conclude that potential production, profit and effective weed management in summer groundnut can be achieved by conventional methods *i.e.* weed free condition where farm labours are easily available. Alternatively integrated weed management method including quizalofop-*p*-ethyl @ 0.04 kg $ha^{-1}$ as post emergence at 20 DAS + 1 HW at 45 DAS.

***Keywords:*** *Herbicide, groundnut, growth and yield*

# Soil Physico-Chemical Properties And Nutrient Balance as Influenced by Integrated Weed and Nutrient Management in Transitional Plain Zone of Luni Basin of Rajasthan (India)

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An experiment was conducted during *kharif* 2019 to 2020 at Instructional Farm, College of Agriculture, Sumerpur (Rajasthan) to study the impact of integrated methods of weed management and organic nutrient sources on soil physical properties and balance sheet after maize harvest (*Zea mays* L.). The experiment comprises 06 weed management and 05 nutrient management practices in split-plot design with three replications. The treatments stale seedbed + hoeing once at 20 DAS + application of 5 t $ha^{-1}$ of straw mulch at 30 DAS and weed free check maintained up to 60 DAS of maize however found significantly effective in increasing the crop productivity but improved the above properties non significantly over rest of treatments. The soil physico-chemical properties *viz*., pH & EC and available nutrients *viz*., N, P, K, Zn and Fe in soil did not influence significantly by various weed management treatments after harvest of maize except organic carbon content. The nutrient balance was negative but minimum was in weed free check and stale seedbed + hoeing at 20 DAS + straw mulch at 30 DAS. Among the organic nutrient management treatments, 75% RDN through vemicompost in two split + seed treatment with *beejamurt* + two sprays of *jeevamurt* did not affect the soil physio-chemical properties *viz*., pH & EC and available nutrients (Fe and Zn) in soil after harvest of maize was remained unaffected while the available NPK and organic carbon of soil was influenced significantly during the study period. The treatment 100% RDN through FYM gave the mean maximum values of these parameters while the lowest was recorded in treatment 75% RDN through vermicompost + seed treatment with *beejamurt* + two sprays of *jeevamurt* (at 500 l $ha^{-1}$ at sowing and 30 DAS). The balance sheet indicated that minimum net loss of nitrogen was in 100% RDN through vermicompost while phosphorus and potassium was recorded in 100% RDN through FYM at the end of the experiment. The mean available nitrogen, phosphorus and organic carbon in the soil were also significantly increased in this treatment. The balance sheet indicated that minimum net loss of nitrogen, phosphorus and potassium was recorded in treatment 75% RDN through vermicompost + seed treatment with *beejamurt* + two sprays of *jeevamurt*.

# Cut In Genome For Biotic Stress Management In Crops: Crispr/Cas9

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In current scenario, agriculture is challenged by numerous biotic stresses due to climate change and emerging races of pathogens. Though, management measures includes both natural and chemical methods, farmers mainly resort to chemical measures which is deleterious to mankind and environment. At this point, developing resistant varieties for biotic stresses could be a viable solution. Cross breeding, mutation breeding and transgenics are the main methods utilised, of which mutation breeding and hybridization create random variability. The new genome editing method CRISPR/Cas9 has potential to edit specific genes in contrast to random mutation. It can be used in plant system by providing guide RNA complementary to our desired gene, so that it can cleave the desired gene in plant genome and disrupt the gene by making Indels (when repaired by NHEJ) or can introduce novel gene (when repaired by HDR). The most common approach for disease resistance is knocking down the susceptibility gene which is required for pathogen colonization. Moreover, it is also possible to edit specific base in DNA using different variants of Cas protein. There are several reports of developing disease resistance in plants to bacteria, fungus and viruses using various targets such as promoter of susceptibility or defence genes, transcription factors, mutation in coding sequence of defence factors by HDR and introducing R genes etc. There is not much reports of developing insect resistance plants using gene editing except one report in rice providing resistance towards BPH. But strategies such as modifying the volatile blends, pigmentation and susceptibility genes is emerging and reliable for developing resistance towards insect pests. It is also proposed to use wild relatives in this concern by *de novo* domestication using multiplex editing of agronomic traits or by utilizing knowledge of molecular mechanism of resistance in wild relatives and editing the genes in cultivated crops. Genome editing by CRISPR/Cas will become increasingly indispensable to develop in relatively short time beneficial resistance traits in crops to meet upcoming challenges and will support the natural farming by reducing the use of chemicals in crop management.

***Keywords:*** *CRISPR/Cas9, Genome editing, Biotic stress, Insect resistance, Natural farming*

# Applications of Acoustics In Insect Pest Management

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Acoustic technology has been applied for many years in studies of insect communication and in the monitoring of calling insect population levels, geographic distributions and species diversity, as well as in the detection of cryptic insects in soil, wood, container crops and stored products. Acoustic devices of various sizes and power levels have been used successfully to trap insect pests that exhibit phonotaxis or other orientation behaviours, including mosquitoes, midges, mole crickets, field crickets, moths, cockroaches and Tephritid fruit flies. The attractiveness of traps depends on the behaviour, physiological state and age of the target insect and varies with several environmental factors, including temperature and light level. Widespread adoption of acoustics for trapping has been limited by the costs of instrumentation and the relatively small segments of insect populations (*e.g.* mate-seeking adults of a limited age-range) that are attracted to a sound source, but trapping effectiveness often can be improved by adding swarm markers, chemical attractants or black lights and by precisely timing temporal and frequency patterns to match the natural communication signals. There remains potential for using ultrasonic bat-cry signals to disrupt behaviour of night-flying insects, but ultrasonic signals have little effect on insects that are not normally preyed upon by bats. Potential areas for growth in the use of acoustic technology in pest management include the production of signals that disrupt vibrational communication, particularly in the Hemiptera and the development of control treatments that combine pheromones and precisely patterned sonic or vibrational signals.

***Key words:*** *Acoustics, Phonotaxis, Swarm markers, Bat-cry signals, Vibrational communication.*

# Identification of effective native isolates of *trichoderma* spp. For use as biopesticide and biofertilizer

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With the raising concern towards natural farming, sustainable agriculture and healthy life, we have made an attempt to identify effective isolates of *Trichoderma* from local sources for the effective control of plant diseases. Totally five native isolates of *Trichoderma spp.* identified as effective ones in dual culture technique and characterized as *T. harzianum (GMV and PSV), T. viride (SMV), T. asperellum (CPV) and T. longibrachiatum (SDKd)* were used to evaluate compatibility against different fungicides *viz.*, dimethomorph 50% WP, azoxystrobin 23% SC, copper oxy chloride 50% WP, Hexaconazole 4% EC, Tebuconazole 25% EC, mancozeb 75% WP, Thiophanate methyl 70% WP, carbendazim 50% WP, Carbendazim 12% + mancozeb 63% and metalaxyl 4%+ mancozeb 64% WP and insecticides viz., thiamethoxam 25% WG, Chlorpyrifos 50% EC and Imidacloprid 20% SC were tested at 50, 100, 200, 400, 600, 1000 and 1500ppm using poisoned food technique in-vitro along with commercial *Trichoderma isolate (T. viride)* as standard check during 2019-20. Same isolates were also used to study nutrient uptake and growth promotion in tomato plants using different treatments methods using pot culture method under green-house condition. Among different isolates, PSV *(T. harzianum)* was found to be effective one which showed compatibility with maximum number of fungicides. The isolate showed least mycelial inhibition of 9.44% in case of dimethomorph 50% WP, 38.66% and 35.63% mycelial inhibition with respect to mancozeb 75% WP and copper oxy chloride 50% WP, respectively at 1500ppm. The isolate showed moderate compatibility with metalaxyl 4%+ mancozeb 64% WP (50.12% mycelial inhibition) and moderate incompatibility in case of Tebuconazole 25% EC and azoxystrobin 23% SC (63.33 and 78.32% inhibition, respectively), whereas, Hexaconazole 4% EC, carbendazim 50% WP and Carbendazim 12% + mancozeb 63% WP showed high incompatibility with 100% mycelial inhibition. Among different insecticides, the isolate PSV recorded least mycelial inhibition in case of chlorpyrifos 50% EC (10.44%) followed by thiamethoxam 25% WG (20.35%) and Imidachloprid 20% SC (51.46%) at 1500ppm which was significantly superior over other native isolates and commercial check. With respect to nutrient uptake and growth promotion, the combination of seed treatment (5g/kg seeds) and soil application (30g/kg soil) was the effective one than individual treatments and among different isolates, PSV isolate was significantly superior over other isolates, showed increase in uptake of maximum number of tested nutrients (N, P, K, Ca, Mg, Zn, Cu and Fe) and promoted most of the growth parameters tested (germination percentage, plant height, number of branches, plant fresh and dry weight, root length, root fresh and dry weight and fruit yield). So, it was clear from the study that local isolate *T. harzianum (PSV)* was the effective one which can promote plant growth and can be used in integrated disease management approaches, which has to be further confirmed through filed trials

# Productivity Assessment of Intercrops Under Agroforestry System

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The growing demand for food, fuel and fodder due to burgeoning human and animal population and shrinkage of available land resources necessitate to increase the production per unit area. Therefore, it is not appropriate to depend completely on traditional agriculture which is uncertain and extremely risky but to develop alternate land use system such as 'agroforestry' which is more sustainable and stabilize the income, besides simultaneously helps in food security and to protect the environment. A field experiment was carried out to evaluate the performance of the intercrops under Melia dubia during kharif, 2018 at agroforestry block, College of agriculture, Rajendranagar, Hyderabad. . The yield among the two clones of Melia dubia has shown decreased over the sole crop. Between the two clones (MTP-I, MTP-II) clone II has recorded significantly higher yield. The results of the present study indicated that between the two clones MTP-II superior over the MTP-I and among the intercrops foxtail millet has shown less decrease in the percentage over the sole crop compared to other intercrop combinations.

***Keywords:*** *Intercrops, grain yield, stover yield, harvest index*

# Incidence of Leaf Webber on Different Rejuvenated Mango Cultivars

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The influence of ecological factors viz., biotic (Host plant) and abiotic factors (weather parameters) on the abundance and population fluctuation of leaf webber, Orthaga exvinacea (Hamp.) on mango cultivars Amrapali, Mallika, Himsagar, Fazli and Langra was studied under Sub-Himalyan Terai region of West Bengal during 2019-20 and 2020-21. The results indicated that the most active period of mango leaf webber in both the years was found during September to December. Peak incidence of leaf webber was observed during first fortnight of November. Cultivar Himsagar (4.75 webs/tree) showed less infestation, while Amrapali (11.38 webs/tree) showed severe infestation and other cultivars viz., Langra (10 webs/tree), Fazli (5.88 webs/tree), Mallika (5.75 webs/tree) showed moderate infestation. The differences were statistically significant with different weather parameters like temperature, humidity and rainfall. Correlation results indicated that the maximum leaf webber incidence was negatively correlated with minimum temperature in cv. Himsagar (r = - 0.944 **) followed by Mallika (r = -0.942**) respectively. Whereas, no strong correlation was found with the weather parameters for mango cvs. Amrapali, Fazli and Langra under this study.

***Key Words:*** *Mango, Leaf webber, weather parameter, incidence, Correlation*

# Management of Sucking Insect Pests on Summer Groundnut

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Groundnut (*Arachis hypogaea* L.) is leading oilseed crop in India as well as tropical and subtropical regions of the world. One of the key limiting factor responsible for lower productivity of groundnut is insect pests. More than 50 insects reported to attack the groundnut crop irrespective of the season, among them, sucking insect pests will threaten the summer groundnut in Karnataka. Incidence of leafhoppers and thrips will starts right from vegetative stage to till the harvest of the crop. Feeding injury by leafhoppers causes yellowing of foliage leading 'V-shape' marking, known as hopper burn, stunting. Whereas, thrips known to transmit Peanut bud necrosis disease (PBND). In order to manage sucking insect pests, chemical insecticides are the most effective weapons. However, some insecticides are expensive, toxic and when used extensively, may be harmful to human health and the environment. Thus, there is a need to design alternate pest management options that have limited adverse effects on the environment and are effective against target insect pests. One such option is the seed treatment with systemic insecticides, which is an alternative, easy, economic and feasible method to manage insect pests during early stage of the crop growth without causing any harmful effect on natural enemies. It protects early stage insect pests and is an eco-friendly technique to bio-control agents like coccinellids and chrysopids under field condition. Seed treatment with systemic insecticide is an integral part of integrated pest management practices, which is comparatively less pollutant to the environment, cost effective, selective and reported to maintain natural equilibrium. At present, there is a great demand for safer and more selective insecticides that spare natural enemies and non-target organisms more selective than conventional insecticides. So, keeping this in a view, tested the effectiveness of some economically viable, environmentally safe, novel, seed dressing chemicals to these insect pests in integrated pest management programme of groundnut. An experiment was carried out to study the efficacy of insecticides against major sucking insect pests of groundnut viz., thrips and leafhoppers under field conditions at Main Agricultural Research Station, Dharwad, Karnataka during summer 2021. Eleven different treatments including control were evaluated. Four seed treatment chemicals alone and along with foliar spray of acetamiprid were evaluated for their efficacy against thrips and leafhoppers on groundnut. The observations were recorded at 15 DAG, 25 DAG, 35 DAG, 45 DAG and 55 DAG in each treatment. Among different insecticides tested, seed treatment with imidacloprid 18.5% + hexaconazole 1.50% FS + foliar spray with acetamiprid 20% SP was found significantly superior in managing sucking insect pests with highest pod yield (3110 Kg/ha), net returns (65580 Rs./ha) and B:C ratio (2.03) which was on par with seed treatment with thiamethoxam 30 FS + foliar spray with acetamiprid 20% SP and seed treatment with imidacloprid 60 FS + foliar spray with acetamiprid 20% SP. Seed treatments were proved to be safer to the natural enemies compared to foliar sprays and combinations of both.

# Eco-Friendly Pesticides For Safe Environment

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The manufacturing of chemical pesticides involves the inclusion of chemicals which are able to kill pests faster. They may contain herbicides for weed control, insecticides for the eradication of insects, and rodenticides for rodent control. There are a number of organic pest control method which is not widely advertised. They form a good alternative to chemical pesticides and will not have a negative impact on the environment or on people. The eco pest control methods are suitable for home and the garden. Insectary plants (mint, rosemary, thyme, marigold) can produce nectar which attracts the honey bee. The honey been is a good pollinator and helps keep pests at bay. Many pests are deterred by salt, including slugs and spider mites. Orange Citrus Oil is a deterrent to many common pests, including slugs, cockroaches, ants. Diatomaceous earth works well at repelling all kinds of insects, both inside the house as well as in the garden. Chrysanthemum flowers contain pyrethrum, which kills insects by infecting their nervous system and completely immobilizing them. Neem Oil, eucalyptus oil helps to repel flies, as well as stinging insects like wasps. Garlic spray is effective against whiteflies, aphids, and spider mites. Hot pepper wax keeps away dozens of garden pests, including aphids and whiteflies, as it produces a spicy taste and aroma that repel many species of insects. Eco-friendly pesticides are not toxic to the environment and will not cause harm to human health.

***Key words:*** *Eco friendly pesticides, Honey bees, garlic spray, neem oil*

# Potential Of Pgpr Mediated Consortia Against Fusarium Wilt In Sustainable Tomato Production

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Soilborne fungal diseases are the most vulnerable among vegetable crops and have major implications in crop yield and productivity. Among them, Fusarium wilt caused by Fusarium oxysporum f. sp. lycopersici (Fol) is one such important fungal disease of tomato that needs strenuous studies. Researchers employed the usage of protective fungicides as a possible remedy against the pathogen. However, the use of chemicals pose threat not only for human health and environmental hazards but is also responsible for development of pesticide resurgence. Hence, Eco-friendly sustainable practices are alternative to chemicals are of prime importance. A study has been conducted to standardise and develop a rhizosphere mediated microbial consortia against Fusarium wilt of tomato. A rhizobiome pool was isolated, out of which 7 fungi, 4 bacteria (2 Gram positive 2 Gram negative) showed antagonism against Fol. Furthermore, studies are being conducted for their interactions among themselves to group the selective antagonists as microbial consortium against Fol.

***Key words:*** *PGPR, rhizosphere, consortia, Fusarium wilt, tomato, Fol*

# Ecological and Eco-Friendly Pest Management for Natural Farming and Safe Environment

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In the Natural Farming (NF) systems, where the focus is on mainly to manage the pests rather eliminating them based on their biological, ecological and behavioural mechanisms for the effective management of pests in the NF are changes in the cultural practices like Crop rotation- Production practices, Plant population density spacing, Companion planting, Maintaining physical conditions like temperatures, crop species and cultivar selection etc., To conserve the natural enemies in the fields through provisions of hedge rows, shelter belts, refugia and growing of eco feast crops. Inundative and inoculative release of bio control agents like predators, parasitoids and insect pathogens. Use of pheromones traps, attractants, botanicals and organic pesticides. Cultural practices are the first key step towards managing the insect pests that suppress pest species and encourage and reinstate the activities of natural enemies in the field to provide habitat for species to suppress the pest population and ecological circumstances in the release area emphasising on the crucial aspects in achieving the desired goals culminating at reduction of crop losses without causing any detrimental effect on the environment. Though there are certain practices prescribed in natural farming, the most adopted practice is use of Jeevamritha, Beejamritha other plant protection materials and eco-friendly pesticides followed by neem oil and fermented cow urine for safe environment. Further, there is always scope for tweaking and innovation in these practices like Ghanajeevamritha and the use of Azolla in paddy field or applying Jeevamritha through drip irrigation. Several studies on direct effect of neem leaf and fruit extracts on target pests and pathogens have been reported (Amadioha, 2000). Aqueous leaf extract of Azadirachta indica induced resistance in barley against Drechslera graminea through biochemical changes in the host plant (Paul and Sharma, 2002). The concentrated culture filtrates (50% dilution) produce highly susceptible reaction on aloe-vera destroying the gel after 72-96 hours of treatment (Shukla et al., 2008) natural products of some plants have been used to control the disease (Bhatia and Awasthi, 2007). A number of reports are available showing the efficacy of plant extracts especially neem showing the antifungal properties (Mesta et al., 2009). Significant reduction in cost of cultivation of all the crops was observed, However, the effect on crop yield is not conclusive. It was also observed that the NF adopted farmers who applied farm yard manure harvested better crop yield than those who did not apply. Thus, natural farming may not look as yield enhancing farming practices.

***Key words:*** *Refugia, Inundative bio control agents, Pheromones traps, Jeevamritha, Beejamritha, Ghanajeevamritha.*

# Sequential Application of Pre-Emergence and Post-Emergence Herbicides For The Control of Phalaris Minor In Wheat

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*Phalaris* minor is most troublesome weed of rice-wheat cropping system mainly in north-western plains. This weed has already developed resistance to the major herbicides which leads to the threat of food security. The presence of this weed can cause complete crop failure (even the population of 2000-3000 plants $m^{-2}$). Generally, farmers are applying only post-emergence herbicides for the control of weeds. Dose higher than the recommended dose (even 2-3 times higher than the recommended dose) does not provide satisfactory control of this weed at farmers' field. To know the impact of sequential application of pre-emergence and post-emergence herbicides a field experiment was conducted during rabi seasons of 2018-19 and 2019-20 at research farm of CCS Haryana Agricultural University, Hisar, Haryana. The experiment was conducted using randomized block design with three replications. Different combinations of pre and post-emergence herbicides were applied to control the *P.minor* along with weedy check and weed free. Reduction of *P.minor* density with the application of pre-emergence herbicides helped to reduce early crop-weed competition for nutrients, moisture, space and light, thus crop plants are able to produce more number of tillers, more grains/spike and consequently higher grain yield. Pre-emergence application of pendimethalin 1500 g/ha, aclonifen + diflufenican (TM) 1000+200 g/ha and pyroxasulfone + pendimethalin (TM) 127.5 + 1500 g/ha resulted in 52.9-56, 44.1-44.6 and 66.2-73% reduction in P.minor population as compared to weedy check. Pre-emergence application of pyroxasulfone + pendimethalin 127.5+ 1500 g/ha fb sequential application of pinoxaden + metsulfuron 64 g/ha or post emergence application of mesosulfuron + iodosulfuron 14.4 g/ha was the most effective weed control treatment and provided ≥79 per cent control of total weeds.

***Keywords:*** *P.minor, Herbicide resistance, Pre-emergence herbicides, Sequential application*

# Compatibility Studies Among Different Microbial Pesticides Commonly Used For Soil Application

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The present study was carried out with the objectives to analyze the compatibility among different microbial pesticides commonly used for soil application through pot culture technique. The study was carried out by amending microbial pesticides in soil in each pot and were sown with cotton seeds and soil collected from each pot after 45 days of treatment and evaluated for the presence of test microbial pesticides by serial dilution. A total of 8 treatments are *Trichoderma viride, Metarhizium anisopliae, Pseudomonas fluorescens, T. viride + M. anisopliae, T. viride + P. Fluorescens, M. anisopliae + P fluorescens, T. viride + M. Anisopliae + P. fluorescens* and control. The results recorded that soil treated with *T. viride*, showed the growth of *T. viride* in plates at $10^{-2}$, $10^{-3}$ and $10^{-4}$ concentrations whereas, in soil treated with *M. anisopliae*, no growth was observed. In case of soil treated with *P. fluorescens*, it was observed at $10^{-6}$ and $10^{-7}$ concentrations whereas in *T. viride + M. anisopliae* treated soil, *T. viride* was only observed at $10^{-2}$, $10^{-3}$ and $10^{-4}$ concentrations and there was no growth of *M. anisopliae*. Soil treated with *T. viride + P. fluorescens, T. viride* was observed at $10^{-2}$, $10^{-3}$ concentrations and *P. fluorescens* also observed in plates at $10^{-5}$ and $10^{-6}$ concentrations. In case of *M. anisopliae + P. fluorescens, P. fluorescens* was only found at $10^{-5}$ and $10^{-6}$ concentrations whereas in *T. viride + M. anisopliae + P. fluorescens* treated soil, *T. viride* was only observed at $10^{-3}$ and $10^{-4}$ concentrations and no other microbial growth was observed in the plates. There is no growth of microbial organisms in control plates. Overall results showed that, at $10^{-2}$, $10^{-3}$, $10^{-4}$ concentrations revealed that *T. viride* was found to be most dominant and *M. anisopliae* growth was nil. While, *P. fluorescens* was observed at higher concentrations of $10^{-5}$, $10^{-6}$, $10^{-7}$. Among the test microbial pesticides, *T. viride* was found to be most dominant and not compatible with other microbial pesticides, showed antagonistic effect.

***Key words:*** *Microbial Pesticides, Soil application, Comaptibility*

# Biochemical Mechanism of *Lantana Camara* Leaf Extracts Against *Meloidogyne Incognita*

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An experiment was carried out on the biochemical mechanism of *Lantana camara* leaf extracts against *Meloidogyne incognita* at Department of Nematology, Jorhat. For this, 25 days old seedlings of tomato were transplanted in 1kg capacity pots. Further these pots were inoculated with freshly hatched second stage juveniles of *M. incognita* @ $1J_2$/cc soil and thereafter drenched with 25, 50, 75 and 100 percent concentrations of *L. camara* leaf extract prepared from fresh green leaves (25 grams) along with two control treatments *viz*., *M. incognita* alone (@ $1J_2$/cc soil) and uninoculated and untreated control were maintained. The pots were arranged in a completely randomized design with five replications for each treatment. After 35 and 45 days of inoculation (DAI), it was observed that maximum plant growth parameters were recorded in the 50 percent concentration whereas; minimum nematode multiplication was recorded in the 100 percent concentration of *L. camara* leaf extracts. Further, biochemical analysis of tomato root revealed the highest activity of peroxidase (PO), polyphenoloxidase (PPO) and total phenol content was observed at 100 percent concentration while the minimum activity was recorded in the 25 percent concentration both after 35 and 45 DAI. The lower concentration of leaf extract *viz*., 25 and 50 percent showed stimulatory effect on plant growth parameter whereas higher concentrations *viz*., 75 and 100 percent concentration of leaf extract showed inhibitory effect on plant growth. The maximum activity of the biochemical compounds was recorded at 35 DAI while the same declined at 45 DAI. The maximum plant growth parameter like shoot height, shoot weight (fresh) and root length and root weight (fresh), dry shoot weight were recorded in the 50 percent concentratation of *L. camara* leaf extract where as the minimum was recorded in the nematode alone treatment. It is advisable that before application of *L. camara* under field conditions to suppress the plant parasitic nematodes, optimal concentrations should be determined which will be toxic to nematodes but neither to the plants to be protected nor to any associated beneficial microorganisms.

***Keywords:*** *Meloidogyne incognita, Lantana camara, tomato, peroxidase, polyphenol oxidase, total phenol content*.

# Exploring Potential Siderophore Producing Fluorescent Pseudomonads For Suppression of Bacterial Wilt In Chilli

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Fluorescent pseudomonads are effective bacterial antagonist against *Ralstonia solanacearum* causing bacterial wilt. Under iron stress condition isolates of fluorescent pseudomonads also secretes a secondary metabolite compound known as siderophore which acts as specific iron chelating agent. The present study aimed to identify, characterize and purify siderophore producing isolates of fluorescent pseudomonads from rhizospheric soil of Chilli as well as evaluating their antagonistic efficacy against bacterial wilt of chilli caused by *Ralstonia solanacearum*. Eleven different isolates of fluorescent pseudomonads from five districts were used for the production of siderophore at optimum temperature of 30ºC, 72 hr of incubation period in shake condition (90 rpm) and pH 7 in an iron free succinate media. All the 11 isolates showed positive result for siderophore production. The maximum percentage of siderophore unit is produced by the isolates PfA2 (85.07%) and PfS2 (82.61%) when screened for siderophore production on a chrome azurol S liquid assay method. By Csaky Assay, the formation of pink colour by all the 11 fluorescent Pseudomonad isolates indicated the Hydroxamate-type of siderophore. They also showed additional features like production of Hydrogen cyanide, Ammonia production, Phosphate solubilization and antagonistic action against *Ralstonia solanaceaum*. Two best effective siderophore producing isolates of fluorescent pseudomonads showing highest inhibition (%) against *Ralstonia solanacearum viz*., PfA2 & PfS2 (6.81 cm & 6.10 cm, respectively) selected for the management of bacterial wilt of chilli caused by *Ralstonia solanacearum*. The percent wilt incident (PWI) of chilli decreased significantly in plants treated with siderophore producing fluorescent Pseudomonads. The lowest record PWI (1.00 %) was recorded in treatment combination with both the isolates PfA2 and PfS2, *viz*., seed treatment + soil treatment + seedling root dip treatment @ 10ml/plant. Correlation studies revealed that wilt incidence was positively correlated with population dynamics of *R. solanacearum* in the chilli crop rhizosphere and was negatively correlated with population dynamics of the isolates of fluorescent pseudomonads in rhizospheric soil and yield of chilli.

***Keywords:*** *Biomanagement, Fluorescent pseudomonads, PWI, Siderophore*

# Climate Smart Agricultural Practices for Sustainable Livelihoods and Food Security

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Agriculture represents a core part of the Indian economy and provides food and livelihood activities to much of the Indian population. Food security and sustainable livelihoods is the all-time concern of people across the globe. Agriculture is in the midst of threat due to climate change and decline in area under crop cultivation. The climate change has a potential impact on every spheres of life. It acts as a critical challenge for global food security. Farming communities are needed to be build their resilience and abilities to adapt to climate change in a way to feed the expanding population without exploiting natural resources. In this frame, Climate Smart Agriculture (CSA) is an approach that calls for integration of the need for adaptation and the possibility of mitigation in agricultural growth strategies to support food security. The concept of CSA was developed by Food and Agricultural Organization for managing agriculture for food security under the changing climate. FAO defines CSA as the "Agriculture that sustainably increases productivity, enhances resilience, reduces or removes greenhouse gases where possible and enhances achievements of national food security and development goals". CSA is a novel concept, which aims to achieve food security through sustainability and resource conservation also, adapt to changing climate. It offers the integration of various existing technologies in a sustainable way to achieve optimum production and better livelihood for farmers in near future.

***Key words:*** *Climate Smart Agriculture (CSA), Climate change, livelihood, Food security, Sustainable, Farmers.*

# THEME - V

## *Crop Management, Technological Improvements and Adaptations for Natural Farming*

# A Spatiotemporal Change Analysis of Vegetative Greenness Using Google Earth Engine

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Satellite derived vegetation indices are broadly used for monitoring plant ecology and earth's vegetative surface. Normalized Difference Vegetation Index (NDVI) is one of the most utilized indices of greenness obtained from the spectral signature. This Index is applied in the vast areas of ecology, forestry, agriculture and biodiversity. Calculating NDVI is not always straight forward due to cloud, atmospheric contamination and data processing failures. To overcome, Google earth engine is used in this study for monitoring vegetation using NDVI from 2015 to 2021 over lower Bhavani river basin with MODIS satellite data. The time series analysis was charted to understand the variations in NDVI values over the time period. The lowest NDVI value of 0.33 and highest value of 0.7 was found in the year of 2016 and 2019. Further, the NDVI tends to correlate better with the different hydro-climatic factors like temperature, precipitation and surface soil wetness. The analysis showed that there exists a strong correlation between the NDVI and hydro-climatic factors, which be evidence for the changes in vegetation phenology. The correlation of NDVI is strong with temperature ($r^2$=0.50) and surface soil wetness ($r^2$=0.44) whereas very low with precipitation. Moreover, inter-annual and monthly variability of vegetation index were plotted to understand the vegetation changes over the period of time.

***Keywords:*** *NDVI, Google earth engine, Time series analysis, Hydro-climatic factors*

# Performance of various genotypes of Chow-chow [Sechium edule (Jacq.) Swartz.] under foothill condition of Nagaland

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The present investigation was conducted during Aug 2019 to May 2021 at Horticulture Research Farm, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema in 20 diverse genotypes of chow-chow [*Sechium edule* (Jacq.)Swartz.]. The experiment was laid out in Randomized Block Design with three replications. Genetic diversity was studied for twenty one quantitative and qualitative traits *viz.*, vine length, days to first flowering, number of nodes at first fruit set, length of internodes, length of leaf, width of leaf, petiole length, no. of fruits per plant, fruit length, fruit weight, fruit diameter, calcium, fat, vitamin C, TSS, moisture, carbohydrate, protein, crude fibre, yield per plant and yield per ha. Data were analyzed statistically for phenotypic and genotypic variance, coefficient of variation, heritability, genetic advance, genetic gain, correlation coefficient, path coefficient, genetic divergence and seed protein banding pattern.

Analysis of variance revealed significant differences among the genotypes for all the characters studied. High PCV and GCV, heritability and genetic gain were observed for vine length, days to first flowering, number of nodes at first fruit set, length of internodes, length of leaf, width of leaf, no. of fruits per plant, fruit length, fruit weight, calcium, fat, vitamin C, TSS, moisture, carbohydrate, protein, crude fibre, yield per plant and yield per ha. Correlation studies indicated that fruit yield per plant was positively and significantly correlated with days to first flowering, number of nodes at first fruit set, length of internodes, length of leaf, width of leaf, petiole length, no. of fruits per plant, fruit length, fruit weight, fruit diameter which indicated the importance of these traits in selection for yield. Path analysis revealed that maximum positive direct effect on fruit yield per plant was imposed by fruit weight, number of fruits per plant and number of nodes at genotypic level. This indicated that these are the real independent characters and have maximum contribution towards increase in fruit yield per plant. Divergence study revealed crude fibre contributed maximum per cent to the diversity followed by Vitamin C, fruit length, yield per plant, protein, carbohydrate, fruit weight, days to first flowering and vine length. Maximum inter cluster distance was observed between cluster II and III which indicated that the genotypes within these clusters were highly divergent. SDS-PAGE analysis showed considerable variation in band number of protein which ranged from 7-11. Protein banding profile showed that the genotype G-15 and G-12 was most distantly related to the rest of the genotypes. Hence, it was recommended that these two genotypes could be utilized for crossing programme to create more genetic diversity. SDS-PAGE marker data provided more sub groupings and revealed higher amount of diversity as compared to morphological data in present study. On the basis of diversity and mean performance of the genotypes for all the traits studied, G-15, G-8 and G-10 were found to be superior for the fruit yield components and quality traits. So, these genotypes can be considered as the best performing genotypes under foothill condition of Nagaland and can be used as parental source in any breeding programme.

***Key words:*** *Chow-chow, correlation, divergence, cluster, genotypes, heritability, SDS-PAGE*

# Importance of Gramin Krishi Mausam Sewa (GKMS) Project in Natural Farming system

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Gramin Krishi Mausam Sewa (GKMS) Project is launched to issue crop and weather-based agro advisories based on the location for the benefit of the farming community. Its importance in present day changing climatic scenario is of great importance. At present agriculture sector needs sustainable development to feed the rapidly growing population of not only the nation but the world as a whole. Thus, weather based agriculture is of great importance for the farming community to sustain their profession for earning bread and butter. The GKMS advisory helps them to optimize the use of available resources in a changing climatic situation for maximization of their production. The forecast are a boon to the farming community whenever, these are proved to be correct as these give benefit to the farmers, if not correct, then also there is hardly any loss to the farmers. The 'Forecast based Agromet Advisory Bulletin' issued from GKMS, Regional Agricultural Research Station, Assam Agricultural University, Shillongani, Nagaon has been catering to the needs of the farming community by providing the Advisories from the scientists of different disciplines of agriculture and veterinary, with a special emphasis on weather based interaction of various crops and livestock, their diseases, pests etc. In this way Gramin Krishi Mausam Sewa provides invaluable services to the farming community of Central Brahmaputra Valley Zone of Assam comprising the three numbers of districts viz.: Nagaon, Morigaon and Hojai which often experiences abnormal weather conditions like very high rainfall, intermittent drought spell during rainy season etc. Most of the farmers practice of this zone of Assam practice rainfed agriculture. Therefore, this project is of much importance for location specific weather forecast needs of the local farmers which help them to mitigate the climatic adversaries to some extent and practice natural farming.

***Keywords:*** *Gramin Krishi Mausam Sewa, Central Brahmaputra Valley Zone, farmers*

# Ecosystem Services to The Watershed Through Soil And Water Conservation Technological Interventions

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Soil erosion is the major threat for soil health and sustainable food production in global scale. The onsite and off site effects of soil erosion challenges the soil and water quality also. Many watershed projects have been introduced in India to conserve the natural resources like soil, water and vegetation. Watersheds provide many ecosystem services like nutrient cycling, carbon storage, soil erosion control, biodiversity, ground water level and agricultural production. The soil and water conservation measures implemented in the fields, effectively reduce onsite soil loss and sediment yield. All the soil and water conservation structures in the watershed directly influence the moisture availability, land use pattern and yield of crops. Increase in the biomass of vegetation in watershed indirectly benefits the soil health by improving the soil organic matter content. The increased soil organic matter when decomposes it will release Nitrogen to the soil which improves the soil fertility and supplement the plant Nitrogen demand. Sendrayanpatti watershed with 479 ha area is selected for the assessment of ecosystem services for soil health improvement. The results revealed that the soil and water conservation measures indirectly improved soil organic matter content and thereby available soil Nitrogen. This accounts for Rs 10,91,272/- benefit in terms of money for the entire watershed and Rs 2,278/- per ha can be saved by the farmer by reducing the Nitrogen fertilizer (Urea).

# Spectral Responses Based Indexing of Soil Colour And Their Impact on Soil Ph Under Different Topography of Pipainti Block of Bhagalpur District, Bihar

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Soils provide mechanical and nutrient support to the plants. However, acidic and alkaline nature of soils affected the nutrient availability and ultimately plant growth. Nature of the soil colour depends on soil mineralogy, organic matter content, salinity, carbonates and content of iron oxides, and has visual perceptual property corresponding to reflected energy of blue, green and red under electromagnetic spectrum (EMS). In this context, the present study was carried out to trace out the degree of soil pH (acidic followed by neutral to alkaline) using visual interpretation of soils and their spectral responses in red, Near Infra Red (NIR) and Short Wave Infra Red (SWIR) bands of satellite image (land sat 8, 2021) and their indexing. However, Suttle Radar Topography Mission (SRTM) and Carto DEM data were used to map the topography. It was observed that soils on elevated topography were much sensitive in SWIR followed by red and NIR bands, which caused to be red tone in soils due to release of iron oxides from granite rocks of Rajmahal hills found in southern part of Pirpainti block. However, index (SWIR+ NIR+ Red/SWIR) was performed to correlate with analysed soil pH. Results revealed that soil pH was low (5.5-6.5) in high indexed values but neutral to slightly alkaline in low indexed values, and outcome was demonstrated through image map, consist the spatial variation of soil pH. It was also observed that 85.43 $km^2$ was found to be acidic in nature on elevated topography, and 123.72 $km^2$ fallen under neutral to slightly alkaline in lowland agro ecosystem (adjoining of river Ganges). Results revealed that visual interpreted satellite images may be helpful to trace out the spatial distribution of soil pH in different topographic settings of Rajmahal hills.

***Key words:*** *Carto DEM, RS-GIS, satellite data and soil pH*

# Effect of Vegetables Intercropping on Soil Parameters In Poplar Based Agroforestry In The Subtropics of Jammu

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A trial was conducted to study the effect of vegetables intercropping on soil parameters in poplar based agroforestry in the subtropics of Jammu. The trial was conducted in the Agroforestry Research Farm, Chatha of Sher-e-Kashmir University of agricultural sciences and technology of Jammu. In Kharif Season Tomato, Brinjal and Okra were planted under 5 years old poplar plantation. Soil samples were collected before starting of trial and taken in each season to record the effect of intercropping on N, P, K and OC. All the vegetables were grown in open as well as under shade of poplar trees with five treatments T1: RDF of NPK, T2: 50%N+50%N through FYM, T3: 100% N through FYM, T4: 50%N+50%N through VC, T5: 100% N through VC. The results of the study showed that the amount of N, P, K increased in the soil year after year Amount of OC also increased at the end of the trial. Highest amount of OC was recorded in treatment T3 with 100% FYM.

***Keywords:*** *Agroforestry, Organic carbon, Vegetables, Intercropping*

# Storage Behaviour and Quality Response of Pink Fleshed Dragon Fruit (*hylocereus* spp.) Coated with Chitosan during Ambient Storage Conditions"

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Dragon fruit undergoes rapid senescence during storage. This study identified the synergistic effect of chitosan coating with different concentrations on the storage behavior and postharvest quality of dragon fruits stored under ambient conditions. The present study was conducted in a completely randomized design. Dragon fruits were coated with 2 %, 3 %, and 4 % at three concentrations and a control (without coating) and stored at ambient temperature for 14 days. Changes in fruit's firmness, shelf life, total soluble solids (TSS), titratable acidity (TA), reducing sugars, total sugars, ascorbic acid, and organoleptic scores were periodically recorded. Among the treatments, the highest shelf life (13.80 days) and most increased firmness (2.04 kg $cm^{-2}$) was recorded in $T_3$-Chitosan @ 4%, while the lowest shelf life was recorded in $T_4$-Control (7.80 days). Quality parameters *viz.*, TSS, titrable acidity, total sugar, reducing sugars, and ascorbic acid were recorded every two days intervals. Among the treatments, $T_3$- Chitosan @ 4% recorded the highest TSS (15$^{o}$B), TA (0.12), highest ascorbic acid content (8.62 $mg100^{-g}$), highest total sugar content (7.4%), reducing sugar (4.96%), highest organoleptic score, aroma, texture, taste and overall acceptability (7.60, 8.20, 8.60 and 7.10) respectively. At the same time, the least was noticed in $T_4$-control on the 14$^{th}$ day of storage. The highest benefit-cost ratio was obtained in $T_3$-Chitosan @4% (1.19), followed by $T_2$-Chitosan @3% (0.98), and $T_1$-Chitosan @ 2% (0.82). While the lowest benefit-cost ratio recorded was in $T_4$-Control (0.77).

***Keywords:*** *Ambient storage, Chitosan-Coating, Dragon fruit, Postharvest Quality, Storage behavior.*

# An Economic Analysis of Post-Harvest Losses in Tomato

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India occupied second position in the world in terms of vegetable production, with 197.23 million tonnes of vegetables from an area of 10.97 million hectares of land during the year 2020-21. Among the various vegetables, tomatoes are the most widely grown accounting for about 21.056 million tonnes of production from 0.86 million hectares of land. (Third advance estimates, Ministry of agriculture and farmer's welfare). In spite of this, tomato growers often face several constraints which hinder their income and one among which is the huge post harvest losses. The present study aims to quantify the postharvest losses with a thorough analysis of identified marketing channels of tomato in Siddipet district of Telangana state. The primary data was collected from 102 tomato growers of the district randomly chosen and the data pertained to the kharif season of the agricultural year 2019-20. The collected data was analysed using appropriate statistical tools and the results indicated that the monetary value of postharvest loss was highest in the case of channel-3 (Farmer-Commission agent-Wholesaler-Unorganised retailer-Consumer) which was Rs. 583.44 per tonne due to the involvement of more number of market intermediaries than any other channel. On the other hand, the lowest was found in the case of channel-2 (Farmer-Organised retailer-Consumer) which was Rs. 145.33 per tonne due to the better post harvest practices being followed by organised retailers. The study suggested the employment of efficient post harvest practices as well as contract farming of tomato growers with processing units which would mitigate the losses to a certain extent.

***Keywords:*** *Tomato, postharvest loss, marketing channel, contract farming*

# Applications of Drone Technology In Insect Pest Management

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The precision insect pest management provides an enabling set of technologies such as field maps of insect distribution, detection methods for insect pests, irrigation, fertilization, timely harvest of the crop and methodology to apply insecticides only on selected area and precision release of natural enemies in the field. The drone mediated technologies which are reliable and cost effective being advocated in the precision pest management in many parts of the world and play a vital role in precision agriculture. Further, the progressive change in growth and development is critical in crop monitoring and taking suitable decisions to maintain health status. As labor availability and technical manpower are extremely limited, particularly in India, drones are gaining popularity in the context of smart farming. Insect pests are known to cause drastic reduction in food grain production across the world. The losses that have been reported by FAO is over 37% due to pests and diseases. Recently, crops cultivated in India have been threatened by invasive pests like fall army worm (*Spodoptera frugiperda*) in corn, Rugose spiraling whitefly in coconut (*Aleurodicus rugiperculatous* Martin) tobacco thrips (*Thrips parvispinus* Karny) in chilli, these pests caused extensive damage during the last years. In India, more than 80% of farmlands are in the category of small and marginal (<1 ha), so it is very difficult to manage the invasive pests. If one field is sprayed, the pests simply shift their feeding to the neighboring fields. For this, drones become essential. Drones are unmanned aerial vehicles exploited in a wide array of disciplines such as defense, monitoring systems, and disaster management but are only beginning to be utilized in agricultural sciences. Despite the fact that drone technology is highly relevant and appropriate for pest management, the adoption of the technology is restricted. Overall, drones can be employed in almost all agricultural field operations and are considered excellent tools for rapid, reliable, and non-destructive detection of field problems.

***Keywords :*** *precision agriculture, pest management, drone technology, cost effective*

# Next generation agro-inputs with nanotechnology: A new approach in agricultural sustainability

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Nanotechnology is the most innovative and emerging technology having the potential to revolutionize the agricultural practices. Nanoparticle synthesis involves two approaches i.e. top – down approach (physical and chemical method) and bottom – up approach (biological method). Many studies had reported the use of various physical and chemical approaches to create nanoparticles of interest but the biogenetic (plant - mediated) synthesis of nanoparticles is now gaining popularity leading towards the green chemistry approach connecting nanotechnology with agriculture, together referred as agri-nanotechnology. Agri-nanotechnology is the next generation technology having significance role in sustainable agriculture which facilitates the enhancement of agro-inputs efficiency by the production of nanocides, nanofertilisers, nanosensors, nanoclays and smart delivery systems. The green chemistry offers several advantages including cost effectiveness, requires less energy, non-hazardous, non-toxic, eco-friendly, ease of the procedures and their adaptability. The use of nanoparticle-based smart delivery systems and nano-sensors holds the promise of controlled agrochemical release and site-targeted delivery of various macromolecules required for improved plant disease resistance, efficient nutrient utilization, and improved plant defense in an environmental friendly manner. Plant genetic modification using nanoparticle-mediated plant transformation provides the potential for crop enhancement. It has been revealed by many researchers that reduction of metal ions into nanoparticles is due to the presence of various plant metabolites (polyphenols, terpenoids, alkaloids, phenolic acids) present in the extracts used for biosynthesis of nanoparticles. Agri – nanotechnology is more advantageous as it allows to screen the plant extracts for new drug discoveries for the treatment of various bacterial and viral diseases, targeted drug delivery due to the small size of nanoparticles, increased therapeutic efficiency, helps to improve and modify crop management techniques. Agrochemicals are traditionally applied to crops through spraying, broadcasting, and drenching, therefore necessitating repeated application of the chemicals as very low effective dosage reaches to the target site due to the process of leaching, microbial degradation, and photolysis. This adversely affects the surroundings leading to multinutrient deficiency, soil degradation, pollution of water resources. Agri-nanotechnology helps to combat all these

problems. For upcoming years, revolution of agriculture system will be based on the precision farming i.e. approach to maximize crop yield while reducing the input (pesticides etc.) which can only possible by transforming nanotechnology towards agri-nanotechnology. Next generation agro-inputs involves the formation of nanocides, nanofertilizers, drug delivery system, nanoclays as carriers for nutrients like zeolites, nanosensors which are used as effective tools for tracking, detecting, and controlling plant pathogens, nano-genetic manipulation of agricultural crops where the genes responsible for triggering the plants expression are transported by using the nanomaterials. Nanosensors reveals the vital information when they have been embedded in the cultivated fields allowing for more precise use of agro-inputs to increase yield and thus aiding in precision farming. Agri-nanotechnology has been piqued the interest of many researchers to explore more in this field to make sustainability of agricultural field, its productivity as well as quality of yield. Extensive research is required to reveal the untapped potential of agri-nanotechnology towards precision farming and commercializing nanoproducts.

***Keywords:*** *Agri-nanotechnology, nanotechnology, nanosensors, nanoparticles*

# Surface Energy Balance Closure Characterization Using High Response Eddy Covariance Measurements and Thermal Inertia Based Physical Soil Heat Flux Model Over Selected Agro-Ecosystems Over India

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The monsoon supplies more than 80% of annual rainfall to more than a billion people in India and the surrounding region between June and September. Therefore, it is necessary to understand how the land surface feeds back affects the progression of the monsoon through its seasonal cycle. In order to understand these process, ISRO 10-m Agro-Meteorological Stations (AMS) have been upgraded with eddy covariance (EC) systems in Indo-UK INCOMPASS project on a range of surface types such as rice-wheat semi-arid agro-ecosystem in Nawagam, Gujarat ($22.79^0$N,$72.57^0$E), sub-humid rice-wheat system in Samastipur, Bihar ($25.86^0$N,$85.78^0$E) and arid grassland system in Jaisalmer, Rajasthan ($26.99^0$N,$71.31^0$N), in order to provide detailed measurements of surface fluxes through the diurnal cycle and how they are modulated by the monsoon seasonal cycle. The present study has brought out the results of analysis of high-frequency 20 Hz measured data on sensible (H) and latent heat fluxes (LE) from EC systems, net radiation (Rn) data and modelled soil heat flux (G) data for the period of June 2016 to March 2018. Thermal Inertia (TI)-based physical model of soil heat flux developed using difference of day night Land surface temperature (LST), ground measured Normalized Difference Vegetation Index (NDVI), soil textural properties and modelled moisture availability has been tested and validated over an independent site in Dharwad, Karnataka (15.50 $^0$N, 74.99 $^0$E) which showed RMS error of 9 -12% across seasons for daytime average with correlation coefficient of 0.7 – 0.8. The Energy Balance Closure (EBC), computed as percent of ratio between difference of net available energy (Rn-G) and sum of H and LE, and sum of H and LE, was found to be significantly high (18 – 30%) for daytime in all the three ecosystems during south-west monsoon period corresponding to high vegetation growth as compared to pre and post monsoon period having low vegetation growth, as exemplified through seasonal dynamics of LAI, vegetation index, Net Ecosystem Exchange (NEE) of $CO_2$. Ranges of seasonal mean of H, LE and rainfall showed substantial differences across Nawagam (37 – 124 $Wm^{-2}$, 150 – 190$Wm^{-2}$, 504 – 862mm) Jaisalmer (129 – 151$Wm^{-2}$, 12 – 64$Wm^{-2}$, 13 – 225 mm) and Samastipur (29-63$Wm^{-2}$, 149 -220$Wm^{-2}$, 74 – 941 mm). The higher the seasonal mean of LE, the higher is the seasonal NEE mean. However, intra-seasonal dynamics showed lead and lag behavior between LE /

evapotranspiration and NEE. Diurnal conservation of evaporative fraction, EF (a flux partitioning ratio of LE and sum of H and LE), was observed for both clear and cloudy days. On cloudy day, evaporative fraction remains at higher level between 0.7 and 1.0. It was observed that EF remained constant during the whole day. Substantial differences between wet to dry months were noticed. EF in cropland was found to vary in a narrower but higher range (0.6 to 0.9) as compared to wider but with lower range (0.1 to 0.5) in grassland These data will be used to quantify the impacts of the atmosphere on the land surface, and vice versa, and to study errors in general circulation models in the coupling of land and atmosphere.

***Key words:*** *INCOMPASS, Thermal Inertia, Energy Balance Closure*

# Aqua Ferti. Seed Drill: Technology for Resource Conservation and Crop Cultivation in Dryland Areas

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Aqua Ferti. Seed drill was designed and developed for sowing and simultaneous application of aqueous fertilizer for dryland areas. A seeder with aqueous fertilizer application system plays an important role in precise placement of seed along with application of aqueous fertilizer at root zone depth. Uncertainty of soil moisture at the time of sowing and its uneven distribution results in poor seed germination along with uneven establishment of plants at initial stage. Also, applied fertilizer remains unavailable due to inadequate soil moisture to dissolve, dilute and convey it to root zone level. Many times applied fertilizer leach out due to post planting irrigation. A design of constant head aqueous fertilizer metering system was modified for controlled application of aqueous fertilizer. A centralize tank of capacity 127 litres made up of stainless steel was used for metering purpose which takes aqueous fertilizer from two storage tanks of capacity 225 litres each made up of PVC material. The total storage capacity of the Aqua ferti seed drill becomes 450 litres. Two pipes were fitted at the bottom of the centralized tank in which nine nozzles were fitted to deliver aqueous fertilizer to the furrow openers. Nine valves were provided in each outlet pipes of centralized tank for controlling discharge rate as well as to deliver aqueous fertilizer to each furrow opener. This help in providing soil moisture required for seed germination. The machine is fitted with vertical rotor type seed metering system for line sowing /planting of rabi crops like wheat, chickpea etc. A multi-crop seed metering system was used in the seeder for sowing of several crops from small to bold size seeds. It consisted of 9 furrow openers and consisted of PTO operated piston pump, fertilizer distributor system and control valves and pressure relief valve. The machine can be operated by a 55 hp tractor and has a field capacity of 0.23 ha/h and field efficiency of 74% with a sowing depth of 2.5-3 cm. The developed technologies are capable of applying required aqueous fertilizer ranges from 8000 to 15000 l/ha for different crops and soil conditions in dryland areas. The field sown with seeder with aqueous fertilizer application system has lesser weeds as compared to conventional operations at initial crop stages.

**Key words:** Constant head aqueous fertilizer metering, Dry land areas, Multi Crop Seeder

# Genetically –Modified Crops and Crop Species Adapted to Global Warming In Dry Regions

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In Genetically Modified (GE) plants their DNA tainted using genes from alien plants. Researcher screens the gene of interest in one plant, and they insert that gene into a cell of another plant. The techniques to grow GE plants are quite different than selective breeding. This involves selecting plants with elite genotypes and cross them. Over time, those desired traits will transmit to offspring. One of the problems with selective breeding is that it can also result in Linkage drag. Genetic engineering allows facilitate scientists to transfer exact sequence of gene. This reduces transfer of desired traits with undesirable traits. Genetic engineering techniques can fasten the process of developing plants with most wanted traits. According to data published during 2016 adoption of Biotech crops helped in minimizing $CO_2$ emissions equivalent to emission of pollutants from automobiles in one year. GMOs also reduce excessive usage of insecticide, pesticide and herbicide by 8.2% and helped hike in crop yields by 22%. A recent and ultramodern prototype of universal climate change is a foremost apprehension and is a most important menace for the intact ecosystem. Synthetic - centric climate change is majorly through emissions of greenhouse gases like carbon dioxide, methane and nitrous oxide majorly from rice field becomes challenge for crop augmentation and efficiency. Scores of attempts in times of yore were made to take in hand this challenge and green revolution is lone such come through but the extent of climate change effects on plants has speckled over time. The utmost thing in agriculture involving out yielding crop varieties, chemical fertilizer input, and chemical pesticides usage are of limited significance under changing climatic conditions. So, escalating crop production and addressing climate change must be done in an incorporated sustainable approach and expansion of Biotech crops can act as an effective adaptive strategy against climate change. There shall always be defy though in dealing with the uncharted dimension of climate change and also the extent to which a particular genetically modified crop would be able to deal with climate change. This chapter is therefore emphasized on genetically modified crop expansion to resist different variables of climate change, piecemeal and in blend and the allied challenges.

***Keywords:*** *GM Crop, Biotech Crop, Climate Change, Crop Yield*

# Potential Contribution of Low Cost Drip Irrigation to The Improvement of Irrigation Productivity

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To develop low-cost filters with optimal selection of off-the- shelf components as well filtering media. Fabrication of primary filter unit with different dimension to reduce the cost of the unit using indigenous material (Poly Vinyl Chloride). Using different filter media namely silica sand (0.3mm) fine silex (0.6mm) Coarse silex (1mm) Pebble size of ½" and pebble size of 1" and Coconut fibre (Bio- media) for operation of the filters. The fabricated primary filter was tested for its filter efficacy by analysis of turbidity, total suspended solids removal and DO level of inlet and outlet water, back washing effects and emission performance of drippers. Flow rate increase with increase in pressure. Flow rate 11$m^3$/h was attained at 2.0kg/$cm^2$ (196.13kpa) pressure and 9$m^3$/h at 1.0kg/$cm^2$ (98.06kpa) in TNAU field and farmer field respectively. Flow rate of reduced height filter was 5$m^3$/h which is lower rather than another filter. Pressure drop was observed as 0.1 kg/$cm^2$ (1m or 9.8kpa) in fabricated low-cost filter under all the field trials. The study revealed that increase in pressure gradually increases the flow rate. Pressure drop was within the permissible limit. The fabricated filter with silica sand, silex and pebble media enhanced the quality of the filtered water rather than the coconut fiber media. Efficiency of the filter depends upon the quality of sources of irrigation water. The daily backwashing is recommended to increase dissolved oxygen and to reduce clogging of the filter. Better uniformity coefficient was observed during the study and it shows that there was no clogging during the filter operation.

***Keywords:*** *Primary filter, Low cost filter,*

# Mapping of Soil Chemical Properties And Available Major Nutrients Status of Lakya Sub Watershed of Dasarahalli-I Micro-Watershed In Chikmagalur Taluk by Using Gis Technique

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A study was undertaken to map the nutrient status of Dasarahalli-I micro-watershed in Chikmagalur taluk using GIS technique. Sixty surface soil samples (0-15cm) of Dasarahalli-I micro-watershed were collected and assessed for the soil chemical properties and available NPK status. The soils under the study were strongly acidic to slightly alkaline in soil reaction with non- saline in nature and soil organic carbon status was low to medium. The available nitrogen in micro-watershed showed 11 ha (1.12%) area with medium status and 58 ha (5.87%) area under low status. The available phosphorous and potassium status was medium in entire micro watershed area.The study highlights the importance of mapping the soil parameters which gives the spatial extent rather than the means which have limited applicability for soil management.

***Keywords:*** *Micro-watershed, available nutrients, global information system, mapping*

# Antivirus-Fat Synthesis or Its Accumulation Among The Species Are Based on Tds And Cec And May Digitally Measurable

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At this digital era author finds that digitally in aquatic and terrestrial environments Total Dissolved Solids, TDS and Cation Exchange Capacity, CEC both have significant roles in in fisheries and mankind having negative correlated with growth and fecundity. This present communication stated that Isoprene the smallest unit of Fatty acid and esteem hygienic bio-molecule synthesis as well may negatively correlated with CEC and TDS. Isoprene has got immense antivirus roles in all kinds of fisheries and mankind, hence environmentally can take important role in synthesising Fatty-acid based on environments. Fish fatty acids and phospholipids has very high demand owing to immunity reasons for fish itself and other animals. Often found that Fatty-acid bio-molecules can be treated as antivirus bio-molecules for fisheries and every mankind. Basic unit of fatty acid synthesis is called Isoprene synthesise by plankton population and this nano-particle prevails more in upper surfaces of aquatic environments in tropical fisheries hence all top feeders species namely *Crocodile Fish, Catla catla, Tilapia spp, Puntius spp* etc remain diseases less by virtue of Isoprene bio-molecules present in aquatic environment of tropical climates. Although we may know that fatty bio-molecules may be either environmental Isoprene, Isoprenoids etc , else synthesised within fish species as phospholipids, or else accumulated as feed supplementation to the species in semi-natural fisheries . In second and third instances extraction of fatty-acids bio-molecules from fish species may possible scientifically without absolute fish-catch and every non-fish eater communities may get happier to get fatty-acids from fisheries as valued medicines including anti-virus roles.

***Key-words:*** *Environment-editing for mankind, Computer and Electronics in Fisheries, Mighty antivirus of digital applications, Machine Learning Techniques*

# Insect Gut Microbiome and Its Potential Biotechnological Implications

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Through discovery and vast usage of Next-Generation Sequencing and bioinformatic pipelines to decode the molecular data of metagenome, the study of microbial communities has greatly improved. Endosymbionts of insect gut influence its nutrition, Physiology, and performance. They play a vast role in degradation of complex materials inside gut (in termites), production of defence compounds, parthenogenesis, changing plant physiology to benefit insect host, and degradation of pesticides. Novel prospects of these gut microbiome studies in biotechnological processes are always forth coming. Potential applications of metagenomics in biotechnological processes include

**1.Vitamin assembly:** The genome of *Wigglesworthia glossinidia*, the symbiont of Tsetse fly, *Glossina brevipalpis* has been sequenced and the annotated to reveal the presence of genes encoding for the synthesis of pantothenate (Vitamin $B_5$), biotin (Vitamin $B_7$), thiamin (Vitamin $B_1$), riboflavin FAD (Vitamin $B_2$), pyridoxine (Vitamin $B_6$), nicotinamide (Vitamin $B_3$) and folate (Vitamin $B_9$)

**2.Biofuel production:** Metagenomic and functional analysis of hindgut microbiota of a wood-feeding higher termite, *Nasutitermes* species revealed that the digestome of the insect gut comprising of microbial as well as termite coded enzymes act together to bring out the complete digestion of lignocelluloses. From the taxonomically annotated data, many microbes that play important roles in the conversion of wood into a biofuel, such as ethanol have been identified. They hold huge potential for replacing fossil fuels in transportation and thereby lowering greenhouse gas emissions

**3. Role in nitrogen fixation:** Through symbiotic association with gut bacteria, Insects can absorb the atmospheric nitrogen.

**4. Antibiotic resistance: I**nsects might play a role in disseminating important antibiotic resistance genes, as evident in Gypsy moth gene resistance against *E.coli.*

**5. Probiotics:** Profiling endosymbionts of gut might offer insights in novel probiotic bacteria.

**6. Implications in biocontrol:** Entomopathogens harbour wide range of habitats including gut microbiome. Profiling data from different ecological regions for potential entomopathogens might serve as a successful monitoring tool.

# Character Association And Path Analysis For Seed Yield And Its Attributing Traits In Dark Brown Sesame (*Sesamum Indicum* L.)

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A total 500 accessions were evaluated to determine the associationship among the traits along with their direct and indirect effects on seed yield during *Kharif* 2019. Observations were recorded on twelve traits *viz.*, days to flower initiation, days to fifty percent flowering, days to maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of capsules per plant, number of seeds per capsule, capsule length (cm), 1000 seed weight (g), seed yield per plant (g) and oil content (%). The experiment results revealed that seed yield per plant exhibited significant positive correlation with number of seeds per capsule followed by capsule length and number of capsules per plant. Path analysis showed that number of seeds per capsule had the high positive direct effect on seed yield followed by number of capsules per plant. On the basis of correlation and path analysis number of seeds per capsule, number capsules per plant and capsule length were observed as the most important traits and selection of these traits would be helpful in crop improvement.

***Keywords:*** *sesame, correlation, path analysis*

# Crop Spectral Library Generation Of Vegetables Grown In Hill Agriculture of Ner- By Hyperspectral Remote Sensing

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North East India is the uniquely diverse hub for a variety of species, habitats and ecosystems, with its hill region, in particular, being the hotspot of biodiversity. The NE hill agriculture is abundantly populated with different varieties of regional vegetables such as eggplant, lablab bean, cucumber, smooth gourd, ridge gourd, snake gourd, sweet gourd, cucumber, Trichosanthes gourd, and tinda etc. There is vast potential for the vegetable crops to benefit the economy of the states of NE. A reliable assessment of the nutritional status of these crops, hence, is vital to the management of a farm, since both excess and deficiency of nutrients can result in severe loss of yield. Precision agriculture values the precise determination of nutritional status not only in preventing those losses, but also in guiding the rational use of nutritional supplements. Particularly, it is imperative to manage macronutrients, nitrogen (N), phosphorus (P) and potassium (K)) and crops in a manner that preserves the environment while increasing yields. Hence, information about NPK content in farm soil is crucial for the right application of fertilizer. To assess soil nutrient status, laboratory-based chemical analyses are currently used, but these methods are complex, tedious, costly, and have poor in-situ performance. In addition, there are plant color guides, which are another way to assess nutritional status but do not allow quantitatively rigorous assessments. To achieve precision farming, soil fertility needs to be assessed in-situ. Remote sensing by satellite and wireless communications offer an opportunity to assess the fertility status of crops globally and provide timely management information to farm managers to control inputs or adjust practices. Hyperspectral remote sensing offers the possibility of analyzing crop and soil properties on the basis of their spectral absorption characteristics. It can be employed for identification and determination of macronutrients (NPK) of soil. It can identify the small divergences within a particular feature (or land cover). In contrast to multispectral remote sensing, it can discriminate within the various classes of vegetation and disease identification within a class. Thus, due to its fine spectral bands, this type of remote sensing data has the prospect to map the vegetable crops. However, hyper-spectral data processing requires in-situ measurements or an existing spectral library. Furthermore, it can be used to identify the disease affected crops and input for developing models for estimation of biophysical and biochemical parameters. This type of spectral library is never generated for the vegetable crops of NER. Therefore, this review study highlights the need to develop a spectral library for vegetable crops of the NE hill region. Moreover, the spectral library can help the spectra-based identification of major vegetables grown in hill ecosystems and sensitive band regions and wavelength for the segregation of healthy and stressed crops. This, in turn, can justify role of hyperspectral remote sensing for accurate analysis of NPK and optimizing the fertilizer application of NE hill agriculture.

***Keywords:*** *Hyperspectral remote sensing, hill agriculture, crop spectral library, vegetable crops of NER, precision farming.*

# Comparative Study of Zinc and Boron Nanofertilizer with Conventional Fertilizer on Production and Nutrient Status of Soil in lentil crop (*lens culinaris medikus*) cv. K-75 under inceptisol of prayagraj, u.p.

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The demand of nano-fertilizer is increasing gradually as it enhances the nutrient use efficiency. It has extensive surface area and carries abundance of nutrient and also reduces the use of conventional fertilizer. Thus improve the productivity of crop plant. Micronutrients are essential for plant growth and yield though it required in less amount. This study was carried out to assess the effect of nano zinc and boron fertilizer with conventional fertilizer on growth, yield and nutrient status of soil in Lentil crop. The experiment consisted of 9 treatment combinations which were replicated thrice and laid out in a simple RBD of three levels of conventional fertilizer (0% Zn B, 50% Zn B and 100% Zn B) and foliar spray of nano- Zn and B chelate fertilizer at three concentrations (0, 60 and 120 mg Zn $L^{-1}$) and (0, 3.25 and 6.5 mg B $L^{-1}$) respectively. The results showed that progressive decrease bulk density (Mg $m^{-3}$ ), particle density (Mg $m^{-3}$) and pH as depth increase, % of pore space, Water retaining capacity (%), EC (dS $m^{-1}$ ), Organic Carbon (%), Available Nitrogen (kg $ha^{-1}$ ), Available Phosphorus (kg ha-1 ), Available Potassium ( kg $ha^{-1}$ ), Available Zn (mg $kg^{-1}$ ) and Available B (mg $kg^{-1}$ ) increased with decreasing depth. It was observed that for postharvest, treatment $T_9$ was best in terms of growth, yield and economic parameters with maximum plant height, number of branches $plant^{-1}$ , number of nodules $plant^{-1}$ pods $plant^{-1}$ , seeds $pod^{-1}$ , test weight and pod yield and maximum cost benefit ratio found in T9. From the result it can be concluded that treatment $T_9$ (Zn+ B 100%, Nano Zn+ B 100% 20Kg Zn +1.6 Kg B $ha^{-1}$ Nano 120 mg $L^{-1}$ Zn+ 6.5 B mg $L^{-1}$ ) was found the best treatment combinations..

***Keywords:*** *Soil physico-chemical properties, Nano-fertilizer, Zinc, Boron and Lentil.*

# Evaluation of genotype environment interaction and identification of superior mango (*mangifera indica l.*) Genotypes using eberhart and russell's stability model

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Mango is one of the most important commercially grown fruit crops in India with greatest collection of varieties. Genotypes does not show same response in all locations due to their interactions with the surrounding environment. Presence of such interactions limits the breeding progress during selection of superior genotypes. Multi location trials are being carried out to study the behaviour of genotypes over different environments. Genotype environment interaction is a major problem in selecting and recommending superior genotypes for the cultivation of crops. This problem gets intensified, when we are dealing with perennial crops like Mango because choosing unstable cultivars to plant in an orchard puts the farmers in a risky income situation for many years. In the present investigation, an attempt has been made to identify the high yielding and stable genotypes of mango by using Eberhart and Russell's stability model. Data on sixteen genotypes of mango tested across four locations viz., Rewa, Sabour, Sangareddy, and Vengurla over a period of nine years is considered for the study. Considering the overall performance, Mallika was found to be the stable genotype for cultivation under unfavourable environmental conditions, while the genotypes Vanraj and Totapari were suitable for cultivation under favourable conditions.

***Keywords:*** *Adaptability, Genotype × Environment interaction, Mango, Perennial, Stability.*

# Burn Severity Mapping of Forest Fires in Nilgiris District Using Google Earth Engine

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Forest fires occur as the drying weather brings distress to the forest ecology in the hills and the threat of wild fire looms large. Burn severity mapping is a major parameter in carrying out mitigation measures and regrowth activities by forest officials or fire managers post fire event. The aim of this study is the generation of a burn severity map for the assessment of the areas affected by wildfires in the study area. In this study, Sentinel-2 multi-temporal satellite dataset are used. The entire analysis, i.e., accessing the datasets, pre-processing, and computation of indices was carried out on Google Earth Engine cloud platform. The Normalized Burn Ratio (NBR) was used, as it was designed to highlight burned areas and estimate burn severity. It uses near-infrared (NIR) and shortwave-infrared (SWIR) wavelengths. Recently burned areas have a low reflectance in the NIR and high reflectance in the SWIR band. The NBR is calculated for images before the fire (pre-fire NBR) and for images after the fire (post-fire NBR) and the post-fire image is subtracted from the pre-fire image to create the differenced NBR (dNBR) image. dNBR used for burn severity assessment, as areas with higher dNBR values indicate more severe damage whereas areas with negative dNBR values might show increased vegetation productivity. Results revealed burn severity map for the Nilgiris district during 2022. Thus, S2 datasets can be useful for rapid mapping of burn areas with improved spatial as well as temporal resolution.

***Keywords:*** *Forest fires, Sentinel-2, Google Earth Engine, burn severity*

# Evaluation of Flow Characteristics For Air Assisted Sprayer Using Hollow Cone Nozzle

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Air Assisted sprayers are designed to apply low to medium volumes of spray using small droplets between 30–350 microns in size. This work carried out using tractor attached Air assisted sprayer and this work has suggested that air assistance to spray is more effective for enhanced distribution and deposition of spray. The droplets of water and chemical are carried to the target plant in an air stream generated by the fan. The air blast sprayer displaces the air in the target plant with the spray-laden air from the machine. It contains at least two fan speeds. Normally, the lower fan speed is used on smaller, less dense trees. As plant size and density increase, more air is needed so the higher fan speed is used. Air blast sprayers generate their own wind, so spraying can be undertaken under calm conditions. However, a slight breeze of 5–8 km/h may improve spray penetration. The size of droplets is controlled by the nozzles used on the machine and the operating pressure. Nozzles are the most important component of any spray machine. The type of nozzle commonly used on air blast sprayers is a hollow cone which produces small droplets. The nozzles are usually arranged in a way that nozzles producing larger droplets are arranged at the bottom. This setup is designed to apply 70% of the spray volume to the top third of the target plant. The aim of calibration is to ensure a specified rate of chemical is applied to the target plant. Flow characteristics states that the flow is uniform and ideal. The work carried out has given the results as the average discharge rate with hollow cone of 1.0 disc blast type is 1.41 L/min and with air 60 blast type is 1.004 L/min.

***Key words :*** *Air Assisted sprayers, larger droplets, spray penetration, calibration,*

# Importance of Grape Germplasm in Climate Resilient Viticulture

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Grape growing is adopted globally but location and location's climate affect suitability of grape growing in particular region. Environmental conditions of particular region play an important role in determining not only yield, but grape quality potential also. Maximum possible quality potential of particular type of grapes is generally achieved when environmental conditions are moderate. Prevailing mild temperature during grape maturity and ripening stages. These conditions are found favourable for obtaining better quality grapes and quality reflects in processed products. Given climate change predictions, the selection of plant materials with an ability to adapt to environmental change will be of particular interest for grapevines. Warmer temperatures during the period of grape ripening are significantly affecting the rate and timing of vine phenology and the final quality of the grape berries. Climate change will also expose vines to increased drought, either because of reduced rainfall, or because of higher evapotranspiration due to elevated temperatures. Slow ripening type grape varieties and clones are targeted to harvest quality yield under such predicted conditions. Rootstocks also play an important role in inducing variations in phenology and ripening levels in given conditions. Rootstocks vary considerably in their ability to resist drought also. Adaptation of planting material, testing of already existing varieties under specific conditions and development of new suitable varieties for expected changes in weather pattern are important strategies for climate resilient viticulture. The choice of more water-use-efficient and drought-tolerant rootstocks is also an excellent measure of adaptation to climate change in viticulture. Available grape germplasm has very important role to develop suitable type grape and creation of variability for mitigation effects of climate change.

***Keyword:*** *Grapevines, varieties, rootstock, high temperature, suitability*

# Soil Health Card Impact in Selective Unnao District Villages of Uttar Pradesh

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This study was conducted to assess the impacts of soil health card (SHC) scheme on judicious use of fertilizers, bio fertilizers, organic fertilizers, soil health, cropping choice, cost reduction, farm profitability and sustainability. To conduct the study 200 farmers and farm women were selected from four villages of Unnao district namely- Nandauli, Pilakhna, Sahpurtonda and Babnakheda during the year 2019-21. As per the adaptation of the SHC scheme, only 73 percent of the farmers were able to understand the content of the SHC, of which 67 per cent farmers followed the recommendations of SHC and 60 per cent farmers agreed that the recommendations were suitable for their agricultural practices. As per the use of fertilizers, the major reduction has been recorded in the use of urea by 26 per cent followed by DAP fertilizer by 7 per cent. The major increase was recorded in Zinc fertilizer and potash fertilizers by 24 and 15 per cent respectively. Other than these use of other micronutrients improved up to 23 per cent. Most of the farmers were not using the biofertilizers because of lack of knowledge and awareness. After SHC scheme a remarkable increase of 54 per cent was recorded in the use of bio fertilizers as seed, root and soil treatment. Use of green manure crops and pulses in crop cycle was also adopted by 60 per cent of farmers. Change in fertilizer use pattern and other soil health improvement practices increased the crops production by 15 to 22 per cent. Overall, the performance of SHC scheme was satisfactory and need focus on quality of soil sample collection, timely distribution and SHCs knowledge enhancement to farmers through various awareness campaigns and training programmes to make it more effective. To make this scheme more successful there is need to ensuring availability of all recommended fertilizers, bio-fertilizers and other inputs at village level at reasonable prices.

***Keywords:*** *SHC, Soil test, Fertilizers, Knowledge,*

# Modern Age Breeding for Climate Resilient Crops

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Climate change impacts on agriculture are being witnessed all over the world but countries like India are more vulnerable in view of the huge population depending upon agriculture and excessive pressure on natural resources. There has been a significant rise in the frequency of extreme weather events in the recent years affecting farm level productivity and adversely impacting stability in food grain availability at the national level. Various adaptation and mitigation strategies including use of climate resilient crops and cultivars for different regions are most essential for agriculture to successfully cope with climate variability. Crop improvement through modern breeding techniques along with efficient agronomic practices innovations in would aid in exploiting the natural variations in crops and is an excellent way forward to fulfil future food requirements. Unlocking the repository of genetic diversity and extensive utilization of wild germplasm invariably is imperative to every crop improvement program. Recent innovations in genomic-assisted breeding (GAB) strategies allow the construction of highly annotated crop pan-genomes to give a snapshot of the full landscape of genetic diversity (GD) and recapture the lost gene repertoire of a species. Pan-genomes provide new platforms to exploit these unique genes or genetic variation for optimizing breeding programs. The advent of genome sequencing approaches, quantitative trait loci (QTL) mapping and genome-wide association (GWAS) studies, directed mutagenesis, plant non-coding RNAs, precise gene editing technologies such as CRISPR-Cas9, and complementation of crop genotyping by crop phenotyping ultimately lead for crop improvements related to climate resilience and nutritional superiority. Therefore, holistic smart breeding approaches can be promising way out to tackle climate change and develop better-adapted crop varieties.

***Keywords:*** *Climate change; Pan genomes; Genomic assisted breeding; QTL mapping; GWAS study; Directed mutagenesis; CRISPR-Cas9*

# Crispr/Cas 9 – An Ingenious Approach For Millet Improvement

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Millets, the nutria cereals are now gaining importance in our diet because of their high nutritive value. They have also attracted farmers for wide cultivation due to their agronomical and nutritive nature. They play an irreplaceable role in climate resilient agriculture. These crops can replace the narrow food basket depending on rice, which is essential for climate smart agriculture and also ensures food security. Though they are hardy in nature, these crops need essential improvement in their performance like high yield, disease, pests and lodging resistance. Developing varieties or hybrids through conventional breeding approaches in millets is tedious and time consuming. Switching to the latest and precise technologies in creating variation can help in developing new improved cultivars. Here comes the role of genome editing, which now acts as a powerful tool in creating variation. Out of these, CRISPR/Cas 9 is gaining importance due to its high precision and accuracy, thereby reducing the off-target events. CRISPR/ Cas 9 is a technique which produces desired mutants, instead like transgenics which results in random integration. It employs the use of CRISPR, a nucleotide sequence and Cas nucleases associated with CRISPRs. The sg RNA guides the Cas nucleases to induce double stranded breaks, thereby creating mutagenic sites. Several candidate genes which are prone for editing, related to stress tolerance were identified in millets like finger millet and cereals like maize, wheat and rice. Some yield contributing traits such as leaf angle, less shattering were modified in *Setaria italica* which improved the grain yield. These together provide an enlightment for its use in the improvement of the performance of small millets. Also, editing in more than one target, may help in precise gene pyramiding, which is tedious through conventional breeding. Thus, CRISPR/ Cas can open a new gate for the upgradation of millets performance in desired aspects.

***Keywords:*** *CRISPR/Cas 9, precise, genome editing, new variation, small millets, high yield*

# Moringa – A Paradise Tree For Livelihood Security To Mitigate Climate Change

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Moringa (*Moringa oleifera* L) is popularly known multi-purpose tree since centuries native to the sub-Himalayan regions of northwest India and Pakistan. It is also indigenous to many other countries in Southeast Asia, Africa and South America grows best in dry sandy soil, it tolerates poor soil, including coastal areas. It is deciduous, perennial tree, drought resistant in nature. It is called by different names such as "Mother's Best Friend" and "Miracle Tree" due to its nutrient-rich properties and is one of the most plant yet discovered. Moringa provides a rich and rare combination of nutrients, amino acids, antioxidants, antiaging and anti-inflammatory properties used for nutrition and healing. Not only this, it's an excellent forage for livestock production due to its good nutritional characteristics and a high yield in production of fresh biomass. It has various roles of aqueous extracts of various parts in enhancing plant growth and productivity have been explored, making it even more valuable plant species. The importance of the use of this plant is because of its high speed and regrowth capacity, and the first cut would itself be available by five or six months after sowing. Nevertheless, it fits well even under ultra-high density plantation also. It has the capability to withstand higher competition with limited space, light, water and nutrients. Although, yields remain stable irrespective of number of cuts taken, this indicates stability in the production of moringa biomass throughout the year. Bromatological composition of moringa shows that it has higher contents of Ca, P and Mg, They are rich in protein specially in leaves, branches and stems. With regard to poultry feed, birds which intake moringa forage meal increased the dry matter intake, nutrient intake. Whereas in cows it enhances the digestibility coefficients of dry matter intake, organic matter, crude protein, Neutral detergent fibre, digestibility and acid detergent fibre parameters increased along with milk production in the diets supplemented with Moringa fodder in different rations. Apart from this, it has its applications in agriculture as natural crop enhancer, in seed priming for improving seedling vigour, to mitigate salinity effect, biodiesel, biopesticide for controlling pests and pathogens, biogas/biofuel. Not only this, it helps in controlling run off, they check floods by preventing soil erosion, indeed improve soil fertility by adding manures upon decomposition and help in reducing temperature and pollution. These all attribute for mitigation of climate change directly or indirectly in sequestering terrestrial carbon sesquestration. Therefore, proving it to be a called as "paradise tree" for both environmental stability and also achieving economic benefits. Henceforth, helps in securing livelihood to vast population in various aspects in an eco-friendly manner to maintain ecological balance sustainably.

***Key words:*** *Moringa, climate change, livelihood security and sustainability*

# Morphometric Analysis Of The Hasdeo Subbasin Using Spatial Data Derived From Gis

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The term "Morphometry" literally means measurement of forms introducing quantitative description for landform. In the present study, morphometric analysis of the Hasdeo Subbasin was done to reveal information on the morphometry of the Hasdeo Subbasin using Alos Pulsar DEM data and to assess its hydrological characteristics and water potentials based on the morphological characteristics. *The study was carried out using spatial data obtained from Geographical Information Systems (GIS). The morphometric parameters considered for the analysis include the linear, areal and relief aspects of the basin.* Morphometric analysis of the river network and the Subbasin revealed that the Hasdeo Subbasin has 6th order river network (as per the Strahler's classification) with a dendritic drainage pattern. The obtained values of bifurcation ratio(1.93), drainage density(0.63), circularity ratio(0.32), elongation ratio(0.46), form factor(0.16), and stream frequency(43.86) respectively. This value shows the subbasin is very long means low peak flows for longer duration, consist of high risk of soil erosion and basins present a wide hydrographic network with many tributary streams with rapid response to precipitations. It is very worthwhile to prioritize area based on morphometric analysis.

***Keyword:*** *Hasdeo Subbasin, Morphomatric analysis, Spatial data, Geographical Information system.*

# Macronutrient-Nanofertilizers: An Innovative Approach For Nutrient Use Efficiency

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Nanofertilizers are those materials in the nanometer scale, usually in the form of nanoparticles containing macro and micronutrient that are delivered to crops in a controlled mode. They are used as a way to increase nutrient efficiency and improved plant nutrition compared to traditional fertilizers. Nanofertilizers are of three classes- nanoscale fertilizers, nanoscale additives and nanoscale coating. Despite many efforts, Nurtient Use Efficiency (NUE) in agriculture remains in a range of less than 50% and reaching the target can result into nutrient overuse. So, nanofertilizers are one of the most promising engineered materials that are being tested either for soil or foliar application. Normally macronutrient fertilizers (N and P) applied to soil may results in significant losses. However, macronutrient nanofertilizers are expected to increase NUE by improving the effectiveness of nutrient delivery to plant, enhanced mobilization of nano formulated nutrients, increase in surface area to volume ratio and providing more area for photosynthesis leading to more sunlight and absorption. Considering upland and submerged condition, nano urea delayed in N released by 39% N compared to urea of 70% N while Urea-HA nanohybrids saved 50% of urea consumption in *Oryza sativa*. Application of Nano Zeolite Phosphorus (NZP) can yield a potential result in determining apparent P recovery efficiency percentage of groundnut. Thus, nanofertilizers have been projected as a tool to meet the criteria of feasible agricultural activities synchronizing the release mechanism of nutrient with increment in yield and NUE by enabling slow and constant release of nutrient.

***Keywords:*** *Nanofertilizer, macronutrient, NUE, Urea HA and NZP*

# Green Synthesised Nano Micronutrient Fertilizer, A Way Onto The Next Generation Agroinputes

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Excessive use of conventional fertilisers in modern agriculture has resulted in several serious issues such as soil degradation, loss of soil organic matter and carbon content, and increased soil compaction. Even commercial nano fertilisers have a hazardous impact on the environment due to toxic chemicals released during their synthesis process, affecting agriculture's sustainability. To overcome this green synthesis of nano fertilizers would be the solutions. In the present study green synthesis of nano iron fertilizer was done using Bidense pilosa leaf extract and using $FeCl_3$ as precursor and it was characterized using various physico chemical technique such as UV–vis, partical size analysier and SEM and the synthesized nano fertilizer was used for foliar application in aerobic rice after optimizing the concentration for seed treatment as iron deficiency is the major issue in aerobic rice. The result reveled that there was drastic increase in the yield of aerobic rice due to foliar application of nano iron compared to soil application of conventional ferrous sulphate. And there was higher organic matter content in the particular nano iron foliar applied plot compared to conventional soil applied fertilizer plot.

# Role of Omic Approaches in Terminal Heat Stress Tolerance

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Heat stress (HT) is key environmental stress that has an impact on all aspects of plant processes. High ambient temperatures cause heat stress, which is a major danger to agricultural output all around the world. Plant growth and development include several temperature-sensitive metabolic processes. The degree and duration of HT, as well as the plant type, influence plant responses to HT. To compensate for stress-induced biochemical and physiological changes, plants have important tolerance mechanisms that rely on ion transporters, proteins, osmoprotectants, antioxidants, and other signalling cascades and transcriptional regulatory components. The capacity to detect the HT stimulus, create and convey the signal, and trigger appropriate physiological and biochemical changes are all required for plant survival under HT stress. Plant genomes contain a large number of heat stress-sensitive genes, which serve as the foundation for all molecular data related to heat stress tolerance (genomics). A large number of genes with potential functions in heat stress responses have been found using genetic screens and genome-wide expression studies. Gene expression and metabolite synthesis produced by HT greatly enhance tolerance. Data from the genome, proteome, transcriptome, microRNAs and metabolome levels are necessary to properly comprehend the molecular underpinnings of stress tolerance. As analytical and experimental technology has progressed, various experimental approaches for identifying biological molecules have been developed. "Omics technologies" are what these are referred to as. The great majority have high throughput, quick data generation rates, and large outputs. Technologies such as bioinformatics, statistics, and computing are employed. These techniques have advanced our understanding of plant biology in general and plant stress tolerance in particular. Microarray technology has recently emerged as a powerful tool for analysing the expression (or transcriptome) patterns of a large number of genes that are triggered or repressed by heat.

***Keywords:*** *Heat stress, tolerance mechanisms, genomics, Omics technologies, Microarray technology*

# Spatial and Temporal Distribution of Soil Available Nutrients In The Jute Growing Pockets of Kendrapara District of Odisha

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Jute is a significant fibre crop in Eastern India, where it plays an essential role in people's livelihoods. The crop's production has been dropping in recent years due to a variety of abiotic issues, the most prominent of which is poor soil nutrient management. To address the issue, surface soil samples were taken from four blocks in Odisha's Kendrapada district to determine the status and extent of soil major and micronutrient deficiency, as well as the relationship between soil attributes and nutrient availability, including the temporal changes in nutrients over 12 years periods. The result showed that the extent of NPS deficiency in this jute growing region was 97.5, 34.58, and 70.83% respectively. The multi-nutrient deficiency was highest for N+S (29%) and lowest for N+P+S (12%). Among micronutrients Fe, Mn, Cu, and Zn varied from 53.32 to 225.36, 40 to 167, 2.57 to 8.10, and 0.76 to 2.20 mg/kg, respectively. Regression study revealed that basic soil parameters such as pH, EC, and OC etc. influenced soil nutrients to the greatest amount (59.8% for Fe, followed by K). When present soil nutrient status was compared to data from 12 years ago, N and S levels had fallen, but other major and micronutrient levels had stayed essentially stable. According to the findings, jute farming requires management to restore long-term output and soil health.

***Key words-*** *Fibre crop, nutrient deficiency, soil health*

# Study on Rainy Days and Characteristics of Occurrence of Rainfall Events Over Upper Bhavani Basin, Tamil Nadu Using Remote Sensing and Gis

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The number of rain days and mean daily rainfall intensity provide good ideas about rainfall distribution compared to monthly or yearly total rainfall as these approximate to the frequency of occurrence and rainfall intensity; both having high significant impacts on agricultural as well as hydrological activities. This particular study mainly focused to understand the variability in rainy days over the Upper Bhavani river basin with special reference to seasonal, annual and decadal variation using long term daily rainfall data (1983-2019) and to find the variation in mean daily intensity with seasonal and annual scales over the years. The average annual rainy days in the Upper Bhavani river basin is 64 days. The average rainy days over the basin varies from 31 (in Karamadai) to 111 days (Avalanche). The basin received less rainy days in the years 1985, 1995, 2000, 2012, 2016 and more number of rainy days were received in the years 1997, 2005, 2015, 2018 and 2019. After the year 2016 an erratic behavior of rain days has been noted during 2017 to 2019. The basin received maximum rainy days during the South West Monsoon (SWM) season and least was found in the winter season (2 days). The South West Monsoon (June-September) received 28 rainy days on an average (44%), followed by North East monsoon, which received 23 days (36%) while in summer season, average rainy days was around 11 days (17 %) and 2 days (3%) where observed during winter season. The upper portion (Western part) and some part of the central portion receives high intense rainfall compared to other regions of the basin. Highest MDI (Mean daily intensity) value was found in Avalanche station (31.1 mm/day) whereas lowest MDI value was found in Kinnakorai station (14.3 mm/day).

***Key words:*** *IDW interpolation, Spatial distribution, Temporal variability, Upper Bhavani, Rainy days.*

# Biotechnological Interventions and Their Role in Crop Improvement

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Due to enormous changes in climate particularly temperature, rainfall and seasonal variations, affecting total yield and to meet the needs of world population there is a tremendous need for the crop improvement technology. It has already been predicted by FAO that there will be 25 % decline in crop yield by 2050 if we will not consider the climatic changes more seriously. It becomes necessary to raise crops which can adapt according to the abiotic stresses. Biotechnology involves two main approaches for crop development i.e. genetic engineering and molecular breeding which helps agricultural sector to combat the inevitable challenges such as malnutrition, food security and climatic changes. Nowadays use of agricultural biotechnology have become popularized as it helps to export the desired traits from one species of crop to different one. The phenomenon of crop improvement with biotechnology basically relies on the gene manipulation in direct or indirect way where direct one includes genome editing, RNA interference and indirect ways includes the breeding techniques. With the help of agricultural biotechnology one can raise transgene crops with desired characters such as pest free crops, tolerant to drought, soil salinity, herbicides, metal toxicity, disease free crops, flavored crops, enhanced nutritional level etc. It favors the development of genotypes that can overcome any stressful or harsh environmental conditions. Different arrays by which biotechnology have marked its place in agriculture includes r-DNA technology, tissue culture, embryo rescue, somatic hybridization, molecular gene-markers, micro-propagation etc. Furthermore, pandemic situations, such as the recent COVID-19 prevalence, have created significant gaps in the global population's food and nutritional security. As a result, the rapid introduction of environmentally sustainable high-yielding varieties is required. Molecular breeding and genetic manipulation have emerged as the two most powerful technologies capable of achieving food and energy security in the coming years. Genome sequencing is another main approach for crop improvement and had been done for rice, sorghum, soyabean etc. Many studies have revealed the importance of NAC genes and its potential in abiotic stress tolerance regulation, synthesis of cell wall, ROS signaling and programmed cell death but still more to go for production of transgenic crops with inbuilt stress tolerant properties. Moreover insect pest control and weed management have become easier and safer with biotechnology. RNAi, chromosome engineering, MARS, nano - biotechnology , large-scale genomic markers, high throughput genotyping, targeted gene replacement, next generation sequencing, precision editing are some emerging technologies which are going to explore more in future for crop improvement and to combat with all the challenges.

***Keywords:*** *Crop improvement, biotechnology, agricultural*

# Halophilic Microbes for Bio-Remediation of Salt Affected Soils

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Soil health is one of the key factors for efficient agricultural production. Increased demand for agriculture commodities generates incentives to convert forests and grasslands to farm fields and pastures which results in increase in soil erosion. Among the soil degradation problems, salt-affected soil is one of the serious problems under arid and semi-arid lands. Soil degradation through salinity or sodicity is universal concern. The problem of salinity and sodicity in India is becoming more serious and is a matter of concern because of alarming increase in the area in the country under these soils. The reclamation of these soils requires additional agricultural inputs and practices like amendments, water and infrastructure for drainage, which is costly and resource consuming. One of the cheapest approach for reclaiming the salt affected soils is the use of microorganisms in the form of different formulations. But the microbial strains available as biofertilizers for different crops do not perform effectively under salt stress and their activity decreases when used in salt affected soils due to osmolysis. To overcome this, attempts have been made to develop bioformulation based on halophiles, that can replace regular biofertilizer applications in salt affected soils. Halophiles are salt-loving organisms that inhabit hypersaline environments. A pot experiment was conducted during Kharif season of 2019, at the Division of Soil Science and Agriculture Chemistry to study the efficacy of halophilic biofertilizers *i.e.* Halo-*Azotobacter*, Halo-Phosphate Solubilizing Bacteria (Halo-PSB), Halo-Zinc and Halo-Mix on the soil health as well as growth and productivity of paddy (PR-113). Regular biofertilizers are ineffective under sodic soils owing to the inability of microbes to tolerate salt stress. Biological parameters such as, microbial biomass carbon, dehydrogenase activity, alkaline phosphatase activity and bacterial count were also increased significantly in sodic soil over corresponding control values. However, microbial biomass carbon, dehydrogenase activity and bacterial count also increased significantly in normal soil, respectively, while there was no significant difference observed in soil alkaline phosphatase activity in normal soils treated with various bioformulations. The soil fungal colonies remained significantly higher in normal soil as compared to sodic soil, even after the application of these bioformulations. Both dehydrogenase activity and phosphatase activity were affected by the type of soil and application of halophilic formulations. In sodic soils, the quantum of increase in enzymatic activity was, however, higher

and significant, upon application of bioformulations. Microbial count for both bacteria and fungi were significantly higher in normal soils as compared to sodic soils, as evident from overall mean values. Bacterial count was significantly higher in inoculated sodic soils over un-inoculated sodic soil.In nutshell, it was observed that Halotolerant strains of bio-fertilizers viz. Halo-*azotobacter*, Halo-phosphorus solubilizing bacteria, Halo-zinc and Halo-mix (combination of all three) were found to be effective in sodic soils. Application of multi-strain bacterial growth consortia could be an effective approach and need to be further explored.

***Keywords:*** *Halophiles, Halo-Azo, Halo-Phosphate Solubilizing Bacteria (Halo-PSB), Halo-Zinc and Halo-Mix, Microbial Biomass Carbon, Dehydrogenase activity, Phosphatase activity*.

# A Biotechnological Intervention For Crop Improvement : Bt Cotton

**Parth Bagadiya[1], Jwala Pranati[2]**

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2. **Professor Jayashankar Telangana State Agriculture University , Rajendranagar, Hyderabad-500030.**

Cotton has been woven and used in India for thousands of years. Indian cotton fabrics dominated the world trade during the succeeding millennia and were exported to many places, including Greece, Rome, Persia, Egypt, Assyria and parts of Asia. Much of the cotton cultivated until the 20th century was of the indigenous 'desi' variety, *Gossypium arboreum* . From the 1990s, hybrid varieties of *G.hirsutum* were promoted. These hybrids cannot resist a variety of local pests and require more fertilizers and pesticides. Cotton suffers from plenty of infestation from moth pests (Lepidopteran) such as the Pink Bollworm (PBW) and sap-sucking (Hemipteran) pests such as aphids and mealy bugs. Cotton is one of the highest pesticide consuming crops which impact the environment through polluting land and water and poisoning humans, animals and insects. At this stage Bt cotton was introduced in India in 2002. The environmental impact quotient was significantly lower for Bt cotton because of reduced pesticide consumption. Bt cotton has been genetically modified by the insertion of one or more genes from a common soil bacterium, *Bacillus thuringiensis*. These genes encode for the production of insecticidal proteins, and thus, genetically transformed plants produce one or more toxins as they grow. The genes that have been inserted into cotton produce toxins that are limited in activity almost exclusively to caterpillar pests (Lepidoptera). However, other strains of *Bacillus thuringiensis* have genes that encode for toxins with insecticidal activity on some beetles (Coleoptera) and flies (Diptera). Some of these genes are being used to control pests in other crops, such as corn.

***Keywords :*** *Bollworms; Genetically modified; lower environmental impact, Bacillus thuringiensis; insecticidal proteins*

# Effect of Sensor Based Irrigation on Yield And Water Use Efficiency of Finger Millet

**(*Eleusine coracana* Gaertn)**

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The field experiment on "Sensor based irrigation management in finger millet (*Eleusine coracana* Gaertn)" was conducted during *summer*-2021 at ZARS, University of Agricultural Sciences, GKVK, Bangalore 560065. The experiment comprised of seven treatments *viz*., $T_1$: Surface irrigation as per Package of practice, $T_2$: Drip irrigation at weekly interval, $T_3$: Drip irrigation at 50 per cent depletion of available moisture (DASM), $T_4$: Drip irrigation at 75 per cent DASM, $T_5$: Green SMI based drip irrigation, $T_6$: Red SMI based drip irrigation, $T_7$: Sensor based automated drip irrigation at 25 per cent DASM replicated thrice in Randomized Complete Block Design. Hall effect water meter was installed to measure the quantity of water flows. To measure the soil moisture instantly, resistance type single point sensors were installed in the field at a depth of 15 cm, in turn all were connected to IoT based field controller and gateway. The results showed that, sensor based automated drip irrigation at 25 per cent DASM recorded significantly higher grain and straw yield (3984 kg $ha^{-1}$ and 4913 kg $ha^{-1}$, respectively). However, it was on par with green SMI based drip irrigation (3658 and 4540 kg $ha^{-1}$, respectively) and drip irrigation at 50 per cent DASM (3560 and 4496 kg $ha^{-1}$, respectively). Net return (Rs. 66045 $ha^{-1}$) and B: C ratio (2.31) was also higher in sensor based automated drip irrigation at 25 per cent DASM. Drip irrigation at 50 per cent DASM recorded the highest water use efficiency (92.7 kg ha $cm^{-1}$) and saved 41.7 per cent water as compared to surface irrigation. Whereas lower water use efficiency (39.1 kg ha $cm^{-1}$) observed in surface irrigation.

***Keywords*** *- Finger millet, irrigation, sensor, automation*

# Crispr for Crop Improvement

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Crops provide food, feed, fuel, and other consumable resources for human life, thereby contributing enormously to society. To feed and nourish a rapidly growing population in the face of climate change, decreased arable land, and shortage of available water resources, there is an urgent need for innovations in crop breeding technology to increase agricultural productivity and accelerate sustainable agricultural development. The availability of genome sequences for several crops and advances in genome editing approaches has opened up possibilities to breed for almost any given desirable trait. Unlike first-generation genome editing tools, such as zinc finger nucleases (ZFNs), transcription activator-like effector nucleases (TALENs), CRISPR/Cas9 genome editing involves simple designing and cloning methods, with the same Cas9 being potentially available for use with different guide RNAs targeting multiple sites in the genome. After proof-of-concept demonstrations in crop plants involving the primary CRISPR-Cas9 module, several modified Cas9 cassettes have been utilized in crop plants for improving target specificity and reducing off-target cleavage (e.g., Nmcas9, Sacas9, and Stcas9). Further, the availability of Cas9 enzymes from additional bacterial species has made available options to enhance specificity and efficiency of gene editing methodologies. CRISPR/Cas9 method of gene editing has been adopted in nearly 20 crop species so far for various traits including yield improvement, biotic and abiotic stress management. CRISPR/Cas9-based genome editing has been utilized to increase crop disease resistance and also to improve tolerance to major abiotic stresses like drought and salinity. Application of these techniques will result in the development of non-genetically modified (Non-GMO) crops with the desired trait that can contribute to increased yield potential under biotic and abiotic stress conditions.

***Keywords:*** *Crop improvement, CRISPR/Cas9, genome editing tools, Non-GMO crops*

# Development of App For Designing of Location Specific Sprinkler Irrigation System

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In India famers are irrigating their crops by different methods of irrigation. Sprinkler irrigation is one of the best methods of irrigation for irrigating the different cereal crops and to increase their production. Sprinkler irrigation is the method of irrigation by which water is sprayed on the land surface in the form of artificial rain. Farmers irrigate the crops through sprinkler irrigation but not get full advantages from this irrigation facility, due to improper design and management of the system. Designing a sprinkler irrigation system is a very difficult task for any farmer or extension worker and it is very difficult to calculate the various parameters. There are numerous computer based software's available to deal with the design related issues but the drawback is that the requirement of hardware and software is not easily available to the users. Now a day's Android platform based smart mobile phone and mobile application are being readily used and adopted by the farmers, extension workers, students and researchers. Therefore, the present study deals with the "Development of App for designing of location specific sprinkler irrigation system". The App was developed through Android Studio Software. The application is coded in JavaScript and html programming language. This android App is an open source mobile operating system by Google and it can be easily installed by the farmers or extension workers through Google Play Store. The result from the study revealed that the developed App is able to calculate designing parameters for sprinkler irrigation system as per user requirement and input data. Developed App has been run successfully but it totally depends on the proper input parameters. In the developed App input data changing facilities are also providing to the users as per their requirement. After finalization and entering all the important input parameters and clicking the finish button, the Sprinkler Irrigation System Design App will creates a PDF file as a designing report for the users based on input data. This App helps user to design their field and install whole sprinkler irrigation system and minimizes their extra designing cost and can get higher return.

# Gene Trapping -A Powereful Tool Of Functional Genomics To Identify Novel Genes

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Gene trapping is a unique method that helps to identify novel gene by producing random gene disruption by inserting a DNA element, which contains a reporter gene and a selectable marker, throughout the genome. It is a type of insertional mutagenesis that disrupts gene function by the integration of a vector in the intergeneric sequences. It provides an important and unique method for studying the relationship between gene expression and function. A powerful tool to characterize novel genes and analyse their importance in biological phenomena. It is insertional based gene discovery that utilizes random integration of reporter gene construct into genome and produce dominant expression phenotype. It is accomplished by using gene trapping vectors which mutate endogenous gene at the site of insertion and identify the site of integration and mutated gene by reporting the expression of the mutated gene. The mutation is generated by inserting a trap vector construct into an intronic or coding region of genomic DNA. It contains selectable reporter tags which are used to identify cell lines in which the vector has successfully interrupted a gene. It is performed with gene trap vectors that simultaneously mutate and report the expression of the endogenous gene at the site of insertion. Based on the component of gene expression cassette which they exploit, trap vectors are classified as: enhancer trap vectors, promoter trap vectors, gene trap vectors, poly A trap vectors and secretory trap vectors. Vectors are introduced in embryonic stem cells in mice and leaves or floral parts in case of plants by electroporation or virus-mediated transformation. The transformed cells are selected on the basis of selectable markers. Insertion events are detected and the trapped lines are established. This technique has been used to identify tissue specific and temporally regulated genes in plants and mice. It proves to be a powerful tool of functional genomics. The ability to efficiently trap, sequence and detect the expression of genes, regardless of their transcriptional activity, has made gene trapping an exceptional tool for gene discovery. A rapid and cost-effective method that is suited for large scale mutagenesis and full genome exploration. Compared to other mutagenesis, this technique is efficient in creating widespread mutation but often leads to unpredictable phenotype

***Keywords:*** *Gene trapping, Insertional mutagenesis, Selectable markers, Trap vectors, Gene expression, Gene expression cassette.*

# Genetic Variability And Character Association Studies For Grain Yield Characters Of Indigenous Aromatic Rice Varieties of Assam

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Genetic variability and character association studies were conducted in a set of 14 indigenous aromatic rice varieties of Assam with respect to seven quantitative grain traits viz. grain length, grain width, spikelet per panicle, total panicle per plant, 100-grain weight, grain weight per panicle and grain weight per plant. Highest genotypic coefficient of variance (GCV) along with highest phenotypic coefficient of variance (PCV) was observed in grain weight per plant followed by grain weight per panicle and total panicle per plant. This revealed high level of variability among the genotypes for these traits. Character association studies revealed significant and positive correlation of grain weight per plant with total panicles per plant (0.78) followed by total spikelets per plant (0.60) and grain weight per panicle (0.55). This indicated that selection of genotypes based on these traits would be effective for improving grain yield per plant and would be helpful for breeding programmes.

***Keywords:*** *Genetic variability, agro-morphological traits, character association, aromatic rice of Assam.*

# Dsr-An Alternate Method of Rice Establishment Technique

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Traditional transplanting practices of growing rice in Assam involve a huge cost in establishment methods adopted by farmers which not only limit the return but also degrades soil and involves huge labour. Adaptation of improved crop establishment methods suitable under adverse climatic conditions is of utmost importance for utilization of natural resources as well as to maintain the sustainability. Therefore, a study has been made in the *kharif* season of 2020 and 2021 to see an alternate rice establishment methodology *viz*., direct seeding, aerobic rice in comparison with conventional transplanting and to see the effects in crop growth and yield parameters. The results suggest that an adoption of direct seeded rice (DSR) is time saving as well as the rice productivity is at *par* with conventional transplanting, while offering the additional benefit of advancing the seeding of succeeding crops by 8-10 days compared with the transplanted rice system. So, DSR may be an alternate way that would sustain food security and can be adapted while replacing conventional transplanting under diverse climatic conditions.

***Key words:*** *Direct Seeding, Aerobic rice, Transplanting, Sustainability*

# Performance of Different orange Flesh Sweet Potato Genotypes (*ipomoea batatas* l.) for Yield and Quality Parameters

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The experiment conducted with eight orange-fleshed sweet potato entries during *Kharif* seasons of 2018 to 2020 at the Regional Horticultural Research Station and extension center, Dharwad (Karnataka) revealed that the Sree Bhadra genotype yielded the highest total and marketable tuber yield of 26.75 and 23.53 t $ha^{-1}$, respectively. TSp 16- 10 was found on par with Sree Bhadra producing total and marketable tuber yield of 26.67 and 23.17 t $ha^{-1}$, respectively. Higher dry matter and starch content of 22.17 and 17.68 per cent were recorded in TSp 16-3, respectively. While ST-14 recorded the higher ß –carotene, 12.99 mg 100g $dry^{-1}$ weight, the TSp 16-10 and TSp 16-5, recorded significantly higher and lower sugar content of 4.64 and 2.32 per cent, respectively.

# Role of Nanoparticles For Sustainable Agriculture

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Currently, global population is increasing rapidly leading to increased nutritional demand and food insecurity. According to UN report, global population is projected to increase approximately 9 billion by 2050, to fulfil nutritional demands of increasing population there is an urgent need to increase food production by 50 % or more. Under conventional farming techniques, nearly one third of crops get damaged due to pest infestation, microbial attack, natural disasters, poor soil quality and lack of availability of nutrients. On the other side, industrialization resulted in depletion of available natural resources on which livelihood of the population depends. There is a need to develop innovative technologies that address all these issues. Nano-technology, technology that accorded for Agro-technological revolution, is the disruptive solution with immense potential to reform present-day agriculture systems with promising food security. Today, nano particles are contemporary material to transform traditional agricultural practices. Introduction of nano materials has a clear advantage of required modification regarding elevated demands due to high reactivity and novel physio chemical properties. Nano based products like nano pesticides, nano fungicides, nano fertilizers (nano urea) and development of nano sensors can provide good results in improvement of soil nutrient condition and plant health management. Nano particles are employed in agriculture sector with an aim to increase crop yields by minimising nutrient losses and to reduce cost of fertilizers, plant protection materials. By understanding interaction between plant and nano particles it opened up ways to improved crop management practices like disease resistance, crop yield and nutrient utilization. Effective utilization of nano technology-based solutions in agriculture could benefit crop productivity, food security and sustainability in future.

***Keywords:*** *Nano Technology, Nano Fertilizers and Sustainable Agriculture*

# Influence of Npk Levels on Growth And Yield of Quality Protein Maize Under Mid Hill Conditions

**Sunil K. Mishra[1] and Vikas Sharma[2]**
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**Regional Agricultural Research Station, Rajouri [2]**

The experiments were conducted on quality protein maize during kharif season at RARS Rajouri during 2016 and 2017. Experiment was carried out during kharif to evaluate the growth and productivity parameters. The experiment consisted of five levels N (0, 60, 120, 180 and 240 kg/ha), P (0, 30, 60, 90, and 120 kg/ha) and K (0, 20, 30, 40, 50). The experiment was laid out with three replications in Factorial Randomized Block Design (FRBD). Different growth parameters were significantly affected by application of N, P, K at different levels. Maize crop fertilized with 180 kg N/ha gave significantly higher results (height of 275.15 cm and LAI 3.20 and dry matter 10152 kg/ha) in comparison to other applications. This significant increase in yield parameters was due to application of higher doses of NPK fertilizers which enhanced nutrients uptake by the crop by better translocation of photosynthates.

***Keywords:*** *QPM, NPK, Hill area.*

# Farm Mecinization Boon for Modern Agriculture

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A field demonstration was conducted in Sartha village of Nalanda district since 2019 under Climate Resilient Agriculture Programme. This demonstration was conducted on wheat crop variety HD-2967, DBW-187 and lentil crop variety HUL-57 and Chick pea Variety GCP-105 instead of local variety. This was conducted on 100 farmer's field on 32 hectare land in 1st year and 415 farmers in 158 hectare in 2nd year in wheat crop. Lentil crop covers the area 3.2 hectare initially and in chick pea it covers 5 hectare. In next year lentil covers 22 hectare in 65 farmers and chickpea covers 28 hectare in 82 farmers. The line sowing was done by Zero tillage/happy seeder instead of broadcasting. Paddy straw remains in the crop field in case of sowing by happy seeder. It acts as mulch and leads to reduction in weed infestation, reduces the pest and disease incidence and increase in interval of irrigation. It leads to conservation of natural resources, reduces the cost of cultivation and improves the soil fertility as well as physical and biological properties of soil. It also saves time that is used during field preparation for cultivation of crop. Previously farmers are getting yield about 45 quintals per hectare in wheat, 7.2 quintal per hectare in lentil and 11.5 quintal per hectare in chick pea by traditional method. Now he is getting 55 to 60 quintal per hectare in wheat, 10.6 quintal per hectare in lentil and 16 quintal per hectare in chick pea by introduction of improved variety and farm mechanization. By these initiatives the crop residue burning is restricted and improves the soil micro flora and fauna and reduces the environmental pollution. The fertilizer use efficiency of crop is also improved due to band placement instead of broadcasting. The labour shortage is one of the major problems these days in agricultural farming practices. The farm mechanization is now a boon and necessity for intensive agriculture and farming becomes a profitable enterprise. The production and productivity of wheat, lentil and chick pea is improved.

***Key words**: Wheat,Conservation,soil, Farm mecinization,Labour,Yield*

# Influence of Germination on The Nutrients And Bioactive Compounds And Their Health Benefits

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FAO points out that there are more than 50,000 edible plant species across the world. But only a very few species are nutritionally important food sources. Cereals and legumes are the important one with good protein, fiber, vitamins, minerals and constitute an important source of various nutrients to the body. Consumption of both grains and pulses together plays a significant role in improvement of protein quality by supplementing lysine for lysine deficient grains. Germination is an incredible event that signals the birth of new life. It is a process that involves various steps associated with uptake of water by the dry seed and initiate the elongation of embryonic axis. During germination, to support growth, a high amount of nutrients is prepared for this process. All the dormant enzymes are activated during the germination and provide best nutrition to the sprout. So, the amount of available nutrients is greatly increases. Germination is the major biological processing method in the field of nutrition. It is the most dynamic process during the plant growth and is also considered as an important step for improving the nutritional value and reducing the antinutritional content. Many studies have reported that, apart from increasing the availability of the body, germinations also increase the bioactive compounds such as GABA (γ-amino butyric acid), vitamins and a variety of polyphenol compounds which can be used as food antioxidants. The α-Galactosides content, oligosaccharides that produce flatulence and trypsin and chymotrypsin inhibitors, which affect the digestion of proteins, can be reduced during germination. The digestibility of proteins increases during germination and the emulsifying capacity of legume proteins also increases Antioxidants are required for the body to protect from the oxidative damage and a number of degenerative diseases. Currently, there is an increased demand for the germinated foods because of various physiological benefits. Germinated brown rice has resulted the positive effect in reducing the blood pressure, lipids and so, it has potential to treat metabolic syndromes. Consumption of brown rice many physiological benefits such as it prevents complications of life, anticancer, stimulate osteoblastogenesis, regulate emotions and memory. The consumption of plant-based food is increasing markedly due to the improvement of people's awareness of well-balanced nutrition. A wide range of food products are developed by using germinated seeds to improve the functional and nutritional quality of the food products. Germinated seeds are used in the food sector as a substitute in bakery and beverage industry and also used in many infant foods to combat protein energy malnutrition. It is also used as a supplement to prevent many non-communicable diseases. Development of germinated seeds based functional foods is the valuable research hotspots in the present and the future.

***Key words:*** *Germination, GABA, legumes, value added products*

**National Webinar**

**On**

# Sustainable Interventions Towards ResourceConservation and Natural Farming

**22nd -23rd April 2022**

Organized by

**Academy of Natural Resource Conservation and Management (ANRCM),Lucknow, U.P.**

*In Collaboration with*

**Assam Agricultural University, Jorhat, Assam**

## Programme

| **Day 1** | **Friday, April 22, 2022** |
|---|---|
| **INAUGURAL SESSION** | |
| **10:30-11:30** | Welcome address by **Dr. T.K. Srivastav**, Vice-President, ANRCM |
| | About ANRCM by **Dr. Sanjay Arora**, Secretary, ANRCM |
| | About National Webinar by **Dr. Kaberi Mahanta**, OrganizingSecretary |
| | Address by Guest of Honour, **Dr. J. Deka**, Dean, FoA, AAU, Jorhat |
| | Address by Guest of Honour, **Dr. M.C. Manna**, Head, Department of Soil Science, DrRPCAU, Pusa, Samastipur |
| | Release of E-Abstract Book by Guests |
| | Address by Chief Guest, **Dr Gagnesh Sharma**, Director, National Center for Organic and Natural, Farming, Ghaziabad, UP (Keynoteaddress) |
| | Vote of thanks by **Dr. Anshuman Kohli**, Co-Organizing Secretary |

## TECHNICAL SESSION-I (11:30-14:00)

### Conservation of Natural Resources for Food Security and Environmental Safety through Organic and Natural Farming

***Chairman***: Dr. D. J. Rajkhowa, Jt. Director, ICAR for NE Region, Nagaland Centre
***Co-chairman***: Dr. G.S. Panwar, Professor and Dean (Agriculture), BUAT, Banda, UP
***Conveners***: Dr. Priyadarshini Bharali, Assistant Professor, AAU, Jorhat
Dr. Tarun Adak, Sr Scientist, ICAR-CISH, Lucknow, UP
Dr Anjan Krishna Sharma, Assistant Professor, AAU, Jorhat
Dr. Amit Mishra, Assistant Professor (Soil Science), BUAT, Banda, UP

**Parallel Event: Earth's Resources Awareness Quiz (11:30 AM to 11:40 AM)**

| | |
|---|---|
| 11:30-12:00 | ***Keynote Speaker:*** **Dr. Sunita Pandey**, Prof & Head, GBPUAT, Pantnagar<br>***Topic:*** **Natural Farming for Sustaining Natural Resources** |
| 12:00-12:15 | ***Lead Speaker:*** **Dr. L. Baishya**, Principal Scientist, ICAR for NE Region, Nagaland Centre<br>***Topic:*** **Scope and opportunities of Natural Resources management withspecial reference to Eastern Himalayan Region** |
| 12:15-12:30 | ***Lead Speaker:*** **Dr. Jagannath Pathak**<br>Associate Professor, Department of Soil Science, BUAT, Banda<br>***Topic:*** **Natural farming: Prospects and way forward in Indian condition** |

**ORAL PRESENTATIONS (12:30 PM to 14:00 PM)**

| Abstract | Authors | Title |
|---|---|---|
| 1.01 | Meenakshi Gupta, Sarabdeep Kour andRajeev Bharat | Livelihood Security in Rainfed Areas throughMixed Cropping Systems |
| 1.02 | Ventina Yumnam and Sanjay-Swami | Integrated Nutrient Management in Lakadongturmeric for higher yield in acidic soil of Meghalaya |
| 1.03 | Tridisha Deka and Sanjay-Swami | Developing Organic Nutrient Management package for higher yield of Black turmeric inacidic soil of Meghalaya |
| 1.04 | P. V. Geetha Sireesha, G. Padmaja, P. C.Rao and M. Venkata Ramana | Effect of organic sources on Carbon sequestration rate under different Agro Climate Zones |
| 1.05 | Bipul Deka, Bipasha Borkotoky and R. K.Thakuria | Use of harvested rainwater in Drip Irrigation forcultivating off-season Polyhouse crops |
| 1.06 | Savita, Sonu Kumari and Bijender Singh Beniwal | Drought-resistance turfgrass management practices |

| | | |
|---|---|---|
| 1.07 | Vinod Gupta, Abhay Kumar Sinha and Pradeep K Rai | Direct Seeding of Rice : Boon for rice cultivation |
| 1.08 | Kriti Singh | Soil Microbial identification and contribution toovercome the Stressed Environmental conditions |
| 1.09 | Vinay M. Gangana Gowdra and C.Seenappa | Ratoon Pigeon pea - A resource conservingtechnique |
| 1.10 | Tamanna Sharma, Vivak M Arya and Vikas Sharma | Natural Farming: A sustainable way to nurture soil health |
| 1.11 | Sheikh Shubeena , Abdul Hai andS.A.Hamdani | Traditional medicinal practices used management of various ailments of livestock by the farmers of Central Kashmir |
| 1.12 | Ninchhen Dolma Tamang and Rajesh Joshi | Effectiveness and Sustainability of Managed Aquifer Recharge in Sikkim Himalaya: Adaptation to Climate Change |
| 1.13 | D. Divyabharathi, Ravi C.S., Ganapathi M. and Nandish M.S. | Inoculation of liquid Plant Growth Promoting Rhizo microorganisms for the production of quality seedlings in cardamom (Elettaria cardamomum Maton.) through sustainable practice |
| 1.14 | Manoj Kumar | Curtailing Water Requirement for Makhana Farming: A Case Report |
| 1.15 | Sherene Jenita Rajammal, T | Crop waste Biochar application on soil Moisture retention under Red gram crop in Rainfed Agriculture |
| 1.16 | Punabati Heisnam, Abhinash Moirangthem, Y. Disco Singhand, B.N. Hazarika | Climate change mitigation on agriculture, ecosystem and rural livelihood of North Eastern Hilly Region |
| **POSTER PRESENTATIONS (14:00-15:00)** | | |
| ***Coordinators:*** Dr Bhabesh Gogoi, Scientist, AAU, Jorhat and Mr. Priyobarta Singh | | |
| 1.17 | Sridhara M. R., R. A. Nandagavi, S. S.Nooli and A. H. Biradar | Soil NPK nutrient balance and nutrient uptake inchickpea (*Cicer arietinum* L.) as influenced by organic foliar nutrition under rainfed condition |
| 1.18 | Tarun Adak and Naresh Babu | Assessing productivity gap analysis of fruit cropsthrough soil indices for its sustainability and policy planning |
| 1.19 | Gadi Sri HarshaVardhan, Silpi Sikha Saikia,Basanta Kumar Borah | Characterization of gut microbes of greater waxmoth (*Galleria mellonella*) |
| 1.20 | P. Neeshma, P. Yavanika, P. Monika, E. Anusha | Agricultural Water Management in the context of Climate Change |

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| 1.21 | Akshika Bhawariya, N.K. Pareek, S.M. Kumawat and Shankar Lal Sunda | Role of Organics in improving productivity of Cluster bean (*Cyamopsis tetragonoloba* L. Taub.)in Arid Region |
| 1.22 | P. K. Rai, V. M. Arya and Preeti | Natural Farming improves soil quality and restoring the ecosystem |
| 1.23 | Sibani Das and Rinku Moni Phukon | Integrated Horticulture based farming system: AReview of Farmers Friendly Approach for Efficient Food Production and Environmental Sustainability |
| 1.24 | T. Ganesh and K. Vemana | *In vitro* evaluation of Root Endophytic Bacteria against *Sclerotium rolfsii* incitant of stem rot inGroundnut |
| 1.25 | Arya Kumar Sarvadamana and Anil Shukla | Effects of Nitrogen scheduling along with Zn andBoron fertilization on growth and yield of Indian Mustard (*Brassica juncea* L.). |
| 1.26 | Aditya Raj, Umesh Singh, Anshuman Kohliand Mainak Ghosh | Hypothesizing Soil aggregation characteristicsunder Natural Farming |
| 1.27 | B. Bhanu Kiran Reddy, K. Chandrashaker, B. Raju and K.B. Suneetha Devi | Changes in alkaline phosphatase activities during decomposition of crop residues |
| 1.28 | Bonjuri Saikia, Anjuma Gayan and Dhruba Jyoti Nath | Soil Microbial Diversity under Long term Organic and Conventional Farming: A Review |
| 1.29 | Thokchom Dorenchand Singh and Sanjay Swami | Toxicity Mechanisms of Heavy Metals in plants |
| 1.30 | Deepak Prajapati, Jagannath Pathak, Deo Kumar, Amit Mishra, J.K.Tiwari, A. K.Chaubey, Amar Singh Gaur, Ashutosh Kumar,Sarvesh Kumar | A review: Zero budget natural farming feasible to small farmers for food, nutritional security and soil health |
| 1.31 | Debasree Saha | Rain water harvesting-a simple method of water conservation |
| 1.32 | Yahiya Akram Laskar, Sarabdeep kour, Alok Patel and Ravi Kumar | Natural Farming as a New Soil management Strategies to Improves Soil Quality and Changes Microbial Community |
| 1.33 | Divya Chadha, Vikas Sharma, Vivak M. Arya, Divya Sharma | Halophilic microbes for bio-remediation of salt affected soils |

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| 1.34 | Punabati Heisnam, Y. Disco Singhand,<br>Abhinash Moirangthem, B.N. Hazarika | A Review: Organic farming for Sustainable<br>Agriculture in North East India |

## TECHNICAL SESSION-II (15:00-18:30)

### Conservation Agriculture, Carbon Sequestration, Nutrient Management and BiodiversityConservation in the Context of Natural and Organic Farming

***Chairman***: **Dr. M. Saikia**, Additional Director Res., AAU, Jorhat
***Co-chairman***: **Dr. Pramod Kumar Sharma**, Professor, Dept. of Soil Science and AgriculturalChemistry, Institute of Agricultural Sciences, BHU, Varanasi
***Conveners***: Dr. Nasima Rahman, Scientist, (Hort.), RARI, Nagaon, Assam Agricultural University, Jorhat, DrS.P. Singh, Assistant Professor, (Soil Sci.), Dr. RPCAU, Pusa, Samastipur, Bihar, Dr Mainak Ghosh, Assistant Professor (Agronomy), BAU, Sabour, Dr. Rajan Bhatt, Sr Scientist, PAU, RRS, Kapurthala, Punjab

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| 15:00-15:30 | ***Keynote Speaker:*** **Dr. Anup Das**, Principal Scientist, ICAR for NE Region,Tripura Centre<br>***Topic:*** Conservation agriculture for achieving sustainable development goalswith reference to north east India. |
| 15:30-15:45 | ***Lead Speaker:*** **Dr. Dibyendu Sarkar**, Assistant Professor, Bidhan ChandraKrishi Viswavidyalaya, West Bengal<br>***Topic:*** Conservation agriculture a pathway to sustainable agriculture |
| 15:45-16:00 | ***Lead Speaker:*** **Dr Jayanta Lyak**, Scientist, ICAR for NE Region, Umiam, Meghalaya<br>***Topic:*** Designing organically managed farming system models forenhancing livelihood of farmers |

| **ORAL PRESENTATIONS (16:00 -17:30)** | | |
|---|---|---|
| 2.01 | Shivanand Goudra and Chandrashekara, C. P. | Crop diversification in Adsali sugarcane under natural, organic and conventional farming practices |
| 2.02 | Kumar Nishkarsh, Deeksha Singh and Divya Sahni | Isolation and identification of microorganism decomposer from sugarcane trash |
| 2.03 | Prabhsimran Singh, Gazala Nazir and G.S.Dheri | Soil carbon sequestration through different management practices |
| 2.04 | Prabhsimran Singh, Gazala Nazir and G.S. Dheri | Changes in soil fertility and productivity of rice- wheat cropping |
| 2.05 | Pooja A. P.,Ameena, M., and Arunjith P. | Resource management through foliar feeding for increasing the productivity |
| 2.06 | Sibino Dolie | Conservation agriculture for enhancing pulse production |
| 2.07 | N. Surbala Devi, D. Saha and Ningthoujam | NH4 - fixation in soil as influenced by addition |
| 2.08 | N.A. Meshram, S. S. Desai and S. S. Sawant | Carbon sequestration under Brideliaretusa |
| 2.09 | B.Anitha and P.Tanuja | Application of organic manures and biofertilizers |
| 2.10 | G.Sridevi, Sabeena M. S. and D. Jayanthi | Impact of permanent manurial experiment on crop yield and soil health |
| 2.11 | Shubham Mishra | Organic Farming, Conservation Agriculture Carbon Sequestration and |
| 2.12 | Deeksha Singh, Kumar Nishkarsh and | Screening of Azotobacter species for Plant |
| 2.13 | Vinayak K. Kumbar, Shivakumar K.M., Yogeeshappa H., Kantesh N. | Impacts of different nutrient management strategies on arecanut |
| 2.14 | Divya Sharma, Vikas Sharma, Vivak M. Arya and Divya Chadha | Effect of Conservation Agriculture on Organic Carbon Changes over Time in |
| 2.15 | Anjan. K. Sarmah, J. K. Choudhary, Jayanta Deka, J.C. Das, K. N. Das | Nutrient management in organic aromatic rice |
| **POSTER PRESENTATIONS (17:30 – 18:30)** | | |
| Coordinators: Dr Poppy Bora, Scientist, AAU, Jorhat and Ms. Sapna Mayuri Bora | | |
| 2.16 | K.T. Dimple, C. Nagamani and S.Mobeena | Conservation agriculture in India |

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| 2.17 | Yabi Gadi and M.M Shulee Ariina | Effect of Biochar and Pig manure on performance of Ricebean [ *Vigna umbellata* (Thunb) Ohwi and Ohashi] and soil properties inDystrudepts |
| 2.18 | Oddula Vamshi and Sannidi Sushma | The benefits biochar in agriculture |
| 2.19 | Divyansh Verma | Impact of organic matter on soil biologicalproperties and soil quality |
| 2.20 | P. Monika, I. Venkatesh and P.Neeshma | Conservation Agriculture- A route towards sustainability |
| 2.21 | Lalit Kumar Verma and Pukhraj Singh | Organic farming: A path for eco-friendlysustainable agriculture |
| 2.22 | Priya Chib, K.R. Sharma, Vikas Sharma and Vivak M. Arya | Cropping systems, effect on soil physical properties and carbon sequestration |
| 2.23 | S.Balo and D. Mukhopadhyay | Low carbon emissions from agriculture: An approach to combat climate change |
| 2.24 | Tanjot Kour and Sarabdeep Kour | Short-term effect of tillage practices and Mustard-based Cropping Systems on Soil Quality in Drylands of India |
| 2.25 | Sushila Aechra | Response of microbial inoculants and split application of vermicompost on wheat (Triticum aestivum L.) production |
| 2.26 | R. Paramesh Kumar Naik, A. Prasanthi, P.<br>V. R. M. Reddy and A.V. Nagavani | Characterization of the power loom dye's effluent water in Nagari division of Chittoor district of Andhra Pradesh |
| 2.27 | Amit Kumar, Pramod Kumar Panda, Nihar Ranjan Shoo and Raghabananda Nayak | Effect of organic nutrients on quality of cashew (Anacardium occidentale L.) value added product cv. BPP-8 |
| 2.28 | Amrendra Yadav, V.K. Kanaujia, Arvind Kumar, Amar Singh, A. K. Singh and Ramanand Patel | Efficacy of weather based agriculture under changing climatic context in the Kannauj and Bulandshahr districts of Uttar Pradesh |
| 2.29 | G. Sunitha, P. Archana and V. Sneha | Conservation Agriculture: A new technique for sustenance of agriculture and natural resources |

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| 2.30 | Archana, B., Sampath, O., Suneetha Devi, K.B and Ravi, P. | Conservation Agriculture for sustainability through land configurations and mulching techniques in Chickpea |
| 2.31 | Ashutosh Kumar, A.K. Choubey, Amar Singh Gaur, Deepak Prajapati, Abhishek Kumar and Anchal Singh | Conservation Agriculture for Sustainable Soil Management and Improve the Livelihood People in India |
| 2.32 | M S S Charan Satya and Sanjay Swami | Conservation Agriculture: A practice for soil carbon sequestration |
| 2.33 | Giridhar Vasant Usendi, RajKumar, D.K. Singh, S.P. Yadav, D.S. Sahu and Kartik Tomar | Effect of different indigenous breeds of poultry layers on production and morphological egg quality traits in Western U.P. |
| 2.34 | Priyanka Kumari, Gopal Kumar, A. K. Jha and Sunil Kumar | Plant growth enhancement with phosphorus- solubilising microorganisms and Biochars: A Review |
| 2.35 | Sandeep Kumar Sahu, Arun Alfred David, Tarence Thomas, AmreenHasan and IskaSrinath Reddy | Rsponsee of Varying Level of Inorganic Fertilizers Farm Yard Manure and Rhizobium Inoculation on Soil Health and Yield Attributes of Blackgram (Vigna mungo L.) var. Shekhar-2 |
| 2.36 | Suresh, H., Vasanthi, B. G., Mudalagiriyappa., Puneetha, K. M. and Madan Kumar, M. | Effect of long term INM on yield and soil properties under finger millet based cropping system in Alfisols of Eastern dry zone of Karnataka |
| 2.37 | N. Surbala Devi, T. Sanahanbi Devi and Lalmalsawma Ralte | Micronutrient status in paddy fields of Valley districts of Manipur |
| 2.38 | N. Surbala Devi, Kh. Manorama and T. Sanahanbi Devi | Effect of urea and organic manure on changes in inorganic and organic nitrogen in paddy soil |
| 2.39 | P. Archana, V. Sneha and G. Sunitha | Integrated farming systems under resource poor conditions - an analysis of constraints |
| 2.40 | Neha Toppo, Arun Alfred David, Tarence Thomas and Iska Srinath Reddy | Organic farming for soil sustainability and food production challenges |

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| 2.41 | Kumar Chiranjeeb, Chhaviraj Baghel and Rajani | Influence of vermicompost and inorganic fertilizer on microbial biomass and fertility status in incubation soil |
| 2.42 | B. Sreeram Praveen, M. Srinivasa Reddy, U. Vijaya Bhaskar Reddy and P. V. Ramesh Babu | Natural farming – A frostering solution to modern agriculture in India |
| 2.43 | Iska Srinath Reddy, Arun Alfred David, Tarence Thomas and Neha Toppo | Carbon capture through Geologic and Biologic Sequestration |
| 2.44 | Rabeen Abdul Gafoor, Shalini Pillai P. and Nishan, M.A. | Effect of integrated nutrient management on growth, yield and yield attributes of finger millet (Eleusine coracana (L.) Gaertn) in the Southern Laterites of Kerala |
| 2.45 | Sanjeev K. Chaudhary, Manoj Kumar, NeerajKotwal, Satish Sharma and Nirmal Sharma | Conservation Agriculture - A sustainable agricultural production system |
| 2.46 | Avini-e Nakhro | Effect of Lime and FYM on growth, yield and quality of Soybean (Glycine max L. Merrill) |
| 2.47 | Chandana Mudigiri | Carbon sequestration |
| 2.48 | G. Aishwarya and R. Naveenkumar | Conservation agriculture techniques for sustainable agriculture |
| 2.49 | Priyambi Saikia, Dilip Kumar Patgiri, Bipul Deka | Effect of biochar on soil organic carbon content |
| 2.50 | Suman Sharma and Devasish Singh | Effect of Zinc application on Biofortification in rice crop |
| 2.51 | Gauri Mohan | Agricultural practices to improve carbon sequestration for mitigation of climate change |
| 2.52 | Meena Yadav, Vivak M. Arya and Ajay Thakur | Impact of resource conservation techniques on soil properties in lower Shivaliks of Jammu |
| 2.53 | R. Kalyani and S. Mobeena | Influence of graded levels of Sulphur on growth, yield and nutrient uptake of different Sesame varieties |
| 2.54 | Mahesh Kumar Vaishnav, Amreen Hasan, Tarence Thomas, Arun Alfred David and Manjul Kumar | Influence of crop residues and Bio-Decomposer on soil physico-chemical properties, growth and yield of Maize (Zea mays L.) |
| 2.55 | Seema A. Jujin, Ravikumar D., Gurumurthy, K T. and Ragini S. Patil | Micro nutrient status of soils under different land use systems of Somawarpet taluk, Kodagu district, Karnataka |

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| 2.56 | V.Sneha, G.Sunitha. and P.Archana | Organic farming: Its Scope and possibilities inTelangana. |
| 2.57 | Amit Kumar, Pramod Kumar Panda, Nihar Ranjan Shoo, Raghabananda Nayak | Effect of organic nutrients on quality of cashew (Anacardium occidentale L.) value added product cv. BPP-8 |
| 2.58 | Soniya Singh | Organic agricultural Strategies for feeding the world more sustainably |
| 2.59 | Siripuram Haripriya | Climate change mitigation, carbon sequestration in organic farming |
| 2.60 | Preeti and P.K. Rai | Phosphate Solubilizing Microbes as Promising Biofertilizers |
| 2.61 | Priya Kumari, Sanjeev Kumar Gupta, S Roy Choudhury and Anshuman Kohli | Biofertilizer –A good organic source for sustainable plant nutrition |
| 2.62 | ManishaChhatwani, Arun Alfred David, Tarence Thomas, Syed H. Mazhar and I Srinath Reddy | Effect of Integrated Nutrient Management on Soil Health, Growth and Yield of Black gram (Vigna mungo L.) Var. Indra Urad-1 |
| 2.63 | Poonam | Role of Organic Farming for Sustainable Environment |
| 2.64 | Shankar Lal Sunda, D. P. S. Dudi, Akshika Bhawariya and R. K. Jakhar | Effect of INM on Soil Health and Productivity of Maize and Residual Effect on Chickpea |
| 2.65 | I. Venakatesh, B. Rakesh and P. Monika | Soil Health – The foundation for life |
| 2.66 | Ranjitha G. and Savita B. | Studies on the effect of iron and zinc nutrition on quality and yield of linseed (Linumusitatissimum L.) |
| 2.67 | Ashutosh Singh and Amit Kumar Pandey | The Role of Potassium in Biotic Stress Resistance |
| 2.68 | Amit Kumar Pandey and Ashutosh Singh | Use of Selenium in Crop production |
| 2.69 | Sheilendra Kumar and S.M. Kumawat | Growth, Productivity and Quality of Pearlmillet (Pennisetum glaucum L.) as Influenced by Different Land Configuration and NutrientManagement Practices in Arid Western Rajasthan |
| 2.70 | Sukirtee, Manoj Kumar Sharma, Krishan Kumar Bhardwaj, Devraj and Ajay Kumar Bhardwaj | Impact of long term organic manure application on zinc status of soil |
| 2.71 | M. Lalitha, S. Dharumarajan, B. Kalaiselvi, R. Srinivasan, Arti Koyal, S. Parvathy and Rajendra Hegde | Vertical Distribution of Soil Available Phosphorus in Paddy Growing Alluvial Soils of Tamil Nadu |

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| 2.72 | Kanneboina Soujanya, B. Anila Kumari and P.Prathyusha | Influence of germination on the nutrients and bioactive compounds and their health benefits |
| 2.73 | Devendra Kumar, Sandeep Rawat, Mamta Chettri and Rajesh Joshi | Predicting the Current and Future Potential Distribution of the Myrica esculenta Buch.-Ham. ex D. Don (Myricaceae) in Hindu-Kush Himalaya |
| 2.74 | Aanmona Bora | Climate-smart agriculture: ensuring food security amidst climate change |
| 2.75 | P.Tanuja and B.Anitha | Effect of organics in cultivation of banana |
| 2.76 | Ragini Kumari, Bipin Kumar, Rajeev Padbhushan, Rajkishore Kumar, B. K. Vimal, Y. K. Singh and Anshuman Kohli | Effect of combined application of mineral fertilizers and organic manures on yield and nutrient concentration in fruit of tomato crop |
| 2.77 | Sarvesh Kumar, Deepak Prajapati, S P Singh and Sapna Gupta | Conservation agriculture, improving soil quality for sustainable production systems under climate change, |

| **Day 2** | **Saturday, April 23, 2022** |
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## TECHNICAL SESSION-III (09:30-12:30)

## Agro-Forestry, Joint Forest Management and Holistic Agroecosystem Management forLivelihood Security in the context of Natural Farming

***Chairman:*** **Dr. K.K. Sood,** Professor, Division of Agroforestry, SKUAST, Jammu
***Co-chairman:*** **Dr. Rakesh Banyal**, Principal Scientist, ICAR-CSSRI, Karnal
***Convener:*** Dr. Ranjita Bezbarua, Scientist, (Agronomy), HRS, AAU, Kahikuchi Dr. Pempa L. Bhutia, Scientist, (Agroforestry), ICAR for NE Region, Nagaland CentreDr Sontara Kalita, Assistant Professor, AAU, Jorhat, Dr Ajay Kumar Mishra, Associate Scientist (Soil Science),International Rice Research Institute South Asia Regional Centre (ISARC), Varanasi, UP

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| 09:30-10:00 | ***Keynote Speaker:*** **Dr. A. K. Handa**, Principal Scientist, ICAR-Central AgroforestryResearch Institute, Jhansi<br>***Topic:*** Agroforestry, a sustainable land use system. I will provide the write up shortly |

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| 10:00-10:15 | ***Lead Speaker:*** **Dr. Rajib Bora**, Principal Scientist, Rain Forest Research Institute,Jorhat<br>***Topic:*** *Aquilaria malacensis* Lamk., A potential Aromatic and Medicinal plant ofagroforestry system in the North-East India. |
| 10:15-10:30 | ***Lead Speaker:*** **Dr. M. S. Hadda**, Former Professor of Soil Conservation, PAU,Ludhiana<br>***Topic:*** Assessment of soil chemical and physical characteristics as affected by soilconservation treatments under semiarid tropical environment |

| **ORAL PRESENTATIONS (10:30 – 12:00 PM)** | | |
|---|---|---|
| 3.01 | Selvi, D. and S.Thiyageshwari | Foliar nutrition of water soluble fertilizers forenhancing yield and quality of Bhendi (*Abelmoschus esculentus* L. Moench) |
| 3.02 | Ch. Gunasekhar, N. Seenivasan, C. N. R. Santhoshini, P. Gouthami and G. Sathish | Influence of foliar spray of Bio-stimulants on post-harvest and vase-life of Tuberose (*Polianthes tuberosa* L.) cv. Suvasini |
| 3.03 | R. Bezbaruah, A.A.Ahmed, J.P.Baruah, S. Pathak, S. Saikia and K Mahanta | Agroforestry Systems as Land Use System |
| 3.04 | Anita Sharma and Rajesh Joshi | Nature-based climate adaptive strategy for developing a climate resilient agricultural systemin Sikkim Himalaya, India |
| 3.05 | Akshaya M | Monitoring Forest cover change in Kerala using Google Earth Engine |
| 3.06 | Pema Tshering Lepcha and Pankaj K.Pandey | Quantifying the Contributions Basin and Climate Characteristics to Water Yield Across Spatio- Temporal Scales in Upstream Teesta River Basin, Sikkim |
| 3.07 | G. Pandey, Tarun Adak and Vinod Kumar Singh | Jackfruit conservation under natural farming for quality food and micronutrient nutrition |
| 3.08 | Devendra Kumar, Sandeep Rawat,Mamta Chettri and Rajesh Joshi | Predicting the Current and Future Potential Distribution of the *Myrica esculenta* Buch.-Ham.ex D. Don (Myricaceae) in Hindu-Kush Himalaya |
| 3.09 | N. A. Deshmukh and H. Rymbai | Fruit crop germplasm: A source for sustaining productivity |
| 3.10 | Venkatesh, L and Rakshit K. C | Studies on effect of pre sowing treatments ongermination of *Carissa carandas* |
| 3.11 | I. Rashmi, Shakir Ali, B. L. | Soil amendments for resource conservation |

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| 3.12 | S. Thiyageshwari and D. Selvi | Phosphorus utilization and response of red gramcultivars to phosphorus in alkaline calcareous soils of Madurai district, Tamil Nadu |
| **POSTER PRESENTATIONS (12:00- 12:30)** | | |
| ***Coordinators:*** Dr Danish Tamuli, Assistant Professor, AAU, Jorhat, and Md Salman Ahmed Choudhury | | |
| 3.13 | S. Bhagowati, K.N. Das, I. Bhupenchandra, A.S.N. Zaman, A. Basumatary, N. Borah, S. Saikia, R.M.Phukon and S. Das | Effect of integrated nutrient management in ricefor availability of different potassium forms and crop yield |
| 3.14 | Sneha, M. A, Mudalagiriyappa, Vasanthi, B. G, Ziya Ul Huq, R. S, Puneetha, K. M., and Madan Kumar, M. | Effect of foliar application of different nano fertilizers on growth and yield of finger millet |
| 3.15 | Imran Hussain and Mizanur Rahman | Assessment of cost and returns of banana cultivation in the Goalpara district of Assam |
| 3.16 | J Rakesh, M Sree Rekha and Ch Sujani Rao | Yield and Economics of Olitorius jute at different plant densities and topping practices |
| 3.17 | S. S. Desai, N.A. Meshram and S. S.Sawant | Impact of *Dendrocalamus stocksii* Munro based agroforestry system on growth performance and yield of crops |
| 3.18 | Harisankar Koiri, R. Ray and S.K. Patra | Development of physical, biological and economicresources in Karma micro-watershed in eastern plateau of India under integrated watershed management programme: A case study |
| 3.19 | Arvind Kumar and Ravi Pratap | Agroforestry for Livelihood Security in Natural Farming |
| 3.20 | Govind Sharma and Shekhar Singh | Impact of Covid-19 pandemic on Air pollution in the Delhi region, India |
| 3.21 | Mubeena P., Usha C. Thomas andDeepa Surandren | Anti-nutritional factors and micro nutrient content of locally available tree fodders and shrubs in Southern Kerala |
| 3.22 | Akanksha Raj, Jajati Mandal and VikashKumar | Determination of suitable extractant and risk assessment of Arsenic in rice |
| 3.23 | Pratibha Kumari and P. K. Sharma | Impact of tillage and crop establishment practiceson soil fertility under rice-wheat cropping system in an Inceptisol |

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| 3.24 | Tanuja Poonia and S. M. Kumawat | Influence of tillage on peanut growth, yield andresource use efficiency in arid soils of Rajasthan |
| 3.25 | Aanmona Bora | Climate-smart agriculture: ensuring food security amidst climate change |
| 3.26 | Sudarshan Varma, Seema A. Jujin,Champa, B.V., Ravikumar, D. and Nagaraja, M.S. | Phosphorus management strategies in low pHsoils of Karnataka |

## TECHNICAL SESSION-IV (12:30-14:30)

## Ecological Pest Management in the Context of Increasing emphasis on Natural Farming

***Chairman:*** **Dr. Rajinder Peshin**, Professor, SKUAST-Jammu
***Co-chairman:*** **Dr. Tarak Nath Goswami**, Assistant Prof., Deptt of Entomology, BAU, Sabour
***Convener:*** Dr. Poppy Bora, Scientist, AAU, Jorhat
Dr. Seema Bhagowati, Scientist, HRS, AAU, Kahikuchi
Dr. Yanendra Kumar Singh, Asstt. Prof. (SSAC), BAU, Sabour
Dr. R.K. Kanojia, SMS, KVK Raebareli, U.P.

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| 12:30-13:00 | ***Keynote Speaker:*** **Dr. Uday Saikia**, Head, NBSS & LUP, Regional Centre, Jorhat ***Topic:*** Climate change exposures, threats, adaptation and mitigation strategies in thecontext of fragile Eastern Himalayan Agro-ecosystem. |

### ORAL PRESENTATIONS (13:00-14:00)

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| 4.01 | Giddi Thirumala Devi, Jeevitha P. andNaveen Gudipati | Eco-friendly management of invasive pest, rugosespiralling whitefly with *Isaria fumosorosea* and *Encarsia guadeloupae* |
| 4.02 | Mayuri Baruah | Bio -intensive approaches against major insect pests in aromatic rice |
| 4.03 | Jeevitha P. | Field evaluation of *Pongamia* oil soap on whiteflies, *Bemisia tabaci* of eggplant at Kasargod, Kerala |
| 4.04 | P. Damodar Reddy and A. Sujatha. | Field evaluation of biopesticides against RugoseSpiraling Whitefly *(Aleurodicus Rugioperculatus*) in oil palm crop |
| 4.05 | Gummudala Yashaswini, Somala Karthik, B Madhuri and D Saicharan | Diversity and Phylogenetic Analysis of Endosymbionts Associated with *Bemisia tabaci* Species Complex |

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| 4.06 | Koosari Supriya, Gummudala Yashaswini, D. Saicharan and B. Madhuri | Susceptibility of the Fall Armyworm, *Spodopterafrugiperda*to Entomopathogenic Nematodes |
| 4.07 | Sumathi, E., V. Baskaran, R.Vishnupriyaand S.V. Krishnamoorthy | Efficacy of eco-friendly pesticides against two Spotted Spider Mite, *Tetranychus urticae* Koch on Carnation |
| 4.08 | Sujata, R.S. Kanwar and Anil Kumar | Seasonal fluctuations in the population of Phytonematodes associated with Kinnow in Haryana |
| 4.09 | Popy Bora, Ankita Saikia and BishalSaikia | Harnessing root endophytes from wild bananagermplasms against Fusarium wilt of Malbhogbanana |
| 4.10 | R. K. Kanojia, Yogesh Chandra Srivastav, M.S. Pal | Comparative study of weed management on growth and yield of summer groundnut (*Arachishypogaea* L.) |

**POSTER PRESENTATIONS (14:00-14:30)**

***Coordinators:***

Dr. Anjumoni Devee, Scientist, AAU, Jorhat and Mr. Tanjil Rahman

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| 4.11 | L. K. Jain, M. P. Verma, H.P.Parewa andAnirudh Choudhary | Soil physico-chemical properties and nutrient balance as influenced by integrated weed and nutrient management in transitional plain zone ofLuni basin of Rajasthan (India) |
| 4.12 | Amit Kyada and Jwala Pranati | Cut in genome for biotic stress management in crops: CRISPR/Cas9 |
| 4.13 | M. Satwika, Sravanthi Erla and B. Madhuri | Applications of acoustics in insect pest management |
| 4.14 | Ajith, C. R., N. S. Pankaja, Mahadeva, J., Umashankar Kumar, N. and Venkatesh | Identification of effective native isolates of Trichoderma spp. for use as bio-pesticide and bio- fertilizer |
| 4.15 | V Ishwarya Laxmi, A Krishna, A. Madhavi Lata and Y. S. Parameswari | Productivity assessment of intercrops under Agroforestry system |
| 4.16 | Polu Parameshwar, Nilesh Bhowmick and Shyamal Kr. Sahoo | Incidence of leaf webber on different rejuvenated mango cultivars |
| 4.17 | Burjikindi Madhuri, Rohini Sugandi, M. Satwika and Gummudala Yashaswini | Management of sucking insect pests on summer groundnut |
| 4.18 | Laveti Gowthami, Ganesuni Lakshmi Prasanna and Vadlamudi Vijaya Bhaskar | Eco-friendly pesticides for safe environment |
| 4.19 | Y. Sireesha, Manasa M. and Y. Deepthi Kiran | Potential of PGPR mediated consortia against Fusarium wilt in sustainable tomato |

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| 4.20 | Priyavardhini Sunkari | Ecological and eco-friendly pest management for Natural Farming and Safe Environment |
| 4.21 | Paras Kamboj, S.S. Punia, Dharam Bir Yadav and Parvender Sheoran | Sequential application of pre-emergence and post-emergence herbicides for the control of Phalaris minor in wheat |
| 4.22 | B. Nandini, C. Srinivas and S.J. Rahman | Compatibility studies among different microbial pesticides commonly used for soil application |
| 4.23 | Kangkana Bordoloi, Bhabesh Bhagawati and Uday Kurulkar | Biochemical mechanism of Lantana camara leaf extracts against Meloidogyne incognita |
| 4.24 | Shenaz Sultana Ahmed and Popy Bora | Exploring potential siderophore producing fluorescent pseudomonads for suppression of bacterial wilt in chilli |
| 4.25 | Y.B. Vala | Climate Smart Agricultural Practices for Sustainable livelihoods and Food security |

**TECHNICAL SESSION-V (14:30 – 17:00)**

**Crop Management, Technological Improvements and Adaptations for Natural Farming**

***Chairman:*** **Dr Y.P. Singh**, Ex-Head, ICAR-CSSRI, RRS, Lucknow ***Co-chairman:*** **Dr. Sanjay Swami**, Professor, CPGS, CAU, Barapani***Conveners:*** **Dr. Harendra Verma**, Scientist, ICAR for NE Region, Nagaland Centre **Dr. N.K. Pareek**, Assistant Professor, SKRAU, Bikaner **Dr. Basanta Borah**, Assistant Professor, AAU, Jorhat **Dr. Sunil Kumar Mishra**, Assistant Professor (Agronomy), SKUAST-Jammu.

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| 14:30-14:45 | ***Lead Speaker:*** Mr. Jajati Mandal, ICAR-Netaji Subhas Fellow, School of ScienceEngineering and Environment, University of Salford, UK<br>***Topic:*** Prospects of using Machine Learning Algorithms in Resource Management |

**ORAL PRESENTATIONS (14:45-16:00)**

| | | |
|---|---|---|
| 5.01 | N.Janani, Balaji Kannan, C.G. Karishma, K.K. Shaheemath Suhara and K.N.Vidya | A spatiotemporal change analysis of vegetativegreenness using Google earth engine |
| 5.02 | MM Shulee Ariina, Yabi Gadi and SPKanaujia | Performance of various genotypes of Chow-chow[*Sechium edule* (Jacq.) Swartz.] under foothill condition of Nagaland |
| 5.03 | Naba Jyoti Deka, Naseema Rahman, Binod Kalita and Amal | Importance of Gramin Krishi Mausam Sewa(GKMS) Project in Natural Farming |

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| | Chandra Sarmah | system |
| 5.04 | Kasthuri Thilagam V., S. Manivannan and OPS Khola | Ecosystem services to the watershed through soil and water conservation technological interventions |
| 5.05 | B. K. Vimal, Ragini Kumari, Anshuman Kohli, Sunil Kumar, Ghanshyam Y. K. Singh and Rajkishore Kumar | Spectral Responses Based Indexing of Soil Colour and their Impact on Soil pH under Different Topography of Pipainti Block of Bhagalpur district, Bihar |
| 5.06 | Lalit Upadhyay, LobzangStanzen and Arvinder Kumar | Effect of vegetables intercropping on soil parameters in poplar based agroforestry in the subtropics of Jammu |
| 5.07 | R. Prashanth, A. Kiran Kumar and K. Sruthi Sai | Storage behaviour and quality response of pink fleshed dragon fruit (Hylocereus spp.) coated with chitosan during ambient storage conditions |
| 5.08 | K. Sruthi Sai, K. Sai Krishna and R. Prashanth | An economic analysis of post-harvest losses in Tomato |
| 5.09 | Sravanthi Erla and Satwika Maharaj | Applications of Drone Technology in Insect Pest Management |
| 5.10 | Bindiya Barsola and Priyanka Kumari | Next generation agro-inputs with nanotechnology: a new approach in agricultural sustainability |
| 5.11 | Devansh Desai and Krupa Patel | Surface Energy Balance Closure Characterization using high response Eddy Covariance Measurements and Thermal Inertia based physical soil heat flux model over selected agro- ecosystems over India |
| 5.12 | Satish D Lande and Indra Mani | Aqua Ferti. Seed Drill:Technology forResource Conservation and Crop Cultivation in Dryland Areas |
| 5.13 | Khushboo Chandra | Genetically -modified crops and crop species adapted to global warming in dry regions |
| 5.14 | K. Nagarajan and Vidya K.N. | Potential contribution of low cost drip |
| **POSTER PRESENTATIONS (16:00-17:30)** | | |

| ***Coordinators:*** Dr Robin Boro, Assistant Professor, Assam Agricultural University, Jorhat and MrAlokesh Ghosh | | |
|---|---|---|
| 5.15 | Gurumurthy, K. T., Sushmitha, C. V. andSeema, A. Jujin | Mapping of soil chemical properties and availablemajor nutrients status of Lakya sub watershed of Dasarahalli-I micro-watershed in Chikmagalur taluk by using GIS technique |
| 5.16 | Debabrata Das | Antivirus-fat synthesis or its accumulation amongthe species are based on TDS and CEC and may digitally measurable |
| 5.17 | Dandu Tejeswini and K. Deepthi | Insect Gut Microbiome and its potential biotechnological implications. |
| 5.18 | Gangishetti Ranjithkumar and RajaniBisen | Character association and Path analysis for seedyield and its attributing traits in Dark brown sesame (*Sesamum indicum* L.) |
| 5.19 | Hiren Das, Bipasha Borkotoky, N. Venuand N. Surbala Devi | Crop Spectral Library Generation of Vegetables Grown in Hill Agriculture of NER- by Hyperspectral Remote Sensing |
| 5.20 | Jadhav Ravindra, Narendra Swaroop,Anurag Kumar Singh and Tarence Thomas | Comparative study of Zinc and Boron nanofertilizer with conventional fertilizer on production and nutrient status of soil in lentilcrop (*Lens culinaris medikus*) Cv. k-75 under Inceptisol of Prayagraj, U.P. |
| 5.21 | K Sai Krishna, Ram Kumar Chaudhary, Mahesh Kumar, K Sruthi Sai and R Prashanth | Evaluation of Genotype Environment Interaction and Identification of Superior Mango (*Mangifera indica L.*) Genotypes Using Eberhart and Russell's Stability Model |
| 5.22 | C.G.Karishma, Balaji Kannan, N.Janani, K.N. Vidya and K.K. Shaheemath Suhara | Burn Severity mapping of forest fires in Nilgiris district using Google Earth Engine |
| 5.23 | D. Chandana and G. Karthik Reddy | Evaluation of flow characteristics for Air AssistedSprayer Using Hollow Cone Nozzle |

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| 5.24 | Ajay Kumar Sharma, R G Somkuwar,Prashant H Nikumbhe, Roshni R Samarth, A K Upadhyay and N A Deshmukh | Importance of grape germplasm in climate resilient viticulture |
| 5.25 | Ratna Sahay, A.K. Singh, Archana Singh, R.C. Maurya, D.K. Tiwari, Sunil Singh andJay Kumar Yadav | Soil Health Card Impact in Selective Unnao District Villages of Uttar Pradesh |
| 5.26 | Jwala Pranati, Parth Bagadiya and Amit Kyada | Modern Age Breeding for Climate Resilient Crops |
| 5.27 | Monika. S, Sudhir Deepak. M, Manjusha. M. R., Malepati. S. N. V. S.Sripriya Bhargavi and Ayushi Kumar | CRISPR/CAS 9 – An indigenous approach for milletimprovement |
| 5.28 | Vidyashree B. S.,Rundan V Gowda and Vishwanath V. E. | Moringa – A paradise tree for livelihood security to mitigate climate change |
| 5.29 | Usha Yadav , M.P. Tripathi, NarendraAgrawal and Sameer Mandal | Morphometric analysis of the Hasdeo Subbasin using spatial data derived from GIS |
| 5.30 | Manoharmayum Monica Devi | Macronutrient-Nanofertilizers: An innovative approach for nutrient use efficiency |
| 5.31 | Akshay Kumar Kurdekar and H. M.Jayadeva | Green synthesized nano micronutrient fertilizer, away onto the next generation Agroinputs |
| 5.32 | Ponaganti Shiva Kishore and Sujaya Dewanjee | Role of omic approaches in terminal heat stress tolerance |
| 5.33 | PrabhudattaSahoo, ShraddhaMohanty*,Bandita Jena, R.K. Nayak | Spatial and temporal distribution of soil availablenutrients in the jute growing pockets of Kendrapara district of Odisha |
| 5.34 | Shaheemath Suhara K. K., Raviraj A., Vidya K. N., Karishma C. G., Rahul and Janani N. | Study on rainy days and characteristics of occurrence of rainfall events over upper Bhavani basin, Tamil Nadu using remote sensing and GIS |
| 5.35 | Vandna Bhardwaj and Bindiya Barsola | Biotechnological interventions and their role incrop improvement |
| 5.36 | Divya Chadha, Vikas Sharma, Vivak M. Arya and Divya | Halophilic microbes for Bio-remediation of salt affected soils |

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| | Sharma | |
| 5.37 | Parth Bagadiya and Jwala Pranati | A Biotechnological intervention for crop improvement : Bt Cotton |
| 5.38 | Abhishek Nanda and Hanumanthappa, D.C. | Effect of sensor based irrigation on yield and water use efficiency of Finger millet (*Eleusine coracana* Gaertn) |
| 5.39 | K. Deepthi and D. Tejeswini | CRISPR for Crop Improvement |
| 5.40 | Chesta Deshmukh, Narendra Agrawal, Dhiraj Khalkho and M. P. Tripathi | Development of APP for designing of location specific sprinkler irrigation system |
| 5.41 | U. Nikhil Sagar, B. V. Ravi Prakash Reddy, Y. Rama Reddy, A.Prasanna Rajesh and K. T. Dimple | Gene trapping- A powerful tool of functional genomics to identify novel genes |
| 5.42 | Abu Saleh Nizamuddin Ahmed | Genetic variability and character association studies for grain yield characters of indigenous aromatic rice varieties of Assam |
| 5.43 | Milon Jyoti Konwar, N.T. Rafique, Sanjay Kumar Chetia, J.L. Borah, P.C. Dey, R.K. Saud, LipikaTalukdar and Pompi Dutta | DSR-an alternate method of rice establishment technique |
| 5.44 | Imamsaheb, S. J., Shreedhar D., Shantappa, T and Alloli, T. B | Performance of different orange flesh sweet potato genotypes (Ipomoea batatas L.) for yield and quality parameters |
| 5.45 | G. Chaitanya Kumar and U. Vijaya Bhaskar Reddy | Role of nanoparticles for sustainable agriculture |
| 5.46 | Sunil K. Mishra and Vikas Sharma | Influence of NPK levels on growth and yield of quality protein Maize under Mid Hill Conditions |
| 5.47 | U. N. Umesh, Kumari Vibha Rani and Brajendu kumar | Farm mechanization boon for modern agriculture |
| 5.48 | Kanneboina Soujanya, B. Anila Kumari and P.Prathyusha | Influence of germination on the nutrients and bioactive compounds and their health benefits |

**VALEDICTORY SESSION**
**(17:30 onwards)**

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| 17:30-17:40 | Welcome address by **Dr. Vikas Sharma**, SKUAST, Jammu |
| 17:40-17:50 | Proceedings of the Webinar and Declaration of Awards by **Dr. AnshumanKohli**, Co-Organizing Secretary |
| 17:50-18:20 | Address by Guest of Honour, **Dr. D.K. Sharma**, Ex-Director ICAR-CSSRI,Karnal |
| 18:20-18:30 | Vote of thanks by **Dr. Kaberi Mahanta**, Organizing Secretary |

# Journal of Natural Resource Conservation and Management (Online)
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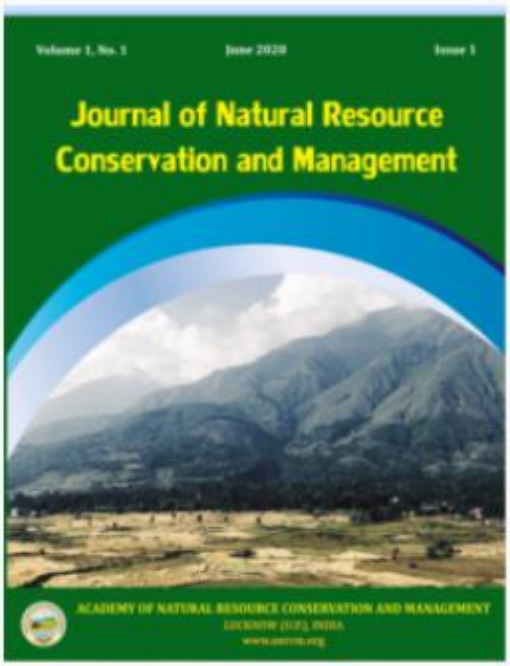
## Scope of the Journal

The journal focuses on all aspects of conservation and management of natural resources for sustainable development. The journal invites reports on both natural and managed ecosystems, and considers all pathways of interaction- environmental, economic, and social. It publishes scientific articles on:




- Assessment and sustainable management of natural resource base
- Degradation of natural resources and remediation measures
- Ecological assessments related to land use and land use change
- Soil erosion and control in relation to management
- Sustainable water use and water quality management
- Climatic influences on natural resources
- Policy issues in natural resource conservation

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