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on

Natural Resource Management for Global Food Security and Sustainable Development Goals

December 02-03, 2022

Abstract Book

EDITORS

Ajay K. Bhardwaj • Raj Kumar • M.S. Nagaraja •
D. Ravikumar • Vikas Sharma • Sanjay Arora • Atul K. Singh

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Influence of Fish Bone Meal on Yield Attributing Characters and Yield of Tomato

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Tomato requires essential nutrients, especially phosphorus, calcium, and sulphur for root growth, early flowering, growth, and development. Slow-release organic substances like FBM, are cheap sources of phosphorus to plants which can be exploited for use with mineral fertilizers along with PSF and VAM to increase phosphorus use efficiency, soil health, and crop yield. To know the influence of fish bone meal on yield attributing characters and yield of the tomato crop, a pot culture experiment was conducted at the Department of Soil Science and Agricultural Chemistry, College of Agriculture, KSNUAHS, Shivamogga. Different levels of mineral fertilizer (DAP) with the raw and acidulated fish bone meal (RFBM and AFBM) were applied and yield attributing characters and yield were recorded. The soil was slightly acidic in pH, low in nitrogen, high in phosphorus, medium in potassium, and sufficient in all other nutrients. Yield attributing characters like fruit diameter, the total number of fruits per plant, and dry matter yield (6.68 cm, 42.00, and 37.69 g plant^{-1}, respectively) and total yield (5.48 kg plant^{-1}) were recorded highest in treatment applied with 75 percent recommended phosphorus through DAP mineral fertilizer and 25 percent through AFBM as compared to control (without application of mineral and organic fertilizer).

Keywords: Fish bone meal, mineral and organic fertilizer, tomato, yield

Agronomic Techniques for Soil Fertility Management

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The Indian population, which increased from 0.68 billion in 1981 to 1.21 billion in 2010, is estimated to reach 1.42 billion in 2025 and 1.48 billion in 2030. To feed the projected population of 1.48 billion by 2030, India needs to produce 350 million tonnes of food grains. The expanded food needs of the future must be met through intensive agriculture without much expansion in the arable land. It is known that agricultural intensification can have negative effects at different scales such as increased soil erosion, a decline in soil fertility and reduced biodiversity at the local level and depletion, pollution of

groundwater and eutrophication of surface waters at the regional level, and changes in atmospheric composition and climate on a global scale. For achieving sustainability under intensive systems of agriculture, the emphasis should be on agronomic approaches which enhance soil fertility along with sustainable crop production. Agronomic approaches include conservation agriculture, organic farming, green manuring, biofertilizer, crop rotation, soil test based fertilizer recommendation, integrated nutrient management, application of soil conditioners, and soil and water conservation measures.

Keywords: Sustainability, Conservation agriculture, soil erosion

Fertility Assessment of Soils of Duglapura-1 Micro Watershed under Chikkamagaluru district, Karnataka

Seema Anantaraj Jujin*, K.T. Gurumurthy and G.N. Thippeshappa, D. Ravikumar, Narayan S. Mavarkar and Basavaraj I. Halingali

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An assessment of fertility status was carried out on the soils of the Duglapura-1 micro watershed during the year 2020-21. Sixty-one surface soil samples (0-15 cm) were collected at 320m X 320 m grid intervals for their fertility status and mapped using ArcGIS software. The soils were low in available nitrogen content (74.86 %). Available phosphorus was medium (72.39 %). The micro-watershed was medium (72.10 %) to high (2.76 %) for available potassium and medium (11.88 %) to high (62.98 %) for available sulphur status. Secondary micro-nutrients viz., calcium and magnesium were sufficient in the entire micro-watershed area. Micronutrients viz., Fe, Cu, and Mn were sufficient, whereas Zn was deficient (16.22 %) in the Duglapura-1 micro watershed area.

Keywords: Duglapura-1, micro-watershed, fertility, micronutrients, mapping

Subsurface Soil Compaction – Causes and Remedy in Agriculture

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Soil compaction encompasses compression with increase in density of soil. The degree of compaction depends upon the nature of soil, amount of energy applied, water content and extent of manipulation

of soil. Compaction of agricultural soils can be in the surface (often caused by stock trampling or rain drop splatter) or in the subsurface (usually in a layer at 10–40 cm). Soil compaction can also be one of the underlying agents of soil erosion, nutrient lessening and pollution which are key issues brought up in many recent reports by the UN and other international organizations. Soil compaction is not a recent phenomenon. It was encountered in the form of ploughpans long before the advent of mechanized agriculture. Managing soil compaction, especially in arid and semi-arid regions, can be achieved through appropriate application of some or all of the following techniques: (a) addition of organic matter; (b) controlled traffic; (c) mechanical loosening such as deep ripping; (d) selecting a rotation which includes crops and pasture plants with strong tap roots able to penetrate and break down compacted soils. Tillage and no till manipulation revealed that tilled soil was more prone to compaction than non-tilled soils. Soil compaction significantly increased the bulk density and decreased the water storage capacity and total porosity of the soil. Even a low-weight tractor can induce subsoil compaction and a high decrease in plant productivity by repeated passes over time.

Keywords: Soil compaction, Till, No-till, Bulk density, Management

Effect of Biostimulants and Micronutrients on Alleviating Salt Stress in Rice Grown Under Sodic Soil Condition

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A higher concentration of Na^+ than Ca^{2+} in sodic soil (sodicity stress) have already demonstrated the negative impacts on rice growth and development and thereby limiting its productivity. The micronutrients deficiency in sodic soil is another associated problem that affects potential yield of rice. Therefore, in the time to come, more sustainable efforts are required in agricultural practices to ensure food production and security under such adverse environmental conditions. A most promising and eco-friendly way to achieve this goal would be to apply biostimulants which are essentially not a direct substitute for fertilizers but their application into the rhizosphere promotes the physiological processes of rice benefitting to nutrient uptake and translocation, as well as enhance tolerance to several abiotic stresses but they are less explored. To address such concern, a field experiment was conducted to evaluate the effect of promising biostimulants and micronutrients mixture (MM-Zn:Mn:Cu:B:Mo-14:5:4:1.2:0.2 @ 1%) on rice variety IR-64 grown under sodic soil at ZARS, V. C. Farm, Mandya during kharif 2020. The biostimulants viz., salt tolerant halophilic microbial consortia (HMC-*Staphylococcus arlettae* and *Paraburkholderia fungorum*) and humic acid (HA @ 0.2%) extracted from vermicompost were applied solely and also in combination with foliar spray (FS) of MM. In this study, treatments inoculated with HMC, FS of MM and HA as compared to RDF recorded higher root and shoot biomass with significantly increased Ca^{2+} and K^+ content while decreased accumulation of Na content and its relative concentration with K (Na/K) and Ca (Na/Ca) in root, straw and grain, indicating

their stimulatory effect on rice to withstand sodicity stress. In this investigation, a particular attention was given to the modiûcations taking place in plant's physiology under salt stress conditions and how different biostimulants either alone or in combination with MM re-program the host's physiology to withstand such stresses.

Keywords: Abiotic stress tolerance, Biostimulants, Foliar spray (FS), Halophilic microbial consortia (HMC), Humic acid (HA), Micronutrients mixture (MM)

Agronomic Techniques for Soil Fertility Management

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The Indian population, which increased from 0.68 billion in 1981 to 1.21 billion in 2010, is estimated to reach 1.42 billion in 2025 and to 1.48 billion in 2030. To feed the projected population of 1.48 billion by 2030, India need to produce 350 million tonnes of food grains. The expanded food needs of future must be met through intensive agriculture without much expansion in the arable land. It is known that agricultural intensification can have negative effects at different scales such as increased soil erosion, decline in soil fertility and reduced biodiversity at the local level and depletion, pollution of groundwater and eutrophication of surface waters at the regional level and changes in atmospheric composition and climate on a global scale. For achieving sustainability under intensive systems of agriculture, the emphasis should be on agronomic approaches which enhances soil fertility along with sustainable crop production. Agronomic approaches include conservation agriculture, organic farming, green manuring, biofertilizer, crop rotation, soil test based fertilizer recommendation, integrated nutrient management, application of soil conditioners and soil and water conservation measures.

Keywords: Agronomic approaches, Biofertilizer, conservation agriculture, organic farming

Soil Carbon Saturation: Concept, Implication and Global Evidences

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Sequestration of atmospheric carbon (C) in soils through improved management of forest and agricultural land is considered to have high potential for global CO_2 mitigation. However, several studies have shown that there is an upper limit of soil organic carbon (SOC) storage, confirming the hypothesis of soil C saturation. It is defined as a soil's unique limit to C stabilization as a function of C input levels (at steady state) based on the cumulative behavior of chemically, physically, biochemically protected and non-protected pools of C. Soil C saturation is a function of SOC stabilization, which is influenced by many factors, such as soil texture, type of vegetation, land use patterns and climatic conditions. These factors are very much crucial in governing soils to exhibit saturated behavior for storing SOC. The major implication of the concept of soil C saturation is to identify sequestration potentials of different soils. Soil organic carbon saturation deficit (CSD) is equal to the maximum saturated capacity of SOC minus the current SOC, which is an important index directly reflecting soil carbon sequestration potential. Identifying the soils that are far from C saturation and increasing C input to those soils will be an efficient way to sequester C because they will have a greater potential to preserve added organic matter. The soils of temperate ecosystem have a finite capacity to store C and the soil C saturation may be more evident in the soils that are high in organic matter content.

Keywords: Carbon, Stabilization, Saturation, Sequestration

Soil Fertility Mapping of Arecanut Growing Areas in Sirsi hobli of Uttara Kannada district, Karnataka

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Sirsi taluk is having highest area in traditional arecanut growing belt but low productivity is a serious concern which may be due to sustained nutrient requirement and low nutrient use efficiency. So there is a need to assess soil fertility status of arecanut holdings. Geo- referenced 150 surface soil samples were collected from arecanut gardens of 42 villages of Sirsi hobli, Uttara Kannada district, and were analysed for soil chemical parameters. The fertility status revealed that the soils were slightly acidic to neutral in soil reaction, non-saline and high in organic carbon content. The macro nutrient availability

showed low available N (100%), low to high available P (24%, 74% and 3%) and medium available K (99%) and sufficient in exchangeable Ca and Mg and medium to high in available S (56% and 94%). With regards to micronutrients, the soils were deficient in Zn (28%) and sufficient in all other micronutrients viz., available Fe, Cu and Mn. Using the all database creation, thematic maps for all the parameters were prepared using QGIS 3.8 software. By overlaying all the nutrient maps, management zone map/ constraint map was prepared, which indicated that the overall study area was poor in available N and deficient in available Zn.

Keywords: Arecanut, Soil fertility assessment, Sirsi taluk, Soil fertility maps

Efficient Utilization of Household Waste and Organic-residue Waste for Quality Vermicompost Production

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The catastrophic growth in population has led to massive urbanization, industrialization, with noticeable advancement in agriculture; increased the economic growth on one hand but gave the ways for generating more municipal and other solid wastes on other, affected soil-water-plant ecosystem ultimately the whole environment and the population. There is a need for effective waste management, as unscientific disposal of organic waste has not only negative impact on the environment and public health but also a cause of untapped nutrient loss adhere with these wastes. The untapped nutrients of these waste may utilized for further crop and soil improvement vide adopting suitable techniques of vermicomposting. Among various methods of composting, one of the best options for treating domestic household waste is vermicomposting. Scientific utilization of organic solid wastes can provide nutrients for plant growth as well as improve soil health, foe utilizing these wastes, vermicomposting can be an eco-friendly and economically viable technology. However, ordinary vermicompost is low in nutrients (macro and micronutrients) and by introducing some low-grade minerals, such as Rock-phosphate (RP) as well as utilizing organic waste (crop residues and household waste), its quality may be enhanced. Vermicompost were prepared using house-hold waste and organic residue mixed with cow dung separately in 65:35 ratio and enriched with rock phosphate @ 2.5% P_2O_5 (w/w) and windrows size 122 x 2.52 x 1.52 dimension made under the shade. Suitable species of epigeic earthworms @ 2 kg per ton of material at suitable temperature and moisture (37^{O}C and 65%) was inoculated in prepared windrows. The earthworms were not being disturbed during the entire period of composting. The water holding capacity (about 50-60%) was maintained throughout the vermicomposting process. At 30, 60, 90, and 120 days of vermicomposting, mechanical turnings were employed to ensure adequate aeration, thorough mixing, and uniform decomposition. In vermicomposting experiment, RP enriched and without enriched house hold vermicompost had narrow C/N ratio than organic residue vermicompost.

House-hold waste vermicompost also had the highest CEC than organic residue vermicompost. The gradual decreased value of water soluble carbon and water soluble carbohydrates was recorded with time progression. Significant increase in total N, K and P was also observed in Rock-Phosphate enriched vermicompost than without enriched vermicompost prepared from same substrate. Similarly in case of micronutrient significant increase in Zn, Fe, Cu and Mn in RP enriched vermicompost. The RP enriched vermicompost had higher enzyme activities like dehydrogenase, alkaline phosphatase and respiration than without enriched vermicompost. The quality of vermicompost and population dynamics of earthworms in vermicompost prepared from enriched household and organic-residue was best compared to without enriched vermicompost. On the basis of nutrients contents (macro and micro nutrient), physical parameters (water holding capacity and bulk density) and recovery per cent, the vermicompost prepared from enriched (RP) and without enriched household wastes, organic-residue waste and cow dung proportions (65:35) on weight basis was considered the best one.

Keywords: Compost, Household waste, Crop-residue, Nutrients

Future of India's Small and Marginal Farmers lies in Integrated Farming System

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The Indian economy depends heavily on the agricultural industry which occupies 47% of the geographical area and possesses only 44% of the total operational land. Agricultural Census data 2010-2011 shows that the small and marginal holdings (below 2.00 ha.) constituted 85.01 percent against 83.29 percent in 2005-06 (FICCI Report, 2020). Despite only owning 44% of the nation's total arable land, small and marginal farmers make up the majority of the farming community in India (85%). Small-scale farmers play a key role in food security which is estimated that, more than 50 percent of the food necessary to feed the 9 billion inhabitants of the globe in 2050 will be produced by small-scale farmers (FAO, 2013). It is imperative to develop strategies and agricultural technologies that enable adequate employment and income generation. Even though Indian agriculture is labour-intensive and demands a lot of manpower and energy, farmers, especially small farmers, are unable to support themselves because there is very less income with more cost incur for all inputs (seeds, livestock breeds, fertilizers, pesticides, energy, feed, labour, etc.). Under the gradual shrinking of land holding, it is necessary to integrate land based enterprises like fishery, poultry, duckery, apiary, field and horticultural crops, etc. within the bio-physical and socio-economic environment of the farmers to make farming more profitable and dependable. No single farm enterprise is likely to be able to sustain the small and marginal farmers to meet the basic needs of farm families like food (cereal, pulses, oilseeds, milk, fruit, honey, meat, etc.), feed fodder, fibre, and fuel, attention should be paid to integrated farming system (IFS). IFS is sometimes known as integrated bio systems, and it refers to agricultural

systems that integrate fish and cattle or livestock and crop production. This system employs a network of interconnected business such that wastage from one component can be used as an input by another, lowering costs and increasing output and revenue. In especially for small and marginal farmers with limited resources, integrated farming system appears to be the potential approach to address the problems of sustainable economic growth of farming communities which is continuously rising demand for food and nutrition, income stability and the improvement of livelihoods in India.

Keyword: Integrated Farming System, Food security, Enterprises, Small and Marginal Farmers, Sustainability

Biochar: A Potential Soil Health Enhancer to Agriculture and Climate Mitigation

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As agricultural leftovers collect in fields, they can generate significant crop management issues and sometimes treated as a burden, owing to a lack of resources to turn it into an asset due that it is a growing issue in the Indian agricultural sector as well as in world. Hence, residue burning has traditionally been used to clear agricultural fields, allowing for easier land preparation and early planting. As a result, the losses of precious biomass and nutrients as well as the release of toxic gases such as CO_2, N_2O and methane, which contribute to global warming and also soil organic matter and fertility status of Indian soils are declining over the decades because of climatic variability and imbalances in fertilization practices. Due to that improving the soil health and productivity of crops in India is a critical need for ensuring sustainable agricultural development in India. Therefore, using the pyrolysis process to convert organic waste to biochar is one possible alternative for increasing natural rates of carbon sequestration in the soil, reducing farm waste burning and improving soil health. This is 2,000 year old approach transforms agricultural waste into a soil amendment that can store carbon, increase soil biodiversity and reduce deforestation. At the international level, improving soil with coal is seen as a way to increase soil productivity, fertility and additionally to mitigate climate change. Presently biochar, gaining scientific attention and popularity in the agriculture sector. Biochar is a solid material made by pyrolysis process of any biomass, including weeds, agricultural leftovers and other plant wastes, to carbonise it and use it as a soil amendment and carbon sequestration medium. Result of various study revealed that application of biochar improves soil physical, chemical and soil biota characteristics by way of improved soil pH, CEC, water holding capacity, soil permeability and modify soil bulk density and aggregate stability. Biochar has additionally been tested to reduce methane

and nitrous oxide emissions from agricultural soils, which give an advantage in mitigating climate change effects. Therefore, it can be concluded that biochar has the potential to reducing residue burning and keeping a threshold level of organic matter in the soil which is enhance physical, chemical and biological integrity of the soil as well as lengthy-term agricultural output.

Keywords: Biochar, Residue burning, Soil health and Climate mitigation

Vermicompost Influencing the Agricultural Yield & Quality

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Vermicompost is a nutrient-rich, microbiological-active organic amendment that the interactions between earthworms and microorganisms during the breakdown of organic matter. It stabilized to divided peat-like material with a low C: N ratio, high porosity and high water holding capacity is the most nutrients are present in form to the plants. The agroforestry species produce huge amount of biomass and recycling of biomass by vermicomposting and other incorporation in soil by means of residue management practices for improvement of soil fertility. It prevents nutrient losses and increases the use efficiency of chemical fertilizers and it is free from pathogens, toxic elements, weed, seeds etc. it is necessary to monitor the temperatures of large-scale bin systems (high heat-retentive properties) as the raw materials or feedstocks used can compost and heating up the worm bins as they decay and killing the worms and the temperatures between 15-25° (59-77°). They can survive at 10° (50°) and above 30° may harm them. The important of the agricultural sustainability for the future of the national economy and the Vermicompost is very valuable resource as organic fertilizers because it provides macro and micronutrients for plants and is a low cost, environmentally- friendly, invaluable alternative to chemical fertilizers. Earthworms have the potential to reduce the retention of pollutant and plant essential metals in the organic horizons by decomposing organic matter.

Keywords: Vermicompost, Earthworm, Microbiological active, C: N ratio, Environmental balance, organic matter

Effect of Soil Management Strategies on Soil Erosion and Crop Productivity in Degraded Ecosystem of Chambal Tablelands

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Soil erosion is an age-old environmental problem and a continuous process which undergoes huge loss of natural resources, threatening agricultural productivity, risking farmers income and impairing ecosystem services. In semi-arid regions erratic rainfall pattern, soil loss, low soil moisture and organic carbon and sodicity resulting in poor soil condition are some of the major constrain in soybean production.Impact of different combinations of soil amendments treatments viz., control (T_1);Recommended Dose of Fertilizer (RDF) for soybean (T_2); RDF + Gypsum(T_3); RDF + FYM (T_4); RDF + crop residue (CR) (T_5); RDF+ Gypsum + CR (mustard crop residue) (T_6); RDF+ Gypsum + FYM (T_7); RDF+ Gypsum + CR+ FYM (T_8) were imposed on soybean crop during kharif season at research farm ICAR-IISWC, RC, Kota for three year duration. Results showed mean runoff and soil loss differed significantly among the treatments and were consistently highest in control plots and lowest in T_6, T_8 plots. Soil loss rate increased linearly with increase in runoff loss in all the treatments. Higher soil and nutrient conservation were observed combined amendment followed by sole amendment treatments. Application of amendments not only reduced soil loss but improved crop productivity. Higher soybean grain production was registered in T_8, T_6 and T_7treatments. Gypsum application individually and combined with FYM/CR showed significant effect on soybean yield. Soybean yield in sole and combined amendment treatments improved by 30-35% over chemical fertilizer treatment.Significant increase in available sulfur content and improved soil properties were observed with combined amendment treatments. Resource conservation measures such assoil amendments application are economically viable options for farmers for improving soil and crop productivity in degraded ecosystems of semi-arid regions.

Keywords: soil amendments, runoff, soil loss, crop productivity, soil properties,

Fertility Status of Paddy Growing Soils of Varada River Flooded Areas of Shivamogga district

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A survey type investigation was carried out on Varada river basin areas of Sagara and Soraba taluk of Shivamogga district, Karnataka, India. Total 100 soil samples were collected from 0 to15 cm depths in selected villages of paddy growing lands of Varada river basin. Results revealed that pH values in the surface soils ranged from 4.48 to 5.96 of river basin varied from moderately acidic (4.48) to slightly acidic (5.96) with non-saline nature of soils (0.02-0.08dSm^{-1}) which may be due to flooding and low (5.81 g kg^{-1}) to high (7.21 g kg^{-1}) level of soil organic carbon. Available nitrogen (101.71-307.32 kg ha^{-1}) was found low to medium and it has significantly strong positive correlation with SOC ($p<0.01$), potassium (54.16-97.84 kg ha^{-1}) and sulphur (1.19-7.04 mg kg^{-1}) found low status of paddy growing soils. Available P_2O_5 (20.77-74.44 kg ha^{-1}) content was medium to high in the study area and because of low mobility of available P it was negatively correlated with Zn ($p<0.01$). The exchangeable calcium (1.38-3.41 cmol (p$^+$) kg^{-1}) and magnesium (0.32-0.83 cmol (p$^+$) kg^{-1}) in most of soils deficient while DTPA extractable iron (19.06-36.52 mg kg^{-1}), manganese (1.93-20.34 mg kg^{-1}) and copper (1.26-6.19 mg kg^{-1}) was sufficient and available zinc was ranged from 0.37 to 2.67 mg kg^{-1} both sufficient and deficient was recorded in the Varada river basin areas.

Keywords: Varada river basin, Fertility status, Macro-nutrients, Micro-nutrients

Effect of Weed Management and Phosphorus Nutrition on Growth and Yield Attributes of Cowpea

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A field experiment entitled "Effect of Weed Management and Phosphorus Fertilization on Weeds and Productivity of Cowpea [Vigna unguiculata (L.) Walp.]" has been conducted during Kharif 2019 at the Instructional Farm, Rajasthan College of Agriculture, Udaipur consisting 18 treatment combinations

comprised of 6 weed management treatments and 3 phosphorus doses. These treatments combinations were analysed using factorial RBD with 3 replications. The results of experiment elucidate that all the weed management treatments consistently increased all the growth parameters under study. With respect to plant height, dry matter accumulation and LAI of cowpea, pendimethalin 1000 g ha^{-1} along with hoeing & weeding at 15-20 DAS was found better at 25 DAS compared to other treatments, except weed free treatment; whereas with regard to plant height, dry matter accumulation and LAI at 50 DAS & harvest, branches $plant^{-1}$, effective root nodules & their dry weight, application of pendimethalin 750 g ha^{-1} as pre-emergence in combination with imazethapyr + imazamox 33.75 g ha^{-1} as post-emergence found superior compared to other treatments, except weed free treatment. The highest number of pods $plant^{-1}$, number of seeds pod^{-1}, length of pod, pod yield $plant^{-1}$, seed yield $plant^{-1}$ and weight of 100 seeds were recorded with weed free treatment which was statistically at par with pendimethalin 750 g ha^{-1} as pre-emergence in combination with imazethapyr + imazamox 33.75 g ha^{-1} as post-emergence. Addition of 40 kg P_2O_5 ha^{-1} influentially increased plant dry matter at 50 DAS & harvest, number of branches $plant^{-1}$, dry weight of effective root nodules $plant^{-1}$ and CGR of cowpea in relation to 30 kg P_2O_5 ha^{-1} and further increase in phosphorus by 10 kg failed to enhance all these parameters significantly. Application of each successive levels of phosphorus markedly increased the number of effective root nodules $plant^{-1}$ and LAI of cowpea compared to their counterparts and the increment was at decreasing rate. Yield attributes like number of pods $plant^{-1}$, length of pod, pod yield $plant^{-1}$ and seed yield $plant^{-1}$ pointedly increased with application of phosphorus at 40 kg P_2O_5 ha^{-1} compared to 30 kg P_2O_5 ha^{-1} at significant level and further addition of phosphorus from 40 to 50 kg P_2O_5 ha^{-1} failed to bring any significant improvement in these parameters. The productivity of cowpea in Zone-IV (a) of Rajasthan is low and far below than its potential yield, mainly on account of inadequate weed management as well as poor nutrition especially phosphorus application. Therefore, adoption of proper weed management practices and application of fertilizer in sufficient amount would improve productivity of cowpea.

Keywords: Weed Management, Phosphorus Nutrition, Growth Parameters and Yield Attributes

Long-term Adoption of Bed Planted Conservation Agriculture Enhances Soil Organic Carbon Stabilization within Aggregates in the Indo-Gangetic Plains

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The traditional methods of crop planting and management are no longer practical for achieving the many objectives of sustainable development. Significant negative effects of this approach include soil deterioration, increased carbon emissions, reduced soil productivity, etc. Determining the effects of conservation agriculture (CA) practices such as permanent broad beds (PBB), permanent narrow beds

(PNB), and zero tilled flat beds (ZT) with residue retention was the goal of the study. The outcomes demonstrated that the CA techniques had significantly improved soil aggregation. In comparison to the conventionally tilled (CT) plots, the macroaggregates were, respectively, 33, 29, and 24% higher in the PBB with residue (PBB+R), PNB with residue (PNB+R), and ZT with residue (ZT+R) plots (CA plots) (0-5 cm). Similarly, zero tillage and residue retention measures in both soil layers increased the concentrations of soil organic carbon (SOC) in the aggregates. In comparison to the CT plots in the topsoil, the PBB+R plots had light fraction inside microaggregates inside macroaggregates (LF_mM) and intra-aggregate particulate organic matter inside microaggregates inside macroaggregates (iPOM_mM) that were 64 and 19% higher, respectively. In the plots under PBB+R, PNB+R, and ZT+R, the amounts of the iPOM_mM fraction were comparable, but the long-term adoption of CA had greatly improved the proportion of light fractions of microaggregates within macroaggregates (LF_mM) in the 0-5 and 5-15 cm soil layers. The PBB+R plots were 13% higher than PNB+R plots and had the highest LF_mM related C concentration. In the 0-5 and 5-15 cm soil layers, respectively, long-term adoption of PBB+R treatment enhanced the iPOM_mM related SOC by 39 and 48% more than CT treatment. Growing maize/cotton-wheat under CA practice is a viable option in the age of climate change to achieve food security while preserving the natural resources because aggregate-associated C is an ecosystem property that strongly affects organic carbon sequestration and stabilization, water holding capacity, and resistance to erosion.

Keywords: Conservation agriculture, zero-till, bed planting, Soil organic carbon

Soil Conservation and Management – An Overview

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Soil is a vital natural resource that supports plants, animals, and human populations as well as serving as a habitat for a wide variety of species. Due to human activity, productive soils are increasingly deteriorating throughout the world. A century of declining soil quality has resulted in the loss of wetlands, forests, and cultivable lands. Soil conservation is not only a technical problem. Several practices in agriculture today have resulted in misuse and degradation of previously fertile land. Improper choice of cropping patterns and implements, unsuitable cultivation techniques are the exploitation of natural pastures and forests. In this study to solve some of these problems, many mistakes have been made resulting in failures and worsening of the situation in many countries. Soil conservation is various practices of farming operations and management strategies which are conducted with the purpose of controlling soil losses. Soil conservation activities such as cover crops, crop rotation, mixed cropping, mulching and minimum tillage can improve soil health by increasing the number of soil organisms. Soil conservation and management aim for protective, supporting and improving the quality of soils. This study discusses soil quality and the many methods for conserving soil and management.

Keywords: Soil Quality, Soil Conservation, Soil Management, Farming Operations

Characterization of Lowland Acid soils for Secondary Nutrients in Hilly Zone of Karnataka

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Hilly zone of Karnataka receives high rainfall leading to acidic soil and become problematic for crop production. Liming of acid soil is a fundamental management technique to address acid soil issues in upland paddy fields. Calcium and Magnesium is highly mobile in soil, due to high rainfall leaching of secondary nutrients which gets accumulated in low land paddy fields. Nutrient status will differ in upland, midland and lowland paddy fields. The present investigation was made to study the "Characterization of Lowland Acid Soils for Secondary Nutrients in Hilly Zone of Karnataka". Soil samples were collected from the Kodagu and Chikkamagaluru districts to know the status of secondary nutrients, along with different forms of soil acidity were analyzed. Experimental results revealed that the soils of the Kodagu and Chikkamagaluru districts are moderately acidic to neutral in soil reaction, ranging from 5.16 to 6.97. EC values of all the soil samples grouped under the non-saline (< 2.0 dSm^{-1}) class. Organic carbon content low to high ranged from 4.12 to 22.90 g kg^{-1}, and the Cation exchange capacity of soils ranged from 10.60 to 26.90 cmol (p^+) kg^{-1}, respectively. Potential acidity appears to be a dominant fraction in the soil which includes both exchangeable and pH-dependent acidity. However, their distribution in soil was found to be in the following order, viz., Potential acidity > Exchangeable acidity > Active acidity. Available Calcium in soil was high, ranged 4.30 to 16.00 cmol (p^+) kg^{-1}. Available Magnesium in soil ranged from 2.00 to 9.80 cmol (p^+) kg^{-1}. Available sulphur in soil was medium to high, ranging from 9.40 to 22.90 mg kg^{-1}.

Keywords: Acidic soil, Nutrient status, Calcium, Magnesium

Soil Degradation Risk of Salicornia Farms Irrigated with Sea Water in Coastal Environments (Case Study: Southern Coastal Strip of Iran)

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There are 1480 kilometers of coastal strip in southern part of Iran, promising a valuable and infinite resource of water for this arid and semi-arid country. Sali-cornia (e.g. S. Bigelovii or S. Europea) is a potential forage and oilseed halophyte plant that can be cultivated in such systems and irrigated with highly saline sea water. Severity of soil degradation will depend on the amount of applied water as well as its management in the farm. So, although there is no physical constraint on supplying large amounts of hyper saline sea water for the Salicornia fields, optimization of irrigation water consumption will be very important and determinal in stability of the system. Under such circumstances, it will be essential to accurately determine Salicornia water requirement for the specified regions. This re-search was carried out to investigate Salicornia Evapotranspiration (ETc) and Irrigation Water Requirement (IWR) in the southern coastal strip of Iran. For this purpose, the long-term meteorological statistics of Abadan, Mahshahr, Hendijan, Bandar Daylam, Bushehr, Bandar Dayeer, Bandar Lengeh, Bandar Abbas, Min-ab, Jask, Konarak and Chabahar stations in southern coastal strip of the country were prepared. Results of this study showed that the mean daily and seasonal ETc of Salicornia is 7.5 mm.day^{-1} (from 4.9 to 9.0 mm.day^{-1}) and 1567 mm (from 1228 to 1799 mm), respectively. Also the IWR of Salicornia depends on the cultivated region, efficiency of irrigation system and leaching requirement, and varies from about 19'000 to 40'000 cubic meters per hectare. In addition, results showed that although there is no physical limitation for the supply of Salicornia IWR in the studied region, but considering high levels of seawater salinities and prediction of significant volumes of saline water for irrigation of Salicornia farms, the risk of salinization and gradual soil resource degradation will be remained for this case.

Keywords: Persian Gulf, Oman Sea, Salicornia Water Demand, Soil Salinization

Soil Health Perspective and their Management

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Since ancient times, agriculture has been the core of the Indian economy. But presently Indian agriculture is facing so many problems like Deforestation land use shifting and indiscriminate use of plant nutrients, heavy use of pesticides, negligible use of organic manures, declining fertilizer use efficiency, lack of irrigation water and minimizing of cultivable lands etc. The major challenges in 21st century are food security, environmental quality, and soil health. Besides, shrinking land holdings and increasing cost of inputs lacking in adoption of scientific use of plant nutrient for higher crop productivity. Currently, it is highly challenging to supply the need for food, feed, fuel, fodder, and fiber from the growing human and animal population without significantly degrading the environment. The term 'soil health' invariably crosses roads with other name 'soil quality.' The soil health refers to self-regulation, stability, resilience, and lack of stress symptoms in a soil as an ecosystem. Soil health describes the biological integrity of the soil community - the balance among organisms within a soil and between soil organisms and their environment." It involves integration of physical, chemical, and biological properties of a soil and role of this harmonious blend in sustaining productivity growth and environmental security. A healthy soil may function is as follows:

- Sustain biological activity, diversity, and productivity
- Regulate, store of nutrients and cycle water and, decompose organic matter
- Filtering and buffering, degrading, mineralizing, immobilizing, and detoxifying organic and inorganic materials
- Inactivate toxic compounds, suppress pathogens, protect water quality, and enhance catchment soil health.

Keywords: Food security, Soil quality, Environmental quality

Impact of Different Land Use Systems on Soil Fertility Status in Westernghat-Chikamagalur, Karnataka

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Soil degradation is a worldwide problem due to unscientific land use pattern and cropping techniques which attracted attention in sustainable agricultural production systems. Soil fertility fluctuates throughout the growing season each year due to land use changes and unscientific nutrient management practices by the addition of unbalanced fertilizers, manure, compost, mulch and lime in addition to leaching. The present study was conducted to assess the impact of different land-use systems on major nutrient status viz: Nitrogen, Phosphorus and Potassium in soils of central part of westernghat, Karnataka. The land use types include both manmade systems (Agriculture: paddy; Horticulture: coffee, arecanut, tea and banana); forest plantation (accacia and teak) and natural systems (Evergreen, semi-evergreen and grassland). In each land use systems, samples were collected from two depths (0-15 cm and 15-30 cm) at 20 locations during pre-monsoon and post monsoon period. Soil samples were analyzed for available nitrogen, available phosphorus and available potassium. The results revealed that available nitrogen content in surface soil was significantly higher (394.55 kg ha^{-1}) than that of subsurface soil (330.57 kg ha^{-1}). Among manmade land use systems, available nitrogen content was significantly higher in coffee (435.82 kg ha^{-1}) followed by in soils under banana (404.40 kg ha^{-1}). Similarly, in natural system the available-N content was in the range of 294.97 to 376.55 kg ha^{-1} with minimum in grassland and maximum in semi-evergreen forest. Available-P varied significantly among different land use systems. The highest available-P content was recorded in soils under coffee (29.31 kg ha^{-1}) followed by evergreen forest (28.37 kg ha^{-1}), semi-evergreen (27.26 kg ha^{-1}) and other systems. The available-P was least in grassland (20.28 kg ha^{-1}). The available K_2O content in soils under paddy was 299.42 kg ha^{-1} and it was significantly lower than other systems but was at par with those observed in grassland (311.01 kg ha^{-1}), acacia (321.01 kg ha^{-1}) and teak system (329.86 kg ha^{-1}). These results indicated that well-managed horticultural system in general and coffee in particular had better soil fertility which is comparable to that found in natural forest system.

Keywords: Land use system, Soil fertility, Nutrient dynamics, Major nutrients

Influence of Nitrogen Levels on Herbage Yield and Economy of Promising Entries of Oat (*Avena sativa* L.) under Chhattisgarh Plains

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In order to find out performance of promising entries of oat under different nitrogen level, the present research work entitled "Influence of nitrogen levels on herbage yield and economic of promising entries of oat (Avena sativa L.) under Chhattisgarh plains" was conducted during Rabi season of 2020-21 at Agriculture Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). The soil was clay loam having neutral reaction (pH 7.0), low available soil nitrogen (150.52 kg ha^{-1}), medium available soil phosphorous (16.23 kg ha^{-1}) and high exchangeable soil potassium (364 kg ha^{-1}). The experiment consisted with ten promising entries of oat as a main plot treatment and three nitrogen levels viz. 60, 90 and 120 kg N ha^{-1} as sub plot treatment was laid out in split plot design with three replications. The ten promising entries of oat were OL-1874-1, Kent, OL-1876-1, RO-11-1-3, JO-06-23, SKO-241, RO-11-1, OS-6, RO-11-1-2, and HFO-806. The crop was sown 20th November, 2020 with a seed rate of 100 kg ha^{-1} and harvested at 50% flowering. The crop was fertilized with 100:40:20 kg N : P_2O_5 : K_2O ha^{-1}. The 60% nitrogen and whole quantity of phosphorous and potassium was applied as basal and remaining 40% N was given at 40 days after sowing. Among different promising entries of oat, OL-1874-1 gave the highest yield of herbage (448.9 q ha^{-1}), dry fodder (94.2 q ha^{-1}) and per day productivity, gross return (Rs 67333 ha^{-1}), net return (Rs 41234 ha^{-1}) and Benefit : Cost ratio (2.58). Among nitrogen levels, yield viz. herbage yield (345 q ha^{-1}), dry fodder yield (76.27 q ha^{-1}) and productivity (3.88 and 0.86 q ha^{-1} day^{-1}), respectively and economic of gross return (Rs 51737 ha^{-1}), net return (Rs 25227 ha^{-1}) and Benefit : Cost ratio (1.95) increased with increasing levels of from application of 60 to 120 kg N ha^{-1}.

Keywords: Fodder oats, economics, N levels, Promising entries, Yield

Effect of Biochar on Nitrogen Retention in Soils

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Nitrogen (N) is an essential element for plant growth and a key agricultural input into soils. Excessive application of fertilizers caused the release of nutrient elements, such as nitrogen from agricultural

fields to aquatic systems. Leaching of nutrients from soils may deplete soil fertility, accelerate soil acidification, increases fertilizer costs for the farmers, reduce crop yields and most importantly impose a threat to environmental health. It is therefore very important to develop effective technologies to hold nutrients such as nitrogen in soils. An option to reduce nitrogen leaching could be the application of biochar to the soils. Biochar is a product, derived from the thermal decomposition of biomass at elevated temperatures with limited or no supply of oxygen. Biochar application to soil increases the cation exchange capacity and the overall sorption capacity and thus may influence the soil function to retain nutrients such as nitrogen and filter harmful chemicals. Adding biochar may increase net nitrification rate, stimulate N immobilization, reduce N_2O emission, decrease NH_3 volatilization, enhance ammonium-oxidising bacterial abundance and alter N availability for crops. Biochar has been found to improve agriculturally significant soil parameters such as soil pH, cation exchange capacity and soil water holding capacity. Nutrient affinity i.e., retention of N on permeable soils under rainy conditions was found higher with biochar application and hence reduces the need for fertilizer/manure/compost application. Biochar has the potential in reducing inorganic N losses from inorganic and organic fertilizer sources in coarse-textured soils. The reduction in N leaching varied greatly with the characteristics of the biochar and amount applied.

Keywords: Biochar, Nitrogen, Retention

Strategy of Natural Resource Conservation and Management for Sustainable Food Supply and Livelihood Security-A Case Study in Semi-Arid Tropics, Bundelkhand Region, Central India

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Soil and water both are essential natural resource for livelihood and agricultural production. Both natural resource represent the human civilization because these support the plants which provide nutrition to mankind and their livestock's. Such natural resource management becomes an important concern for 21st century due to high demand of water by rapidly increasing human population. Under such circumstances, management of these resources at a watershed scale has become one of the important strategies for sustainable food supply and livelihood security through implementation of rainwater harvesting structures. In this way, a study was carried out in Garhkundar-Dabar (GKD) watershed located in semi-arid tropics, Bundelkhand region of Central India. Bundelkhand region of semi-arid tropics is far behind in the availability of soil and water due to erratic rainfall and hard rock terrains. Agricultural productivity of this area was also very poor which oscillated between 0.5 to 1.5 t ha^{-1}. The study of last 20 years (2000-2019) revealed that 10 are severe drought years, 5 normal and 5

surplus years. In spite of such erratic rainfall, results of the study area were found satisfactory and adoptive strategies provide sufficient water supply, sustainable food and livelihood security. Adoptive natural resource management include interventions of checkdams, spillways, gabions, nalla plugs, injection pits, bunding and agroforestry based crop cultivation etc. These interventions were implemented under RS and GIS environment and field survey for doing most effective. These strategies generate water approximately 25 thousand cubic m resulting reduced number of dry wells to 2% from 86% and transform 60-90 ha agricultural land into 260-265 ha cultivated land during both seasons. These technology also ensure that if rainfall occurring is less than 50% of average annual rainfall in a particular area then there are very minimal chance to drought.

Keywords: GKD watershed, RS and GIS, Rainfall, natural resource management

Production and Characterization of Biochar from different Sources of Biomass

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The biochar was produced from different biomass and characterize it for physical and physicochemical properties**.** Biochar is produced from the pyrolysis of a variety of biomass materials viz., Coconut husk, coconut shell, paddy straw, rice husk, eichhornia, sugarcane bagasse, grass, cotton stalks, prosopis and neem wood in pyrolysis unit. The biochars differed much in their characteristics. Recovery of biochar was high in Prosopis showed its superiority over others in providing high pore space, higher pH, EC, CEC, organic C, total N, Mg, available nutrients and carbon fractions. The wood biochar viz., Prosopis wood biochar as superior one that can act as a soil conditioner and has the capacity to enhance supplying and retaining nutrients and by providing other benefits such as improving soil physical properties followed by cotton stalk biochar and drymatter biomass biochars. Considering the higher recovery and its distribution, resource of Prosopis can be harnessed. Due to the wide variations noticed among the different biomass, characterisation of biochar from each biomass becomes a pre requisite before mass production for agriculture purpose.

Keywords: biochar, Biomass, carbon fractions, labile carbon, nitrogen fraction

Vertical Distribution of Available and Total Micronutrients and their Relationship with Soil Properties in different Land Management Units of Kanginhal Sub-watershed in Northern Dry Zone of Karnataka

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A study on vertical distribution of available and total micronutrients (B, Fe, Mn, Zn and Cu) in different land management units (LMUs) of Kanginhal sub-watershed of Gadag district in Northern dry zone of Karnataka was undertaken during 2017-18. Kanginhal sub-watershed covering an area of 3693.87 ha and major parent material is weathered schist. The climate of the area is semi-arid or hot tropical and monsoonic type. The average annual rainfall was 539.8 mm. Entire sub-watershed is having black soils with clay texture. The soils depth of the sub-watershed is predominately very deep and gradient of land is nearly level to very gently sloping. Available and total boron did not follow definite trend in their distribution in all the LMUs and had significant positive correlation with clay (r=0.954** and r=0.973**, respectively) and significant negative correlation with sand (r=-0.759**and r=-0.805**, respectively). Available boron positively and significantly correlated with OC, whereas total boron showed positive correlation with OC. Available Fe, Mn, Zn and Cu decreased with depth and were positively and significantly correlated with OC and clay and negatively correlated with pH and CaCO3. Total Fe, Zn and Cu contents decreased with depth and showed significant positive correlation with OC (r=0.980**, r=0.995**and r=0.996**, respectively) and positive correlation with clay (r=0.347, r=0.378 and r=0.405, respectively). However, total Mn did not follow any regular trend with depth and was significantly and positively correlated with clay. Among the six LMUs, the highest available boron of 0.73 mg/kg recorded in Ap horizon of LMU-6 and lowest in Ap horizon of LMU-1. The available Fe, Mn, Zn and Cu contents were maximum of 5.04, 5.36, 0.56 and 1.56 mg/kg in Ap horizon of LMU-5 and minimum in Ap horizon of LMU-1.

Keywords: Land management units (LMUs), sub-watershed, available and total micronutrients

Inventory of Land Resources of a micro watershed in Upper Tungabhadra Catchment area in Karnataka

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An intrinsic investigation was studied on land resources of micro watershed covering 1067 ha area in upper Tungabhadra catchment in Karnataka. The land resource parameters like soil depth, surface soil texture, gravelliness, slope and erosion, water resources etc were depicted in thematic maps using Arc GIS techniques on a 1:7,920 scale. The investigated micro watershed area indicated moderately shallow to very deep soil depth but the major area comprised of deep (38.11 %) and very deep (34.26 %) soils. The major surface texture was clay (36.46 %) and sandy clay loam (35.70 %) in the selected micro watershed. The erosion classes were slight (19.73 %) to moderate (72.07 %) due to nearly level to very gently sloping (1-3 %) lands, but larger area was very gently sloping land occupying 86.17 per cent. The surface gravelliness comprised non gravelly (61.14 %), gravelly (28.64 %) and very gravelly (2.02 %) land in the study area. Totally, 32 soil phases were found based on soil heterogeneity in the micro watershed. The surface grid soil (0-15 cm) samples (104 No's) were collected to assess the soil fertility status and depicted in thematic maps. The pH of the soils ranged from 5.0-9.0 with major area being strongly alkaline in reaction covering about 324 ha (30.41 %). Major area is found to be medium in organic carbon status covering 971 ha (91.03 %) in non-saline (<2 dS/m) soils. About 980 ha (91.80 %) showed low in available N and medium in available P_2O_5, whereas available K_2O was medium in 502 ha (47.01 %) and available sulphur was also medium in 744 ha (69.70 %). The available micro nutrients status like copper and manganese were represented sufficient level. But, zinc (73.21 %) and iron (21.90 %) were deficient respectively. Boron status was found low (53.84 %) to medium (37.96 %) in the micro watershed.

Keywords: Land Resource, Grid Survey, GIS techniques and Soil fertility status

Effect of different Amendments on Chemical Properties and Soil Fertility of Sodic Soil in Onion-maize Crop Sequence

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A field experiment entitled, "Effect of different amendments on chemical properties and soil fertility of sodic soil in onion-maize crop sequence" was conducted at Instructional Farm, Post Graduate Institute, MPKV, Rahuri. The experiment comprised of nine treatments viz., T_1: Absolute control, T_2: GRDF of onion (100:50:50 kg ha^{-1} N, P_2O_5 and K_2O + 20 t ha^{-1} FYM), T_3: GRDF + compost @ 5 t ha^{-1}, T_4: GRDF + PMC compost @ 5 t ha^{-1}, T_5: GRDF + PBSW @ 75,000 L ha^{-1}, T_6: GRDF + gypsum as per 100 per cent gypsum requirement, T_7: GRDF + sulphur as per $^1/_{5^{th}}$ of gypsum requirement, T_8: GRDF + phosphogypsum as per 100 per cent gypsum requirement and T_9: GRDF + zeolite @ 500 kg ha^{-1} for onion crop. The residual effect of these treatment plus GRDF (120:60:40 kg ha^{-1} N, P_2O_5 and K_2O + 10 t ha^{-1} FYM) to maize crop in onion-maize cropping sequence. The treatments were replicated thrice and imposed on statistically laid out field with randomized block design. The soil of experimental field was fine montmorillonite isohyperthermic family of Sodic Calciustert. The soil was strongly alkaline in reaction (pHs 8.56) with moderately high total soluble salts content (ECe) 3.20 dSm^{-1}. Organic carbon content in soil was moderate (0.57%) whereas, the calcium carbonate was high (12.20 %). The soil was low in available nitrogen (143 kg ha^{-1}), phosphorus (8.50 kg ha^{-1}) and very high in available potassium (452 kg ha^{-1}). The organic carbon of sodic soil after onion-maize cropping sequence was increased significantly in GRDF + residual effect of PMC compost (0.72%). The calcium carbonate in GRDF + residual effect of PBSW was significantly lower in (9.32%) after onion-maize cropping sequence. The ESP of sodic soil initially was 18.43 and decreased by the end of sequence i.e., at harvest of maize was significantly reduced (12.12) in treatment GRDF + gypsum as per 100 per cent GR. The SAR of sodic soil showed same trend as observed in ESP. The periodical soil available nitrogen showed significantly higher in treatment GRDF + gypsum as per 100 per cent GR at 30, 60, 90 DAT and at harvest of onion (229, 310, 263 and 254 kg ha^{-1}, respectively) and their residual effect in maize with GRDF to maize at tasseling and harvest (338 and 246 kg ha^{-1}, respectively). The periodical soil available phosphorus showed significantly higher in treatment GRDF + gypsum as per 100 per cent GR at 30, 60, 90 DAT and at harvest in onion (23.4, 22.5, 23.0 and 22.4 kg ha^{-1}, respectively) and their residual effect in maize with GRDF of maize at tasseling and harvest (23.6 and 21.8 kg ha^{-1}, respectively). The periodical soil available potassium showed significantly higher in treatment GRDF + PBSW @ 75,000 L ha^{-1} at 30, 60, 90 DAT and at harvest of onion (650, 627, 612 and 597 kg ha^{-1}, respectively) and their residual effect + GRDF of maize at tasseling and harvest of maize (653 and 594 kg ha^{-1}, respectively) in onion-maize cropping sequence.

Keywords: sodic soil, reclamation, amendments

Identification of Yield-reducing Factors using Comparative Performance Analysis Method in Wheat Fields of Abarkoh

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Mostly the actual yields obtained by farmers are less than the potential yields of the region, due to management, climatic, soil properties or other living and non-living stress factors. The goal of this experiment is finding of limiting factors which affected the wheat yield and then reducing the yield gap between potential and actual yields of farmers in the fields of Mehrdasht and Bahman districts of Abarkooh city located in Yazd province. Eleven wheat farms were selected with the coordination and consultation of agricultural service centers in different regions of Abarkooh counties. Soil samples were prepared from all farms before planting. All agricultural operations performed by farmers such as tillage methods, planting date, cultivars used, seed rate, cultivation area, crop rotation, fertilizers used and fertilization time, irrigation operations, pest and disease control, weeding and/or spraying herbicide and harvest methods were noted or measured. At the end of tillering phase and harvest time, soil was sampled and its nutrients, organic matter and salinity were determined. At harvest time, samples were taken from different parts of the field by one square meter plots and 10 plants were randomly selected to measure yield components. The farmer's performance with the combine was also recorded based on the farmers' claims and the approval of the local expert. Nitrogen, phosphorus and potassium levels were measured in grain, straw and soil after harvesting operation. Meteorological data were collected daily from the Abarkoh weather station. The potential yield of region was calculated using regression model and the difference between obtained yield and potential yield was considered as yield gap. Eighty percent of potential yield is also considered as exploitable yield. Using step-by-step regression, the most effective factors in yield reduction were identified and a suitable regression model was fitted for these variables against grain yield. Then, the degree of influence of each variable was determined using Comparative Performance Analysis.The results showed that the average yield obtained from these farms was 5040 kg/ha and the yield gap was 4659 kg/ha, of which 2721 kg can be attainable. The order of the importance of agricultural operations in reducing yield in the form of insufficient number of irrigations (24 percent), lack of crop rotation with pulses (18 percent), low consumption of nitrogen fertilizer (16 percent), the method of preparing the cultivation bed and plowing times (12 percent), lack of manure fertilizer consumption (12%), improper weed control (11%), improper planting date (4%) and insufficient nitrogen split (3%). The average of nitrogen use efficiency in the studied farms was 33.29 kg/kg and the average of water use efficiency was 0.62 kg/m^3. In farms that had a higher than average nitrogen and water use efficiency, the management of cultivation bed preparation, crop rotation, soil fertility and organic matter management, and irrigation management were better than other farms. The analyze of grain yield components also showed that

the share of the number of spikes per square meter, number of seeds per spike, 1000 kernel weight and harvest index in yield reduction are 39, 24, 12 and 25% respectively. Based on the results obtained , we can to define an optimal crop management : enough irrigation (10 times), rotation with legumes, use enough nitrogen fertilizer, use animal manure to increase soil organic matter, plowing in summer and autumn, weed control, proper planting date and Nitrogen split 3 times. Considering that management factors mentioned above have mutual effects on each other and cannot cause a significant yield increase alone, therefore, in order to have a successful agriculture, it is necessary to act on the basis of a suitable management package.

Keywords: exploitable yield, agronomic principles, wheat, potential yield

Soil Arthropods Potential Nutrient Recycler in Soil in Desert Area

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Up to 45% of the Earth's total area is made up of dry regions. Low moisture content, irregular and unpredictable precipitation, and extremely high surface temperatures are characteristics of dry areas. Due to the spatial and temporal paucity of green plant material, which restricts herbivory, plant litter is frequently the primary source of food for primary consumers in desert regions. Therefore, detritivorous arthropods typically dominate the main consumer guild in dry environments. These macro-detritivores represent the foundation of numerous energetically efficient food chains since they are mostly preyed upon by small ectothermic and reptilian animals. By controlling the physical and chemical conditions both above and belowground, burrowing arthropods play a crucial role in ecological engineering. Consequently, it is anticipated that macro-arthropods will be essential to the cycling of nutrients in the desert. It is necessary to focus research on these essential tasks of arthropods as well as their role in nitrogen fixation and nutrient transfer, which makes them important regulators of nutrient dynamics in dry environments.

Keywords: Dry lands, soil arthropods, nutrient, macro-detritivores

Correlation studies among various growth and yield parameters influenced by microbial enriched Arecahusk compost in Maize under Maize-Green gram cropping sequence in Typic Rhodustalf

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At present majority of arecanut husk waste is disposed-of by burning, which leads to the loss of potential source of organic matter and valuable plant nutrients. The value of arecanut waste as organic material has not been fully realized so far. In this perspective an experiment was conducted to study the arecanut husk and its composting at Agricultural and Horticultural Research Station, Bhavikere, in kharif season for two consecutive years (2020-21 and 2021-22), fallowing a sequential cropping system consisting of maize fallowed by green gram. A fully randomized complete block design consisting of ten treatments which are replicated thrice. Results indicated that application of 75% RDN with 25% RDN as arecahusk compost (AHC) and entire quantity of recommended dose of Farm Yard Manure (FYM) as AHC (based on N equivalent) increased the growth, yield and root parameters over recommended dose of fertilizers (100% RDF + 7.5 t FYM). Correlation analysis depicted that growth parameters positively correlated (0.97*** to 0.99***), yield parameters (0.95*** to 1.00***) and root parameters (0.98*** to 0.99***) for grain yield (93.60, 95.67 q ha^{-1}) and stover yield (110.66, 116.15 q ha^{-1}) in both years 2020 and 2021. It was also recorded 14.89% grain yield increase over control. We conclude that arecahusk compost could be a potential alternative to FYM, which overcomes the problem of procuring FYM and disposal of arecahusk by areca growing farmers and it also minimize the dependence on chemical fertilizers.

Keywords: FYM, AHC, growth, yield, enrichment and INM

Effect of Enriched Lake Biomass Compost on Growth and Yield of French Bean (*Phaseolus vulgaris*)

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An experiment was carried out in Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, Bangalore to study the effect of enriched lake biomass compost on growth

and yield of French bean. The experiment was conducted in two phases i.e., preparation of lake biomass compost (LBC) and a pot culture experiment for the evaluation of the lake biomass compost. For the compost preparation lake biomass such as water hyacinth and alligator weed were collected from the selected lakes and used as raw materials. Cow dung, the main accelerator for compost preparation and microbial inoculum (Pleurotus sajorcaju, Phanerochaete chrysosporium, and Trichoderma harzianum) were used as additives to hasten the rate of decomposition. The LBC was enriched with different sources such as neem cake (NCE-LBC), single super phosphate (SSPE-LBC), microbial consortium (MCE-LBC) and the combination of all sources (MNSE-LBC) for 15 days. After enrichment it was applied to soil in different combinations and the observations were recorded in intervals of 30, 60 and at the time of harvest. Results of the study revealed that there was significant increase in growth and yield parameters of French bean. Significantly highest plant height (164.17 cm), number of leaves (92) and number of branches (17.67) per plant were recorded in treatment T_{11} (MNSE-LBC+100%NPK) followed by T_{12} (MNSE-LBC+75%NPK) and T_9 (SSPE-LBC+100%NPK). Similar trend was followed in case of yield parameters with highest number of pods per plant, pod yield per plant and pod length of 132.33, 0.99 kg and 19.73 cm, respectively. The enriched lake biomass compost can serve as best source of nutrients for urban farmers to increase the growth and yield of crops by supplying the adequate quantity of nutrients through applied lake biomass compost and the waste generated from the lakes can be better utilized in sustainable method.

Keywords: Lake biomass, Compost, Growth, Yield, French bean, Nutrient source

Development of Micro-Level Land and Water Action Plan – A Case Study in a Watershed in Lower Tungabhadra Catchment of Karnataka

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A scientifically sound and technically feasible action plan is imperative in order to conserve natural resources like soil and water and also to harvest valuable rainwater in a region. Remote sensing and GIS data give us an array of opportunities to identify apt conservation structures for a particular area based on well-established criteria. Crucial or vulnerable sites can also be identified by carefully examining the thematic maps and suitable conservation structures can be proposed based on different parameters. Suitable measures as well as suitable sites can be identified by Integrating Spatial distribution map of soil texture, drainage order, physiography, LULC, geomorphology, village proximity, etc., in a GIS environment using scientific and logical conditions. Hence, a study was carried out in Nagavangala micro-watershed to develop a micro level land and water action plan using RS

and GIS techniques. Based upon the careful interpretation of various thematic maps in a GIS environment, multiple locations and feasible structures were suggested. These structures help reduce the run-off velocity of the flowing water and help conserve precious water resources. Accordingly, Drainage line treatment structures and water harvesting structures were proposed at multiple locations. Check dams and boulder checks were found to be suitable. A total of six check dams and three boulder checks were found to be necessary. Hence, were proposed at necessary locations. Similarly, appropriate conservation structures for individual land parcels were also proposed on the basis of per cent slope, erosion severity, amount of rainfall, land use, and soil type. The different kinds of conservation structures recommended are contour bund and contour trench cum bund. It was found that 841.27 ha area required Contour trench cum bund and 15.95 ha area required contour bund.

Keywords: GIS data, water resources, conservation structures

Effect of Potassium Humate and Bio-inoculants on Soil Fertility, Enzymatic Activity and Microbial Population under French Bean (*Phaseolus vulgaris* L.) in Alfisols

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The investigation entitled "Effect of potassium humate and bio-inoculants on soil fertility, enzymatic activity and microbial population under French bean (*Phaseolus vulgaris* L.) in alfisols" was conducted during 2018-19 at Regional Horticulture Research and Extension Centre (RHREC), Bengaluru. The experiment was laid out in RCBD with 13 treatments replicated thrice. Potassium humate was applied as foliar spray (0.5%, 1 and 1.5%) and soil application (20 kg ha^{-1}). The results revealed that application of RDF + potassium humate @ 20 kg ha^{-1}along with bio-inoculants has significantly increased the soil pH (7.35), organic carbon content (0.83%), available nitrogen (339.31 kg ha^{-1}), available potassium (224.15 kg ha^{-1}), Rhizobium (6.54 CFU x 10^4 g^{-1} of soil), KSB population (44.16 CFU x 10^3 g^{-1} of soil) and enzymatic activity [Dehydrogenase activity (10.75 P kat kg^{-1} soil)] and there is no significant difference in EC, available phosphorus, exchangeable calcium and magnesium and micronutrient in soil after harvest of crop.

Keywords: Potassium humate, Bio-inoculants, Soil fertility, Enzymatic activity, Microbial population

Biochar for Bioremediation

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Biochar is a carbon rich material produced by thermal degradation of biomass in an oxygen free environment (pyrolysis). Biochar plays a multidisciplinary role in both agricultural and environmental sustainability development owing to its long-time persistence in soil. Biochar due to its higher surface area, enriched functional groups and variable charge aids in increasing water holding capacity, cation exchange capacity, pH of the soil and bioremediation of various hydrocarbons and heavy metals. The application of biochar in remediation had increased in recent years. Pollutants, both organic and inorganic, can be bioremediated with the help of biochar. The main mechanism is an increase in microbial diversity that breaks down hydrocarbons (petroleum) in contaminated soils modified with biochar. Although heavy metals and metalloids cannot degrade or be eliminated entirely from the ecosystem, they can be changed from one form to another and from one concentration to another. Additionally, organisms can accumulate metalloids and heavy metals. Therefore, two strategies are most frequently employed in the heavy metal and metalloid bioremediation process. Metal and metalloid absorption and accumulation in timber plants and crops with bioenergy potential in metal-polluted farmlands, as well as their removal by harvesting the biomass that contains or has accumulated metals and metalloids, as well as their transformation into less toxic products (complex form), which can be absorbed by native microorganisms and further reduce their toxicity and migration. Normally worthless yet expensive to dispose of, biomass is now a useful resource for the manufacture of biochar. Because biomass becomes an effective, indigenous, sustainable, and value-added commodity for urban, rural agriculture, and forest communities, tipping fees, overflowing landfills, open burning, and pollution are avoided. India is the third largest coconut producing country of the world with an area of about 1.12 million hectares contributing to 18% of world production. India produces about 6000 million nuts annually. A whole coconut consists of 50% husk, 15% shell, 25% meat and 10% water. The 65% of residues from coconut can be successfully converted to biochar for bioremediation. In addition, Biochar can improve soil structure, physicochemical properties, fertility, and revegetation as well as promote soil microbial populations. It can also significantly reduce the bioavailability and leachability of cationic metals and metalloids in soils. However, the application of biochar-aided phytoremediation is competent in trying to clean up multi-metal-polluted soils because biochar seems to become less effective in stabilizing highly harmful cationic metals and metalloids, which provide their mobility in soils.

Keywords: Biochar, Coconut shell, Bioremediation, Pyrolysis, Porosity

Upliftment in Farm Revenue through the Improved Cultivation Practices in Rice (Pratiksha Variety) under Medium Land Condition at Chopra block of Uttar Dinajpur district in West Bengal : A Case study

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Rice is a widespread crop growing in the Chopra block of Uttar Dinajpur district. Most of the farmers are growing rice on their land for livelihood. But due to the improper package of practices of rice crops in new alluvial soil (slightly acidic in nature), they are facing the problem of low crop yield inspite of using high doses of chemical fertilizer application. The farmers of this block are growing traditional rice varieties (Pratiksha) with low yield potential to meet the market demand. Hence, Uttar Dinajpur Krishi Vigyan Kendra (KVK) extended their hand to adopt new improved cultivation practices through the FLD programme in the farmers yield to achieve high productivity and farm income. The experiment was conducted in Randomised Block Design (RBD) in 3 replication at 7 farmers' field having 80*52 m2 area covering a total of 2.912 acres of medium land during 2019-20 and 2020-21 in the Kharif season. The results found that the average yield was recorded 6047 Kg/ha in Improved techiques of cultivation followed by 5316 Kg/ha with the traditional method of cultivation. Net profit and B:C ratio were recorded 52320/ha, Rs.67480/ha and 2.76, 1.94 with improved and farmers practices respectively. Here, all yield attributing parameters were increased because of suitable environmental conditions for plant growth and development, which ultimately contributes to the increase the farm income. After a successful demonstration of the results. The farmers of particular area are quite impressed to adopt such a new improved package of practices for rice crop in their fields. Therefore, farmers of Chopra village and neighbouring villages are very interested in growing rice with proper management practices to achieve maximum output with low input implementation.

Keywords: Crop yield, Farmers Practice, Improved Technology, Rice, Seed rate, Yield attributing parameters

Long-term Nutrient Management Effects on Soil Aggregation and C Stabilization in Vertisols of Central India

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Intensive tillage practices have lowered soil organic carbon content and impaired soil physical quality, emphasizing the importance of conservation-oriented activities. We investigated the effect of long-term application of farmyard manure (FYM) or gliricidia, either alone or in combination with NPK, on nitrogen (N) substitution basis on aggregate stability and carbon distribution in different aggregate fractions after 35 years of cotton-greengram intercropping on a cracking clayey Black soil. The results revealed that irrespective of treatments, the fraction of macro-aggregates (> 0.25 mm) was higher than that of micro-aggregates. The partial substitution of N by FYM/Gliricidia in NPK (INM) increased water stable aggregates by roughly 15% compared to control and 6.5% to NPK treatment. The structural indices such as mean weight diameter, geometric mean diameter, and aggregate ratio were highest (0.89, 0.87, and 3.87, respectively) in INM-based treatments. There was a higher organic carbon content in macro-aggregates, particularly in 2.0-1.0 mm aggregate fraction followed by > 2.0 mm, whereas micro-aggregates had the lowest in < 0.10 mm aggregate fraction. The INM-based treatments had higher carbon preservation capacity, particularly in all macro-aggregates fractions, compared to unfertilized control and NPK. Overall, aggregate-associated carbon of all sizes had a substantial positive correlation with macro-aggregates, mean weight diameter, and aggregate ratio but was negatively correlated with micro-aggregates. It is concluded that supplementing Gliricidia/FYM with NPK promotes soil aggregation and increases carbon in macro-aggregates. This will help in sustainable cotton-greengram productivity in the region.

Keywords: Black soils, nutrient management, aggregation, carbon storage, carbon preservation capacity

Influence of Liming Material and Bio-inoculants on the Yield and Nutrient Uptake of Frenchbean under Hilly Zone of Karnataka

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A field experiment was conducted at the College of Horticulture, Mudigere, Chikamagaluru district, Karnataka, to investigate the effect of liming material and bio-inoculants on the productivity of frenchbean under the Hilly Zone of Karnataka during spring season 2019-20. The experiment was laid out in RCBD with nine treatments and three replications. The treatments consisted of three levels of granulated lime (100, 75 and 50 % lime requirement (LR)) and agriculture lime at 100 % LR, both with and without bio-inoculants. The bio-inoculants applied were Azatobacter, PSB and KSB. A treatment without lime application was considered as control. RDF and FYM were common to all treatments including control. The liming materials were applied based on SMP (Shoemaker, Mclean and Pratt) buffer method. The results revealed a significant improvement in the total dry matter accumulation at harvest (19.34 g plant^{-1}), green pod and stover yield (12.93 and 2.93 t ha^{-1}, respectively) and total nitrogen, phosphorous and potassium uptake (41.13, 15.37 and 38.13 Kg ha^{-1}, respectively) of frenchbean due to soil application of granulated lime @ 100% LR and bio-inoculants compared to control (no lime).

Keywords: Agriculture lime, Bio-inoculants, Granulated lime, French bean, Lime reqirement (LR).

Study of Potassium Release Pattern in Red sandy, Medium Black and Deep Black Soils of Northern Telangana Zone: A Laboratory Incubation Study

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An incubation study was carried out of surface soil samples (0-15 cm) to study the release pattern of K under the influence of different levels of urea, DAP and MOP in soils of Red sandy, Medium black and

Deep black soils of Northern Telangana Zone. The release of available Potassium was the highest with T_{18} (N-P_2O_5-K_2O @ 100-60-40 kg ha^{-1}) and low with T_1 (N-P_2O_5-K_2O @ 60-20-20 kg ha^{-1}). Release of available Potassium was highest at 15 DAI, there after slowly decreased, sharply decreased at 45, 60 DAI respectively in all type of soils. K release was high in Deep black soils, moderate in Medium black and low in Red sandy soils.

Keywords: Potassium release pattern, Red sandy, Medium black and Deep black soils, Northern Telangana Zone and Incubation study

Delineation of Spectrophotometrically Analysed Secondary and Micronutrient Status of Soils of Biswanath District of Assam

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A total of three hundred geo-referenced soil samples were spectrophotometrically analysed from eight blocks of Biswanath District of Assam for determining the phosphorous, potassium, secondary nutrients and micronutrient status of the soils. The Biswanath district is situated on the Northern side of the Brahmaputra River and extends to the hills of Arunachal Pradesh, India and has an area of over 1415.185 sq. km. The phosphorous content of the district ranged from 20.50 to 39.47 kg ha^{-1}. The average amount of phosphorous content was recorded as 27.89 kg ha^{-1} and categorized as medium. The potassium content of the district ranged from 50.50 to 215.64 kg ha^{-1}. The average amount of potassium content in Biswanath District was recorded as 100.90 kg ha^{-1} and considered as low (< 132.0 kg ha^{-1}). The overall soils of the Biswanath district were low in potassium content. The calcium and magnesium content of the district varied from 1.18 to 3.12 c mol (p+) kg^{-1} and 0.40 to 2.50 c mol (p+) kg^{-1}. The average calcium and magnesium contents were 2.39 and 1.14 c mol (p+) kg^{-1} which indicates sufficient availability of calcium and magnesium in the soils. The sulphur content varied from 6.00 to 20.50 mg kg^{-1} and the average sulphur content was 12.93 mg kg^{-1} which is fairly high (< 10 mg kg^{-1}) in the soils of Biswanath District. Among the micronutrients, Fe and Mn content varied from 11.43 to 98.76 and 7.21 to 49.87 mg kg^{-1} with an average concentration of 63.98 and 49.87 mg kg^{-1} respectively. The zinc content of the soils exhibited wide variation (0.06 to 2.34 mg kg^{-1}) but the average value was found high (0.81 mg kg^{-1}). Copper content varied from 0.14 to 4.32 mg kg^{-1} having an average content of 0.60 mg kg^{-1} and the Boron content varied from 0.11 to 0.81 mg kg^{-1} and having an average content of 0.37 mg kg^{-1}. Among all the micronutrients zinc and boron content of the district is very low and therefore much importance should be given to fertilizer application of zinc and boron to the soil for sustainable crop production and renourishing of the fertility status of zinc and boron in soil.

Keywords: micronutrient, fertility, concentration, spectrophotometrically

Sustainable Soil Conservation and Management to Achieve Sustainable Development Goals (SDGs)

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Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support life, Soil is a core component of land resources and the foundation of agricultural development and ecological sustainability. It is the basis of Sustaining plant and animal life, regulating water, filtering potential for pollutants, nutrients cycling and many more ecological functions. Sustainable management of the world's agricultural soils and sustainable production intensification has become an imperative for global food security. Soil quality or health is the capacity of a specific kind of soil to function, within its natural or managed ecosystem boundaries, to sustain biological productivity, maintain environmental quality and promote plant and animal health. Sustainable soil-use refers to "the use of soil as a natural resource on a way that does not exert any negative effects - that are irreparable under rational conditions - either on the soil itself or any other systems of the environment". The United Nations General Assembly has declared 2015 the International Year of Soils to raise awareness of the life-supporting functions of soil, better protection and sustainable management of this precious resource. Soil perform role in selected SDG- no poverty (SDG 1), zero hunger (SDG 2), good health and well being (SDG 3), clean water and sanitation (SDG 6), affordable and clean energy (SDG 7), responsible consumption and production (SDG 12), climate action (SDG 13) and life on land (SDG 15). Land degradation and soil depletion represent a real and escalating global threat and involves number of processes, including: erosion by wind, water and tillage, compaction, sealing, nutrient imbalance, loss of soil organic matter, acidification, salinization and pollution which affects soil health & its sustainable use. There is an urgent need to stop land degradation and soil nutrient depletion and establish frameworks for sustainable land and soil management systems by introducing & practicing-soil protection, reclamation and land management strategies, suitable technologies, restoration of degraded soils, extension programs and sound education systems and by afforestation programs etc. Promoting the sustainable management of land and soils can contribute to healthy soils and thus to the effort of eradicating hunger and food insecurity and to stable ecosystems by enhancing biomass production, nutrient cycling and environment amelioration (FAO, 2015).

Keywords: Sustainable development goals (SDG), management, degradation, strategies

Effect of INM on Summer Pearl Millet (*Pennisetum glaucum* L.) and its Residual Effect on Succeeding Kharif Green Gram (*Vigna radiata* L.) under Typic Ustochrepts

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A field experiment was conducted during summer and kharif, 2019 at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat). The experiment was laid out in a randomized completely block design with ten treatments comprising combinations of FYM, RDF and Bio NP Consortium with four replications. Treatments were given to summer pearl millet crop whereas succeeding kharif green gram was grown under absolute residual basis with same layout of experiment. The higher grain yield (3105 kg ha^{-1}) and straw yield (6048 kg ha^{-1}) of pearl millet was observed under the treatment of 100% RDF + 15t FYM ha^{-1} + bio-NP consortia. The content and uptake of major (N, P, K, and S) as well as micronutrient (Fe, Mn, Zn and Cu) in grain and straw were also significantly improved with application of 100 % RDF + 15 t FYM ha^{-1} + Bio NP Consortia over 100% RDF only. Significantly higher grain yield of green gram was noticed under the residual effect of 100% RDF + 15t FYM ha^{-1} + bio-NP consortia and the improvement was 620 kg ha^{-1} or 72% over control. The results revealed that residual effect of integrated nutrient management on N, P, K, S and Cu content in grain and haulm was found non-significant. The Fe and Zn contents in grain were found non-significant whereas in case of haulm higher iron and zinc contents noticed under 100% RDF + 15t FYM ha^{-1} + bio-NP consortia. The differences in soil EC, OC and CEC due to the residual effect of INM treatments were found significant. Significantly the highest organic carbon (3.83 g kg^{-1} and CEC [17.24 C mol (P) kg^{-1}] were observed due to application of 15 t FYM ha^{-1} + 5.0 t Vermicompost ha^{-1} + Bio NP Consortium. The significant influence of residual effect of INM on available N, P_2O_5, K_2O, and S in the soil was noticed under residual effect of 100% RDF + 15t FYM ha^{-1} + bio-NP consortia. DTPA extractable micronutrient (Fe, Mn, and Cu) were significantly higher under 15 t FYM ha^{-1} + 5.0 t Vermicompost ha^{-1} + Bio NP Consortium however, DTPA extractable Zn was found significantly the highest under 100% RDF + 15t FYM ha^{-1} + bio-NP consortia. Microbial biomass carbon, dehydrogenase activity (DHA) and soil bacterial population were significantly influenced by residual effect of INM. The improvement in MBC and DHA was mainly due to favourable residual effect of the organics on microorganism activity.

Keywords: Bio NP consortium, Dehydrogenase activity, Microbial biomass carbon, Residual effect and Soil properties.

Effect of Biochar Application on the Yield and Quality of Chinese Potato in Highly Weathered Tropical Soils of Kerala

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To explore the beneficial effects of biochar on the yield and quality of Chinese potato in the lateritic soils of Kerala, a field experiment was carried out in a soil belonging to Velappaya series and Fine loamy kaolinitic, isohyperthermic, Typic plinthustults as per USDA classification. Three levels of biochar (5, 7.5, 10 t/ha), FYM 10 t/ha, soil test-based POP + biochar 10 t/ha, soil test based POP and absolute control were the treatments. Soil test-based POP consisted of NPK recommendation for Chinese potato + FYM 10 t/ha. The highest tuber yield was recorded in the plots which received soil test-based POP + biochar application (24.04 t ha^{-1}), followed by soil test-based POP (22.31 t ha^{-1}) which were on par with each other. All other treatments, except control recorded comparable yield. The advantage of biochar on increasing protein content and decreasing crude fibre content are visible from the data. In tuber, the carbohydrate content estimated was highest in the treatment biochar 10 t ha^{-1} which was on par with soil test-based POP + biochar. Protein content on the other hand was highest in the treatments soil test-based POP (1.742 %) and soil test-based POP + biochar (1.682 %). However, the protein content observed in the control plots was only 1.356 per cent. In respect of crude fibre, the treatment effect was comparable. Lowest crude fibre content was registered by FYM 10 t ha^{-1} (5.83 %).

Keywords: Biochar, Lateritic soils, Quality parameters, Organic amendments, Chinese potato.

Sustainable Soil Management and Food Security

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Soil is a fundamental resource that produces food, feed, fuel and fiber. It supports both food security and environmental quality which are critical to human survival. Traditionally, the primary purpose of soil has been as a medium for plant growth and food security, whereas, now it serves multiple functions, such as environmental quality, global climate change and a repository for urban/industrial waste. Soil

is a dynamic resource and is prone to quick degradation due to land exploitation, for feeding a rapidly growing population. Overcultivation, decreased or increased water abstraction, under-fertilization or overfertilization, careless use of biocides, failure to maintain soil organic matter levels and clearing natural vegetation, etc., can endanger soil sustainability in a variety of ways, such as physical and chemical processes (e.g., increased soil erosion, salinization and desertification) and biological processes (e.g., by decreasing soil fertility). Thus, the widespread deterioration of restricted soil resources can affect global food security while simultaneously endangering environmental quality. Also, soil act as a source and sink for GHGs emissions (CO_2, CH_4, N_2O). In such a situation adopting sustainable soil management practices is critical for the future of human and environmental systems. The need to maintain and improve multifunctionality necessitates improved and prudent soil management to meet the needs of current and future generations. The degree to which soil stewardship and protection are practiced determines the sustainability of land use, the sufficiency of food supply, the quality of air and water resources and the survival of humanity. Adopting traditional agronomic methods coupled with current farming techniques, the elimination or minimized use of synthetic pesticides and fertilizers, use of cover crops, compost and animal dung for improving soil fertility can lead to sustainable soil management. Cover crops are an important strategy for sustainable soil management because they may scavenge soil residual nitrogen and employ their biological roles to maintain an efficient nitrogen cycle. Similarly, to promote SOC storage and contribute to sustainable food production, no-tillage practices, cover crop management and manure application are recommended. The GHG emissions can be reduced through periodical soil testing, synchronized fertilization procedures and optimal water control for flooding paddy fields. Apart from implementing sustainable soil management techniques, some political and social approaches will be required, based on a shared understanding that soil is necessary for a sustainable community.

Keywords: Soil, management, conservation, food security

A Balanced Approach for Nitrogen Management in Rice-wheat Cropping System: Precision Nutrient Management

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Nitrogen (N) is the most critical externally added input for any crop production system. The half of the global population directly or indirectly depends on nitrogenous fertilizers for food supply. Today, Rice, wheat, and maize are consuming more than 90 % of total nitrogenous fertilizer used in cereals. Underuse of nitrogen is associated with lower crop production while overuse leads to several soil and environmental related consequences. Therefore, the response to applied nitrogen and its use efficiency have to be monitored properly for obtaining the maximum potential and sustainable yield. The efficiency of applied nitrogenous fertilizers is very low due to its various losses i.e. volatilization,

leaching, surface runoff and denitrification from soil-plant system. Therefore, the proper understanding of advanced soil and plant management practices which helps in enhancement of nitrogen recovery efficiency is one of the key factors to enhance crop output, decreasing cost of cultivation and to maintain environmental quality which ultimately adds towards the goal of achieving long term sustainable production system. The current approach of fixed-rate, fixed-time (blanket) fertilizer application is not helpful in achieving higher NUE. This is mainly because this approach does not consider the existence of large variability in the inherent soil nutrient supply and site-specific crop responses to nutrients among farms. To address this concern, the concept of precision nutrient management to manage among-farm nutrient variability was developed in Asia. In this, prescriptive N management relies on earlier information on the average native soil N, crop N need and its duration, while the corrective N management is based on the diagnostic tools such as SPAD meter and leaf color chart (LCC). Also enhanced efficiency fertilizers (EEFs) are continuously being developed to regulate the release of N from fertilizers, allowing for improved uptake and utilization by plants, thereby lowering losses and increasing crop productivity per unit of fertilizer.

Keywords: Nitrogen, Rice-Wheat System, Precision nutrient management and Nutrient use efficiency

Response of Organic and Inorganic Fertilizers on Growth and Yield of Black Gram

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A Field experiment was conducted at Student's Research Farm, Doon P.G. College of Agriculture and Allied Sciences, Rampur, Selaqui, Dehradun during kharif season of 2020. The study aimed to investigate the effect of Organic and Inorganic fertilizers on growth and yield of Black gram. The experiment consisted of 9 treatments, T_1 (absolute control), T_2 (100% recommended dose of fertilizer), T_3 (100% recommended N through Farm Yard Manure), T_4 (100% recommended N through vermicompost), T_5 (100% recommended N through biofertilizers), T_6 (50% recommended dose of fertilizer and 50% N through Farm Yard Manure), T_7 (50% recommended dose of fertilizer and 50% N through vermicompost), T_6 (50% recommended dose of fertilizer and 50% N through biofertilizers), T_7 (75% recommended dose of fertilizer and 25% N through Farm Yard Manure), T_8 (75% recommended dose of fertilizer and 25% N through vermicompost), T_9 (75% recommended dose of fertilizer and 25% N through biofertilizers). Experiment was laid out in Randomized Block Design. All the recommended package of practices except treatments was adopted in the experiment to get maximum crop growth and yield from each plot. The results revealed that the highest emergence count, maximum plant height, dry weight, relative water content, chlorophyll content, days taken 50 percent flowering and days taken to 50 percent maturity was recorded in treatment second (T_2) 100% recommended dose of

fertilizer. Treatment ninth (T_9) 75% recommended dose of fertilizer and 25% N through biofertilizers recorded highest seed yield, straw yield and the yield attribute characters of the crop during the experiment.

Keywords: Black gram, Vermicompost, FYM, Biofertilizers, Growth, Yield

Nitrogen Management Options with Nano-urea and their Growth and Yield Responses in Rice-wheat Cropping

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Rice-wheat rotation is an important cropping system in the Indo-Gangetic plain (IGP) of India. The introduction of high-yielding semi-dwarf varieties and availability of irrigation and fertilizer inputs during the 1960s, has played a significant role in green revolution. Yet, yield stagnation has been noted in this cropping system during the last few decades because of low fertilizer use-efficiency and significant losses to the environment. Recently introduced nano-urea in India is being seen as a viable option to partially replace granular urea. Nano-fertilizers have been found to have increased nutrient use efficiency due to the high surface area to volume ratio and better application modes. Therefore, a field experiment was started in 2020 at ICAR-Central Soil Salinity Research Institute, Karnal (Haryana) to study the different nitrogen management options for integration of nano-urea with the conventional options to reduce nitrogen fertilizer use and increase use-efficiency. The first-year results of yield indicated that at least two doses of urea can be replaced with nano-urea without yield loss, and that can be further improved by using Greenseeker (GS) and Leaf Colour Chart (LCC) based nitrogen application methods. Based on the soil available nitrogen, no decrease in the available pool was noticed up to 50 % replacement of urea with nano-urea, yet the management of N using GS and LCC could sustain replacement up to 66 %. The plant chlorophyll profiles indicated that up to 50 % replacement of urea with nano-urea does not make any changes in plant N uptake.

Keywords: Nano-urea, rice-wheat system, nitrogen management, yield, Greenseeker, LCC

Effect of Integrated Nutrient Management on Fertility Status of Soil under Papaya (*Carica papaya* L.) Cultivation

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The experiment was carried out on papaya cv. Gujarat Junagadh Papaya 1 during the year 2019-20 and 2020-21 at College of Horticulture, SDAU, Jagudan. The experiment was laid out in randomized block design with three replications. Total ten treatments were evaluated in the present study viz., RDF through chemical fertilizers (T_1), 50% RDN through urea + 50% RDN through Neem cake (NC) (T_2), 50% RDN through urea + 50% RDN through Castor cake (CC) (T_3), 50% RDN through urea + 25% RDN through NC + 25 % RDN through CC (T_4), 40% RDN through urea + 40% RDN through NC + Biofertilizers (BF) (T_5), 40% RDN through urea + 40% RDN through CC +BF (T_6), 40% RDN through urea + 20% RDN through NC + 20% RDN through CC +BF (T_7), 30% RDN through urea + 30% RDN through NC +BF (T_8), 30% RDN through urea + 30% RDN through CC +BF (T_9), 30% RDN through urea + 15% RDN through NC + 15% RDN through CC + BF (T_{10}). The common dose of FYM @ 10 kg per plant were applied along with Trichoderma @ 5 g and biofertilizers (Azotobacter, PSB and KSM) @ 10 ml each per plant as per treatments at the time of planting. Nitrogen through urea was applied in four equal splits (at 60, 120, 180 and 240 days after planting) as per treatments, however, treatments of organic manures were applied in two equal splits (at the time of planting and 60 days after planting). Experimental field soil was loamy sand in texture, mildly alkaline, non-saline in nature, low in organic carbon and available nitrogen, medium in available phosphorus and high in available potassium. The results based on pooled data revealed that treatment T_3 recorded significantly maximum organic carbon (0.495% and 0.328%), available N (256.33 kg/ha and 215.50 kg/ha) and exchangeable magnesium (17.70 me/100 g and 19.97 me/100 g) at 0-15 cm and 30-60 cm soil depth, respectively. While, treatment T_4 significantly improved organic carbon (0.435%) and exchangeable magnesium (18.28 me/100 g) at 15-30 cm soil depth. However, maximum available N (224.50 kg/ha) was found at 15-30 cm soil depth under treatment T_2. Maximum available P_2O_5 (44.40 kg/ha and 37.63 kg/ha) was noted in treatment T_1 at 0-15 cm and 15-30 cm soil depth, respectively. Whereas, maximum available P_2O_5 (32.58 kg/ha) was at 30-60 cm soil depth. Treatment T_1 recorded significantly maximum available K_2O (357.83 kg/ha, 350.98 kg/ha and 325.46 kg/ha) at all soil depth (0-15 cm, 15-30 cm and 30-60 cm), respectively. Maximum exchangeable calcium (26.88 me/100 g and 28.98 me/100 g) was recorded in treatment T_3 at soil layer 0-15 cm and 15-30 cm, respectively. Whereas, at 30-60 cm soil depth, maximum exchangeable calcium (29.11 me/100 g) was found. Treatment T_3 increased significantly maximum available sulphur (11.95 mg/kg, 10.90 mg/kg and 9.48 mg/kg) at 0-15 cm, 15-30 cm and 30-60 cm soil depth, respectively. Therefore, the application of different INM treatments significantly influenced post-harvest availability of plant nutrients in soil.

Keywords: Biofertilizers, Castor cake, FYM, Neem cake, Trichoderma, Urea

Effects of Paper Mill Sludge Amendment on Soil Characteristics and Agronomical Performance of Fenugreek Plants

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This study investigated the effects of paper mill sludge amendment on soil characteristics and agronomical performance of fenugreek (Trigonella foenumgraecum var. Pusa Early Bunching) cultivated in the paper mill sludge amended soil. Pot experiments were performed using various paper mill sludge amendment rates (10, 25, 50, 75 and 100%) to study their effects on soil and yield of fenugreek (T. foenumgraecum) plants. Moreover, heavy metals (Cd, Cu, Fe, and Zn) accumulation in fenugreek (T. foenumgraecum) was also studied during the investigation. Results showed that the paper mill sludge had significantly ($p < 0.05$) higher nutrient elements which induced their concentration in the soil after mixing. Correspondingly, the maximum shoot length, root length, biomass, chlorophyll content and yield of fenugreek (T. foenumgraecum) using 25% paper mill sludge treatment and decreased with the increase in the treatment rates. The accumulation of different heavy metals in fenugreek (T. foenumgraecum) was in order of Fe > Zn > Cu > Zn. Furthermore, the developed modified polynomial quadratic model precisely predicted the total heavy metals uptake (mg dwt.) by fenugreek (T. foenumgraecum). This study suggested that paper mill sludge was a good fertilizer resource for fenugreek (T. foenumgraecum) cultivation at 25% treatment. The higher treatments i.e., 50%, 75%, and 100% inhibited the growth and yield of fenugreek (T. foenumgraecum). Moreover, content of different heavy metals was also found significantly higher in higher treatment of paper mill sludge.

Keywords: Fenugreek, Paper mill sludge, Heavy metals

Effect of Conservation Agriculture in Finger Millet + Pigeon Pea Intercropping System on Carbon Dynamics and its Influence on Soil Properties under Dry Land Condition

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The field experiment was conducted to study the effect of different tillage and cover crops on carbon dynamics and their influence of soil properties under conservation agriculture production system in fingermillet +pigeon pea intercropping (8:2) at AICRP form dry land agriculture, Bengaluru. The relative

proportion of the different carbon fractions determines the soil quality and is highly dependent on soil type and climate conditions. The soil organic carbonpools studies showed that among tillage practice viz., conventional, reduced and zero tillage, zero tillage recorded significantly higher less labile carbon(1.15 g/kg), total organic carbon (6.72g/kg), total carbon(6.83 g/kg) and microbial biomass carbon (223.57ì g/g).Numerically higher very labile (2.75 g/kg), labile carbon (1.85 g/kg) was found in conventional tillage, and non labile carbon pools (3.58g/kg), total carbon (6.83 g/kg), permanganate oxidizable carbon (0.66 g/kg), water soluble carbon (1.10 g/kg) was recorded in zero tillage. Similarly, among cover crops significantly higher labile carbon (1.90 g/kg) and microbial biomass carbon (227.73 ì g/g), numerically higher permanganate oxidizable carbon (0.68 g/kg), water-soluble carbon (1.20 g/kg), total organic carbon (6.75 g/kg), total inorganic carbon (0.15g/kg) and total carbon (6.90) were observed with horse gram while numerically higher very labile carbon(2.40), less labile carbon (1.15 g/kg), non-labile carbon (3.31g/kg) was recorded in field bean. Interaction between different tillage and cover crop on carbon dynamics was found to be non-significant with all carbon pools where as microbial biomass carbon was found significantly superior in zero tillage with horse gram as cover crop. Correlationbetweendifferentformsofcarbonwithsoilphysicalproperties showed that, very labile (r = -0.791 and -0.899) and labile carbon (r = -0.894 and -0.788) was negatively correlated with bulk density and particle density, respectively, however it showed high positive correlation with porosity(r =0.853)and (r=0.863), respectively. Other carbon fractions like less labile carbon, non-labile carbon, permanganate oxidizable carbon, water soluble carbon, total organic carbon was negatively correlated with bulk density and particle density while it is positively correlated with maximum water holding capacity. Correlation among different forms of carbon with soil chemical properties found that very labile carbon had significant high positive correlation with pH (r = 0.827)and EC (r = 0.718). Permanganate oxidizable carbon (r = 0.880), TOC (r = 0.765) and TC (r = 0.759) had significant high positive correlation with cation exchange capacity, whereas non-labile carbon showed non-significant correlation with cation exchange capacity.

Keywords: Carbon dynamics, Conservation agriculture and Intercropping system

Effect of Varied Levels of Sugarcane Pressmud and Bio Compost on Soil Microbial Population and Enzymes Activities in Finger Millet

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The effect of sugarcane pressmud and bio compost along with NPK at varied levels on finger millet was studied in a field experiment conducted during kharif 2017 at the research block of M/s Sri

Chamundeshwari Sugars Ltd, Bharathi Nagar, Maddurtaluk, Mandya District, located in Southern Dry Zone of Karnataka. The experiment was laid out in randomized complete block design with eight treatments replicated thrice. The results showed that application of RDF + pressmud 10 t ha-1 significantly increased soil microbial (fungi, bacteria and actinomyces) population and enzymes activities (urease and dehydrogenase)as compared to control was on par with T_2 (RDF+ Pressmud 10 t ha^{-1}). In conclusion application of sugarcane pressmud or bio compost @ 10 t ha^{-1} along with recommended NPK would be the nutrient recommendation for finger millet in Southern Dry Zone of Karnataka.

Keywords: Pressmud, Biocompost, FYM, fungi, bacteria and actinomyces, urease and dehydrogenase, Nutrients

Effect of Different Levels of Secondary Nutrients on Growth and Yield of Banana

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An experiment was conducted in farmer's field at Aldur village, Mudigere taluk, Chikmagalur district during the year 2021-2022. The experiment was laid out in Randomized Complete Block Design comprising of seven treatments with 3 replications. The treatments consist of 100% recommended dose of fertilizer (RDF) along with 150g, 300g and 450g of advance – enriched OM as basal dose and at 45 days after planting. Among the treatments, T_7 - RDF + 450g Advance – enriched OM at 45 days after planting recorded maximum pseudostem height (264.93 cm), pseudostem girth (63.25 cm), total number of leaves (18.33) and leaf area (0.84 m^2) at shooting stage. Finger length (13.65 cm), finger girth (3.98 cm), finger weight (97.23 g), hand weight (1.44 kg), bunch length (74.50 cm), bunch weight (13.56 kg) and yield per hectare (31.75 t) were also recorded maximum in T_7. The present findings can be commercially used in making banana production more profitable by the different levels of secondary nutrients under hill zone of Karnataka.

Keywords: Banana, Secondary Nutrient, Enriched Organic manure

Land Degradation Evaluation using Geospatial Technology in the Ballia district of Uttar Pradesh, India

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Land degradation is a significant issue in agricultural productivity, caused by a variety of reasons such as salinity, alkalinity, erosion etc. Remote sensing and geographic information systems (GIS) are excellent methods for detecting, analysing, mapping, and monitoring land degradation. A study was undertaken in the Ballia district of Uttar Pradesh to develop a spatial variability map and calculate remote sensing indices to determine the level of deterioration. For a period of 26 years, from 1994 to 2019, Landsat data were utilised to interpret images and compute several soil degradation indices such as the Normalized Difference Soil Index (NDSI), Normalized Difference Vegetation Index (NDVI). Annual NDVI value was decreasing from northwest to southeast of Ballia.Low NDVI value from 0.04 to 0.18, was mainly observed in the southeast of the study area and in the western areas (Pandah, Nagra and Rasra) of the Ballia while high NDVI above 0.3, was mainly located in the northwest region of Ballia. NDSI fell dramatically from 1994 to2019, with a particularly steep drop in 2004. The NDSI value range in the study area was -0.078 to -0.141, -0.400 to -0.056, and -0.292 to -0.121 in 1994, 2004 and 2019. When NDVI values are much higher than NDSI(soil),it is observed than in 1994 there is a positive trend of the study area,but the trend deviated from 2004 to 2019. Vegetation index (NDVI) decreased as Salinity (NDSI)increased so on the NDSI (soil) from 1994 to 2019 highly associated with rainfall's down trend and ultimately lowered crop yield and deteriorated soil. Remarkable changes were noticed in entire region of Ballia from 1994 to 2019 due to the influence of intensive agriculture, intermittent drought and fluctuating rainfall accounted massive degradation to soil quality.

Keywords: Land degradation, Remote sensing, Geographic information systems (GIS), Normalized Difference Soil Index (NDSI), Normalized Difference Vegetation Index (NDVI)

Evaluation of Critical Limits of Zinc in Soil for Pearl millet Grown on Swell shrink Soils

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Pot culture experiment was conducted at Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dhule during Kharif season to determine the critical limits of zinc in swell shrink soils for pearl millet. Experiment was laid out in factorial completely randomized design comprising of three levels of zinc status in soil viz., low zinc status soil (< 0.6 mg kg^{-1}), medium zinc status soil (0.6-1.2 mg kg^{-1}), high zinc status soil (> 1.2 mg kg^{-1}) as main treatments, two levels of zinc application viz., control and optimum level (20 kg $ZnSO_4$ ha^{-1}) and three replications. The soil as above three categories was collected from different eighteen locations for filling the pots. Iron and zinc rich variety of pearl millet cv. Dhanshakti was used for the investigation. The nutrient uptake and Bray's per cent yield of pearl millet were calculated. The critical levels of zinc in soil were worked out according to graphical and statistical method of Cate and Nelson (1965 and 1971).

As per the graphical method of Cate and Nelson (1965) and statistical method of Cate and Nelson (1971), the critical level of zinc in soil for pearl millet was 0.81 mg kg^{-1}. As per the graphical method of Cate and Nelson (1965) the critical level for zinc in pearl millet (cv. Dhanshakti) was 22.7 mg kg^{-1}. However, as per the statistical method of Cate and Nelson (1971) the critical level for zinc in pearl millet (cv. Dhanshakti) was 22.64 mg kg^{-1}. The N, P, K, Fe and Zn uptake by pearl millet showed significant negative correlation with soil pH and $CaCO_3$ content and showed significant positive correlation with organic carbon content. The study concluded that application of balance fertilization along with zinc containing fertilizer is essential for increasing the availability of the soil nutrient status and their uptake by pearl millet. The iron and zinc rich and high yielding pearl millet variety Dhanshakti responds to the application of zinc in soils having less than 0.81 mg kg^{-1} DTPA extractable Zn in swell shrink soils of Dhule region of Maharashtra.

Keywords: Pearl millet, Nutrient uptake, Zinc fertilizer

Dissolution of Mussoorie Rock Phosphate in an Inceptisol (Fluventic Haplustept) using different Amendments

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To study the relative efficiency of amending the mussoorie rock phosphate (MRP) with different amendments in order to enhance its dissolution rate in an Inceptisol (Fluventic Haplustept), an incubation experiment was conducted under controlled environment with six treatments viz., control (no P addition), Single Super Phosphate (SSP), Mussorie Rock Phosphate (MRP), MRP with green leaf manure (GLM), MRP with phosphobacteria (Pb) and partially acidulated rock phosphate (PARP). These P sources were mixed at the rate of 5000 mg kg^{-1} with 200 g of sieved soil and incubated for 120 days. The experiment was conducted in a Factorial Completely Randomised Design. The incubation was done at standard moisture condition which is the field capacity at the time of start of the experiment and maintained throughout the incubation period. A set of six treatments, replicated thrice was removed at every stage which included 0, 30, 60, 90 and 120 days. The soil samples drawn were subjected to P fractionation, the results tabulated and statistically scrutinized. The results of the incubation trial had shown that the quantity of different fractions of P was in the order of NaOH-Po < NaOH-Pi < NaCl-P < residual P < HCl-P. It was also noticed that the NaCl-P and NaOH-Pi were increasing with the advancement of incubation period due to the dissolution of MRP with or without amendments. Among the different amendments, the MRP treated with GLM was found to register higher NaCl-P and NaOH-Pi with concomitant decrease in HCl-P. The regression analyses had shown that NaCl-P had increased at the rate of 0.571 mg kg^{-1} day^{-1}, whereas it was 5.480 mg kg^{-1} day^{-1} of NaOH-Pi and 0.374 mg kg^{-1} day^{-1} of NaOH-Po, with respect to HCl-P it decreased at the rate of 7.393 mg kg^{-1} day^{-1}. There were vast differences among the different amendments with respect to their capacity to dissolve MRP applied and it was found that the dissolution rate as measured by HCl-P was 14.440 mg kg^{-1} day^{-1} in the case of GLM addition, 12.236 mg kg^{-1} day^{-1} with respect to Pb inoculation and 11.615 mg kg^{-1} day^{-1} when PARP was added. In contrast, the rate of dissolution of MRP when applied alone was only 7.393 mg kg^{-1} day^{-1}. It can be concluded that the MRP could be used as a suitable alternative to SSP in neutral and calcareous soils provided it is amended with amendments which could supply proton for its dissolution.

Keywords: Mussoorie rock phosphate, P fractions, P dissolution, Nutrient release

Sustainable Use of Very Saline Soil for Food Security

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After India and Pakistan, Iran is considered to be at the top of the threatened countries in terms of salinity. Agriculture with very saline water such as drainage water, very saline surface and underground water, and seawater in saline soils has always been one of the biggest challenges for researchers, producers, and farmers. The existence of a significant amount of saline surface and underground water, agricultural runoff, and huge water resources in the coastal strip that usually do not have a place in conventional agriculture can be used as an opportunity to increase production in biosaline agriculture or haloculture systems. Biosaline agriculture is a technology for the economic and sustainable use of very saline soil and water resources with an environmental approach. Economic products include all kinds of plant and animal and non-biological or industrial products, especially water and energy. Biosaline agriculture can open new horizons in the development and production of agricultural products using highly saline soils and waters. In general, biosaline agriculture can be used to increase production in the agricultural sector, especially the production of fodder, oilseeds, and protein as well as aquaculture, control of fine dust by improving vegetation in areas where the use of good quality water sources is not possible, and carbon deposition. Cultivation of plants tolerant to salinity and halophytes is proposed as a logical, practical, and economically justifiable option for exploiting saline water and soil resources and saving freshwater resources for other important purposes. Due to the necessity of exploiting unconventional and saline soil and water resources to ensure and improve the food security of human societies, technologies of biosaline agriculture have been developed under different titles, some of which are discussed in this lecture.

Keywords: Biosaline agriculture, environment, haloculture, hypersaline, sea agriculture.

Microbe-Mediated Nutrient Management in Field Crops

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The uncontrolled increase in the global population, the increasing demand for food and rapidly changing environment has caused major decrease in the agricultural productivity. Plants, being sessile in nature, must acquire the essential nutrients including macro and micronutrients from the soil.

While macronutrients such as nitrogen, phosphorus, potassium and sulphur supplied by mineral fertilizers are vital to crop production. Agriculturally beneficial microorganisms may also contribute directly (i.e., biological N_2 fixation, P solubilisation and phytohormone production, etc.) or indirectly (i.e., antimicrobial compounds biosynthesis and elicitation of induced systemic resistance, etc.) to crop improvement and fertilizers efficiency. Microbe-based bioformulations that increase plant performance are greatly needed and in particular bioformulations that exhibit complementary and synergistic effects with mineral fertilization. Such an integrated soil fertility management strategy has been demonstrated through several controlled and uncontrolled experiments, but more efforts have to be made in order to thoroughly understand the multiple functions of beneficial microorganisms within the soil microbial community itself and in interaction with plants and mineral resources. Microbe-mediated nutrition along with inorganic fertilization can sustain soil fertility and productivity over a long period. Microbial culture solubilises fixed native form of nutrient and improves crop acquisition also. Collective use of nitrogen fixing and phosphorus dissolving bacteria are more effective instead of single application. Microbial culture along with inorganic fertilization enhances nutrient concentration and grain yield. Besides this, soil microbial activity also improves considerably. Uses of microbe-mediated cultures are cost effective and eco-friendly.

Keywords: Bioformulations, Microbial Inoculants, Nitrogen, Fertilizer Use Efficiency

Post-harvest Soil Nutrient Status, Yield and Nutrient Uptake of Bhendi as Influenced by Foliar Application of Effective Microorganisms Solution

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To find out the influence of foliar application of effective microorganisms on yield and nutrient uptake of bhendi and soil fertility status, a field experiment was carried out at coastal deltaic region of Karaikal, U.T. of Puducherry. The experiment consisted of two factors viz., fertilizer levels (no RDF, 75 per cent RDF and 100 per cent RDF) and frequencies of 1 per cent EM spray (no spray, weekly spray and fortnightly spray), totally constituting nine treatments, laid out in FRBD with three replications. Application of 100 per cent RDF recorded the highest fruit yield and this was found to be 109.38 per cent more than the treatment which did not receive fertilizer. Foliar application of 1 per cent EM at fortnightly interval recorded higher fruit yield and this was observed to be 18.02 per cent more than no EM spray and was on par with weekly spray of 1 per cent EM. As regards the nutrient uptake, the N, P and K uptake by fruit was higher in the treatments which received 100 per cent RDF. Similarly, the fortnightly spray of EM had also increased the uptake of N, P and K. However, it was comparable with weekly EM spray for N and K uptake. Application of 100 per cent RDF recorded higher uptake of

N, P and K by plant and similar trend was also observed with fortnightly spray of EM. Both fertilizer and EM did not influence significantly the pH and organic carbon of the post-harvest soil. However, EC has given significant variation with fertilizer alone. The available N, P and K status of the post-harvest soil recorded was higher in the treatment applied with 100 per cent RDF. However, it did not differ significantly with 75 per cent RDF for P and K status of the soil. Fortnightly spray of EM could influence only the $KMnO_4$-N status of the soil. Among the nine treatment combinations tried, application of 100 per cent RDF and EM spray at fortnightly intervals was found to be beneficial in recording higher fruit yield of bhendi as well as nutrient status of the post-harvest soil.

Keywords: Bhendi, Effective microogranisms, INM, Foliar application, Soil properties, Nutrient uptake.

Evaluating the Effectiveness of Modern Irrigation Systems in Yazd Province, Iran

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Yazd province is one of the dry regions in Iran and has about 34 thousand hectares of irrigated land. The main water consumption in Yazd province is in the agriculture sector, and due to the arid region tolerance requirements, it is necessary to optimize water consumption for the stability of agricultural production. One of the ways to achieve better water consumption efficiency is the development of modern irrigation networks, which can be effective in the sustainability of human societies. Irrigation system development like any other technology has many resistance and difficulties, which is necessary to examine before the consumption of additional resources. In this research, the barriers to the irrigation system development were categorized and examined to know the importance and priority of the factors. The statistical population of the study consisted of adopters farmers of modern irrigation systems in Yazd province. Moreover, the whole study area was struggling with water shortage, salinity, and other problems of an arid environment. The standard questionnaire was used to collect data and drive a descriptive survey. Related IR-NSRC faculty members confirmed the questionnaire content validity. Collected data were analyzed using the IBM SPSS Modeler 16.0 and MS Excel 2010. The results in Yazd province showed that the reduction of production costs and the possibility of expanding the cultivated area is the most important encouraging factor and the main motivation for farmers to use modern irrigation systems. It seems the main demands for better productivity of governmental investment in the development and expansion of modern irrigation systems are to focus on improving the knowledge of farmers and providing simpler accessible funding for them.

Keywords: Water efficiency, Pressurized Irrigation, Optimization

Evaluation of Salinity Tolerance Threshold in 12 Selected Pomegranate (*Punica granatum*) Genotypes

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Salinity tolerance threshold of plants including fruit trees is obtained based on the reduction in yield (total biomass or reduced fruit production) under saline conditions compared to non- saline conditions. In order to determine salinity tolerance threshold and yield decreases percentage per unit increase of soil salinity in selected pomegranate genotypes, a factorial experiment was carried out based on completely randomized design (CRD), with two factors genotypes in 12 types (Shisheh Kap Ferdus, Malas Yazdi, Malas Saveh, Rabab Neyriz, Golnar Saveh, Golnar Sarvestan, Golnar Shahdad, Narak Lasjerd Semnan, Vahshi Babolsar, Post Siyah Ardakan, Chah Afzal and Voshik Torsh Saravan) and soil salinity in five levels (1.5, 3.8, 6.2, 9.3 and 12.6 dSm^{-1}). At the end of experiment, salinity tolerance threshold and yield reduction slope were calculated based on increased dry weight (biomass) in during applying salinity treatments. The results showed, the lowest salinity tolerance threshold was observed in Voshik Torsh Saravan (3.02 dS/m), Malas Saveh (3.25 dS/m) and Golnar Saveh (3.40 dS/m) genotypes, respectively. On the contrary, the highest salinity tolerance threshold was observed in Golnar Shahdad (4.90 ds/m), Chah Afzal (4.70 ds/m), Post Siyah Ardakan (4.38 ds/m) and Malas Yazdi (4.17 ds/m) genotypes, respectively. The highest yield reduction slope was observed in Golnar Saveh (7.89%), Golnar Sarvestan (7.39%), Voshik Torsh Saravan (6.69%) and Malas Saveh (6.33%) genotypes, respectively. In contrast, the lowest yield reduction slope was observed in Chah Afzal (2.83%), Post Siyah Ardakan (2.88%) and Narak Lasjerd Semnan (2.89%) genotypes, respectively. Overall, the results showed the levels of salinity that reduced the yield by 50% in Chah Afzal, Post Siyah Ardakan and Narak Lasjerd Semnan genotypes were about twice greater than salinity that reduced the yield by 50% in Golnar Saveh, Golnar Sarvestan, Voshik Torsh Saravan and Malas Saveh genotypes. EC_{50} in Chah Afzal, Post Siyah Ardakan and Narak Lasjerd Semnan genotypes were observed in salinity intensity of 22.37, 21.74 and 21.10 dS/m. Given that in previous studies has been reported that 50% of the yield was decreased by salinity level of 8.4 ds/m, while in Chah Afzal, Post Siyah Ardakan and Narak Lasjerd Semnan genotypes only 10.47%, 11.58% and 13.30% of yield was reduced by salinity of 8.4 dS/m, respectively. Therefore, Chah Afzal, Post Siyah Ardakan and Narak Lasjerd Semnan genotypes were selected for further studied and complementary experiments and planting as rootstocks in Chah Afzal region of National Salinity Research Center.

Keywords: Chah Afzal, Narak Lasjerd Semnan, Post Siyah Ardakan, Saline water and soil, Total biomass, Yield reduction slope

Need and Scope of Nanofertilizers in Wheat

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Wheat is a staple food crop next to rice in India. Green revolution has seen the increase in the input use intensity in agriculture which has impacted the economy and ecology of crop cultivation. The bulk fertilizers use in wheat is characterized by the lower nutrient use efficiency as well as their imbalanced application. Nanofertilizers can prove as efficient alternative to these bulk ones. Nanoparticles are characterized by the smaller size and consequent higher surface area, reactivity, thus, imparts the various important properties to fertilizers such as higher solubility, controlled release and increased effectiveness. Nanofertilizers reported to increase chlorophyll and protein content in wheat in addition to yields. There is also reported increase in nutrient use efficiency with the application of the nanofertilizers compared to bulk fertilizers. Application of nano fertilizers also reported to have positive impact on yields under abiotic stress conditions in wheat. Micronutrient concentration increased in wheat grain with their application in nanoform.

Keywords: Efficiency, size, surface area, solubility, effectiveness, chlorophyll, protein, abiotic stress

Evaluation of Growth Traits in Some of Pomegranate Genotypes under Salinity Stress

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In order to evaluate the effect of salinity stress on some morphological traits of selected pomegranate genotypes, an experiment was conducted in a randomized complete block design with three replications in 2018 at Chah Afzal station. The analysis of variance showed that the effect of genotype on all studied traits, including plant height, number of fruits, leaf area ratio, and necrosis, was significant. Based on the results, the highest height was observed in the Chah Afzal genotype (111.67 cm), and the lowest plant height was obtained in the Post Siah Yazd genotype (66.33 cm). Also, the wild genotypes of Vahshi Babolsar (72.67 cm) and Narak Lasjerd Semnan (95 cm) had no significant difference. The highest number of fruits was observed in Malas Yazdi genotypes (5). Also, the lowest number of fruits was obtained in Chah Afzal, Yazd black bark, and Rabab Neyriz genotypes, all three of which did not bear fruit. The highest leaf area ratio was observed in the Post Siah Yazd genotype (435.33 mm2 /g

plant dry matter) obtained with Rabab Neyriz genotypes (318 mm2/g plants dry matter) had no significant difference. In contrast, the lowest leaf area ratio was obtained in the Vahshi Babolsar genotype (172.92 mm2/g plants dry matter). Regarding necrosis, the highest percentage of necrosis was observed in the Rabab Neyriz cultivar (14.67%), and the lowest percentage was observed in the Vahshi Babolsar genotype (4.67%) and Chah Afzal (8.33%), respectively.

Keywords: Salinity stress, genotype, and morphological traits

Extraction Studies of Bixin - A Natural Colorant from Annatto (*Bixa orellana* L.) using Organic Solvents

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Annatto is a tropical tree or shrub grown for its fruits. The fruits comprise of reddish-brown seeds. Pericarp of the seeds are responsible for reddish-yellow-orange natural food colorant. Bixin is an apocarotenoid, a major colorant obtained from annatto seeds are enriched with antioxidant and anti-microbial properties. In this study, bixin was extracted using solvents namely ethanol and methanol by varying the parameters like seed to solvent ratio (1:5, 1:10 and 1:15), temperature (50, 60 and 70°C) and time (10, 20 and 30 min). Methanol showed the highest bixin content of 1.2 % at 70°C in 30 min with 1:10 seed to solvent ratio. In case of ethanol the highest bixin content 0.98 % was obtained at 70°C in 30 min with 1:10 seed to solvent ratio. Increase in temperature and time increased the solubility of bixin from the seeds to solvent especially, in methanol due to the presence of methyl easter group in the chemical structure. The highest total phenol of 3.03 mg GAE/g was observed in ethanol extract obtained at 50°C in 30 min with 1:5. The highest total phenol in methanol extract was 8.11 mg GAE/g was observed in at 70°C in 20 min with 1:15 seed to solvent ratio. Increase in temperature decreased the phenol content. Lowest hue angle in ethanol and methanol extract was 36.90°and 27.28°, respectively at 70°C in 30 min with 1:5 seed to solvent ratio which indicate the intensity of the redness. The maximum redness was observed at maximum time and temperature with minimum seed to solvent ratio. This may due to higher dissolution rate in lowest seed to solvent ratio that results in higher concentrated extract with high redness intensity. Methanol was found best to extract higher bixin content with higher total phenol and redness pigment by hot extraction method.

Keywords: Annatto, bixin, methanol, ethanol, hot extraction

Spatial and Temporal Variation of Rainfall using a Multi-scale Entropy Approach in the Western part of Rajasthan, India

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Rainfall is the major contributor to the hydrological cycle, therefore it is crucial to monitor rainfall in order to use water resources sustainably. The western portion of state Rajasthan is included in this study area and used various entropy indices based on monthly and annual time scales to investigate the spatial and temporal variability of rainfall data for a period of 121 years. According to monthly analysis of rainfall, the highest SVI_{AE} value was recorded during the March (0.457) for Jalor station followed by Sirohi (0.427), Barmer (0.377), Pali (0.319), Jaisalmer (0.278) and Jodhpur (0.271), while lowest SVI_{AE} determined during July for Pali (0.033) station, followed by Jodhpur (0.038), Sirohi (0.042), Barmer (0.052), Jalor (0.055), Jaisalmer (0.057). Similar patterns were seen in the monthly examination of rainy days. Furthermore, as per annual analysis of rainfall data, highest SVI_{AE} (0.881) recorded for Barmer station in 1918 whereas lowest SVI_{AE} (0.164) was determined in 2019 for Jaisalmer station which indicates that variation in rainy days was high for Barmer station and less for Jaisalmer station. However, highest SVI_{IE} (1.0) was found for Jaisalmer and Jodhpur stations in 1918 while lowest SVI_{IE} (0.206) recorded in 2019 for Jaisalmer station based on rainy days assessment. The findings and observations suggested that the proposed entropy theory is capable of detecting variations in rainfall amounts and rainy days at various time scales. The outcomes of this investigation can also be used to recommend changes to the rainfall models, local agricultural policies, and the design of structures that conserve soil water.

Keywords: Rainfall variation, Multi-scale Entropy, Western Rajasthan, Rainfall models

Characterization of Diverse Chemotypes of Betel Leaf (*Piper betle* L) and Assessment of the Essential Oil Produced by the Creeper for Rural Entrepreneurship Generation and Environmental Sustainability

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India is a country of rich plant biodiversity. Apart from food security this gene-pool has enormous prospect for utilization in other industries. The pharmaceutical, aromatherapy, perfumery and food industries are rapidly shifting towards natural product. In India including West Bengal, high quality

betel leaves were produced as a well-known masticatory with contribution towards domestic and fresh vegetable export business. The crop is grown vegetatively for a long time and suffers from authenticity problem and ambiguity in nomenclature of the cultivars. On the other hand a huge amount of un-sold leaves perishes inside the baroj or adjoining places. The genetic screening and characterization of cultivars were limited due to lesser focus by the scientific community and unavailability of reliable markers. The leaf of this creeper is loaded with diverse bioactive compounds producing a range of compounds regulating an array of fragrance, colour and taste. The Metabolomic profile identifies the polar and non-polar volatile components present in the leaf. In this paper an account of the comparative leaf morphology and essential oil (quantitative and qualitative) profiling of the predominant chemotypes of India was presented. The morpho-metabolome profile is able to differentiate the cultivars. Additionally the exact amount of essential oil produced by individual chemotypes were estimated with identification of the major signature compounds present in leaf metabolome. This information could be utilized to develop the complete coding sequence (CDC) of the aroma-genes present in Piper betle. The coding sequence information of aroma-genes could be utilized to construct robust DNA markers to validate the authenticity of the germplasms. The essential oil extraction from waste and excess leaves with low cost oil extraction techniques could support rural entrepreneurship generation. The highly perishable betel leaves that remain unsold within the baroj (betel-vine) or in baroj adjoining places cause environmental hazard. The partially decomposed stacked leaves act as the hub of different pathogens and causes health hazard for rural live-stock population. In some cases the pathogen contaminates local water bodies and creates human health problem. The utilization of excess betel leaves for essential oil extraction and subsequent chemotyping of the oil increases rural employability and mitigate ecological imbalance and ensure environmental sustainability. The assessment of betel-leaf chemotypes with standardization of essential oil extraction technique will be an attempt to assist in waste to wealth generation.

Keywords: betel leaf (*Piper betle* L.), Betel leaf essential oil (BLEO), morhophology, metabolome, germplasm assessment, rural entrepreneurship, environmental sustainability

Effect of Imposition of Water Stress at Different Growth Stages on Root Attributes and their Impact on Yield of Finger Millet Genotypes

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An field experiment was conducted in College of Agriculture, Shivamogga during summer 2021 and 2022 on sandy clay loam soil to evaluate the effect of imposition of water stress at different growth

stages on root attributes and their impact on yield of finger millet genotypes. Degrees of stress imposed at vegetative, reproductive and grain filling stages for 15 days were tested on selected short, medium and long duration finger millet genotypes by adopting split plot design. Stress imposed at vegetative stage caused highest per cent increase in root length (36.70 %), surface area (31.00 %), volume (20.70 %), diameter (21.20 %) and root to shoot ratio (57.15 %) over control. Further, imposition of water stress at reproductive stage unveiled significantly highest decrement in grain (26.60 q ha^{-1}) and straw (62.16 q ha^{-1}) yield by 32.20 and 45.80 per cent as compared to control. Among the genotypes tested, ML-365 showed largest tolerance across different stages of imposed stress. The observed root length (57.88 to 35.10 %), surface area (41.08 to 24.47 %), volume (31.43 to 19.24 %), diameter (28.94 to 19.64 %) and root to shoot ratio (64.29 to 41.63 %) reported highest per cent increase at vegetative to reproductive stage, respectively. Thereby, had a least significant marginal yield (7.73, 21.59 and 12.65 %) reduction and closely followed by GPU-28 (10.95, 28.58 and 12.65 %) at vegetative, reproductive and grain filling stage, respectively. Genotypes that are exposed to natural water stress during initial growth stages up to 40-45 days has a better ability to recuperate than the water stress experienced at later stages. Based on the results, KMR-204, ML-365 and KMR-301, respectively in short, medium and long duration genotypes excelled better.

Keywords: Water stress, Finger millet, Genotypes

Synthesis, Characterization and Release of Nano-Enabled Phosphorus Fertilizer in Acid Soils of Assam

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A study was undertaken to synthesize and characterize zeolite based nano phosphorus (P) fertilizer and to compare its release pattern with conventional chemical fertilizer (SSP) in three different types of soil representing major soil orders of Assam, taking recommended fertilizer dose applicable for maize. The zeolite was modified using hexadecyltrimethylammonium bromide and subsequently, the nano P fertilizer was synthesized by treating the surfactant modified zeolite with fertilizer (KH_2PO_4). The nano-fertilizer was characterized using X-ray diffraction, scanning electron microscopy, energy dispersive x-ray spectroscopy and transmission electron microscopy. Maximum adsorption of 7.4% added P was found in nano-fertilizer which was 60% higher as compared to unmodified zeolite. The incubation study showed that the treatment receiving recommended dose of P through SSP reached the maximum peak at 32 days of incubation beyond which no further increasing trend was observed. Relatively, the treatment receiving recommended dose of P through nano-fertilizer had a gradual increase of P upto 90 days of incubation. A similar trend was also observed in nano treated P fertilizer

receiving 2.5 times reduction, 5 times reduction, and 10 times reduction from the recommended dose. The differences in clay content affected the P release pattern which followed the sequence: Majuli (sandy clay loam) > Jorhat (silty clay loam) > Titabar (clay loam). The parabolic diffusion equation was found to be the best fit for describing the P release as compared to other kinetic models. The results indicate that nutrient use efficiency of phosphatic fertilizers can be significantly improved by nano phosphorus.

Keywords: Zeolite-A, Nano fertilizer, Slow release, Acid soil, Parabolic diffusion, Soil chemistry

Meteorological Drought Assessment using Standardized Precipitation Index in Meerut Division, Uttar Pradesh India

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Drought is amongst the most precarious phenomena that cause serious repercussions, especially over the agriculture-dominated regions. A detailed assessment of droughts is necessary to develop robust frameworks for combating its ill effects. The scope of the present research is to assess drought events using the Standardized Precipitation Index (SPI), which can provide accurate results of drought features on a spatiotemporal scale. It was evaluated using mean monthly precipitation long time-series data (1901-2021) for four selected metrological station. The nonparametric Mann–Kendall test was performed for trend analysis in drought events to investigate the consistency of drought events. The frequency results of drought events revealed that Ghaziabad station was the highest drought frequency station, while the lowest drought frequency was observed in Baghpat station. Among all the stations, mild drought was the most dominant drought category. The results of trend analysis Mann–Kendall test indicate significantly increasing trend of drought for all selected station. The information reported in this study will be helpful for proper planning and management of water resources over the basin and hence, reduce the pernicious effects of droughts. These results could be associated with the consequences of climate change as it is postulated that droughts would become more common in the future. The results of this study would help planners to develop sound policy on water resources and also assist in forecasting systems to provide advance warnings.

Keywords: Metrological Drought, Mann-Kendall test, Standardized Precipitation Index, Trend analysis

Mulching and its Alternative Sources

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Mulching improves crop yield, decreases pesticide' inputs to the field, saves irrigation water and contributes to tackle the food demand for the growing world population. Biodegradable mulches have emerged as a promising alternative to alleviate polyethylene pollution. In India, rainfed areas are characterized by uncertain yields which are mainly due to moisture stress caused by either inadequate or uneven distribution of rainfall. With all positive benefits plastic mulches are quite costly and its disposal causes environmental pollution. Further, these mulch sheets are to be freshly purchased for every season as they get mutilated. Unlike conventional plastic mulch, biodegradable mulches are not removed from field. Biodegradable and locally available materials like gunny bag, areca husk, paddy husk, etc serve as mulching materials and get degraded by adding nutrients and organic carbon to soil. FCV tobacco is grown in Karnataka light soils where soils are low in inherent fertility with fairly less water-holding capacity hence necessity to conserve soil moisture. A field experiment was carried out to know the effect of different moisture conservation materials (HDPE weed mat, transparent polyethylene mulch, mulching sheet, gunny bag, areca husk, hydrogel) on the performance of FCV Tobacco (*Nicotiana tabacum* L.) on sandy loam soil at AINP (T), Navile, Shivamogga, Karnataka during kharif season of 2019, 2020 and 2021. Seven treatments with control where no moisture conservation practices were examined in a Randomized Complete Block Design (RCBD) in three replications. Mulching was done by covering the ridge with mulching material and by applying hydrogel to plant hole before planting in the respective treatment. Experimental results revealed that significantly higher leaf area (797.9 cm^2, 648.5 cm^2 at X position and at L position respectively) was recorded with application of areca husk (dry) as crop residue @ 10 t per ha on the ridge. Yield performance of FCV tobacco was influenced significantly with the application of different moisture conservation materials. The data revealed that significantly higher green leaf yield (12280 kg ha^{-1}) and cured leaf yield (1696 kg ha^{-1}) was recorded with the application of areca husk (dry) as crop residue @ 10 t per ha on the ridge and it was followed by covering the ridges with mulching sheets (11608 kg ha^{-1} green leaf yield and 1576 kg ha^{-1} cured leaf yield). Areca husk is readily available in the southern transition zone of Karnataka where the areca crop is widely grown. Areca husk has become a menace due to its improper disposal and underutilization. It holds the soil moisture, protects the soil from being eroded, reduces the loss of soil moisture and adds organic matter.

Keywords: FCV tobacco, Biodegradable, Areca husk

Effect of Hydrogel on FCV Tobacco Yield

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The availability of limited soil moisture in rainfed regions is the most challenging constraint to harvest the maximum agronomic benefits. Rainfall is irregular due to fluctuating climate and the time between two showers is also increasing. The adaptation of smart water-saving techniques is desperate to combat soil moisture stress and soil quality. Hydrogel may be a boon to avoid crop losses due to irregular and uneven rainfall. The application of hydrogel to conserve soil moisture and plant nutrients to satisfy the crop needs is considered one of the most efficient strategies. Hydrogel is a hydrophilic polymer having high water holding capacity and can provide water to crops during moisture stress. Karnataka light soils where FCV tobacco is grown have shallow to moderately deep soil and low water holding capacity. A field experiment was carried out to know the effect of hydrogel at different time and levels on the performance of FCV Tobacco (*Nicotiana tabacum* L.) on sandy loam soil at AINP (T), Navile, Shivamogga, Karnataka during Kharif season of 2021. Seven treatments were examined in a Randomized Complete Block Design (RCBD) in three replications. Vaaridhar Pusa hydrogel used in the study is a semi synthetic, cross linked, derivatized cellulose-graft-anionic polyacrylate super absorbent polymer. Three rates of [2.5 kg ha^{-1} (0.14 g $plant^{-1}$), 3.75 kg ha^{-1}(0.20 g $plant^{-1}$) and 5.0 kg ha^{-1} (0.30 g $plant^{-1}$)] hydrogel application at the time of planting and after a rainy day during the crop growth period along with control were the seven different treatment combinations. Experimental results revealed that significantly higher leaf area (915.3 cm^2, 773.2 cm^2 at X position and at L position respectively) was recorded with soil application of 5 kg ha^{-1} (0.30 g plant $hole^{-1}$) after a rainy day. Yield performance of FCV tobacco was influenced significantly with the application of hydrogel. The data revealed that significantly higher green leaf yield (12062 kg ha^{-1}) and cured leaf yield (1432 kg ha^{-1}) was recorded with the soil application of 5 kg ha^{-1} (0.30 g plant $hole^{-1}$) after a rainy day and it was followed by soil application of hydrogel @ 3.75 kg ha^{-1} (0.20 g plant $hole^{-1}$) after a rainy (1380 kg ha^{-1} cured leaf yield).

Keywords: FCV Tobacco, hydrogel

Estimation of Soil Moisture Index for the Valanchery Micro-watershed using Landsat Imagery

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Soil moisture is essential for the crops for its growth and production, which is also vital part in involving the vegetation, climate and drought. Soil moisture index is an indicator of agricultural drought. The Soil Moisture Index (SMI) is the proportion of difference between the current soil moisture and the permanent wilting point to the field capacity and the residual soil moisture. This study aims to estimate the Normalized Difference Vegetation Index (NDVI), Land Surface Temperature (LST) and SMI of the Valanchery micro-watershed. Landsat 8 imagery were used for the analysis of the soil moisture. Multispectral satellite imagery which includes the visible, Red and NIR bands and the Thermal bands of the Landsat 8 were utilized for this study. NDVI and LST are essential components in determining the SMI. The results of the study indicate that the NDVI ranged from 0.06 to 0.47 during the year 2017, which ranged from -0.017 to 0.5344 during the year 2022, the lower values of NDVI indicate the presence of water bodies which are due to the tributaries of the Bharathapuzha river. LST ranges from 22.7 to 30.9° C during the year 2017, which ranged from 16.9 to 23.3° C during the year 2022. From the analysis of NDVI and LST, it is observed that the increase in the vegetation, decreases the LST. Soil Moisture Index of 2017 was observed to be in the range of 0.12 to 0.38 which increased during the year 2022 in the range from 0.24 to 0.50. Soil Moisture Index values were found to be increasing during the year 2022 but there was an increase in the spatial variability low soil moisture, which could be seen as an impact of urbanization. From the results of the study, it can be concluded that there is a relationship between the NDVI, LST and SMI. As the dynamics of vegetation cover alters the LST as well as the resulting Soil Moisture Index. This study is essential to plan the agricultural water needs, its allocation and to study about the agricultural droughts.

Keywords: Soil Moisture, Agricultural Drought, NDVI

Effect of Process Parameters on Quality Characteristics of Microwave Steam Distilled Lemongrass Essential Oil

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Microwave energy is being used proficiently in the field of extraction. Microwaves could be utilized efficiently for the extraction of organic compounds from environmental matrices. Microwave techniques have the advantage of bringing about heating through kinetic effects inside the sample, thus enhancing the extraction efficacy. Microwave steam distillation was carried out for the extraction of lemongrass essential oil and the quality characteristics of the essential oil were determined. The results indicated that the physical quality characteristics such as specific gravity, refractive index, solubility and colour of essential oil were found to be similar in microwave assisted process and steam distillation without microwave power. Gas Chromatographs of essential oil extracted through microwave steam distillation process showed higher percentage of the main aromatic chemical constituent citral than that of steam distillation process. Scanning Electron Microscopy of lemongrass subjected to microwave steam distillation provided evidences to sudden rupture of essential oil glands and complete extraction of oil. Microwave steam distillation could be considered as an extraction technique that results in the rapid production of high quality essential oil at shorter extraction period with minimum energy consumption.

Keywords: Essential oil, Lemongrass, Microwave steam distillation

Temporal Variability of Soil Moisture Status in Valanchery Micro-watershed of River Bharathapuzha from the Mid-lands of Kerala

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Soil moisture plays a fundamental role in agricultural production and in hydrologic and water balance studies. Thus, the knowledge of its variability is also important from the perspective of agriculture, hydrologic and climate change analysis. But the analysis of soil moisture variability is difficult because it depends on physical phenomenon such as rainfall, temperature, other climatic parameters, soil physical properties, land cover and topography. The characterization of temporal variability of soil moisture in the soil profile is highly relevant for irrigation planning, understanding the hydrological

processes, and to apply them to conservation planning. The aim of this study is to quantify the temporal variability of soil moisture status in the unsaturated zones in Valanchery micro-watershed of river Bharathapuzha and to assess the change in soil moisture at different soil depths. The tipping bucket rain gauge was installed to measure the hourly rainfall. Continuous soil moisture measurement was done using three TEROS-12, capacitance based soil moisture sensors which were connected with data logger for determining the real time moisture variation. ZL6 data logger was used to measure electrical signals and convert the readings to engineering units using ZENTRA Utility, which is a user friendly interface software. This data logger carried out real time moisture measurements at the study area. The sensors were inserted horizontally into the undisturbed soil at different depths of 0.40 m, 0.80 m and 1.20 m. The signals corresponding to different soil moisture values were recorded at 1 hour interval for the entire period of 14 months from September 2021 to October 2022 and were converted to moisture content on weight basis. The highest monthly rainfall was recorded in the month of October 2021 (528.05 mm). During March 2022 the sensor installed at 0.40 m depth reached the lowest soil moisture percentage of 14.87%, while the sensor at 0.80 m depth reached 18.98% and the sensor at 1.20 m depth reached 20.60%, as the lowest values. It was found that the standard deviation (SD) and coefficient of variation (CV) of soil moisture given by the sensors installed at (0.40 m and 0.80 m); (0.80 m and 1.2 m); (0.40 m and 1.20) depths were (3.26 and 0.13); (0.22 and 0.01); (3.48 and 0.12), respectively. The study showed that the temporal variation of soil moisture on account of rainfall variability was maximum for top layer of soil (0 to 0.40 m), while, the variations were considerably lower in the case of second and third layer of soil. These variations will be reflected in the crop yield especially for shallow rooted crops, if it is rain-fed agriculture.

Keywords: sensor, soil moisture, Teros-12, Zentra, ZL6

Impact of Calcium Nitrate Foliar Feeding on Growth Quality and Yield parameters of Byadgi Chilli (*Capsicum annuum*. L)

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Red chilli (*Capsicum annuum*. L) is known throughout the world as spice on account of its pungency, oleoresin and essential oil which has gained greater importance in the global market than whole chilli. The major constraints in chilli production is premature flower and fruit dropping as it is terminal bearing habit due to shortage of calcium which is highly immobile in the plant. The present study was conducted in the farmer's field at Agadi village in Dharwad district, Karnataka to study the effect of calcium nitrate ($Ca(NO_3)_2$) foliar feeding on growth, quality and yield parameters of Byadgi chilli. The

result revealed that growth parameters like plant height, number of branches and dry matter production has significantly influenced by the concentrations and frequency of foliar feeding of $Ca(NO_3)_2$ at 75 and 140 DAT. Three foliar sprays of 1.5 per cent $Ca(NO_3)_2$ one each at 45, 60 and 75 DAT significantly improved the quality parameters like, color value and oleoresin content and also yield of Byadgi chilli over 1 per cent $Ca(NO_3)_2$ and NAA foliar feeding. 1.5 per cent concentration is more superior in improving the growth, quality and yield of Byadgi chillies.

Keywords: Calcium nitrate, Chilli, Quality, Yield

Influence of Hydrogel on Physiology, Yield and Soil Attributes of Ginger (*Zingiber officinale* Rosc.) under different Irrigation Intervals

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A filed experiment was conducted at Kademanuganahalli, Mysore District of Karnataka During 2017 to study the Influence of hydrogel on physiology, yield and soil attributes of ginger under different irrigation intervals. The experiment was laid out in split plot design with two replications. Three different levels of irrigation (M_1= 7 days, M_2= 14 days and M_3= 21 days interval) and eight levels of Pusa hydrogel (S_1= Control, S_2= 2.0 kg/ha, S_3= 2.5 kg/ha, S_4= 3.0 kg/ha, S_5= 3.5 kg/ha, S_6= 4.0 kg/ha, S_7= 4.5 kg/ha and S_8= 5.0 kg hydrogel/ha) were allocated to main plots and sub plots, respectively. Results showed that hydrogel, irrigation levels and their interactions had a significant effect on physiology and yield attributes of ginger. The soil reaction (pH), total soluble salts content (EC) and organic carbon content of soils did not differ significantly due to irrigation intervals, levels of hydrogel application and interaction between them. The maximum Absolute Growth Rate, Crop Growth Rate, chlorophyll content, primary and secondary fingers per clump, length and width of rhizomes and fresh rhizome yield were recorded in treatment with 5.0 kg hydrogel per hectare and at 14 days irrigation interval.

Keywords: Ginger, Hydrogel, Irrigation, Physiology, Yield

Growth and Yield of Lettuce as Influenced by Salinity Levels and Rooting Substrates under Hydroponic System of Cultivation

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With the advent of civilization, open field/soil-based agriculture is facing some major challenges, most importantly decrease in per capita land availability. Due to rapid urbanization and industrialization as well as melting of icebergs, arable land under cultivation is further going to decrease. Naturally, soil-less culture is becoming more relevant in the present scenario, to cope-up with these challenges. Hydroponics is a method of growing plants using mineral nutrient solutions, without soil. In this perspective an experiment was conducted during Rabi 2019 at ZARS, V. C. Farm, Mandya with an objective to study the effect of salinity levels and rooting substrates on growth and yield of lettuce under hydroponic system. The experimental design was Randomized Complete Block Design which involved 4 × 4 factorial scheme with four Salinity levels of nutrient solution (0.5, 0.75, 1.1 and 1.3 dS m^{-1}) and four rooting substrate (Rockwool, sponge sphagnum moss and floral bed), that totalized 16 treatments with 2 replicates. The evaluated variables were number of leaves $plant^{-1}$, leaf area, leaf length, chlorophyll content, shoot length, shoot fresh and dry weight, root length, fresh and dry root weight and root to shoot ratio. Analyzed variables were significantly affected by salinity levels and rooting substrates. The results showed that nutrient solution having salinity level of 1.3 dS m^{-1} with rockwool rooting substrate recorded significantly higher growth and yield parameter of lettuce.

Keywords: Hydroponics, lettuce, salinity and rooting substrates

Effect of Irrigation Levels and Hydrogel on Growth and Yield of Summer Groundnut (*Arachis hypogaea* L.) in Inceptisols of Gujarat

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A field experiment on "Effect of irrigation levels and hydrogel on growth and yield of summer groundnut (*Arachis hypogaea* L.) in Inceptisols of Gujarat" was carried out at Agronomy Farm, B. A.

College of Agriculture, Anand Agricultural University, Anand during summer season of the year 2020. The experiment was laid out in split plot design. Twelve treatment combinations comprising of three levels of irrigation schedules based on IW/CPE ratio as main plot treatments as well as four hydrogel treatments in the sub plot treatments, with three replications. The results revealed that all the growth as well as yield parameters viz., plant population, plant height and dry biomass, yield parameters viz., number of pods per plants, seed index, pod yield, haulm yield and quality parameters viz., protein content were significantly increased by irrigation scheduling at 0.8 IW/CEP ratio when compared to the control that is irrigation given at critical growth stages. Application of hydrogel at different levels showed different effects on plant growth parameters and yield attributing characters. The higher plant population at harvest, plant height at 60 DAS and at harvest as well as dry biomass at 40 DAS was increased by the application of hydrogel @ 6 kg ha^{-1}. More ever, the number of pods per plant, pod yield, haulm yield, and seed index were increased by the application of hydrogel @ 6 kg ha^{-1}. Water use efficiency (kg ha mm^{-1}) was also increased by the application hydrogel @ 6 kg ha^{-1}. The interaction effect that is treatment combination 0.8 IW/CEP ratio and hydrogel @ 6 ka ha^{-1} recorded significantly higher number of pods per plant, pod yield and kernel yield. From the results, it might be concluded that summer groundnut crop cv. GG 34 should be irrigated at 0.8 IW/CPE ratio (at 7 days interval in March, April, May and June) in conjunction with soil application of hydrogel at 6 kg ha^{-1} for securing higher yield and net return under middle Gujarat condition.

Keywords: Hydrogel, Irrigation, IW/CPE ratio, Groundnut, Growth and Yield

Spatio-temporal Variation of Surface Water Resousce Over Samastipur District of Bihar using RS and GIS Approach

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The study region, Samastipur district of Bihar surrounded by 5 km buffer zone was divided into 67 square grids of 8 km × 8 km spatial resolution ArcGIS. The monthly rainfall images (TRMM_3B43) for the period of 20 years from the years of 2000 to 2019 and the monthly dataset of LST (GLDAS_NOAH025_M_EP) products of $0.25^{o} \times 0.25^{o}$ grid size for the period of 21 years from 2000 to 2020 were downloaded and used for analysis. The climatic variables viz. monthly rainfall and LST values were extracted using the model builder tool of ArcGIS and validated and compared with ground-based climatic variables measured at Meteorological station (MS), Pusa. Bias in extracted climatic variables was identified and was corrected using linear scaling. The Landuse and Landcover (LULC) map of study area were developed using supervised classification technique in ArcGIS. The accuracy assessment was carried out using visual observation, Google Earth image, mathematical analysis and

the kappa coefficient. The validated soil map of the study area was procured from NBSS and LUP, Nagpur, India. The potential evapotranspiration (PET), actual evapotranspiration (AET) and available water capacity (AWC) were computed. The Thematic maps of PET, AET and availability of surplus and deficit water over the study area were developed using inverse distance weighted interpolation technique. The study investigated that estimated PET was progressively increasing from January to June and thereafter gradually decreasing from July to December. PET was found maximum (120.7 mm) for the month June and minimum (5.5 mm) for the month January and similar pattern were observed in case of AET. The change in the pattern of distribution of estimated monthly average PET and AET in each month were observed due to the change in atmospheric demand of climatic variables. During the months of July (85.3 mm), August (83.9 mm) and September (81.1 mm), AET and PET were found to be equal. The study area undergoes an annual water deficit of 121.2 mm distributed during the months of February to May, November and December whereas, the annual water surplus of 523.8 mm during the months of January, July to September.

Keywords: PET, AET, Water surplus and Deficit.

Impact of Foliar Application of nano Ca on qualitative Parameters of Tomato (*Solanum lycopersicum* L.)

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Indiscriminate application of nutrients to the soil over years will lead to accumulation in soil, to the level toxic to plants. Therefore, an efficient mechanism is very essential to reduce the amount of nutrient (soil/foliar) application, without compromising plant growth and yield is very essential. Hence, in recent years, the application of nanoscale particles is being preferred to enhance the agronomic effectiveness of nutrients in plants. In view of this, an experiment was conducted during kharif, 2020 to know the effect of foliar application of nano CaO on qualitative parameters of tomato. The experiment was laid out in a Completely Randomized Design (CRD) with thirteen treatments comprising different concentrations of nano CaO (100, 200, 300, 400, 500, 600, 700, 800, 900, 1000 and 1500 ppm), $Ca(NO_3)_2$ and control. Each treatment was replicated thrice. The foliar application of nano CaO was done at 30 and 45 DAT. Nano CaO 600 ppm recorded minimum values for TSS (3.90 ^{0}Brix), pH (4.38), total sugars (2.40 %), reducing sugars (2.15 %), lycopene content (5.80 mg 100g-1) and maximum values for ascorbic acid (25.40 mg 100 g^{-1}) and titrable acidity (0.52 %).

Keywords: Tomato, Nano CaO, Quality parameters

Assessment of Urbanization Impact on Ground and Surface Water Quality using Water Quality Index in Bangalore

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The present work aims to assess the water quality index (WQI) of surface and ground water in and around Bangalore. The main objective was to examine the urbanization impact on variation in water quality. The surface and ground water samples were collected and subjected to comprehensive physico-chemical analysis involving major cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Fe, Mn, Zn, Cu, Ni, Pb, Cr, Cd), anions (HCO_3^{-}, CO_3^{2-}, Cl^{-}, SO_4^{2-}, NO_3^{-}, PO_4^{3-}, B) besides general parameters (pH, EC, DO, BOD, COD) by following standard procedures. The water quality parameters were compared with the Bureau of Indian Standards (BIS). All these parameters were included for calculating the WQI. Water quality index was developed for all the 24 parameters based on Horton's Water quality index (Horton, 1965) Weighted Arithmetic Water Quality Index Method. Water quality index values indicated that 28.57 per cent of samples were good, 28.57 per cent were poor, and only 17.14 per cent of the samples belong to very poor and unsuitable and remaining 8.57 per cent samples belong to excellent. Majority of surface water lake samples collected from peri-urban and urban areas were found un-suitable for irrigation compared to ground water collected from rural, peri-urban and urban areas of Bangalore. While, eighty-two per cent of ground water samples were highly alkaline and hazardous. Ninty-four per cent of samples were very hard.

Keywords: WQI, BOD, DO, COD, BIS,

Hydroponics in Modern Era

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Hydroponics is Cultivation of plants in nutrition solution without using soil. This method can be more useful in area where the soil is not suitable for cultivation of crops. Growing of crops in Soil is now facing various problems such as industrialization, manmade and natural disaster, climate change, excessive usage of chemicals and pesticides that reducing fertility of soil. For those reasons using of various methods for producing food for growing population has been popularized. Out of that the best is Hydroponics which can be established in small space. Where we can get more yield per unit

area compared to traditional agriculture methods. At the same time, we can minimize the waste of fertilizers. Even weeds, Pest and disease incidence is low to negligible by which we can reduce the pesticides and chemical usage. Indirectly we are promoting the organic foods with high quality and taste. It helps us to utilize the water more efficiently, where we can save water up to 90% at the same time growth of the plant is completely dependent on the nutrient solution. Thus, there is controlled plant growth. Out of various methods in hydroponics, NFT Nutrient film technic has gained more popularity because of various advantages compared to others. The crops like poor man's orange cucumber, Chilli, Capsicum, micro greens and lettuce showed best performance when cultivated using hydroponics. In India, hydroponics is still a dream of many educated farmers and they are starting as small start-up companies. On the other side, big farms are entering in to the international market as a result fetching good demand for the produce. Now a days this technological gaining more popularity because these farms offer a good pathway towards a high sustainable food that concentrates on the health of our food, bodies and nature by not using any chemicals at high concentrations, sometimes no usage too.

Keywords: Hydroponics, soil less culture, Nutrient film technology, yield, Quality

Influence of Levels of Water-Soluble Fertilizers on Yield, Quality and Economics of Sugarcane through Fertigation

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A field experiment was conducted at Zonal Agricultural Research Station, V. C. Farm, Mandya during 2018-19 to study the effect of water-soluble fertilizer levels (urea, MAP, MOP) under drip fertigation on yield, quality and economics of sugarcane. The experiment site was red sandy loam with neutral pH (6.7), low electrical conductivity (0.24 dSm^{-1}), medium organic carbon (5.6 g kg^{-1}), low available nitrogen (273 kg ha^{-1}), medium phosphorus (28 kg ha^{-1}) and potassium (268 kg ha^{-1}). The investigation was carried out in Randomized Complete Block Design with seven treatments and replicated thrice using VCF-0517 variety. The treatments comprised of four levels of fertigation viz., 150, 125, 100 and 75 per cent RDF through water soluble fertilizers, 100 per cent RDF through conventional fertilizers without FYM, 100 per cent RDF through conventional fertilizers with FYM and control. The results revealed that application of 125 per cent RDF through water soluble fertilizers recorded significantly higher yield and yield parameters viz., number of millable canes $clump^{-1}$ (14.33), cane length (346.33 cm), number of internodes $cane^{-1}$(21.00), cane girth (13.80 cm), single cane weight (2.97 Kg) and cane yield (212 t ha^{-1}) and was on par with 150 per cent RDF and 100 per cent RDF through water soluble fertilizer application. Least number of millable canes $clump^{-1}$(8.67), cane length (220.00 cm), number

of internodes cane^{-1} (17.87), cane girth (10.2 cm), single cane weight (1.72 Kg) and cane yield (112.60 t ha^{-1}) was recorded in control. Similarly, fertilizer level @ 75 per cent RDF through water soluble fertilizers recorded significantly higher yield and yield parameters viz., number of millable canes clump^{-1} (13.00), cane length (305.00 cm), number of internodes cane^{-1} (19.53), cane girth (12.40 cm), single cane weight (2.44 Kg) and cane yield (195 t ha^{-1}) than normal method of sugarcane cultivation with 100 per cent RDF soil application which clearly indicated that 25 per cent of the recommended dose of fertilizer could be saved with higher cane yield over normal practice of sugarcane cultivation thereby reducing the cost of sugarcane cultivation. Quality parameters like pol (18.0%), CCS production (12.44%), sugar yield (26.38 t ha^{-1}) and juice extraction per centage (69.65 %) were observed significantly higher with 125 per cent RDF through drip fertigation and was on par with 150 per cent RDF and 100 per cent RDF through water soluble fertilizer application. Other quality attributes like brix (%) and purity (%) of sugarcane exhibited no significant difference due to water soluble fertilizer levels. The brix, pol, purity, CCS per cent, sugar yield, juice extraction per centage and cane yield were increased with increase in fertilizer levels up to 125 per cent RDF then declined by further increased in fertilizer level. Economic perspectives such as higher gross returns (Rs. 487600 ha^{-1}), net returns (Rs. 368532 ha^{-1}) and B: C ratio (4.10) was noticed with application of 125 per cent RDF and hence concluded that fertigation at 125 per cent RDF found optimum for higher yield and net returns.

Keywords: Soil application, water-soluble fertilizer, Sugarcane

Bioremediation of Metribuzin by Bacterial Consortia from Polluted Soils of Assam

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Herbicides are toxic xenobiotics, which have been used for managing the weeds in agricultural lands and aquatic bodies. Herbicides, as a tool for weed management, are gaining immense popularity as it provides economic, efficient, and timely control of weeds. Farmers often used the herbicide(s) without considering either long or short-term effects on soil, water, and food chain as well as on its natural habitats. The residual effect of herbicides in the environment is mostly influenced by their degradation pattern and their half-life ($T_{1/2}$). However, the half-life is not absolute because it depends on the soil type, temperature, and concentration of the herbicide applied. Microbes play an important role in degradation as well as counteracting the residual effect of herbicides. The continuous use of the herbicide metribuzin belonging to triazinone group used as a pre-emergency herbicide against grasses and broad leaves weeds has called the special attention due to the multifaceted toxicity, persistence of the herbicide molecule in soil and enters finally the entire food chain. The build-up of herbicide residues in soil affecting the soil microbial community that is primarily involved in nutrient cycling and crop

residue decomposition resulting in poor soil health. In cognizance of the above, a laboratory pot study was conducted to work out the consequences of bacterial consortia on pretilachlor-treated soil with treatments comprised of T_1 – metribuzin @ 500g/ha T_2 – metribuzin @ 500g/ha +Vermicompost @ 2 ton/ha T_3 – metribuzin @ 500g/ha + Bacterial consortia @ 10 ml /6 kg soil and T_4 – metribuzin @ 500 g/ha + Vermicompost @ 2 ton/ha + Bacterial consortia @ 10 ml /6 kg soil with repetition of four CRD as the statistical design. Bacterial consortia of (52.32 – 782.4) x 10^6 CFU g^{-1}soil were inoculated to the pots @ 10ml per 6kg soil with 30 % soil moisture content. All together 26 bacterial cultures were isolated, out of which 4 from coal, 8 from petroleum oil, 3 from brick, 5 from cement, and 6 from paper-polluted soil using specific media. Identification of the bacterial isolates was done by sequencing of 16SrRNA and phylogenetic tree of which most of the bacteria belong to the strains Bacillus, Pseudomonas, Fictibacillus, and Acinetobacter. The treatments (T3 and T4) with bacterial consortia resulted from faster degradation with shorter half-lives of pretilachlor over the treatments (T1 and T2) without bacterial consortia. Soil samples were collected periodically from the day of herbicide application (within 4 hours of application) till 30 days after application (DAA) of herbicides and detection of herbicide residue was done in GC-1000 with Electron Capture Detector (ECD), The degradation of the herbicides in soil followed a first-order kinetic. It was also evident from the degradation pattern that the single metribuzin doses degraded slower at the beginning of the experiment over the doubled herbicide dose which can probably be explained by the microorganisms' adaptability to the higher doses.

Keywords: Bioremediation, metribuzin, degradation, half-life, bacterial consortia

Innovative Approach for Enhancing Water Productivity in Mango cv Amrapali

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Modern era of science thrust upon ecological and environmental sustainability which will benefit the farmers in terms of resource conservation and precise management. Scientific efforts to develop innovative approach to sustain environmental sustainability are always praiseworthy. In this context, it is of national importance to conserve the precise ground water and enhance water productivity in fruit production. Improved water use will certainly benefit fruit growers in semi-arid, arid, rainfed and other water scarcity areas. Experimentation on mango cv Amrapali under subtropical Lucknow condition suggested the scope to precise water use in mango and thereby achieve sustainability option. Statistical histographic distribution of weekly averaged pan evaporation indicated maximum frequency level (12.5 per cent) at 8 to 10 mm/day class intervals. Analysis of data showed weekly average maximum temperatures varied from 16.43 to 44.21°C with mean values of 33.20°C and minimum temperatures

of 4.93 to 22.21°C with mean value of 16.31°C during vegetative to reproductive stages of Amrapali. Weekly average maximum and minimum relative humidity were 75.70 and 52.90 per cent respectively. The values of course ranged between 64.57 to 93.43 and 34.00 to 65.00 per cent respectively. Bright sunshine hours of 3.04 to 9.47 h (mean 7.44 h) and wind speed of 1.53 to 4.80 km/h (mean 2.76 km/h) was recorded. Maximum weekly average rainfalls of 12.09 mm were also recorded. It was inferred from the histographic distribution that 12.5 per cent was maximum frequency level of weekly average reference evapotranspiration (5 to 6 mm/day class intervals) was existed. During fruit set to developmental period, lack of rainfall forced to apply water precisely. Water quantity of ten to thirty liters was applied to tree basin at fruit set, pea, marble and egg periods to improve fruit size and yield. Water quantities of one hundred and fifty, one hundred and seventy, one hundred and eighty to one hundred and ninety liters of water were applied. Water productivity of 4.1 to 7.9 kg/m^3 of applied water were quantified. Thus, innovative approach of applying lower quantity of water at critical reproductive stages may be fruitful to improve water use and its productivity. This approach may attribute to the ecological and environmental sustainability by way of scientific water conservation and insurance of fruit productivity.

Keywords: Amrapali fruit, innovative approach, histographic analysis, subtropical Lucknow condition, water use

Effect of Moisture Stress on Quinoa Yield in Lysimetric Conditions

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The water and soil resources are limited, and the optimal use of water resources in the agriculture needs the most accurate determination of the amount of crop water requirement in different stages of growth. Quinoa (*Chenopodium* quinoa Willd.) is one of the plants that has outstanding economic and agronomic characteristics among the sorghums, and in addition to the production of oil and protein, it is also important in terms of forage production. The present research was conducted to determine the dry biomass and grain yield of quinoa (Chenopodium quinoa willd.) at different moisture levels of 0.8, 0.6, 0.4 and 0.2 of the total available water (TAW) under controlled conditions (lysimeter) in two spring and autumn (2019-2020) cropping season. For this purpose, 12 lysimeters with a length of 50, a width of 40 and a height of 50 cm were prepared and then each of the lysimeters was filled with sandy loam soil with a bulk density of 1.4 g/cm^3 and placed separately on electronic balance. After seeding, irrigation was done based on the amount of soil moisture discharge in each interval and the leaching

requirement equal to 20%. At the end, the quinoa plants were harvested and after drying, dry biomass and grain yield were measured. The results showed that with a decrease in the moisture level at the beginning of irrigation from 0.4 to 0.2 TAW, the amount of biomass and seed yield had a significant decrease of 24 and 37% in spring cropping and 34 and 47% in autumn cropping, respectively. But the decrease in moisture levels from 0.8 to 0.6 and 0.6 to 0.4 did not cause a significant decrease in seed yield and biomass in both spring and winter cropping.

Keywords: Crop coefficient, Evapotranspiration, Lysimeter, Quinoa.

Foliar Application of Urea and Micronutrients on Growth, Yield and Soil Chemical Properties after Harvest of Groundnut in Loamy Sand

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A field experiment entitled "foliar application of urea and micronutrients on growth, yield attributes and yields of groundnut in loamy sand" was conducted at Agronomy Instructional Farm, C. P. College of Agriculture, S.D. Agricultural University, Sardarkrushinagar, Gujarat during summer season of 2019-20. Total eight treatments viz., Control/RDF (T_1), T_1 + 1.5 % Urea spray at 35 DAS (T_2), T_1 + 1.5 % Urea spray at 50 DAS (T_3), T_1 + 1.5 % Urea spray at 35 DAS and 50 DAS (T_4), T_1 + 0.5 % $FeSO_4$ and $ZnSO_4$ at 35 DAS (T_5), T_1 + 0.5 % $FeSO_4$ and $ZnSO_4$ at 35 DAS and 50 DAS (T_6), T_1 + 1.5 % Urea spray + 0.5 % $FeSO_4$ and $ZnSO_4$ at 35 DAS (T_7), T_1 + 1.5 % Urea spray + 0.5 % $FeSO_4$ and $ZnSO_4$ at 35 DAS and 50 DAS (T_8) were laid out in randomized block design with four replications. The results reveal that application of RDF + 1.5 % Urea spray + 0.5 % $FeSO_4$ and $ZnSO_4$ at 35 DAS and 50 DAS significantly increased the no. of pods/ plant, pod yield/ plant (g), pod yield (kg/ha) and haulm yield (kg/ha). Available nitrogen, P_2O_5, K_2O, DTPA extractable Fe & Zn content in soil after harvest of crop did not differ significantly due to by foliar application of urea and micronutrients.

Keywords: Urea, $FeSO_4$, $ZnSO_4$, groundnut, yield

Standardization of the Assay Media Conditions for the Development of Precise Assay Method of Soil Urease Activity

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Urea is the most important nitrogen fertilizer widely used in crop production and its fate in soils is controlled largely by soil enzyme urease. Thus, urease is the important enzyme in hydrolysis of fertilizer urea and thereby, making the availability of nitrogen to crop plants. The use of precise assay method is most important aspects in regulating soil urease activity which are useful to improve use efficiency of urea, and minimize the problems related to use of urea. In this context, the present investigation entitled, "standardization of the assay media conditions for the precise assay method of soil urease activity." was undertaken during 2020-21 at the laboratory of the Department of Soil Science and Agricultural Chemistry, MPKV, Rahuri.The surface (0-15cm) soil sample from Typic Haplustept was selected as a representative of Inceptisol and used for various laboratory experiments conducted for optimizing assay media/components for standardization of in vivo assay method for measuring activity of urease from Inceptisol. The results indicated that, all the assay components viz., substrate concentration (0.2 M), buffer strength (0.05 M), weight of soil (5 g), amount of toluene (0.2 ml) and incubation time (2 h) were found optimum as per Tabatabai and Bremner (1972) method for measuring activity of urease from Inceptisol (Typic Haplustept) soil except one assay component: THAM buffer with its pH 9.0. The THAM buffer, pH 8.5 was found to be optimum for measuring the activity of urease from Inceptisol. Even though the urease activity in 5 g weight of soil and 2 h incubation time found the highest value, the 2g weight of soil and 1 h incubation time also statistically at par with 5 g weight of soil and 2 h incubation time respectively. Hence the use of 2 g soil and 1 h incubation time in assay procedure are also sufficient for measuring urease activity if the soil sample size and time are limiting factors, by using 2 g soil and 1 h incubation time urease activity from large number of samples can be done in a short time. These results show the need for standardization of assay method for measuring urease activity in various soil types and laboratory conditions.

Keywords: Urea, Urease activity, Inceptisol, Assay

Soil Moisture Dynamics in Conservation Agriculture

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An experiment was conducted to assess soil moisture dynamics with respect to in-situ green manuring and conservation tillage practices at the All India Coordinated Research Project for Dryland Agriculture (AICRPDA), University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bengaluru. The experiment was laid out in split plot design with three each main plot treatments of conservation tillage practices and sub plot treatments of different in-situ green manuring practices and replicated thrice. Zero tillage (ZT) and Horsegram in-situ green manuring showed the best results in conservation of soil moisture in dryland Agriculture. Among different tillage practices the ZT had recorded significantly highest soil moisture content 14.37 and 16.91 per cent at 30 and 60 cm depth as compared to reduced tillage (RT) (13.48 and 15.82 %) and conventional tillage practice (CT) (12.32 and 14.50 %). Among different in-situ green manuring practices the horsegram in-situ green manuring has found with significantly highest moisture content 14.74 and 17.23 per cent at 30 and 60 cm depth followed by sunhemp in-situ green manuring practice. The higher steady state infiltration rate was recorded in CT (4.64 cm hr^{-1}) followed by RT (4.31 cm hr^{-1}) and ZT (4.0 cm hr^{-1}). Similarly, among various in-situ green manuring practices the horsegram has recorded the higher steady state infiltration rate of 4.68 cm hr^{-1} as compared to sunhemp in-situ green manuring practice.

Keywords: Conservation tillage, Zero tillage, Green manuring, Soil moisture and Infiltration rate.

Exploit TWW (Treated Waste Water) for Agriculture

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At 'G20-Summit (15-16th Nov 2022, Bali, Indonesia), H.E. Prime Minister Modiji highlighted the issue of Climate, Food, and Energy Security for the growing population in the world i.e. 8 billion-2022. Similarly, 197 countries signed the agreement on 10th Nov 2022, the UNEP, Glasgow, and committed to achieving the target of SDG 6.3 by 2030. Therefore, TWW management is one of the prime targets of the UN's Sustainable Development Goals (SDG 6.3) & environment protection (COP26), which explicitly focus on reducing water pollution, treatment of wastewater, and re-reuse for agriculture-food security, and landscape, forestry, and gardens. Wastewater treatment means the removal of impurities from wastewater, before reaching aquifers or natural bodies of water such as rivers, lakes, and Oceans. 'UNWWDR2017' report said more than 80 percent of the world's wastewater flows back into the

environment without being treated and unfortunately proper data on wastewater treatment and reuse is not available at this stage. Some European Countries has made a significant contribution to wastewater treatment and reuse for agriculture, construction, and cleaning purpose. Since 1980, India has initiated the treatment of wastewater and re-use for irrigation of lawns, gardens, landscapes, and forestry at Chennai Municipal Corporation. Many research institutes e.g. Indian Agricultural Research Institute, Karnal, University of Agricultural Science, Dharwad, have also carried out research work on the use of TWW for agriculture purposes. Ministry of Jal Shakti (Department of Water Resource), Government of India, formulated National Frame Work on Safe Reuse of Treated Water (SRTW) with the vision, of 'widespread and safe reuse of treated used water in India that reduces the pressure on scarce freshwater resources, reduces pollution of the environment and risks to public health, and achieves socio-economic benefits by adopting a sustainable circular economy approach. Under the framework of the Ministry of Jal Shakti, Haryana State Government has taken an initiative and implemented 'the use of TWW for agriculture via Drip & Sprinkler Irrigation. The concerned article describes the algorithm for use of TWW for Agriculture by using Micro (Drip) / Sprinkler Irrigation systems validating norms specified by various governments along with briefing wastewater treatment, water quality parameters for crop suitability, and minimum residual level (MRL) and, a case study. It also describes the pros-cons, hurdles & limitations on the acceptance level of the public. It helps to clear doubts among the society and encourages State/Central Government, Private companies, and Growers to adopt this model to overcome water scarcity and address the environmental & water pollution issues as meeting the target of SDG.

Keywords: Wastewater Treatment, Indian Agriculture, TWW, MRL, Algorithm, Micro (Drip), Sprinkler Irrigation

Salinity Ingress Preventing 'Bandhara': A Potential Biodiversity Hotspot for Wetland-dependent Avifauna

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The term 'Bandhara' is used to refer to a man-made shallow lake built to prevent the ingress of coastal salinity into the freshwater reservoirs and groundwaters of the nearby land area. The problem of Salinity ingress was first detected in Gujarat in the late sixties and early seventies due to the massive exploitation of groundwater. It is estimated that 7 lakh hectares of coastal land in Saurashtra (a region of Gujarat, India) is in the process of losing its fertility due to a salinity problem. These challenges led to the formation of the Salinity Ingress Prevention Cell (SIPC) by the government of Gujarat. SIPC was tasked with the responsibility of construction of civil structures such as tidal regulators, Bandharas, Lining canals, and other suitable measures to prevent salinity ingress. A total of 29 Bandhara have been developed in the coastal area of Saurashtra to prevent salinity ingress and Avaniya Bandhara is

one of them. Bandhara serves as a potential wetland and a critical habitat for migratory water-dependent birds. The present study was conducted to estimate the avifaunal diversity of a water reservoir called "Avaniya Bandhara", situated near a village, named 'Avaniya' (21°42'27.10''N, 72°12'29.66''E) of Bhavnagar district, Gujarat, India. The Bandhara was monitored from October 2021 to September 2022. The study recorded 110 wetland-dependent species (12 Orders, 24 Families, and 70 Genera) with maximum diversity of order Charadriiformes (41 species). Out of the total species, 99 are under the Least concern category, 7 are Near Threatened and 4 are under the Vulnerable category of IUCN. Among the recorded species, 73 species are Common, 21 species are Uncommon, 13 species are Occasional and 3 species are Rare in the study area. The study represents the status of the avifaunal diversity of Avaniya Bandhara and provides a general idea about the threats to the habitat and associated birds which will aid in future research perspectives and conservation strategies.

Keywords: Salinity ingress, coastal land, Wetland

Partial Root Drying for Tomato under Greenhouse

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Field experiment was carried out in a naturally ventilated greenhouse to assess the effect of deficit irrigation and partial root drying on vegetative growth, yield, and water use efficiency (WUE) of tomato at Tamil Nadu Agricultural University (TNAU), Coimbatore during the summer of 2022. The experiment was laid out with a randomized block design (RBD) and five treatments with four replications. The treatments include Full irrigation (FI) at 100% crop evapotranspiration (ET_c), Deficit irrigation (DI) at 75% of ET_c (DI_{25}), Partial root drying (PRD) at 75% of ET_c (PRD_{25}), DI at 50% of ET_c (DI_{50}) and PRD at 50% of ET_c (PRD_{50}). The quantity of water was applied with drip irrigation and fertigation was scheduled based on (ET_c) and fertigation schedule respectively. The highest fruit yield was obtained under FULL irrigation (225 t ha^{-1}) than the DI_{25}, PRD_{25}, DI_{50}, and PRD_{50} treatment which produced the yield 169.50, 173.25, 154.40, and 161.50 respectively. The yield in comparison to deficit irrigation which received the same quantity of water, the PRD treatments produced an increased yield of 5-10%. PRD and DI irrigation improved water use efficiency (WUE) considerably, and that was 30.35% and 25.71% respectively higher than FI. The water productivity was obtained higher under the irrigation treatment PRD than the deficit irrigation (DI). Results suggest that PRD treatment may be an option in a water shortage area as it used 50% less water than the FI irrigation treatment with a slight decrease in the yield.

Keywords: Crop evapotranspiration; Deficit irrigation; Greenhouse; PRD; WUE

Effect of Fertigation on Soil Nutrient Status and Fertilizer use Efficiency in Ridge gourd [*Luffa acuntangula* (L.) Roxb] Crop Grown under Protected Condition

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An investigation was carried out at Main Agricultural and Horticultural Research Station, Iruvakki, KSNUAHS, Shivamogga during Rabi season 2021 to study the effect of fertigation on soil nutrient status and Fertilizer use efficiency in Ridge gourd [*Luffa acutangula* (L.) Robx.]Grown under protected condition. The experiment was laid out in Randomized Block Design under polyhouse with seven treatments replicated thrice. The treatment includes three level of (100, 75 and 125 %NPK) RDF through fertigation and three levels of (100, 75 and 125 %) RDF through soil application along with absolute control. The fertigation was given at 10 days interval in 9 splits.The results revealed that there was significant increased in Ridge gourd yield (25.86 t ha^{-1}), soil available nutrient status (N, P2O5 AND K_2O) and fertilizer use efficiency of Ridge gourd grown under polyhouse condition receiving NPK fertigation than soil application. The treatment with125 per cent RDF recorded significantly higher available N (243.90 kg ha^{-1}), available P_2O_5 (39.63 kg ha^{-1}), available K_2O (150.10 kg ha^{-1}) and available S (35.14) at 0-15 cm of soil depth. Further, fertilizer use efficiency [NUE (46.82 %), PUE (17.05 %) and KUE (69.97 %)] was recorded higher in 125 per cent RDF through fertigation followed by 100 per cent RDF through fertigation. The fertigation treatments recorded significantly higher fertilizer use efficiency than soil application under protected condition.

Keywords: Ridge gourd, Fertilizer Use Efficiency and Available nutrients

Impact of Greywater Irrigation on Soil Physico-chemical Properties, Nutrients Status and Enzymes Activity under Okra Crop (*Abelmoschus esculentus*)

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A field study was carried out to investigate use of grey water as a source of irrigation in Okra crop and its effects on soil physico-chemical properties and enzyme activities, at farmer's field at Yelavatti, Shivamogga Taluk and district, which comes under University of Agricultural and Horticultural

Sciences, Shivamogga, Karnataka. The experiment was laid out in RCBD with nine treatments and three replications. Four types of water were used for this investigation, such as grey water, treated grey water, structured grey and bore well water as a control. From this investigation it was understood that the soil physico-chemical properties were highly influenced by the use of grey water. A significant change in the soil pH (8.43) and soil EC (0.47), Soil macro nutrient status (N - 325.29 kg ha^{-1}, P - 105.67 kg ha^{-1} and K- 449.53 kg ha^{-1}) as well as micronutrient (Fe - 40.53 mg kg^{-1}, Mn - 21.57 mg kg^{-1}, Zn - 4.26mg kg^{-1}, and Cu - 3.10 mg kg^{-1}) status also changed by the continuous use of the grey water compared to control plots. The enzymes activity recorded in grey water applied conditions were 35.87 µg TPF g^{-1} of soil day^{-1} Dehydrogenase, 325.11 µg NH_4^+ g^{-1} soil hr^{-1} urease and 34.47 PNP g^{-1} soil hr^{-1}. Hence the direct grey water application significantly changed the soil physico- chemical properties, soil nutrient status and soil biological activity. These results shows that the reusing of waste grey water as a irrigation source in the agriculture can improve the nutrient status of the soil upto a great extend and it successively reduce the external use of synthetic fertilizer in the field.

Keywords: grey water, treated grey water, structured grey water and enzymes

Screening of Low Pb and Cd Accumulating Genotype of *Andrographis paniculata* (Burm. F.) Nees

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Heavy metal (HM) pollution in the soil is a major environmental threat to food safety and human health. World widely, approximately 235 million ha of agricultural soils in countries like Japan, China, Bangladesh, India, and Australia are polluted with HMs. Pb and Cd are common heavy metals (HMs) in the environment, and their accumulation in medicinal herbs poses a severe problem due to health risks. The presence of the HMs in herbs used for medicinal purposes is a serious concern for their safe consumption. Generally, these herbs are considered non-toxic and free from any harmful side effects and are used as therapeutics and dietary supplements worldwide. Kalmegh [Andrographis paniculata (Burm. F.) Nees] is one of the important medicinal plants used in preventing and treating respiratory illness and is known for its anti-viral activity. In present study, different genotypes of Andrographis paniculata were examined for their Pb and Cd accumulation and translocation in soil contaminated with Pb and Cd. Results demonstrated that the differential expression of the metal accumulation in genotypes of A. paniculata was majorly associated with ionomics and biomass. Four genotypes of A. paniculata were screened out and were divided in the three categories. The accumulation of Pb and Cd in these genotypes was within the prescribed limits for medicinal herbs. These genotypes demonstrated their potential for commercial production due to higher biomass and mineral content and a lower reduction in biomass and metabolite contents under metal stress. The results of the study

also suggested that genotypes with a higher accumulation of Pb and Cd in the root can be used for phytostabilization of Pb and Cd contaminated land and the above-ground part of the plant can be used for extraction of pure pharmacologically important compounds.

Keywords: Heavy metals, Phytotoxicity, Phyto-excluders, Phyto –stabilizers

Nutrient Concentration in Hydrophytes as Influenced by different Filterbeds in the Vertical Flow Constructed Wetland

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A column study was constructed in the Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, Dharwad during 2017-18 to study the nutrient concentration (NPK and B) in hydrophytes as influenced by different filterbeds in the vertical flow constructed wetland to assess the nutrient removal rate by plant uptake using domestic sewage effluent. The experiment was laid out in CRD in three replications with twenty treatment combinations consisting of five types of filterbeds ('gravel', 'gravel-sand-gravel', 'gavel-sand-brick-gravel', 'gravel-sand-charcoal-gravel' and 'gravel-sand-(charcoal+brick)-gravel' and four hydrophytes (Typha, Paragrass, Canna and Phragmites). The study revealed that both filterbeds and hydrophytes had significant influence on plant nitrogen, phosphorus, potassium and boron concentration. The highest nitrogen concentration in plant was recorded by 'gravel' filterbed and phragmites. The nitrogen content in plant may also be a genetic factor. The highest plant phosphorus concentration was observed in canna. Interestingly, the highest phosphatase activity was also recorded in canna suggesting higher availability of P to canna. Among filterbeds 'gravel-sand-(charcoal+brick)-gravel' favoured higher plant phosphorus concentration in the plant biomass. The higher magnitude of plant potassium was recorded in gravel filterbed which increased the length of the root which contributed for higher potassium uptake. The highest plant potassium concentration was recorded by canna while paragrass registered low plant potassium concentration. Phragmites recorded the highest boron concentration due to its high shoot biomass so, it can be used for effective boron removal from sewage effluent.

Keywords: constructed wetland, filterbeds, hydrophytes and sewage effluent

Estimation of Surface runoff from Pare Pallam Catchment of Karamadai using GIS Techniques

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Land and water are the two essential natural resources vital for the existence of life. So the conservation and management of these resources are very much needed for the effective utilization of the resources. The most crucial step in managing water resources is estimating watershed runoff generated from rainfall, as the runoff and rainfall are critical factors in determining water availability for surface storage and groundwater recharge. So, this study mainly estimates the surface runoff generated from the Pare Pallam sub-catchment of Karamadai, Tamil Nadu, India, using the heavy to extreme daily rainfall events received in the study area within the span of 20 years (2000–2019). The study was performed in the ArcGIS environment using remote sensing data. The SCS CN (Soil Conservation Service-Curve Number) method was used to estimate surface runoff. The land use and land cover changes in the catchment were analyzed each decade and studied for their impact on the runoff depth. The curve number was assigned based on land use and the hydrologic soil group. The weighted curve number was calculated from the area under each land use and then used to calculate storm runoff. The runoff depth in this catchment varies from 9.97 mm to 60.35 mm, where the maximum runoff was observed in 2011. In the Pare Pallam catchment, the average annual rainfall falls under heavy to extreme categories within the span of 20 years was 149.675 mm. The average runoff generated out of the same was 21.4 mm and a volume of 453228.79 m^3.

Keywords: Runoff; SCS Curve Number, GIS, Hydrologic soil group

Impact of Water Shortage on the Economy and the Environment

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Water is a shared resource to everyone. As we know that water is very essential to everyone's health, our communities, our environment, and our economy. As our nation grows, so that the demand for water will continue to rise. The effects of wastage of water are very dire. Many places around the world have no easily access of water to safe potable water. Furthermore, the cost of desalination and making water potable is constantly increasing these days. It is important for everyone that water systems have a safe and clean supply of water, but they also must ensure that there is enough water available to supply to every day. Other uses include agriculture, fish habitat, industry, hydropower, and recreation. All of these uses add up and can put enormous pressure on local water supplies, especially during summer when the demand is highest. Depleting reservoirs and groundwater can

put water supplies, human health, and the environment at serious risk. Lower water levels can contribute to higher concentrations of natural or human pollutants. Using water more efficiently helps maintain supplies at safe levels, protecting human health and the environment. Untreated waste water can affect our ecosystems through oxygen depletion, biodegradation of organic materials, and water-borne pathogens. Every ecosystem relies on water, however big or small. So, if water is polluted with chemicals, toxins, or by products of other human waste, these environments could be put in serious danger. Wasting of water also have a disastrous effect on the ecosystem. If towns or cities use water from aquatic environments, and if these are not replenished, then the local species which live in these environments may die. In places where water is scarce, any wastage limits the water available for the needs of other people. Wasting water may limit its availability to other communities, especially in areas where water shortage is common.

Keywords: Water, Wastage, shortage

Impact of Irrigation Regimes and Nutrient Levels on Yield, Total Water Consumption and Water Saving Percentage of Transplanted Rice (*Oryza sativa* L.)

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Field experiment was conducted at Agricultural College and Research Institute, Killikulam during Early Pishanam 2019 to evaluate suitable irrigation regime and nutrient levels to enhance the growth and physiological characteristics of rice. Experiment was carried out in strip plot design and was replicated thrice. Vertical strips consists of 3 irrigation regimes such as irrigation at 10 cm depletion of field water tube (FWT) from 10 DAT to 10 days prior to harvest (A_1), irrigation at 15 cm depletion of field water tube (FWT) up to maximum tillering stage (30-35 DAT) and thereafter 10 cm depletion of field water tube (FWT) up to 10 days prior to harvest (A_2) and continuous flooding (A_3). The horizontal strip consists of nutrient management practices such as 100% Recommended Dose of Fertilizer (RDF) alone (B_1), 100% RDF along with recommended dose of Green Leaf Manure (GLM) (B_2), 125 % RDF (100% N through inorganic fertilizer + 25% N through GLM) (B_3), 150% RDF (100% N thorough inorganic fertilizer + 50% N through GLM) (B_4) and absolute control (B_5). Glyricidia was taken as GLM and the variety used was ASD 16. Observations such as grain yield, straw yield, total water consumption and water saving percentage were recorded. The results revealed that different irrigation regimes and nutrient levels had significant effect on yield and irrigation parameters. Continuous submergence + Application of 150 % RDF (100 % N through inorganic and 50 % N through GLM) (A_3B_4) recorded maximum grain and straw yield (6758 and 7531kg ha^{-1}). However, it was on par with irrigation at 10 cm depletion of FWT along with application of 150 % RDF (100 % N through inorganic and 50 % N through GLM) (A_1B_4). Water saving percentage was high with irrigation at 15 cm depletion of FWT +

100% RDF along with application of recommended dose of GLM (A_2B_2) which registered 32.9 %. Conversely, total water consumption was high with Continuous submergence with no fertilizer plot (A_3B_5) of about 1609 mm and irrigation at 15 cm depletion of FWT + 100% RDF along with application of recommended dose of GLM (A_2B_2) recorded least water consumption (791 mm) throughout the crop growth period.

Keywords: Rice, Irrigation Regimes, Nutrient Levels, Green leaf manure, Yield, Water saving percentage

Effect of Different Adenine Sulphate, Agar and pH Levels on *In vitro* Multiplication of Gerbera (*Gerbera jamesonii*)

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The experiment was conducted during 2009-10 at Plant Tissue Culture Laboratory of Uttar Pradesh Horticulture Department, Lucknow and Bundelkhand University, Brahmanand Mahavidyalaya, Rath, U.P. to study the in vitro multiplication of gerbera cultivars (Tamara and Panama) for shoot explants using culture medium (MS + BAP 2.0 mg/l + IAA 1.0 mg/l) supplemented with various concentration of the AdS 0.0,12.5,25,50,100 mg/l, among the various concentration of the agar 7,6,3,2,1mg/l and various pH 5.8,6.0,6.5,7.0 was tested. culture medium MS + BAP 2.0 mg/l + IAA 1.0 mg/l with 25 mg/l AdS+ 3 gm/l Agar tested with 6.5 pH gave the maximum culture regeneration, number of multiple shoots and shoot length in gerbera cultivars (Tamara and Panama).

Keywords: Gerbera, in vitro, adenine sulphate, Agar, pH

Phosphorus Adsorption-desorption and its Dynamics under Soybean Grown in Vertisol

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The experiment was conducted to study the various levels of phosphorus on yield, quality and soil nutrient status under soybean grown in Vertisol. The grain (22.20 q ha^{-1}) and straw (28.49 q ha^{-1}) yield of soybean was influenced significantly with the application of 30:90:30 kg N, P_2O_5 and K_2O ha^{-1},

however found at par with 30:75:30 and 30:60:30 kg N, P_2O_5 and K_2O ha^{-1}. The uptake of N (191 kg ha^{-1}), P (21.75 kg ha^{-1}) and K (55.5 kg ha^{-1}) was higher with the application of 30:90:30 kg N, P_2O_5 and K_2O ha^{-1}. The effect of various levels of P on soil chemical properties were non-significant. However, the available P status was increased significantly with the incremental levels of P along with recommended dose of N and K. The various inorganic P fractions (Ca-P, Fe-P, Al-P organic-P) was improved with incremental levels of P showing sequential order of contribution of organic-P (83.9%), Ca-P (9.43%), Fe-P (3.83) and Al-P (2.76%). The uptake response was increased with increasing levels of P, however, the apparent P use efficiency was higher (22.86%) with the application of 30:60:30 kg N, P_2O_5 and K_2O ha^{-1}. The adsorption-desorption study of P indicate that, the fixation potential of soil under study was increased with increasing concentration of equilibrium P solution. The fixation potential of soil was ranged between 82.3 to 87.2% indicating most of the added P to soil get fixed and released. However, the release of the added P was ranged between 45.2 to 47.9%. The nodule number (238), nodule weight (0.324 mg) was increased significantly with the application of 60 kg P_2O_5, while higher dose of P was found beneficial for root length (181.5 cm) and root volume (0.081 cm^3). The application of 30:75:30 (B: C ratio; 2.16) and 30:60:30 (B: C ratio; 2.15) was beneficial for getting higher B:C ratio monetary returns.

Keywords: Soybean, phosphorus, phosphorus use efficiency, P adsorption-Desorption

Comparative Evaluation of Gonandajala and Liquid Organic Manures on Growth and Yield of Rice

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A study was conducted at Organic Farming Research Centre, KeladiShivappaNayaka University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, during kharif seasons of 2021-22, to evaluate the Gonandajala and liquid organic manures on performance of Rice variety HMT. The experiment was conducted in randomized block design comprised of 9 treatments and 3 replications. Among the different treatments evaluated the treatment T7 with application of Gonandajala @ 10 l/ha + Jeevamrutha 100 l/ha recorded maximum plant height (93.6 cm), Grain yield (45.3q/ha) and Straw yield (79.6 q/ha) and it was on par with the treatment Gonandajala @ 10 l/ha + cow urine 100 l/ha (T8) and Gonandajala @ 10 l/ha + vermiwash 100 l/ha (T6), it is observed that available nitrogen, phosphorus potash in soil was maximum in the same treatment, The soil microbial population such as bacteria, fungi, actinomycetes, P solubilizersandnitrogen fixers were estimated at initial 30,60 days of sowing at harvest. The microbial population also maximum in the same treatment. Hence the Combind application gonandajala along with jeevamrutha, cowurine, and vermiwash performed better when compared to individual application gonandajala.

Keywords: Rice, Liquid Organic Manure, Yield

Effect of Set Furrow Method of Cultivation on Soil Moisture, Yield and Economics of Finger Millet + Pigeonpea (8:2) Intercropping System under Rainfed Condition

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The productivity levels of different crops in rainfed areas are meager and there is an urgent thrust on improving the productivity, enhancing the income levels besides, conserving the precious natural resources viz., soil and water. For efficient conservation, land configuration techniques such as set furrow method of cultivation could be an option in improving the productivity of the rainfed farmers by cultivating finger millet +pigeonpea in 8:2 row proportions. To know the effect of set furrow method of cultivation present study was conducted at All India Co-ordinated Research Project for Dryland Agriculture, GKVK, UAS, Bangalore by adopting split plot design with 3 replications. The main plot treatments were M_1: Sowing in centre of the furrow and M_2: Sowing on sides of the furrow and subplot treatments were S_1: Finger millet + pigeonpea (8:2) with conservation furrow, S_2: Set furrow cultivation of finger millet + pigeonpea (8:2), S_3: Set furrow cultivation of finger millet + pigeonpea (8:2) + vermicompost @ 2.5 t ha^{-1}, S_4: Set furrow cultivation of finger millet + pigeonpea (8:2) + gliricidia @ 2.5 t ha^{-1} and S_5: Set furrow cultivation of finger millet + pigeonpea (8:2) + horsegram as in-situ mulching. The results clearly indicated that soil moisture content at 90 DAS (15.44, 19.78, 21.70 and 25.62 % at 0-15, 15-30, 30-45 and 45-60 cm, respectively) and150 DAS (17.22, 18.00, 21.28 and 24.10 % at 0-15, 15-30, 30-45 and 45-60 cm, respectively) of pigeonpea was recorded highest in sowing in centre of the furrow compared to sowing on sides of the furrow and among sub plots, higher soil moisture content was observed in set furrow cultivation of finger millet + pigeonpea (8:2) + vermicompost @ 2.5 t ha^{-1} (17.22, 22.75, 25.10 and 29.53 % at 0-15, 15-30, 30-45 and 45-60 cm, respectively at 90 DAS and 20.11, 20.71, 24.63 and 27.82 % at 0-15, 15-30, 30-45 and 45-60 cm, respectively at 150 DAS) compared to other treatments. Similarly, higher straw/stalk yield of finger millet and pigeonpea up to 4.03 and 8.11 per cent, respectively with gross returns (₹ . 1,02,116 ha^{-1}), net returns (₹ . 51,504 ha^{-1}) and B:C ratio (2.06) were noticed in M_1 as compared to M_2 and among sub plots, in S_3 higher straw/stalk yield up to 27.18 and 37.30 per cent in finger millet and pigeonpea, respectively with gross returns (₹ . 1,06,291 ha^{-1}) were observed. Whereas, higher net returns and B:C ratio was observed in S_5 due to lower cost of cultivation. Finally, it can be concluded that set furrow with vermicompost resulted in higher soil moisture attributed to higher yield of both finger millet and pigeonpea crops.

Keywords: Set furrow cultivation, vermicompost, horsegram, soil moisture content

Effect of Varied Levels of Sugarcane Pressmud and Bio Compost on Soil Microbial Population and Enzymes Activities in Finger Millet

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The effect of sugarcane pressmud and bio compost along with NPK at varied levels on finger millet was studied in a field experiment conducted during kharif 2017 at the research block of M/s Sri Chamundeshwari Sugars Ltd, Bharathi Nagar, Maddur taluk, Mandya District, located in Southern Dry Zone of Karnataka. The experiment was laid out in randomized complete block design with eight treatments replicated thrice. The results showed that application of RDF + pressmud 10 t ha-1 significantly increased soil microbial (fungi, bacteria and actinomyces) population and enzymes activities (urease and dehydrogenase) as compared to control was on par with T_2 (RDF+ Pressmud 10 t ha^{-1}). In conclusion application of sugarcane pressmud or bio compost @ 10 t ha^{-1} along with recommended NPK would be the nutrient recommendation for finger millet in Southern Dry Zone of Karnataka.

Keywords: Pressmud, Biocompost, FYM, fungi, bacteria and actinomyces, urease and dehydrogenase, Nutrients

Evaluation of the Effect of Foliar Nano Nitrogen and Zinc on Chlorophyll (SPAD) and Qualitative Traits of Green Chilli in Comparison with Urea and $ZnSO_4$

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An experiment was carried out at AHRS, Bavikere, UAHS, Shivamogga to study the effect of foliar nano nitrogen and zinc application on the growth, yield and quality of green chilli. There were eight treatments which replicated three times using the RCBD design. Treatment combinations of foliar nano nitrogen and zinc and foliar urea and $ZnSO_4$ with different levels of RDN (75 %, 100 %, 125 %) were tested against control (100 % RDF). Among the treatments, application of RDN (125 %) and foliar

nano N (0.4 %) and Zn (0.4 %) at 30 and 45 DAT registered significantly higher chlorophyll, oleoresin, ascorbic acid and TSS. T_3 reported significantly superior ascorbic acid content and oleoresin content to the tune of 14.94 per cent and 22.10 per cent over control.

Keywords: Green chilli, Nano fertilizers, Chlorophyll, Ascorbic acid, Oleoresin

Evaluating the Effectiveness of Modern Irrigation Systems in Yazd Province, Iran

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Yazd province, in central plateau of Iran, is one of the arid regions of the country with about 110 thousand hectares of irrigated land.The main water consumption in Yazd province is in the agriculture sector, and due to the arid region tolerance requirements, it is necessary to optimize water consumption for the stability of agricultural production. One of the ways to achieve better water consumption efficiency is the development of modern irrigation networks, which can be effective in the sustainability of human societies. Irrigation system development like any other technology has many resistance and difficulties, which is necessary to examine before the consumption of additional resources. In this research, the barriers to the irrigation system development were categorized and examined to know the importance and priority of the factors. The statistical population of the study consisted of adopters farmers of modern irrigation systems in Yazd province. Moreover, the whole study area was struggling with water shortage, salinity, and other problems of an arid environment. The standard questionnaire was used to collect data and drive a descriptive survey. Related IR-NSRC faculty members confirmed the questionnaire content validity. Collected data were analyzed using the IBM SPSS Modeler 16.0 and MS Excel 2010. The results in Yazd province showed that the reduction of production costs and the possibility of expanding the cultivated area are the most important encouraging factor and the main motivation for farmers to use modern irrigation systems. It seems the main demands for better productivity of governmental investment in the development and expansion of modern irrigation systems are to focus on improving the knowledge of farmers and providing simpler accessible funding for them.

Keywords: Drip Irrigation, Development, Irrigation Performance, Water Scarcity

Integrated Nutrient Management on Growth and Yield of Okra [*Abelmoschus esculentus* (L) Monech]

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The present study in okra entitled "Studies on NPK, Vermiwash and vermicompost on growth and yield of okra (Abelmoschus esculentus L)" has been carried out with the objectives to see the effect of different treatments and to find out the optimum nutrient treatment combination for better growth and yield of okra. This experiment was conducted with 13 treatment combinations of NPK, Vermicompost and Foliar spraying of Vermiwash in RBD with three replications. Seeds of Okra hybrid No.10 were sown on plot size of 3.6 m X 3.0 m. The observations were recorded treatment wise by selecting 10 random plants. The growth and yield of the different treatment were worked out. The treatment T_{10} (Vermicompost @ 5t/ha + Vermiwash 5 sprays at 1week interval after 30 DAS) recorded maximum plant height (104.50 cm), nodes per plant (39.70), internodal length (7.83 cm) at 90 DAS. The earliest flowering in 36.51 days and days taken to 50% flowering (42.05) were recorded under treatment T_{10} (Vermicompost @ 5t/ha + Vermiwash 5 sprays at 1week interval after 30 DAS) and late flowering in 39.78 days was recorded with treatment T_{13} (Recommended NPK (N 20 kg + P 50 kg + K 30 kg/ha as basal + another 20 kg of N on 30 DAS as top dressing while earthing up).. Among the fruit characters, fruit length (12.20 cm), fruit width (16.95 mm), number of fruits per plant (21.16), fruit weight (14.13 g), yield per plant (124.58 g) and yield per hectare (161.81 q ha-1) were observed maximum by application of Vermicompost @ 5t/ha + Vermiwash 5 sprays at 1week interval after 30 DAS (T_{10}).

Keywords: Vermicompost, Vermiwash, Okra

Impact of Iron and Zinc Nutrition on Quality and Yield of Linseed (*Linum usitatissimum* L.)

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In rabi 2020–2021, a field experiment was carried out at the College of Agriculture, Vijayapura, to examine the impact of iron and zinc nutrition on quality and yield of linseed given that the iron and zinc concentration of the soil is below the critical limit. The experiment was laid out in RCBD 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 experiment's findings showed that the application of iron and zinc together led to a noticeable increase in growth parameters, Major and micronutrient content in linseed seed over RPP alone. Among the different treatments RPP + 15 kg $FeSO_4$ ha^{-1} + 15 kg $ZnSO_4$ ha^{-1} was resulted maximum plant height (46.5 cm) at flowering and at harvest (49.1 cm), dry matter accumulation (5.08 gram $plant^{-1}$), Major nutrient content like Nitrogen (3.30%), phosphorus (1.22%), Potassium (3.57%) and sulphur (0.56%) and micronutrient content like Iron (83.6 mg kg^{-1}), zinc(35.07 mg kg^{-1}), Manganese (42.0 mg kg^{-1}), Copper(17.0 mg kg^{-1}) 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 growth parameters, Major and micronutrient content in linseed seed in linseed crop. Based on the results of the experiment, it can be said that applying these micronutrients (iron and zinc) in combination with RPP is a better way to provide a balanced nutrition for linseed crops and ensure greater output.

Keywords: Iron, Zinc, Micronutrients, Major Nutrients

Importance of Plant Bioactive Compounds for Human Health

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The agro-ecosystem includes soil, cultivated plants, and other compartments. This system has basic ecological and nutritional functions for human health, including fluxes of nutrients and energy and their interactions among different species, which control global food production. This food production is primarily dependent on crop productivity, and it is primarily controlled by the molecular–physiological functions of plant mineral nutrients and their deficiency. Plant-derived nutrients are crucial for human nutrition and maintenance of human health. These plant nutrients can play a crucial role in sustainably promoting agricultural production. Recently, several studies have reported on plant nutrition and its impact on human health, with topics such as the role of plants in human health with a focus on greening biotechnology. There is increased concern about the concept of medicinal plants for human health and their importance for general well-being. These plant foods represent the main source for most mineral macro- and micronutrients, which are range of bioactive ingredients, which can support preventing many chronic diseases such as Alzheimer's, cataracts, cancer, cardiovascular disease, diabetes, and age-related functional decline. The biofortification process is effective in enriching many crops, mainly staples, with nutrients such as Fe, Cu, Mn, Ca, and Zn in addition to folate and vitamins. The main reason for biofortification is fighting hidden hunger, which results from consumed

foods not having enough nutrients. Therefore, the sound management of plant nutrition can be achieved with these objectives: (1) improving nutrient efficiency, crop productivity, and then farmer income, (2) increasing the recovery of nutrients and their recycling from wastes, (3) improving and sustaining soil health and its quality, (4) enhancing human health with tailored nutritious crops, and (5) minimizing greenhouse gas emissions, nutrient pollution, and biodiversity loss.

Keywords: Biofortification, Crop productivity, Food production, Food system, Human health, Plant nutrients

Nutritional and Dietary Potential of Traditional Food Plants from Kasaragod District, Kerala to Ensure food Security and Human Health

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The Western ghats of Kerala are home to many indigenous, traditional and underutilized food plants that have great nutritional and therapeutic potential. The knowledge of ethnic cuisines and traditional medicine majorly lies among the tribal communities and is handed down to subsequent generations. The present work investigates the nutritional and dietary potential of five selected traditional food plants (TFPs) that are commonly consumed by local communities of Kasaragod district, Kerala through Daily Required Dietary Intake (DRNI) analysis. The TFPs chosen for the study are as follows; *Achyranthes aspera* L., *Amaranthus viridis* L., *Amorphophallus paeoniifolius* Dennst. Nicolson, *Boerhaavia diffusa* L. and *Ipomea batatas* (L.) Lam. cultivar. The aim of this study is to bio-prospect and screen the proximate components, mineral elements, antioxidant components and their antioxidant activity in the selected TFPs. It also discusses the alterations observed in the chemical structure of components after different cooking methods through the Fourier Transform Infrared Spectroscopy-Attenuated Total Reflectance (FTIR-ATR) approach. Results revealed that the highest percentage of moisture (9.32%) and fiber (3.61%) were documented in *A. aspera* whereas *I. batatas* showed high quantities of ash (21.093%) and crude protein (9.47%) and *A. viridis* recorded the maximum percentage of total carbohydrate (79.80%). Macro and microelement quantification were performed by Inductively coupled plasma optical emission spectroscopy (ICP-OES) and showed that *B. diffusa* and *A. viridis* were rich in K (5024.75, 4876.13 mg/100g), Ca (2294.18, 2059.42 mg/100g) and Cu (1.1993, 0.8612 mg/100g). The elevated amounts of Mn (24.2935 mg/100g) were estimated in *A. viridis* which is nearly 20 times higher than the other four TFPs. Besides the screening of nutritional components, the health benefits of the plants were also investigated. In the quantification of antioxidant components, total polyphenols ranged from 29.34 mg/g (*A. viridis*) to 120.36 mg/g (*I. batatas*), total flavonoids ranged from 1.00 mg/g (*A. paeoniifolius*) to 24.60 mg/g (*A. aspera*), vitamin C ranged from 8.583 µM/g (*A. paeoniifolius*) to 64.67 µM/g (*I. batatas*) and carotenoids were recorded from 50.61 µg/g (*I. batatas*) to 715.03 µg/g (*A. aspera*). All the components

varied greatly across the five sample plants. The elevated amounts of chlorophyll a (3907.075 µM/g) and b (2719.303 µM/g) were documented in *A. aspera*. Through diphenyl picryl hydrazyl hydrate (DPPH) radical scavenging assay, it was identified that I. batatas had the least IC_{50} value, indicating their high antioxidant activity. In total, the study discloses the dietary potential of targeted TFPs which is evidenced by DRNI analysis and urges for the inclusion of these underutilized food plants in the mainstream food systems to ensure food and nutritional security.

Keywords: Traditional food plants, nutrition, proximate composition, antioxidant components, antioxidant activity, Daily Required Dietary intake, mineral elements

Effect of Sulphur, Zinc and Boron Nutrition on Shelf Life of Onion (*Allium cepa* L.) in Northern Transitional Zone of Karnataka

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A field experiment was carried out to study the response of onion to different levels of sulphur (30 and 40 kg ha^{-1}), zinc sulphate (15 and 25 kg ha^{-1}) and borax (7.5 and 10 kg ha^{-1}) during rabi 2020-21 and 2021-22 at All India Network Research Project on Onion and Garlic (AINRPOG), Seed Unit, Main Agriculture Research Station, University of Agricultural Sciences, Dharwad. All the treatments except absolute control and RPP received supplemental foliar applications of zinc sulphate (0.5%) and borax (0.25%) at 30, 45 and 60 days after transplanting. The experiment was laidout in randomized complete block design with sixteen treatments each replicated thrice. Results revealed that combined application of sulphur, zinc and boron exerted positive and significant influence on shelf life of onion bulb. Soil application of sulphur @ 40 kg ha^{-1} + zinc sulphate @ 25 kg ha^{-1} + borax @ 10 kg ha^{-1} significantly reduced the physiological loss in weight (10.61%), sprouting (4.10%) and rotting loss (1.90%) after two months of storage period. However, it was on par with the treatment that received sulphur @ 40 kg ha^{-1} + zinc sulphate @ 25 kg ha^{-1} + borax @ 7.5 kg ha^{-1}, sulphur @ 40 kg ha^{-1} + zinc sulphate @ 15 kg ha^{-1} + borax @ 10 kg ha^{-1} and sulphur @ 30 kg ha^{-1} + zinc sulphate @ 25 kg ha^{-1} + borax @ 10 kg ha^{-1}. It is concluded that application of sulphur (40 kg ha^{-1}), zinc sulphate (25 kg ha^{-1}) and borax (10 kg ha^{-1}) foliar application of zinc sulphate (0.5%) and borax (0.25%) at 30, 45 and 60 days after transplanting is found to be the most appropriate combination for improving the shelf life of onion.

Keywords: Onion, Sulphur, Zinc, Boron, Storability

Effect of Various Processing Techniques and Storage on Anti-nutritional and Bioactive Characteristics of Barley

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This study aimed to investigate the influence of various processing techniques on the anti- nutritional bioactive characteristics of barley. Barley grains were subjected to seven different pretreatments viz., soaking, germination (48 h), germination (72 h), cooking, malting, roasting and popping. During the study, the assessment of anti-nutritional and bioactive characteristics of barley depicted that the barley subjected to germination (72 h) recorded minimum phytic acid (1708.13 mg/100g) and tannin content of (45.20 mg TAE/100g) as compared to other treatments. Germination (72 h) also recorded the maximum total phenolic content and antioxidant activity (214.76 mg GAE/100g and 44.74%) significantly. During the storage period of 90 days, the mean anti-nutritional components and bioactive compounds decreased significantly. On the basis of anti- nutritional and bioactive characteristics of barley, treatment T3 (germination 72 h) was found to be the best among all processing methods.

Keywords: Antinutritional, bioactive, cooking, Germination, malting, popping, roasting

Women as Agripreneurs in Dairy farming for Sustainable Livelihood

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The growth and development of dairy in India took place in sequential efforts of the government in both during pre and post-independence period. Dairy farming is expected to have tremendous opportunities for development of farm women. In total it is one of the most important sources of rural transformation. In India, women's involvement in livestock management is a longstanding tradition and dairy farming has been an integral part of homestead farming system. Although much of the work related to livestock farming is carried out by women. Some important components like cleaning of claves, keeping of animals in shed, cleaning of shed, manure collection and dungcake making, regular milking of animals are done mainly by women in an appreciable manner. Selling out lets like animal fodder, dairy product processing industries, Packaging, establishment of bio gas plants and bio waste management units are new opportunities for employment generation as well as achieving rural self-reliance in the country in future and health condition of dairy farmers. Establishment of

new processing units for dairy products; packaging, preservation, cold chain logistics & storage, fodder production farms, supply of feed in the form of concentrates and grain, credit and insurance, distribution and marketing are promising allied opportunities for investment and employment generation in the areas of dairy farming. Therefore the study aims to reveal the training needs of farm women involved in livestock management. The present study was conducted in Shettykottanuru village of Kolar distict of Karnataka with a sample size of sixty respondents. It was observed that farm women are in need of interventional programmes on various aspects of dairy farming and suggested improved dairy farming practices for sustainable livelihood in agriculture through entrepreneurship development. Women entrepreneurs need to be lauded for their increased utilization of modern technology, increased investments, finding a niche in the export market, creating a sizable employment for others and setting the trend for other women entrepreneurs in the organized sector.

Keywords: Dairy farming, Rural transformation, Bio gas plant

Effect of Nutrient Management in Ginger on Soil Fertility Status

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A survey-based study was conducted at College of Agriculture, Shivamogga during 2021-22 to assess the fertility status of soils under ginger cultivation in Shivamogga district**.** The survey was carried out covering three different clusters in Sagara, Shikaripura and Shivamogga rural areas. Twenty ginger growing farmers from each taluk were selected and interviewed to obtain information related to nutrient management practices and ginger yields. The soil samples from a depth of 0-15 cm were collected after ginger harvest. The quantity of organic manures used for ginger ranged from 9.50 to 34.87 t ha^{-1}. The quantity of major nutrients added through inorganic fertilizers ranged from 84.57 to 315.45 kg N ha^{-1}, 58.69 to 342.65 kg P_2O_5 ha^{-1} and 52.12 to 303.09 kg K_2O ha^{-1}. The total nutrient addition among the farmers applying low organic manures and high fertilizers (category 1); low organic manures and very high fertilizers (category 2); high organic manures and moderately high fertilizers (category 3) varied significantly in order of category 2 > category 3 > category 1. The soil pH of ginger grown areas were in acidic to neutral range and all the soils were found to be non-saline. The soil organic-C content was found significantly higher in high organic manure applying ginger farmers (Category 3). The available nitrogen, phosphorus and potassium status varied significantly. Nutrient availability in ginger fields were found strongly correlated with nutrient applications (category 2 > category 3 > category 1). The exchangeable calcium and magnesium content and DTPA-extractable micronutrients were observed in sufficient ranges in all three categories of ginger fields. Ginger yields varied significantly in the order of category 3 > category 2 > category 1. Yield reductions were observed with very high levels of nutrient applications.

Keywords: Ginger, Soil fertility, Nutrient management

Effect of Fertigation on Soil Nutrient status, Nutrients Uptake and Productivity of Ridge gourd (*Luffa acutangula* (L.) Robx.) Under Protected Cultivation

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An investigation was carried out at Main Agricultural and Horticultural Research Station, Iruvakki, KSNUAHS, Shivamogga during Rabi season 2021 to study the effect of fertigation on soil nutrient status, nutrients uptake and productivity of Ridge gourd [*Luffa acutangula* (L.) Robx.] under protected cultivation. The experiment was laid out in Randomized Block Design under polyhouse with seven treatments replicated thrice. The fertigation was given at 10 days interval in 9 splits. The results of the experiment indicated that fertigation with 125 per cent RDF increased growth, yield and soil nutrient status over soil application. Fertigation with 125 per cent RDF (T_7) recorded significantly higher values of vine length (278.30 cm) and number of leaves per vine (88.50), number of fruits per vine (15.20), average fruit weight (392.67 g), fruit length (49.23 cm), fruit girth (18.23 cm), fruit yield per vine (2.79 kg) and fruit yield (25.86 t ha^{-1}) than other treatment studied. Significantly higher nitrogen (72.98 kg ha^{-1}), phosphorus (37.90 kg ha^{-1}) and potassium (78.01 kg ha^{-1}) uptake by Ridge gourd (vine + fruit) was registered in treatment with 125 per cent RDF through fertigation. Similarly, available N (234.60 kg ha^{-1}), available P_2O_5 (37.66 kg ha^{-1}), available K_2O (147.11 kg ha^{-1}) and available S (34.88 mg kg^{-1}) was recorded significantly higher in 125 per cent RDF through fertigation which was statistically on par with 100 per cent RDF through fertigation (T_5). Therefore, fertigation levels significantly influenced growth, yield and soil available nutrients than soil application in Ridge gourd grown under protected cultivation.

Keywords: Ridge gourd, Polyhouse, Fertigation, Yield

Role of Phytochemicals in Obesity Management

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Obesity and overweight are defined as a condition of excessive or abnormal fat accumulation in adipose tissue, to the extent that health may be impaired. Energy imbalance causes excess fat formation, particularly in the abdominal area. Increased intake of energy-dense foods, decreased intake of food

rich in micronutrients and bioactive substances, and decreased physical activities all contribute to this energy imbalance (Greenberg and Martin, 2006). The basic pathogenesis of obesity revolves around up-regulation of appetite or down regulation of calorie utilization (Lee, 2012). This dysregulation leads to the formation of excess of adipocytes, increasing cytokine release and resulting in many vascular complications (hyperlipidaemia, cardiovascular abnormalities and atherosclerosis). Though current medications have been licensed for the treatment of obesity, long-term use may have negative effects. The Food and Drug Administration (FDA) approved modern medications including orlistat, liraglutide, naltrexone and phentermine for obesity control. However, long-term usage is not safe and produces mood enhancement and cardiovascular excitement (Aronne, 2002). As a result of the negative effects of modern pharmaceuticals, herbal treatments have become increasingly popular. Herbal medications are considered as one of the traditional forms of medicine. Herbal treatments often contain a number of phyto-constituents that often work together synergistically. Herbal remedies have proven to be effective in treating both minor and major health issues. They have been widely used worldwide in recent decades due to their cost effectiveness and lack of hazardous side effects when compared to several chemically manufactured medications (Asif, 2012). To stimulate weight loss and prevent diet-induced obesity, a number of natural products and medicinal plants, including crude extracts and identified components from plants, are being employed. Due to their natural richness in phyto-components with various anti-obesity and anti-oxidant actions, which directly affect the body metabolism and fat oxidation, they have been widely employed in the management of obesity (Ekoe et al., 2013). Some phyto-constituents present in herbs, such as inulin, pectin, phenols, flavonoids, saponins, tannins, organic acid, dietary fibres, phytosterols, dietary carotenoids, polyphenols, plant indoles, and others, have potential hypolipidemic properties through various mechanisms, including decreased lipid absorption, decreased energy intake, increased energy expenditure, decreased pre-adipocyte differentiation and proliferation, and decreased lipogenesis and increased lipolysis. The major therapeutic approaches for effective treatment of obesity include lipase and amylase inhibition, regulation of lipid metabolism and inhibition of adipocyte differentiation (Ahmed et al., 2014). Several anti-obesity, hypoglycaemic and hypolipidemic properties have been reported previously through studies in plants like *Garcinia cambogia*, *Emblica officinalis*, *Terminalia chebula*, *Terminalia bellerica*, *Moringa oleifera*, *Piper longum* and *Curcuma longum* etc. Hence, pharmacologically these plants have shown strong rationale in the prevention and management of obesity associated clinical conditions.

Keywords: Obesity, herbal medicine, lipid absorption, phyto-constituents

Impact of Foliar Nutrition on Dry Matter Accumulation of Summer Cowpea

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A field experiment was conducted at Krishi Vigyan Kendra (KVK) farm, Vijayapur, University of Agricultural Sciences (UAS), Dharwad to study the "Impact of foliar nutrition on dry matter accumulation of summer cowpea" during summer season of 2021. Total nine treatment combinations were laid out in RBD (Randomized Block Design) with three replications. Cowpea variety DC-15 was sown at a distance of 45cm x 10cm. Plant population was uniform during the course of investigation. The total dry matter accumulation at 60 days after sowing and at harvest varied significantly. Both during 60 DAS and at harvest significantly higher total dry matter accumulation of 25.32 g plant^{-1} and 34.23 g plant^{-1} respectively, was recorded with foliar application of RPP + 19:19:19 @ 1% + Vermiwash @ 10% at flower initiation and peak flowering stage which was on par with treatments RPP + 19:19:19 @ 1% + Cow urine @ 10% which recorded 23.93 g plant^{-1} at 60 days after sowing and 32.77 g plant^{-1} at harvest. Whereas significantly lowest dry matter accumulation of 17.25 g plant^{-1} at 60 days after sowing and 27.59 g plant^{-1} at harvest was recorded with application of recommended Package of Practice.

Keywords: Dry matter accumulation**,** Foliar nutrition, summer, Vermiwash, 19:19:19

Organic Foliar Application – A Nutritional Boost to Pulses Productivity

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India is the world's top producer and consumer of pulses. The area under pulse crop is increasing continuously but productivity is decreasing over years. Reduced production is caused by a lack of care, an uneven fertilizer application, and the emergence of physiological problems, particularly inefficient assimilate partitioning, poor pod setting, excessive flower abscission and lack of nutrients during the critical stages of the crop growth leads to the nutrient stress. Majority of the pulse crops are short duration and prominently cultivated under rainfed condition, the soil application of nutrients alone cannot fulfill the nutrient requirement of crops when they are lack or unavailable in the soils, foliar fertilization is an economical way of supplementing the required plant nutrients. Foliar

fertilization, also known as foliar feeding, entails the delivery of nutrients, plant hormones, stimulants and other growth promoting substances in liquid form to plants through aerial parts of the plants, such as leaves and stems in order to improve yield and quality, pest resistance, drought tolerance and plant regeneration from transplant shock, hail damage and other weather extremes. Organic systems rely on management of organic matter to enhance the soil fertility and productivity. The liquid organic solutions like beejamrutha, jeevamrutha, bio digester filtrate, vermiwash and panchagavya are prepared from cow dung, cow urine, milk, curd, ghee, legume flour and jaggery which helps in quick buildup of soil fertility through enhanced activity of soil micro flora and fauna. Organic manures are mainly used to stimulate growth by providing proper nutrients at the right dose and proper stage of the crop growth. Liquid concoctions are the source of macro nutrients, essential micro nutrients, many vitamins, essential amino acids, growth promoting factors like indole acetic acid, gibberellic acid and certain beneficial microorganisms. With the use of these organics, there is an opportunity for increasing pulse yield and quality by raising soil fertility and productivity by increased ability of conservation of soil organic carbon and soil moisture. Use of liquid organic manures were environmentally safe and economically feasible.

Keywords: Foliar nutrition, Jeevamrutha, Liquid manures, Organic, Pulses, Vermiwash

Studies on Post harvest Application of different Chemicals on Shelf Life of Sapota cv. kalipatti

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The present investigation entitled "Studies on post harvest application of different chemicals on shelf life of sapota cv. Kalipatti" conducted during 2020–21 at PG laboratory, Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). The sapota fruits are climacteric, they ripen quickly after harvest and become softened due to a rapid increase in the activity of various oxidative enzymes, according to the original article published in the International Journal of Agricultural Science and Study (IJASR). As a result, proper post-harvest management is needed to keep sapota fruits fresh. Various chemicals, such as calcium chloride, potassium permanganate, salicylic acid, and kinetin, have been used to slow down the metabolic activities of the fruit to delay ripening, minimize losses, and preserve colour and consistency (Tsomu and Patel, 2014). These chemicals inhibit the growth and spread of microorganisms by decreasing shrivelling, resulting in improved shelf life and fruit marketability for a longer period of time. Therefore, this investigation was administered to hunt out administered the "Influence of pre-harvest spraying treatments of chemicals and plant growth regulators on chemical parameters post-harvest losses and shelf life of sapota [Manilkara achras (Mill.) Forsberg] fruits cv. Kalipatti". The study material comprised of nine treatments which were $CaCl_2$ 4 % and $CaCl_2$ 2 %, $CaCl_2$ 1 % for 5 minutes, GA3 200 ppm , GA3 150 ppm GA3 100 ppm for 5 minutes and

BA 150 ppm, BA 75 ppm , BA 50 ppm for 5 minutes. Treated and untreated fruits were packed in card board cartoons of 30× 30 ×30 cm size with 6 vents each of 3 cm diameter equally on opposite sides and stored in PG laboratory. The experiment was framed in Completely Randomized Design with nine treatments and a control. The fruits were subjected to various quantitative and qualitative analysis on at 3rd, 6th, 9th and 12th days of storage period. By end of storage period the chemical parameters like TSS (24.80 %) was recorded maximum in fruit when treated with $CaCl_2$ over control. It can be concluded that, $CaCl_2$ 4 % was found best treatment which not only extended the shelf life of sapota fruits but also reduced the post – harvest losses and increased chemical parameters like TSS.

Keywords: Sapota, storage period, shelf life, quantitative and qualitative analysis

Effect of Nutrient Management on Soil Enzyme Activities in Ginger

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Ginger is an important spice crop gown in Shivamogga district. A survey-based study was conducted at College of Agriculture, Shivamogga during 2021-22 to assess the enzyme activities of soils under ginger cultivation in Shivamogga district covering three different locations in Sagara, Shikaripura and Shivamogga. Twenty farmers from each taluk were selected and interviewed on nutrient management practices. The soil samples were collected after ginger harvest. Based on nutrient additions, the farmers were grouped into three categories namely – category 1 (low organic manures and high fertilizers), category 2 (low organic manures and very high fertilizers) and category 3 (high organic manures and moderately high fertilizers). The quantity of organic manures used for ginger ranged from 9.50 to 34.87 t ha^{-1}. The quantity of major nutrients added through inorganic fertilizers ranged from 84.57 to 315.45 kg N ha^{-1}, 58.69 to 342.65 kg P_2O_5 ha^{-1} and 52.12 to 303.09 kg K_2O ha^{-1}. The total nutrient addition among the farmers varied significantly in order of category 2 > category 3 > category 1. Enzyme activities were found higher with higher application of organic manures. Dehydrogenase activity varied significantly in the order of category 3 > category 2 > category 1. Urease and acid phosphatase activities were found in the order of category 3 > category 2 = category 1.

Keywords: Ginger, Nutrient management, Enzyme

Canopy Architecture Management in Young Plants for Higher Productivity in Mango

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Canopy management refers an interpretation of physiology of light penetration inside tree canopy which is a critical component of overall tree productivity. Training and pruning are important components of canopy management which affect the quantity of sunlight intercepted by trees, as tree shape determines the exposure of leaf area to incoming radiation. In topical and sub tropical fruits, particularly mango, there is much necessity for standardizing canopy management technology during initial year of planting for optimised light distribution within canopy for maximizing photosynthesis, flower bud formation, fruit growth and colour development in mango. Therefore, an experiment was laid out in randomized block design with five treatments having four replications during 2015 at ICAR-CISH, Lucknow. Mango cv. Dashehari was tipped off at 70-72 cm during planting at 5 m x 5 m spacing to emerge primary branches. Primary branches were tipped off at 60 cm growth for emergence of secondary branches, which were again tipped off at 60 cm growth for emergence of tertiary branches. Treatments were comprised of P_3S_2 (3 Primary branches and 2 secondary branches), P_4S_2 (4 Primary branches and 2 secondary branches), P_3S_3 (3 Primary branches and 3 secondary branches), P_4S_3 (4 Primary branches and 3 secondary branches) and without canopy management as control. Results exhibited that the T_1 and T_3 had maximum number of 'A' grade fruits (44.42 and 22.53% more than control, respectively) and control had highest number of 'C' grade fruits, whereas fruits of 'B' and 'D' grades were non-significant among the treatments. Fruit yield was significantly increased by 46.14 and 33.89 per cent in T3 and T1 over control, respectively. Same treatments also exhibited higher yield efficiency (39.42 and 13.20% more than control, respectively).

Keywords: Canopy management, Pruning, Yield efficiency

Management of Secondary Nutrients in Acid Soils and its Effect on Growth Parameters of Banana cv. Ney Poovan

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An experiment was conducted in farmer's field at Aldur village, Mudigere taluk, Chikkamagalur district during the year 2021-2022, entitled as "Management of secondary nutrients in acid soils and its effect on growth parameters of banana cv.''Ney Poovan'' in Hill Zone of Karnataka. The experiment was

laid out in Randomized Complete Block Design comprising of eleven treatments, replicated thrice. Secondary nutrients such as calcium and magnesium are deficient in acid soils, which leads to poor growth and quality of fruits. Hence application of secondary nutrients to plants is equally important as NPK application. The treatment consists of agricultural lime, dolomite and gypsum at 250 and 500g either in single or in combinations which supplies calcium, magnesium and sulphur to plants. The growth parameters like pesudostem height (34.80, 155.03 and 267.8 cm), pseudostem girth (12.37, 42.06 and 62.15 cm), total number of leaves (8.0, 12.83 and 18.83), leaf area (0.08, 0.52 and 0.81 m^2) and leaf area index (0.11, 1.26 and 2.62) at 2, 4 months after planting and also at shooting stage was obtained maximum in the treatment consisting RDF + 500 g of agricultural lime, dolomite and gypsum in 1:1:1 (T_9) compared to control (T_1) for all the above parameters. Hence, it can be concluded that treatment (T_9) proved its potentiality in increasing the growth parameters of banana cv. Banana under hill zone of Karnataka.

Keywords: Banana, Secondary nutrients, Growth and Acid soils

Zinc-Fortification of Potato: A Potential Option for Improving Yield and Human Health

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Zinc (Zn) is essential for the normal healthy growth and reproduction of plants, animals and humans, crop yields are decreased and crop products usually have lower quality when the Zn supply for plants is insufficient. Since most of the Indian soils are deficient in Zn, management of Zn nutrient has received greater attention in potato production system to combat wide spread Zn deficiency. Zn-fortification gives significant results in increasing growth, production as well as tuber quality. Potato is one of the best Zn accumulators and responds well to the applied Zn fertilizer. The amount of Zn loaded into potatoes through foliar and soil fertilizer applications can boost Zn concentration in potato tubers by up to 3 to 4 times, which is much more than the majority of regularly produced fruit crops. Zn fertilization has been shown to increase ascorbic acid concentration while decreasing tyrosine and total phenol in potato tubers, improving the quality of the tubers for processing. The specific role of zinc in plant growth as well as in soil health improvement by enhanced use of zinc-fertilizer and finally the implications for re-designing Zn fertilization practices in potato cultivation in terms of dose, time and methods. The most prevalent nutritional issue today, particularly for women, children, and babies, is hidden hunger. Infant mortality and recurrent infections are strongly influenced by Zn deficiency. Importantly, Zn must be consumed every day because it is not significantly stored in the human body. Because of oxidative stress, which is linked to ageing, heart disease, the incidence of mouth, pharynx, and colon cancer, among other serious degenerative diseases, zinc fortification has

an impact on the antioxidant content in potato tubers. These antioxidants act as scavengers of free radicals in our bodies. Therefore, the key objective is to focus on the benefits of using zinc fertilization to improve the agronomic performance of potato crops. Producing potato crops with higher tuber Zn contents can boost dietary Zn intake. Consequently, Zn-fortified potatoes may be a viable solution for reducing the widespread Zn-driven malnutrition in Asian nations.

Keywords: Potato, Zinc-Fortification, Hidden Hunger, Malnutrition and Human Health

Influence of Fish Bone Meal on Yield Attributing Characters and Yield of Tomato

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Tomato requires essential nutrients especially phosphorus, calcium and sulphur for root growth, early flowering, growth and development. Slow release organic substances like FBM, is a cheap source of phosphorus to plants which can be exploited with the mineral fertilizers along with PSF and VAM to increase phosphorus use efficiency, soil health and crop yield. To know the influence of fish bone meal on yield attributing characters and yield of tomato crop, a pot culture experiment was conducted at Department of Soil Science and Agricultural Chemistry, College of Agriculture, KSNUAHS, Shivamogga. Different levels of mineral fertilizer (DAP) with raw and acidulated fish bone meal (RFBM and AFBM) were applied and yield attributing characters and yield were recorded. Soil was slightly acidic in pH, low in nitrogen, high in phosphorus, medium in potassium and sufficient in all other nutrients. Yield attributing characters like fruit diameter, total number of fruits per plant and dry matter yield (6.68 cm, 42.00 and 37.69 g plant^{-1}, respectively) and total yield (5.48 kg plant^{-1}) were recorded highest in treatment applied with 75 per cent recommended phosphorus through DAP mineral fertilizer and 25 per cent through AFBM as compared to control (without application of mineral and organic fertilizer).

Keywords: Fish bone meal, mineral and organic fertilizer, tomato, yield

Influence of Different Levels of Phosphorus and Citric Acid on Growth Parameters of Soybean in an Alfisol

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A pot culture experiment was conducted during Kharif 2021, at College of Agriculture, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga to assess the effect of different levels of phosphorus and citric acid application on productivity of soybean (JS-335) and phosphorus status in an Alfisol. Citric acid (CA), a low molecular weight organic acid exuded by plant roots in very low concentration undergoes rapid microbial dissociation in soil and helps in phosphorus solubilization. Phosphorus (P) is an essential vital nutrient element for soybean growth and development because of its important role in plant structure development and energy transformation. Phosphorus use efficiency (PUE) is very low especially in Alfisols in India due to the presence of higher amount of free aluminium (Al) and iron (Fe) oxides, hydroxides and amorphous aluminosilicate clays. Therefore, this experiment was conducted with an objective to know the effect of external application of CA at four different rates (0, 2.5, 5.0 and 7.5 kg ha^{-1}) along with four different levels of P_2O_5 (0, 40, 60 and 80 kg ha^{-1}) in factorial completely randomised design experimental design with three replication. The results indicated that application of CA @ 7.5 kg ha^{-1} significantly increased plant height i.e., 23.49, 43.26 and 47.47 cm, number of branches i.e., 7.12, 9.17 and 10.79 at 30, 60 days after sowing (DAS) and at harvest of soybean. Similarly significantly higher plant height 27.23, 45.02 and 52.77 cm and number of branches 8.09, 9.26 and 11.25 were recorded with 80 kg P_2O_5 ha^{-1}. Whereas, positive interaction effect was observed in plant height at 60 DAS (47.54 cm) and at harvest (54.40 cm) with application of P at 80 kg ha^{-1} and CA at 7.5 kg ha^{-1} while plant height at 30 DAS and number of branches per plant at different growth stages were found to be non-significant. Significantly higher grain (12.71 g pot^{-1}) and stover yield (15.04 g pot^{-1}) at harvest of soybean were found with the application 80 kg P ha^{-1} + 7.5 kg CA ha^{-1}. This study concluded that CA application at 7.5 kg ha^{-1} with recommended P application (80 kg ha^{-1}) increased plant height and number of branches along with yields of soybean.

Keywords: Phosphorus, Citric acid, Soybean

Effect of Various Pre-treatments/Osmotic Agents and Storage on Quality of Osmo-dried Aonla Slices

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Aonla (*Emblica officinalis*) is also called as the fruit of 21st Century and is popularly known as Amla. Its origin is central to southern India. It is grown in subtropical countries including Indian subcontinent, southern china and South East Asia. India is the largest aonla producing country in the world with area 92000/ ha, annual production of 103900 MT/ha and productivity 10.86 MT/ha (National Horticulture Board, 2018). Aonla fruits are rich in vitamin C (649.92mg/100mg), containing moisture (80.18%), total phenols (24.58 mgGAE/100g), total fiber (2.31%), reducing sugars (8.88%) and total sugars (10.74%), fat (0.1%), mineral matter (0.7%), ash (0.31%), carbohydrates (14.1%), and iron (12 microgram/g) (Mondal et al. 2017). Aonla fruits are available for a brief time from October to January and fresh consumption of the fruit is not possible due to its sour and astringent nature. There are several techniques of dehydration of different fruits and vegetables but osmotic dehydration has gained more attention due to its potential implementation in the food processing industry. It is one of the most widely used preservation technique for the production of safe, stable, nutritious food obtained by placing the solid food, whole or in pieces in sugar or salt aqueous solution of high osmotic pressure.it helps to reduce 30 to 70 per cent of water content of the food and decreases colour changes and increases flavour retention in osmo-dried fruits and vegetables (Lenart and Lewicki 1988).

Keywords: aonla slices, osmo-dried, glycerol, sugar, salt, storage life.

Study on Nutritional and Sensory Quality of Wheat Flour Biscuits Blended with Amla Powder and Soya Flour

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Amla is one of the major fruit having a greater concentration of dietary fiber and Ascorbic acid. Many processes have been developed to convert the Amla fruits into a variety of products having a higher nutritional value and to ensure its availability through all season. The fibrous network around the fruit makes it hard and hence the fruit can be stored without any damage. In the present study, Refined wheat flour and Soya flour to prepare the biscuits with the aim of studying the sensory and nutritional

properties. Biscuits prepared from 100% Refined wheat flour was used as a control (T_1) and Amla powder was prepared and incorporated to prepared biscuits at 5% (T_2), 10% (T_3), and 15% (T_4) respectively. The study shows that the Moisture content, Protein, Ash and Crude Fibre in the sample T_2 (5%) has higher values than in sample T_1 respectively. Among all the samples, biscuits with 80% Wheat flour, 15% Soya flour and 5% (T_2), Amla powder was scored highest during sensory analysis. In sample T_1 the chemical parameters like Fat, protein, Ash, Fiber and Vitamin C content was increased when compared to biscuits prepared using 100% refined wheat flour. Sensory Analysis was carried out using 5- point Hedonic Scale and chemical analysis was done

Keywords: Biscuits. Amla powder, Soya powder, sensory quality, proximate analysis

Study on Nutritional and Sensory Quality of Salt Biscuits Fortified with Flaxseed Powder and Fenugreek Leaves

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Considering the potential of flaxseed and fenugreek leaves as functional ingredient, roasted flaxseed flour and dried fenugreek leaves were incorporated by substituting refined wheat flour at 10%, 20% and 2%, 4% in biscuits formulations. Because flaxseed is rich source omega-3 fatty acid and dietary fiber and fenugreek is known for its mineral content especially iron content so its good remedy for anemic patients. Both flax seed and fenugreek having the anti hypercholesterolemic and hypoglycemic properties.Thickness and length of biscuits increased. Addition of flaxseed powder restricted the spread of biscuits. 20% flaxseed powder, 4% fenugreek leaves incorporated biscuits were found to be well comparable with control in sensory evaluation. Chemical composition showed that moisture, fat, protein, fiber, ash, calcium and iron content increased in flaxseed powder and fenugreek leaves incorporated biscuits than control.

Keywords: salt biscuits, sensory quality, flaxseed powder, fenugreek leaves and Fortification

Effect of NPS Compost and Foliar Application of Humic Acid on Yield and Quality of Safed Musli

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This experiment was conducted during kharif 2019-20 to 2022-23 at Research Farm, Nagarjun Medicinal Plants Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. The site of experiment having history of 10 years safed musli cultivation along with application of various organic sources i.e., FYM, vermicompost, biogass slurry no chemical fertilizers were applied last 10 years only organic site of this experiment. The soil of the experimental site was Vertisol which was moderately alkaline in reaction, low in available nitrogen, medium in available phosphorus and high in available potassium. The experiment was laid out in Randomized Block Design with nine treatments replicated in three replications. The treatments comprised of absolute control, Vermicompost @ 5 t ha^{-1}, NPS compost @ 3 t ha^{-1}, Vermicompost @ 2.5 t ha^{-1} + 2 spray of 0.5 % humic acid, Vermicompost @ 5.0 t ha^{-1} + 2 spray of 0.5 % humic acid, Vermicompost @ 7.5 t ha^{-1} + 2 spray of 0.5 % humic acid, NPS compost @ 1.5 t ha^{-1} + 2 spray of 0.5 % humic acid, NPS compost @ 3.0 t ha^{-1} + 2 spray of 0.5 % humic acid, NPS compost @ 4.5 t ha^{-1} + 2 spray of 0.5 % humic acid. The results indicated that the application of NPS compost @ 4.5 t ha^{-1} + 2 spray of 0.5 % humic acid at 60 and 90 DAP were recorded significantly highest fresh root and dry root yield which was found at par with application NPS compost @ 3.0 t ha^{-1} + 2 spray of 0.5 % humic acid. Also, significant improvement in quality was recorded with application of NPS compost @ 4.5 t ha^{-1} + 2 spray of 0.5 % humic acid which was found at par with application of NPS compost @ 3.0 t ha^{-1} + 2 spray of 0.5 % humic acid. However, the significant improvement in chemical properties of soil were recorded with application of NPS compost @ 4.5 t ha^{-1} + 2 spray of 0.5 % humic acid followed by NPS compost @ 3.0 t ha^{-1} + 2 spray of 0.5 % humic acid

Keywords: Safed musali, NPS compost, Vermicompost

Effect of Nano-N and Nano-Zn Foliar Fertilization on Proximate and Mineral Composition of Finger millet Under Dryland Condition

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During the recent time, small millets are re-evaluated as 'nutri-cereals' because of their nutritional quality. Among various small millets, finger millet (*Eleusine coracana* L. Gaertn) is of prime importance due to its potential in terms of production and productivity. Though finger millet is a less nutrient demanding crop, improved varieties respond well to added nutrients. Nitrogen is the most limiting macro-nutrient and zinc is the micronutrient that determines the crop productivity. Foliar application of urea and zinc is a well-known strategy to abate acute deficiency at any crop growing stage. Recent developments in the field of nano-technology and use of nano-urea and nano-zinc as foliar nutrients in combination with conventional fertilizers enhanced the scope of nitrogen and zinc supplementation with increased efficiency. In this view the present study entitled "Effect of nano-N and nano-Zn foliar fertilization on proximate and mineral composition of finger millet under dryland condition" was carried out at AICRP for Dryland Agriculture, UAS, GKVK, Bengaluru during Kharif 2021 with Finger millet as test crop with 12 treatments replicated thrice. Proximate and mineral composition of the finger millet grain was determined using standard analytical methods. The results revealed that combined foliar application of nano-N and nano-Zn along with 100 per cent RDF recorded higher ash (2.40 %), crude protein (8.88 %), fat (1.46 %) and crude fibre (2.90 %). Whereas, application of 50 per cent RDF (T_2) registered higher carbohydrates content than the rest of the treatments. Similar trend was with mineral composition of finger millet grain recorded higher K (600 mg 100 g^{-1}), Ca (346 mg 100 g^{-1}), Mg (161.34 mg 100 g^{-1}), Fe (3.32 mg 100 g^{-1}), Cu (0.53 mg 100 g^{-1}), Mn (23.56 mg 100 g^{-1}) and Zn (28.41 mg 100 g^{-1}) in T_{12}. Whereas, higher P (267.47 mg 100 g^{-1}) content was recorded with application of 100 per cent RDF + foliar spray of nano-N (T_6). Lower mineral composition was with application of 50 per cent RDF (T_2). In conclusion, the proximate and mineral composition of Finger millet can be increased with reduced application of conventional fertilizers along with foliar spray of nano fertilizers compared to only conventional fertilizers.

Keywords: Nano nitrogen, Nano zinc, Proximate composition, Mineral composition, Finger millet, Conventional fertilizer

Assessment of Critical Limits of Boron in Potato Growing Soils of West Bengal

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Potato is one of the cheapest sources of energy rich natural nutritive foods containing starch, sugar and protein in ample quantities as well as carotene, phenol and ascorbic acid in minute quantities. Potato is an important vegetable crop as well as the most important staple food crop in India after rice and wheat. A green house experiment of potato, in which ten kilograms of soil was placed in polyethylene lined earthen pot, and was conducted on each of the soils of twenty three different locations. The NPK recommended dose was applied at the rate of 200, 150 and 150 kg ha^{-1} in the form of GR grade reagent quality of Urea, Single Super Phosphate and Muriate of Potash to avoid any Boron (B) addition through them. The half N and full quantity P and K were applied as basal dose and rest of N was applied in two equal split doses - one at 20 and another at 35 days after sowing. Treatment combination of B application in the form of Boric Acid ($H_3BO_{3)}$ reagent grade in the pot experiment was: B_0: 0 kg B ha^{-1} ; $B_{1.0}$: 1 kg B ha^{-1} ; $B_{2.0}$: 2kg B ha^{-1} and $B_{4.0}$: 4 kg B ha^{-1} . Critical limit of B in soil for the B nutrition of potato plants was determined following both the graphical and statistical methods of Cate and Nelson (1965 and 1971). The Bray % Yield (BPY) of potato (leaf and tuber) and available B concentration of initial soils (before sowing) of 15 sites were used for estimating critical value of available Zn. The result indicated that in respect of potato cultivation B concentration below 0.48 mg kg^{-1} would show deficiency of B. Below this concentration of B would be considered as deficiency of B concentration in potato shoot which would influence to reduce yield and quality of potato.

Keywords: Critical limit, Bray % Yield (BPY), pot experimen

Seabuckthorn an Underutilized Resource for Food Security and Livelihood Enhancement in Ladakh

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Seabuckthorn (*Hippophae rhamnoides* L.) belongs to the family Elaeagnaceae is an ecologically and economically important thorny shrub wildly grown in Ladakh. It is one of the potential

underutilized plant species having diverse uses ranging from medicinal to cosmetic, has the potential to change the economy of Ladakh. Seabuckthorn berry is one of the most nutritious of all fruit and have immense medicinal properties. Seabuckthorn growing in Ladakh is found to be with a high concentration of vitamins including vitamin C (275 mg/100g), vitamin A (432.4 IU/100g), and high amount of minerals including potassium (647.2 mg/l), calcium (176.6 mg/l) and iron (30.9 mg/l). Some of the health benefits of seabuckthorn berries products include antiinflammation, antimicrobial action, pain relief, the promotion of tissue regeneration, boosting of the immune system, protection against cancer and cardiovascular disease. Seabuckthorn is a power house of antioxidant and is loaded with bioactive compounds , vitamins and minerals that provide balanced nutrients to enhance food security and healthy living. Despite being a dominant inhabitant of Ladakh, it is underutilized and used to a limited extent by the local populace. There is immense potential for sustainable development and livelihood enhancement of rural communities of Ladakh region through cultivation and processing of seabuckthorn. Awareness programs related to nutritional worth and development and demonstration of value-added product resulted in economy generation for local inhabitant and food security. Strengthen the local entrepreneurs and encourage them to develop and market value added products, government policy and incentives for establishing processing unit in rural areas will enhance the livelihood of rural communities.

Keywords: Seabuckthorn, Underutilized, Antioxidant, Food Security, Processing

Standardization and Quantification of Procedure for Preparation of Garcinia Gummigutta Ghee

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Garcinia gummi-gutta is an evergreen, small or medium-sized dioecious with a rounded crown and horizontal or drooping branches. The bark is dark and smooth. Fruit a green, ovoid berry, 5 cm in diameter, yellow or red when ripe, with 6-8 grooves. Seed 6-8, smooth, large, about 5 cm long and 2 cm wide surrounded by a succulent aril. This project examines the information regarding the standardization of procedure, extraction, and quantification of Garcinia gummigutta seed ghee. Seeds of Garcinia gummigutta were separated from the rind manually for an experiment. We studied the three treatments for standardization of procedure of Garcinia gummigutta seed ghee. Compared to all the treatments, the maximum and minimum yield was obtained in the second and third treatment i.e., 25.83% and 8% respectively. Considering all the parameters the combination of low flame intensity with roasting time of 15 minutes and adding 15g of ghee extractor was found as standard method for extraction of ghee from Garcinia gummigutta seeds

Keywords: Seed ghee, Garcinia gummigutta, Ghee yield

Evaluation of Coloured Sorghum Genotypes for Grain Yield, Protein, Iron and Zinc Content

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Sorghum is a widely consumed cereal staple food crop in the sub-tropical and semi-arid regions of Africa and Asia and a second cheapest source of energy and micronutrients (after pearl millet). Micronutrient malnutrition, primarily the result of diets poor in bio-available vitamins and minerals, causes blindness and anemia (even death) in more than half of the world's population, especially among women and children. Considering this, the experiment was carried out at College of Agriculture, Raichur, to evaluate coloured sorghum genotypes for grain yield, protein, Iron (Fe) and zinc (Zn) content. The material consisted of 100-coloured sorghum genotypes along with four checks viz., M 35-1, AKJ 1, Paiyur 2 and GS-23. In this study, the average grain yield per plant (GYPP) recorded was 52.25 g, with a range of 9.58 g to 120 g. The highest and lowest GYPP was observed for the genotypes IS 29032 (120 g) and IS 11180 (9.58 g) respectively. Protein content of genotypes varied from 4 to 20.10 mg/100 mg with a mean of 8.87 mg/100 mg of protein. IS 32072 (Purple) genotype showed high protein content (20.10 mg/100 mg) and IS 28244 (Red) genotype showed the lowest content (4 mg/100 mg) of protein. The Fe content varied from 19.51 to 59.94 mg/kg with a mean of 39.20 mg/kg. The genotype, IS 23865 (Red) showed high Fe (59.54 mg/kg) content and IS 33310 (Red) showed the lowest content of Fe (19.51 mg/kg). The Zn content varied from 8.36 to 51.11 mg/kg with a mean of 28.31 mg/kg of Zn. The genotype, IS 23954 (Red) showed high Zn content (51.11 mg/kg) and lowest Zn content (8.36 mg/kg) showed by IS 33310 (Red). Among the checks, GS-23 recorded high protein (11.68 mg/100 mg), Fe (46.75 mg/kg) and Zn content (38.27 mg/kg) compared to other checks. Among 100 coloured sorghum genotypes, 16 genotypes showed higher protein content and 13 genotypes showed higher Fe and Zn content when compared to check GS-23, so these genotypes can be used for further breeding program for the development of new high yielding and bio-fortified varieties.

Keywords: Coloured sorghum Genotypes, Iron, Zinc, Protein

Development of Beetroot (*Beta vulgaris*) based Value Added Beverage: A Remarkable Step towards Sustainable Food Security and Human Health

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Beetroot (*Beta vulgaris*), is a classic and well-liked vegetable in many countries, including India. It is a particularly nutrient-dense vegetable that ranks 10th among all vegetables in terms of antioxidant capacity and total phenolic compounds. It is also abundant in many important nutrients and active compounds that might improve human health. As a result, eating beetroot can be considered a disease prevention strategy. It is a part of the beet plant's taproot. It has a moderate calorie value and is particularly high in fiber and sugars. It is also a potent dietary source of nutrients and contains a number of bioactive substances, such as betalains and carotenoids. Beetroot use in the creation of products with added value is still a mystery, nevertheless. The goal of the current study was to compare the shelf life of a food product made using beetroot flour over a period of 60 days in two distinct packaging materials: aluminium foil and low-density polyethylene, both of which were made using the dehydration technique. The development of food products including beetroot flour was then carried out, followed by a sensory assessment of such products. The study's findings give beetroot flour an adequate sensory evaluation and proximate value. Beetroot instant Khata Meeta Panna mix (20%), (30%), and (40%) with beetroot flour inclusion were the goods created. The results show that the Beetroot quick Khata Meeta Panna mix, which contains 30% beetroot flour, was approved and conducted to storage testing. Sensory evaluation and moisture content testing showed that the product had excellent keeping qualities. The study is expected to increase the usage of beetroot, a widely cultivated but under-utilized food source, in the form of food products made from its flour blend to give the populace nutrition and health-promoting phytochemicals.

Keywords: Beetroot, instant mix, proximate composition, sensory evaluation and storage study

Effect of Different Levels of Secondary Nutrients on Growth and Yield of Banana

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An experiment was conducted in farmer's field at Aldur village, Mudigere taluk, Chikmagalur district during the year 2021-2022. The experiment was laid out in Randomized Complete Block Design comprising of seven treatments with 3 replications. The treatments consist of 100% recommended dose of fertilizer (RDF) along with 150g, 300g and 450g of advance – enriched OM as basal doseand at 45 days after planting. Among the treatments, T_7 - RDF + 450g Advance – enriched OM at 45 days after planting recorded maximumpseudostem height (264.93 cm), pseudostem girth (63.25 cm), total number of leaves (18.33) and leaf area (0.84 m^2) at shooting stage. Finger length (13.65 cm), finger girth (3.98 cm), finger weight (97.23 g), hand weight (1.44 kg), bunch length (74.50 cm), bunch weight (13.56 kg) and yield per hectare (31.75 t) were also recorded maximum in T_7. The present findings can be commercially used in making banana production more profitable by the different levels of secondary nutrients under hill zone of Karnataka.

Keywords: Banana, Secondary Nutrient, Enriched Organic manure

Zinc Nutrition in Plants: A Significant Way to Meet National Nutritional Security

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Zinc (Zn) is considered as the key element effecting growth, development and life of the living organisms along with playing essential role in physiological activities. In humans, a lack of Zn causes anorexia, loss of appetite, loss of smell and taste, and other symptoms, and it may affect the immune system, causing arteriosclerosis and anemia. In developing countries, deficiencies of micronutrients especially Zn is one of the primary cause of economic loss. Daily intake of zinc for an average human as per recommendations are, an average male need 11 mg of Zn daily while an average female needs 8 mg of Zn (NIH, 2021). About 50% of population in Asia (about 2 billion people) is at the risk of Zn deficiency. To overcome the challenge of Zn deficiency, agronomic biofortification of Zn could be a possible solution. Cereals being the staple food of the country, when biofortification value of the cereals

increases, the nutritional uptake by the humans will increase. Women are more prone to anemia and Zn is most essential nutrient which helps recover from anemic conditions. Biofortification of cereals will help eliminate malnutrition and also makes affordable choices to fulfill nutritional requirements through regular diet. Biofortification through agronomic practices refers to the application of micronutrient containing mineral fertilizer to the plants either through soil application or foliar application, which ultimately increases the nutrient contents in the economical /edible parts of the plants. In India, Zn is now considered as fourth most important yield limiting nutrient of agricultural crops. Zinc deficiency in Indian soils is likely to increase from 42 to 63% by 2025. This situation makes the nutrient requisitely applied externally in order to get maximum benefits. Availability of Zn is affected by various factors like parent material from which the soils are originated, pH, organic matter, soil texture, soil moisture, soil temperature and the interaction of Zn with other nutrients etc. Among the various sources of zinc, $ZnSO_4$ complex as fertilizer may increase the solubility of Zn^{2+} in soils and accounts for the increased availability of zinc when used along with acidifying fertilizers. Nano formulations of Zn are the emerging technique which supplies nutrient to the plants even at very low quantities. Zn shares an antagonistic relationship with the element phosphorous, whose presence in the soil will make the Zn unavailable to the plants, and in such situations switching the mode of application to foliar will protect the plants from Zn deficiency. Ultimately, providing the nutrition through proper and regular diet is the solution to reach national nutritional security which becomes feasible through proper management strategies, biofortification being one among them which is more economical in eliminating malnutrition.

Keywords: Anorexia, Arteriosclerosis, Anemia, Micronutrients, Biofortification, Malnutrition, $ZnSO_4$ (zinc sulphate), Nano formulations, Antagonistic

Water Productivity of different farming systems under *Dalbergia Sissoo*-wheat based Agroforestry Systems

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Water is essential for survival of all living beings including from small tiny organisms to big trees and animals. It is inevitable that the production per unit water consumed, water productivity must be increased to meet the challenge water scarcity. Need to increase water productivity is a growing global concern. The present work was carried out during the crop year 2015-16 at Dusty Acre Research Farm, Department of Forestry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.). The present investigation was aimed to find out the Rabi water productivity under different farming practices viz., agriculture, silviculture, managed and unmanaged agroforestry system. The experiment was taken under 17 year old Dalbergia sissoo which was under 4 pruning regime P_0 (no pruning), P_{25} (25 % pruning), P_{50} (50 % pruning) and P_{75} (75 % pruning). During rabi season Wheat (GW-273 variety) was grown. In main plot 4 farming practices (treatments) viz., agriculture, silviculture, managed and

unmanaged agroforestry system and subplot consists of 3 different levels of fertilizer doses and seed rate viz., F_1 (recommended dose of fertilizer & seed rate), F_2 (25 % more N than recommended fertilizer and seed rate) and F_3 (25 % more seed rate than recommended fertilizer & seed rate) were tested in strip plot design with 5 replications. To compare the water productivity of different farming practices data on girth, height and necessary data were taken. Water includes green water; blue water and total water were taken for computation of water productivity. Study of Rabi season water productivity for different farming practices shows that maximum water productivity was found in silviculture farming practice (743 kg ha^{-1} cm^{-1}) and it was significantly superior over the farming practices. Water productivity of managed agroforestry (226 kg ha^{-1} cm^{-1}) was at par with unmanaged agroforestry (196 kg ha^{-1} cm^{-1}), the water productivity of agriculture (136 kg ha^{-1} cm^{-1}) farming practice was lowest. Effects of fertilizer doses and seed rate on water productivity was found non-significant. Results indicated that silviculture system alone contributes higher water productivity.

Keywords: Green water, Blue water, Water productivity, farming system, pruning and fertilizer.

Pulse Enriched Beetroot Soup Mix: An Innovative Step towards Uplifting the Human Health

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Beetroot are rich in glycine, betaine, saponins, betacyanin, carotenoids, folates, betanins, polyphenols and flavonoids. Beetroot contributes to human health and wellbeing because it has antioxidant property due to the presence of nitrogen pigment betalain. Beetroot is one of the natural foods which boosts the energy as it has one of the highest nitrates and sugar contents. Instant soup is almost ready to eat and take less time to cook. It has an important role for to maintain nutrition of the people by covering a wide range of dried foods. There is a big demand of dry soup mixes in the global market. A balance of nutrients may be obtained by including whole cereals, vegetables, pulses and milk products, etc. Such these diets supply a large proportion of our energy need of carbohydrate, protein, dietary fiber, amino acids and minerals. Also, functional ingredients can be easily incorporated into soup powders to provide health benefits. In view of this development and evaluation of Pulse Enriched Beetroot soup mix was carried out. The physical properties of beetroot include the mass, length, colour, diameter and shape has found that 180 g, 16.25 g, dark red colour, 5.43 cm and round shape respectively. Beetroot powder were prepared by blanching and unblanching. Blanched beetroot powder has scored high in sensory evaluation due to enhanced colour and appearance. Different variation of pulse enriched soup mix was formulated with blanched and unblanched beetroot powder to be at 5 and (10 %) and pulses at (15%) each i.e., whole black gram and whole green gram. Commercially available vegetable noor soup was considered as control. The result showed that (5%) of blanched beetroot powder enriched soup was accepted in all the parameters that includes appearance, colour, texture, taste, overall

acceptability found to be 9.0, 9.5, 8.5, 9.2, 9.5 respectively, compared to all the variations. The moisture, carbohydrates, fiber, fat, protein and potassium of best accepted product was 3.2 g, 8.9 g, 1.5 g, 1.6 g and 30 mg respectively. Shelf life study was carried out to check the keeping quality of pulse enriched beetroot soup mix. The results showed that upto 15 days all the variations of soup mixes showed no increase in moisture content and showed greater sensory scores compared to 30th day. It could be concluded that the results of this study clearly demonstrated the usefulness of supplementing dried vegetarian soup mixture with beetroot powder as a valuable food addition to enhance nutritional characteristics and technological quality of the resultant soup.

Keywords: Beetroot, Blanched, Unblanched, Pulse enriched, Soup mix

Development of Beetroot (*Beta vulgaris*) based Value Added Beverage: A Remarkable Step towards Sustainable Food Security and Human Health

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Beetroot (*Beta vulgaris*), is a classic and well-liked vegetable in many countries, including India. It is a particularly nutrient-dense vegetable that ranks 10th among all vegetables in terms of antioxidant capacity and total phenolic compounds. It is also abundant in many important nutrients and active compounds that might improve human health. As a result, eating beetroot can be considered a disease prevention strategy. It is a part of the beet plant's taproot. It has a moderate calorie value and is particularly high in fiber and sugars. It is also a potent dietary source of nutrients and contains a number of bioactive substances, such as betalains and carotenoids. Beetroot use in the creation of products with added value is still a mystery, nevertheless. The goal of the current study was to compare the shelf life of a food product made using beetroot flour over a period of 60 days in two distinct packaging materials: aluminium foil and low-density polyethylene, both of which were made using the dehydration technique. The development of food products including beetroot flour was then carried out, followed by a sensory assessment of such products. The study's findings give beetroot flour an adequate sensory evaluation and proximate value. Beetroot instant Khata Meeta Panna mix (20%), (30%), and (40%) with beetroot flour inclusion were the goods created. The results show that the Beetroot quick Khata Meeta Panna mix, which contains 30% beetroot flour, was approved and conducted to storage testing. Sensory evaluation and moisture content testing showed that the product had excellent keeping qualities. The study is expected to increase the usage of beetroot, a widely cultivated but under-utilized food source, in the form of food products made from its flour blend to give the populace nutrition and health-promoting phytochemicals.

Keywords: Beetroot, instant mix, proximate composition, sensory evaluation and storage study

Chemical Weed Control Measures on Weed Flora and Yield of Wheat

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Wheat (*Triticum aestivum*) is one of the chief staple crops cultivated all over the country in the world. In India after rice second important food crop is wheat. InIndiayear 2021-22 total production and yield of wheat is 109.59 m tonnes and 3519 kg/ha. Field experiment was conducted at college farm, College of Agriculture, Rewa, JNKVV(M.P.) in Rabi season. The experiment was laid out in arandomized block design with three replications andplot size is about4.5×3.6 m^2. Seven different herbicides were applied one pre-emergence pendimethalin @ 1 kg/haand all other as post- emergence sulfosulfuron @ 0.025 kg/ha, clodinafop-propargyl @ 0.06 kg/ha, sulfosulfuron + metsulfuron methyl @ 0.03 +0.002 kg/ha and clodinafop-propargyl +metsulfuron-methyl @0.06 +0.004 kg/ha at 60 DAS. The average yield loss in wheat due to weeds is about 25-30 %. Chemical herbicides are mainly used for handling these problems. Wheat variety GW-322 was sown as test crop and the herbicides at 60 DAS. The best weed control was achieved by clodinafop-propargyl + metsulfuron-methyl (vesta) as it registered lower weed count and higher weed control efficiency (94.18%). Wheat parameters like plant height (84.18 cm), number of tiller/m^2 (446.7), number of Spikelets/ear (18.90), and number of grain /ear (56.70) were significantly higher investa. Based on performance of clodinafop propargyl + metsulfuron-methyl and sulfosulfuron + metsulfuron-methyl were found efficient in controlling both broad leaf and grassy weeds in wheat.

Keywords: Wheat, Pre and post emergence herbicide, Yield

Evaluation of Coloured Sorghum Genotypes for Grain Yield, Protein, Iron and Zinc Content

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Sorghum is a widely consumed cereal staple food crop in the sub-tropical and semi-arid regions of Africa and Asia and a second cheapest source of energy and micronutrients (after pearl millet). Micronutrient malnutrition, primarily the result of diets poor in bio-available vitamins and minerals, causes blindness and anemia (even death) in more than half of the world's population, especially among women and children. Considering this, the experiment was carried out at College of Agriculture,

Raichur, to evaluate coloured sorghum genotypes for grain yield, protein, Iron (Fe) and zinc (Zn) content. The material consisted of 100-coloured sorghum genotypes along with four checks viz., M 35-1, AKJ 1, Paiyur 2 and GS-23. In this study, the average grain yield per plant (GYPP) recorded was 52.25 g, with a range of 9.58 g to 120 g. The highest and lowest GYPP was observed for the genotypes IS 29032 (120 g) and IS 11180 (9.58 g) respectively. Protein content of genotypes varied from 4 to 20.10 mg/100 mg with a mean of 8.87 mg/100 mg of protein. IS 32072 (Purple) genotype showed high protein content (20.10 mg/100 mg) and IS 28244 (Red) genotype showed the lowest content (4 mg/100 mg) of protein. The Fe content varied from 19.51 to 59.94 mg/kg with a mean of 39.20 mg/kg. The genotype, IS 23865 (Red) showed high Fe (59.54 mg/kg) content and IS 33310 (Red) showed the lowest content of Fe (19.51 mg/kg). The Zn content varied from 8.36 to 51.11 mg/kg with a mean of 28.31 mg/kg of Zn. The genotype, IS 23954 (Red) showed high Zn content (51.11 mg/kg) and lowest Zn content (8.36 mg/kg) showed by IS 33310 (Red). Among the checks, GS-23 recorded high protein (11.68 mg/100 mg), Fe (46.75 mg/kg) and Zn content (38.27 mg/kg) compared to other checks. Among 100 coloured sorghum genotypes, 16 genotypes showed higher protein content and 13 genotypes showed higher Fe and Zn content when compared to check GS-23, so these genotypes can be used for further breeding program for the development of new high yielding and bio-fortified varieties.

Keywords: Coloured sorghum Genotypes, Iron, Zinc, Protein

Standardization of Organic Nutrient Management Practices for Brinjal

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A field experiment was carried out at organic farming research centre, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, during Kharif season of 2020-21 to evaluate suitable organic nutrient management practices in Brinjal crop Lalitha Variety. The experiment was conducted in Randamized Block Design comprising of nine treatments involving different levels of FYM, Vermicompost and combinations of both FYM and Vermicompost**.** Among the different treatments, application of recommended dose of FYM (25 t/ha) along with 100% N equivalent vermicompost (T5) has recorded significantly highest number of fruits per plant (16.22) and fruit yield (1.45 kg/plant) and the treatment was on par to FYM (25 t/ha) along with 100% N equivalent FYM (T1). Both T5 and T1 treatments were significantly superior over other treatments also significant variation was observed among the treatments for available Organic carbon, available nitrogen, phosphorus and potash in soil. Among the availability of secondary nutrients, organic nutrient management practices significantly enhance the availability of sulpur status in the soil.

Keywords: FYM, Vermicompost, Organic nutrient management, Brinjal

Green Nanoparticles Improve Plant Growth and Soil Health

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In past few years, scientist's attention has been drawn more frequently to the synthesis of green nanoparticles (NPs) originating from plants and microorganisms because of their eco-friendliness and ease of manufacturing compared to conventional methods. A variety of plant species and microorganisms, including bacteria, algae, and fungi, are now used for NP synthesis in the development of green nanotechnology. In order to fulfil the rising need for food, intensive farming is being employed. However, this approach eventually creates a dangerous cycle where soil fertility is depleted and agricultural outputs fall. Due to such intense farming techniques, it has been estimated that 40% of the world's agricultural land has been badly degraded, resulting in a significant loss of soil fertility. Green nanoparticles like nano-Silicon or nano-Zinc application improve plant tolerance to extreme climate events by increasing the accumulation of free proline and amino acids, nutrient and water uptake, and antioxidant enzyme activity like superoxide dismutase, catalase, peroxidase, nitrate reductase, and glutathione reductase. Also, the antimicrobial effect of some nanoparticles affects plant-microbe relationships that promote soil fertility and crop growth both. Green synthesized nanoparticles can be an environment friendly approach in the way of promoting sustainable agriculture. However, relatively few studies in this field have been done. Therefore, additional study is urgently required to understand the behaviour of nanoparticles, their fate as a result of changing agricultural inputs, and how they interact with the biomacromolecules found in the living systems and habitats.

Keywords: Green nanoparticles, soil fertility, antimicrobial, antioxidant, nano-Zinc, nano-Silicon, intense farming, sustainable agriculture

Quality parameters of Chia (*Salvia hispanica*. L) as Influenced by different Spacing and Fertilizer Levels in Eastern Dry Zone of Karnataka

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Indian diets reliance primarily on traditional staple food crops for energy. Traditional staple crops, while providing enough calories to prevent hunger, do not provide all of the nutrients required for a healthy diet.Improving people's health necessitates improving their nutrition through better and more nutritious food.As chia is a rich source of omega-3 and 6 fatty acids, dietary fibre, proteins, oil, minerals, vitamins and great source of antioxidants and amino acids particularly lysine, which are essential for normal human growth and development. Also, it appears to be the most important for the prevention of several diseases. Chia is an annual pseudo cereal and oilseed crop belonging to the family of Lamiaceae originated in Mexico and Guatemala. Chia cultivation is gaining popularity around the world due to its health benefits, and it has been designated as a super food crop for its superior nutritional value. In view of this, A field experiment was conducted during Kharif season-2019 at Agricultural Research Station, Chintamani, Karnataka. The experiment comprised of four spacings (45 × 15, 45 × 30, 60 × 15 and 60 × 30 cm) and three fertilizer levels (40:20:20, 60:40:40 and 80:60:60 kg NPK ha^{-1}) to study the effect of spacing and fertilizer levels onyield and quality parameters of chia (Salvia hispanica. L).The experiment was laid out in statistical design of Factorial Randomized lock Design (FRBD), replicated thrice. The results were found that the quality parameters of chia were significantly not influenced by spacing and fertilizer levels. However, the higher amount of calcium (546 mg/100), magnesium (412 mg/100 g), iron (6.1 mg/100 g), zinc (5.2 mg/100 g) recorded with 60 × 30 cm spacing, and among different fertilizer levels, application of 80:60:60 kg NPK ha^{-1} noted calcium (584 mg/100), magnesium (432 mg/100 g), iron (6.3 mg/100 g), zinc (5.6 mg/100 g) compared to other treatments.

Keywords: Spacing, Fertilizer, Nutrients, diet

Plant Nutrition for Human Health: Approaches to Tackle Hidden Hunger

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Is there any link between plant nutrition and human health? The overall response to the question is very favorable, Human beings and the enormous wealth of plants in this green world are intrinsically linked. The agroecosystem includes soil, cultivated plants, and other compartments. This system performs fundamental ecological and nutritional tasks for maintaining human health, such as managing nutrient and energy fluxes and interactions between many species to regulate food production on a global scale. According to the UN-India, India has about 195 million undernourished people, accounting for one-quarter of the world's hunger burden. In addition, over 43% of children in India are chronically malnourished. In terms of the food security index 2022, India ranks 68th out of 113 large countries. At least 25 mineral elements are presumably necessary for human health. Most of these elements are obtained through plant-based diets. Unfortunately, both developed and emerging countries suffer from mineral malnutrition, this is regarded as one of the greatest challenges faced by human beings. The mineral elements that are most frequently deficient in human diets were Fe, Zn, I, Se, Ca, Mg, and Cu. The manipulation of transporters, especially those positioned in the node for the distribution of mineral elements to the grain to increase the grain's bioavailability of critical elements, can be advantageous to both plants and humans. Vitamin and mineral shortages are typically among the major problems with the nutritional status of food crops. In order to address these malnutrition-related problems, some of the strategies include simple plant selection for cultivars with high nutrient density in the seeds, Genetic engineering, conventional breeding approaches, and Biofortification. Among them, Biofortification is one approach that researchers commonly explore to address this issue in a variety of crops, including beans, cowpeas, pearl millet, maize, rice, wheat, cassava, and sweet potatoes. Recently the major strategy for transgenic improvement of plant nutrient levels involves elevating the levels of expression of anabolic biosynthetic genes. Genome sequencing approaches provide novel approaches for the identification of plant biosynthetic genes which are involved in the enrichment of the nutritional content of plants. Furthermore, molecular breeding can enrich the phytonutrient content of several crop plants. By adopting all these approaches, it is possible to raise the nutritional value of plants, which benefits human health.

Keywords: nutrition, human health, food security

Food Quality and Well Being

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Food is a crucial pillar of sustained societal growth and global status. The desire for healthier lives has grown over the past few decades. In today's food economy, food quality is a key concern. The totality of a food item's attributes that a consumer find acceptable, constitutes the food quality. Food quality and health are linked inextricably. The emphasis placed on food quality has a significant impact on health. Typically, two steps are involved in examination of food quality. The first one focuses on the process of purchasing, while the second one deals with what happens when you consume the food. The consumption of good-quality food improves human well-being, including blood pressure, longevity and immunological function. The quality of the food has a favourable impact on customer retention and satisfaction. WHO estimated that about 1 in 10 people worldwide get sick and 420,000 pass away each year as a result of eating tainted food. So, it is essential to address and resolve issues with food quality from a comprehensive, multi-level, and multi-perspective stance. Food quality and safety issues have become incredibly important during the last few years. Ingredients, nutrition information, and additives are the most important indicators of high-quality food, whereas packaging, origin, and method of production are the best indicators of a product's effect on the environment. When assessing the quality of food, consumers most typically consider freshness, taste, and appearance. The idea of food quality is based on a nuanced and multifaceted concept that is impacted by numerous contextual and situational aspects.

Keywords: Food quality, health, multi-perspective, well-being

Evaluation of Growth and Yield Performance of *Allium sativum* L. Varieties Under Agri-horticulture Systems in Mid-hill Situations of Himalaya

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The present experiment was carried out under agri-horticulture systems at Horticulture Research Block, College of Forestry, VCSG Uttarakhand University of Horticulture and Forestry, Uttarakhand,

India; to evaluate the growth and yield performance of garlic (*Allium sativum* L.) varieties under three different fruit crops based agri-horticulture system. The experiment consists of eight treatments comprising two garlic varieties (UUHF G 12-1 and Agrifound Parvati); three fruit trees based agri-horticulture system and a control (conventional agriculture field) were tested in factorial Randomized block design (FRBD) with three replications of each treatment. Growth and yield parameters viz. plant height (86.33 cm), leaf length (42.53 cm), leaf width (1.2 cm), number of leaves per plant (7.91), bulb neck diameter (1.03 cm), bulb diameter (4.09 cm), bulb length (4.46 cm), bulb weight (64.83 g), number of cloves per bulb (8.91), clove weight (6.26 g), clove length (3.40 cm), clove width (2.48 cm) and bulb yield (14.62 t ha^{-1}) were recorded maximum for V_1 (UUHF G 12-1). Among studied farming systems better performance of crop was found under peach based agri-horticulture system followed by apricot and plum based agri-horticulture system, while reduced performance was found under the open farming system.

Keywords: Agroforestry, fruits trees, Prunus, *Allium sativum*, intercropping and crop performance

Utilization of Stingless Bee, *Tetragonula iridipennis* Smith as a Pollinator of Gherkin under Protected Cultivation

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Agricultural practices gradually evolved to raise the production and productivity without expanding the area. One of the technologies to cope up with change in climatic condition is protected cultivation. However, this condition creates a physical barrier, which prevents the access of natural pollinators to flowers. The most promising pollinator seems to be the stingless bees because of vestigial sting. The present investigations was carried out to know the activity of stingless bee, Tetragonula iridipennis Smith in pollination of gherkin crop cultivated under greenhouse located in Devar seed farm, Ranebennur taluk, Haveri district, Karnataka of southern India during two seasons, rabi (2020-2021). At the time of flower initiation, five stingless bee colonies were introduced inside the greenhouse. The mean number of bees started activity from 07:00 AM (0.25 bees/m^2/10 min) and gradually increased with the peak activity of 12.60 bees/m^2/10 min (11:00 AM to 12:00 PM). In the afternoon hours, activity was decreased slowly from 10.05 bees/m^2/10 min (12:00 PM to 1:00 PM) to 0.80 bees/m^2/10 min (05:00 PM to 06:00 PM). The average time spent by the individual bees on female flower (25.43±10.41 sec/flower) was longest compare to male flower (7.71±4.18 sec/flower) during forenoon hours. In the afternoon hours also, the average handling time by stingless bees on female flower (55.99±26.72 sec/flower) was longest compare to male flower (20.88±7.47 sec/flower). In gherkin flower, stigma becomes more receptive during five to six hours after flower opening and the present results of foraging activity of stingless bees coincided with anthesis of gherkin. Looking to the handling time of stingless bees on female flower and male flower, floral handling time was long in case of female flowers which produces

nectar than male flower which produces pollen. Pollen availability was more during late morning hours so, pollen foragers visits more on male flowers spending less time on individual flower indicating stingless bees are very good pollinator. But, in afternoon due to lack of pollen, male flowers increase the nectar production in order to attract bees towards it so, activity of nectar foragers will increase on male flower and they will spend more time on male flower to gather nectar. While collecting nectar stingless bee potentially transfer collected pollen to stigma of the pistillate flower led to fruitful pollination. Thus, the current findings confirms that the stingless bee, *T. iridipennis* Smith are the prominent foragers of gherkin crop under protected cultivation. The utilization of native bee species like stingless bees for improving the crop yield helps in biodiversity conservation.

Keywords: Stingless bee, Gherkin, Pollination, Foraging, Pollen, Activity, Greenhouse

Impact of Biorationals on Soil Arthropod Fauna in Acid Lime Ecosystem

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The soil is an important natural resource that harbours life for various living organisms. In this regards arthropods are not an exception. The soil arthropod fauna play a vital role in decomposition of waste material and maintaining good health of soil. Modern agriculture mainly depends on use of synthetic pesticides for the management of harmful insect pests. Pesticides are found as common contaminants in soil, air, water ecosystems and produce adverse effect on non-target organisms present in various ecosystems. They can harm plants and animals ranging from beneficial soil microorganisms and insects, non-target plants, fish, birds and other wildlife. As soil is the entity which supports for greater activity of micro and macro arthropod fauna, application of broad range synthetic pesticides may adversely affect abundance, richness and diversity of these organisms. In this regard, a field experiment was laid out in randomized block design with eight treatments and three replications at College of Agriculture, Vijayapura to study the impact of biorationals on soil meso and macro arthropod fauna in acid lime ecosystem. The results of the study revealed that selected biorationals viz., bio digester solution (10 %), pongamia leaf extract (5 %), *Prosopis juliflora* leaf extract (5 %), *Beauveria bassiana* (2×10^8 conidia/g), *Bacillus thuringiensis* 8 L and neem based insecticide were found on par with untreated control with respect to activity of soil meso fauna (collembola, diplura, soil mites, staphylinds and maggots) and soil macro fauna (ants, beetles, crickets, cockroach and earwigs). However, the plots treated with synthetic insecticide, thiamethoxam 25 WG were recorded significantly less activity of soil meso and macro arthropod fauna. It is evident from the investigation that biorationals are safer to non-target soil arthropod fauna and can efficiently utilized for management of insect pests in acid lime ecosystem.

Keywords: Biorationals, meso fauna, macro fauna, collembola, soil mites, ants, beetles

Effect of Humic Acid Application on Soil Residual Nutrient Status

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Agriculture is highly dependent on the use of chemical fertilizers, but the excess use of high analysis fertilizers leads to depletion of nutrient status in soil. Imbalanced nutrients application causes micronutrient deficiencies in soil viz., zinc, boron and iron which are limiting the crop productivity. Organic manures contain all the nutrients though in lower concentration and hence maintain optimum soil environment. Organic matter is considered as the "Life of Soil" due to its importance in maintaining soil fertility and its depletion is a major concern to food security in the years to come. Hence, there is a need to improve the soil fertility in a sustainable manner by utilizing locally available organic sources. Since transportation and application of organic manures is a laborious process, use of humic substances extracted from locally available organic wastes in crop production is a better option. A pot culture experiment was conducted to study the effect of humic acid on soil residual nutrient status in groundnut in an Alfisol at Main Agricultural Research Station, Dharwad. The experiment was laid out in Completely Randomized Design (CRD) with thirteen treatments and three replications. Highest available nitrogen (253.33 kg ha^{-1}), phosphorus (44.50 kg ha^{-1}), potassium (285.00 kg ha^{-1}), iron (14.70 mg kg^{-1}), zinc (0.90 mg kg^{-1}), manganese (4.90 mg kg^{-1}) and copper (1.46 mg kg^{-1}) in soil at harvest was recorded in the treatment with the soil application of humic acid from vermicompost @ 20 kg ha^{-1} supplemented with 0.2 per cent foliar spray at 30 DAS and was significantly superior to control and rest of the treatments expect T_7 which received humic acid from vermicompost @ 20 kg ha^{-1} supplemented with 0.1 per cent foliar spray at 30 DAS.

Keywords: Nutrient status, Humic acid, vermicompost, Organic manures

Impact of Land Use Systems on Soil Organic Carbon under Entisols of Punjab in North-western India

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Soil organic carbon concentration is an indicator of soil fertility and quality because it influences the physical, chemical and biological properties of soil. The evaluation of different land use systems for the distribution of soil organic carbon (SOC) is the most critical issue to address in order to maintain sustainable agricultural production. As a result, the current study was carried out to investigate the variation in SOC in various land use systems (agriculture, horticulture and forestry) in the Entisols of Punjab. Soil samples were collected from three land-use systems at various depths (0-20 cm, 20-40 cm, 40-60 cm, 60-80 cm and 80-100 cm) and analyzed in the laboratory. Under different land use systems, the SOC ranges from 0.14-0.99 % OC. According to the results of a study, the forest land use system had the highest SOC, followed by the horticulture land use system. The agriculture land use system had the lowest amount of soil OC in the studied soils at all depths. The maximum SOC concentration was found at the surface soils, regardless of the land use system and it decreases with depth. As a result, the study concluded that land use systems play an important role in controlling OC levels in the soil for sustainable production. The outcome of the results is helpful for better land use management practices under different land use systems in North-western India.

Keywords: Soil organic carbon (SOC), land use systems, agriculture, horticulture and forestry

Effect of Biochar Application on Yield, Quality and Uptake of Nutrients by Maize Grown in Vertisol

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The field experiment was conducted during *kharif*, 2020-21 on the Research Farm, Department of Agronomy, Dr. PDKV, Akola. The experiment was laid out in Randomized Block Design (RBD) with eight treatments and three replications. The treatments comprised of control, various levels of nitrogen and their combinations with 2.5 and 5.0 t ha^{-1} biochar. The results reported that the significantly highest grain (45.33 q ha^{-1}) and straw yield (74.57 q ha^{-1}) of maize were recorded with the application of 125 %

RDN+ Biochar 5.0 t ha^{-1}. The significantly highest content and total uptakes of N (160.72 kg ha^{-1}), P (27.02 kg ha^{-1}) and K (132.44 kg ha^{-1}) by maize were recorded with the application of 125 % RDN + biochar 5 t ha^{-1}, over other treatments but at par with application of 100 % RDN + biochar 5t ha^{-1}. The quality parameters i.e. test weight (27.43 g), protein content (12.19 %), total carbohydrate and crude fiber content in maize grain were recorded significantly higher with the application of 125 % RDN + biochar 5 t ha^{-1}. Higher the dose of biochar applied were recorded maximum nutrient use efficiency.

Keywords: Biochar, Yield of maize, Quality, Uptake of nutrients, Nitrogen.

Influence of Compost Coated and Blended Phosphatic Fertilizers on Phosphorus Dynamics and Nutrient Status of Maize (*Zea mays* L.) in Alfisols

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A field experiment was conducted at College of Agriculture, V.C. Farm, M andya during kharif 2020 to study the effect of compost coated and blended phosphatic fertilizers on phosphorus dynamics and post-harvest nutrient status in Alfisols. The experiment site was red s andy loam with neutral pH (7.15), low electrical conductivity (0.12 dS m^{-1}), medium organic carbon (5.20 g kg^{-1}), medium available nitrogen (280.83 kg ha^{-1}), phosphorus (28.63 kg ha^{-1}) and potassium (276.72 kg ha^{-1}), respectively. The investigation was carried out in Randomized Complete Block Design with eight treatments that include 100, 75 and 50 per cent of compost coated DAP (T_3, T_4 and T_5, respectively) and compost blended rock phosphate (T_6, T_7 and T_8, respectively) along with recommended dose of nitrogen and potassium, keeping 100 % RDF (using uncoated DAP) as check and are replicated three times using maize hybrid MAH-14-5. The results revealed that application of 75 per cent RDP through compost coated DAP with recommended dose of N and K (T_4) recorded higher phosphorus fractions viz., saloid-P (19.98 mg kg^{-1}), Occluded-P (17.83 mg kg^{-1}), organic bound P (144.12 mg kg^{-1}), water soluble P (80.53 mg kg^{-1}) and available P (63.28 mg kg^{-1}) at harvest, respectively. Whereas, higher Al-P (17.85 mg kg^{-1}), Fe-P (21.43 mg kg^{-1}), reductant soluble-P (55.46 mg kg^{-1}) and Ca-P (33.87 mg kg^{-1}) content in soil at harvest was recorded with application of 100 % recommended dose of fertilizers using uncoated DAP (T_2) when compared with rest of the treatments. Moreover, saloid, occluded, organic and total P content in soil increased on the other h and Al-P, Fe-P, reductant soluble-P, Ca-P and water soluble-P in soil decreased with crop growth period in the treatments receiving coated DAP and blended RP. Available nitrogen and sulphur content were recorded higher in treatment receiving 50 % RDP through compost blended RP (293.84 kg ha^{-1} and 11.88 mg kg^{-1}, respectively). Available P status was recorded highest in T_4 (63.28 kg ha^{-1}). Significantly higher content of available K was recorded in treatment T_3 (244.30 kg ha^{-1}) when compared with treatment T_1 and T_8. Available calcium and magnesium content were recorded

higher in T_6 (5.50 and 2.44 cmol (p+) kg^{-1}, respectively). Whereas, higher available S content was recorded in T_8, respectively. Application of recommended dose of fertilizers resulted in higher DTPA-Fe status (T_2- 10.60 mg kg^{-1}). DTPA-Mn and DTPA-Zn status was found to be higher in T_6 (7.78 and 0.67 mg kg^{-1}, respectively) when compared with rest of the treatments.

Keywords: Phosphorus fractions, coated and blended fertilizers, soil nutrient status, Alfisols

Achieving Sustainable Development Goals through the Traditional Agroforestry Systems in Garhwal Himalayan Region

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Traditional agroforestry systems (TAFS) described as a set of age-old agroforestry systems which are generally devoid of organized intentional intensified cultivation of agriculture crops with woody perennial trees or shrubs. Agroforestry systems which are practiced traditionally provide various direct and indirect services. These systems serve as platform for balancing agriculture and forestry in their interactions with landscapes and rural livelihoods in Garhwal Himalayan region and also offer opportunities to meet out various sustainable development goals (SDGs). Various studies suggest that traditional agroforestry systems meet out at least nine out of the 17 SDGs through sustainable food production, ecosystem services and economic benefits. These goals include; No Poverty, Zero hunger, Good health and well-being, Gender equality, Clean Water and Sanitation, Affordable and Clean Energy, Responsible consumption and production, Climate action and Life on l and. Traditional agroforestry system provides multifarious output and reduces poverty and hunger; through providing economic support and edible returns during the lean period of the year and serves as boon system for poor people. Different traditional agroforestry systems provide healthy ecosystem services and agroforestry trees (such as Neem) also possess medicinal properties and contribute to supply of medicine from medicinal agroforestry system. Other systems (like Grewia, Celtis and Ficus based) provides various daily use produces (fuel, fodder, fruits) and helps rural women to become self reliant by selling various outputs from agroforestry and meet out gender equality goals. Trees under traditional agroforestry (like White oak, Khadik) system helps in hydrological regulation and recharge of ground water, also enhanced soil infiltration and filter sediment flow. Agroforestry play a vital role in climate change adaptation and mitigation. Traditional agroforestry sequesters significant amount of atmospheric carbon. Biodiversity in terms of flora and fauna is also higher in traditional agroforestry systems as compared to the sole cropping systems. Traditional agroforestry systems in Garhwal Himalayan region improve farmer's livelihood and are also meeting out the SDGs from a long time.

Keywords: Agrobiodiversity, Carbon sequestration, Ecosystem services, Food production, Livelihood

Biodiversity Conservation and Soil Health

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Agro ecosystems are highly manipulated production systems which, in conventional management models, are dependent upon mechanical tillage in conjunction with inputs of fertilizer and pesticides to consistently sustain their rates of output. The continued growth of human populations and of per capita consumption have resulted in unsustainable exploitation of Earth's biological diversity, exacerbated by climate change, soil erosion, ocean acidification and other anthropogenic environmental impacts. Effective conservation of biodiversity is essential for human survival and the maintenance of ecosystem processes. Biodiversity also secures long-term flows of benefits from nature by providing resilience to disturbance and environmental change. Preserving the quantity and quality of soils is one of the main objectives of current efforts to make agriculture more "sustainable". Soil represents a complex ecosystem with a wide variety of organisms and communities. Soil microorganisms are the largest group of soil organisms, very heterogeneous and making soil a complex and dynamic system. The number, activity and diversity of microorganisms is considered a significant indicator of potential and effective fertility of the soil. Therefore, the application of microbial inoculants either as biofertilizers, stimulants or phytopathogen biological control agents in food production meets the concept of sustainable agriculture: yield stability and quality and preserving the ecological balance, which has great influence on both, the food safety and the economic outcome. Introducing nitrogen-fixators to the soil stimulates growth of useful microbial population whose metabolites participate in the processes of creating and maintaining organic matter in soil as well as in soil phytopathogens control. Biofertilizers play a vital role in maintaining long term soil fertility and sustainability by fixing atmospheric nitrogen, mobilizing fixed macro and micro nutrients and convert insoluble phosphate in the soil into forms available to plants there by increase their efficiency and availability. Biological nitrogen fixation involves the application of effective microorganisms (which fix atmospheric nitrogen, such as Rhizobium/ Bradyrhizobium, Azotobacter, Azospirillum, bacteria from Bacillus, Pseudomonas, Nostoc, Anabaena and mycorrhizal fungi) as inoculates that increase soil biological activity and quality of crops and vegetables. Mixture of effective micro-organisms contain only those normally live in the soil and form an integral part of the soil. Their use can reduce the amount of mineral fertilizers; can affect the microbial processes that may indirectly express favorable effects on the biogenicity of soil and economic outcomes. Also, using biofertilizers can increase the amount of organic matter in soil. Application of biofertilizers is the only option to improve the soil organic carbon for sustenance of soil quality and future agriculture productivity.

Keywords: Biofertilizers, Soil fertility, Sustainability, Phytopathogens

Vermiwash: Effects and its Significance

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In light of the fact that industrialization and urbanization are speeding up and as a result, both urban and rural regions across the nation are seeing a significant increase in solid waste output, it is essential to manage this trash if we want to maintain a healthy, safe environment. The use of organic fertilizers can reduce the negative effects of chemical fertilizers. Vermiwash can be used in this manner to increase crop output. Vermiwash safeguards the ecosystem from different chemical fertilizers. Vermiwash is a liquid fertilizer with a brown color that is collected after the water goes past a worm culture column. The worm leachate serves as a repository for nutrients and microbes. The abundance of enzymes, plant growth hormones, vitamins and micro- and macronutrients in vermiwash boosts crops' ability to resist multiple illnesses as well as their development and yield. Because vermiwash and vermicompost are made from organic manure, the crops they are used to cultivate probably wouldn't harm consumers of other crops. Vermiwash has been shown to be an efficient fertilizer that helps plants grow and produce more either applied directly or in a certain proportion with other fertilizers or manures. With regard to its origin, cost-effectiveness, ease of availability, time savings, repeatability, dependability and eco-friendliness, vermiwash has the potential to be used in agrobiotechnology for sustainable development. It may be used as a powerful biofertilizer to increase the germination and seedling survival rates in agricultural plants growing on soils that are low in nutrients, opening the door for sustainable agriculture employing organic farming techniques.

Keywords: Vermiwash, Organic Fertilizer, Nutrients

Ethnobotany of Macro Deccan Region for Human Health: A Case Study

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Indigenous practices and their role in health benefits are rarely/ not considered in public discourses on food security and human health. The reason for ignorance is not just that ''traditional foods are traditional in origin'' but also the inability of current debates to recognize the significance of aboriginal systems in medical compensation. The usage of plants for various purposes by local communities comprises traditional ethnobotanical knowledge, which is not well documented by indigenous people,

but has been orally and vertically transmitted from generation to generation. Considerable ethnobotanical studies have been carried out in the Deccan Plateau region. However, the accountability of biogeography related local practices in health aspects was never discussed. This study addressed the maximum number of ethnobotanical facets in the Macro Southern Deccan region-Koppal and Bellary district. The study locality is situated in topographically variegated Deccan plateau consisting of varied vegetation, ranging from dry l ands in North-West Koppal to tropical deciduous forests in the South-East Ballari. Centrally located rocky mountains in Vijayanagar have substantial paleobotanical evidence revealing the historical plant use patterns. The current ethnobotanical research was conducted from March 2021 to April 2022 using participant observation, semi-structured interviews, open-ended questionnaires and free listing methods, abiding by the principles of the International Society for Ethnobiology. This research entails participating in day-to-day activities, such as household chores, gathering and preparing food with community members, engaging in plant based goods making and closely observing the ethnobotanical aspects of festivals and rituals. The current study made a qualitative and quantitative effort to bring various ethnobotanical aspects and their significance content into the light. It also scientifically interprets the correlation between the geographical location, climatic conditions and ethnobotanical practices and human health. The results indicate that most ethnobotanical food habits and festivals accustomed to Macro Deccan traditions have a great positive impact on health. It was identified that the potential threats to cultural ethnobotany are misinterpretations and false teachings of Traditional Ethnobotany Knowledge (TEK) through the generations. As a result, TEK turned out to be a bane, instead of a great boon to a healthy lifestyle in certain places. This research discovered the unconsidered typical strategy of rural traditional Indian cultural aspects for physical, physiological and mental wellbeing.The documentation helps prevent loss of grass-roots knowledge associated with biodiversity, secure recognition for such knowledge and add value to it.

Keywords: Ethnobotany, Deccan region, food security, human health

Evaluation of Soil Fertility Index of KVK and RARS Belatal, Mahoba District of Bundelkh and Region

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The experiment was conducted at Agricultural Farm of Krishi Vigyan Kendra (KVK) and Regional Agricultural Research Station (RARS) Belatal Mahoba to evaluate the spatial variability of soil parameters. The total 270 geospatial soil samples were collected from three depth i.e. 0-15 cm, 15-30 cm, 30-45 cm. Study showed that the available N, P, K, S, Mn, Cu, Zn, Fe and B were mean value of 231 kg ha^{-1}, 19 kg ha^{-1}, 229 kg ha^{-1}, 15 mg kg^{-1}, 15 mg kg^{-1}, 0.59 mg kg^{-1}, 0.45 mg kg^{-1}, 17 mg kg^{-1} and 0.59 mg kg^{-1}, respectively. Out of total 270 samples about 59 % samples were neutral and 41 % slightly alkaline in nature. All the samples fall under non saline in nature. In aspect to organic carbon and available

nitrogen, majority of the samples were low in category while available phosphorous, exchangeable potassium and exchangeable sulphur lies under medium in category. Soil pH exhibited significant and positive correlation with EC (r= 0.322*), available nitrogen (r= 0.232*), copper (r= 0.345**) and zinc (r= 0.224*) and negative correlated with available sulphur (r= -0.361**). Organic carbon exhibited significant and positive correlation with available nitrogen (r= 0.670**), phosphorous (r= 0.356**), potassium (r= 0.487**) and zinc (r= 0.211*). The Nutrient index value (NIV) for organic carbon (1.23), available nitrogen (1.23) and zinc (1) was found in low, for available phosphorus (2.06), potassium (2.19), sulphur (2.01), copper (2), boron (1.7) were found in the medium category whereas available manganese (3), iron (3) were found in the high category.

Keywords: Soil fertility, Organic matter, Nutrient Index, Soil properties, Soil testing

Parental Investment Performed by Oriental Darter (*Anhinga Melanogaster*) at Keoladeo National Park, Bharatpur, Rajasthan, India

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Oriental Darter is a residential species at Keoladeo National Park (KNP), Bharatpur, Rajasthan. In India it is a Near Threatened species according to IUCN's red data list. They are sleek water bird brown-black in adult stage. Having longitudinal silvery-grey streaks on their wings which differentiate them from other members of their family especially cormorants. Young ones have white down. They are mainly piscivorous bird, require mainly clear, deep, unpolluted freshwater body. In the current paper parental investment of darters at KNP have been studied for the period of one breeding season only. In KNP breeding period of darters ranges from July to October. We have observed parental investment by darters since nest building to fledging success for the period of one breeding season only in 2021. Kinds of activities performed by male and female darters on nest have been recorded. We used focal animal sampling technique to record different kinds of activities performed by male and female darters. We used t-test to see whether any difference in the percentage of time spent on different activities by different pairs of dartetrs. The analysis part of this paper is under process.

Keywords: National Park, Oriental Darter, Threatened species

An Advance Techniques for Weed Classification Using Deep Learning Techniques

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Weeds are one of the important variables that can reduce agricultural productivity by encroaching on pastures, smothering crops and drastically lowering the quality of the harvested crops. Herbicides are frequently used in agriculture to control weeds, but overuse of these chemicals can also reduce crop yields and pollute the environment. Precision agriculture site-specific weed management is growing in popularity among academics and farmers. Machine learning and Deep learning techniques have been used effectively for data processing and mapping tasks across a variety of industries. Here, we studied to classify publically available benchmark weed images using RGB image texture for feature extraction. The hybrid of CNN+LSTM model shows promising results when compared to CNN and LSTM where the accuracy of these are 97.23 % for the hybrid of CNN+LSTM, 96.22 % for CNN and 91.10 % for LSTM model.

Keywords: Classification, Deep learning, Machine learning and Weeds, Precision agriculture

Estimation of Forest Fragmentation in Urban Forest: A Case Study of Asola and Bhatti Wildlife Sanctuary in Delhi, India

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Delhi is a metropolitan city of India with 31.2 million population. To aid increasing population in the city, urbanization is rapidly taking place. The study area, Asola and Bhatti wildlife sanctuary urban forest is integral part of the city as provide various ecosystem services. It became primary concern to give ecological attention to ensure sustainability. Uncontrolled human interferences created degradation of forest area lead to changes land use pattern, biodiversity loss, encroachment of forest land fragmentation in the forest area. To understand forest fragmentation in the study area, study conducts forest fragmentation analysis for the year 1990 to 2020 using Landscape Fragmentation Tool (LFT). LFT divided the area into two classes: forest class and non- forest class which includes settlements, barren land, water body, scrub land, agriculture land respectively. Result shows forest is fragmented

and isolated but due to management practices initiated by forest department lead to increase in vegetation cover from past three decades. And LFT analysis of three decades shows the status of forest fragmentation in the sanctuary. This study would help to understand and plan strategies for proper maintenance and conservation of the forest.

Keywords: Landscape Fragmentation Tool, Forest fragmentation, Vegetation, Urban forest

Causes of Soil Degradation and its Impact on Food Production

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Soil degradation is a widespread problem in world resulting in decreased agricultural productivity while demand for food continues to be increasing. Human population has increased from 6.1 billion in the year 2000 and is projected to reach 9.8 billion by the year 2050. Accordingly, in order to achieve global food security, food production must increase by 70 per cent between 2005 and 2050. After 50 years of green revolution, the country is also facing the second-generation challenges like decline in the factor productivity, water pollution and soil degradation. The problem of soil degradation has been ever since cultivation of soils started and losing 30 soccer fields of soil for every minute, due to intensive farming and 90 per cent of the earth's precious topsoil is likely to be at risk by 2050. The major causes of soil degradation includes deforestation, overgrazing, waterlogging, removal of natural vegetation, converting forests to farms and degrading marginal l ands, indiscriminate and excessive use of fertilizers, insecticides and pesticides over the years also pose major threats to agriculture and over exploitation of the vegetation for domestic purpose etc. Major threats to the conservation of soil resources are soil erosion both by water and air, salinization/alkalinity, acidity, organic carbon losses, nutrient imbalance, pollution/contamination by toxic substances, soil compaction and crusting. There is an urgent measures are required to arrest the degradation process and to restore productivity of degraded soils so that more food could be produced to provide livelihood and environmental security.

Keywords: Degradation, Food and Agriculture, Global food security

Agro – Pastoralism in Ladakh: Current Trends and Challenges

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Agro – pastoral production system in Ladakh is mainstay of its economy and livelihood. However, due improved economic condition and infrastructure development such as roads, tourism and education it is undergoing changes. This study sought to understand current trend and challenges in sustaining agro – pastoralism in Kargil district. We used semi structured open – ended questionnaires per household to understand agriculture and livestock production system. Twenty village in five valleys comprising 519 households were covered. Overall, ten crops are cultivated in the region. Barley, alfalfa, wheat and peas are cultivated in all villages whereas oats is a new addition. Buckwheat, lentil, foxtail/proso millets and mustard cultivation is abandoned by most households in all the valleys. Likewise, five livestock types; sheep, goats, cow, yak, horse and donkey are reared. Overall livestock population is 5140 heads though it has decreased by 53 % (n=11054) in the aftermath of Kargil war in year 1999. In Chiktan Valley it has decreased by (71 %; n=3216). In Drass and Suru Valley, it has decreased by 70 %; 2959 and 32 %; 4879 respectively. Sheep and goats (shoats) from bulk of livestock population (n= 3766) whereas mule rearing is ab andoned. Herd size of shoats per households has also decreased. Maximum decrease in herd size was observed in Chiktan Valley i.e., from 31.70 to 8.97 heads per households and least in Suru Valley i.e., from 14.88 to 10.23 heads. Similar declining trend is also observed for other livestock types. Overall lack of human resources due to off – farm income opportunities (53 %) is a major challenge in sustaining agro – pastoral production systems, followed by fodder shortages (17 %), climate (10 %) and land division (8 %). In order to sustain agro pastoral production system, it necessary to impart training in value addition of farm products in addition to opening market avenues for crops, handicraft and handloom products.

Keywords: Agro – pastoralism, human resources, Kargil, Livestock, Suru Valley

Ecological Engineering: A Modern Rice Insect Pests Management Method for Global Food Security

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Rice is the most important staple food worldwide. Insects have long been perceived to be constraints to rice production citing annual losses of between 11 to 14 %. Farmers continue to believe that using insecticides is more efficient, but this practice has consequences for human health, fisheries, wildlife and other ecosystem services. "Ecological engineering of rice is a habitat management through cultural and non-pesticidal methods along with floral diversity to increase natural biological control and augment natural enemies for managing rice pests by enhancing natural enemy fitness. Habitat manipulation was based on increasing vegetative diversity would promote pest suppression. The experiment was conducted at ARS Gangavathi during Kharif - 2018 and 2019. Two interventions viz., alleyways and floral diversity through growing cowpea and marigold on the bunds were undertaken in the ecological engineering (EE) plot. The data was pooled, the mean hopper numbers over the crop period were significantly higher in EE plots (68.65/hill) in comparison to farmers' practices (FP) with chemical interventions (22.98/hill). But, the population of green mirids, spiders and coccinellids were significantly higher in EE plots indicating a positive trend for these practices in conservation of natural enemies. The green mirid number in the ecological engineering plots (60.75/10 hills) was 5 times higher than that of the farmers practice (15.40/10hills). Similarly the coccinellid population in EE treatment was three times higher (14.2/10 hills) as compared to the population in FP treatment (4.30/ 10hills). The results also indicated that floral diversity along the bunds and alley ways an along with ecological engineering can significantly reduce insect pests population. Ecological engineering is a long-term strategy for exploiting the rice ecosystem's abundant natural enemy diversity for environmentally friendly and economically profitable rice cultivation. Additionally, it aims to create a sustainable agro-ecosystem and reduce reliance on pesticides.

Keywords: Ecological engineering, insect pest, ecosystem and sustainable

Oceanic Pollution and Its Impacts on Aquatic Organisms

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Different contaminants produced by human activity have a significant negative impact on marine habitats. Pollutants enter the maritime environment primarily through the atmosphere, water, ships, as well as other human activities. The contaminants have a significant impact on the maritime flora and wildlife as well as disrupt food supply chains. The marine sediments, flora and fauna include a variety of synthetic chemical wastes, such as carbon tetrachloride, polychlorinated biphenyls, trichloroethylene and vinyl chloride. The effects of this kind of marine pollution on human health might be either direct or indirect. Before the contaminants in the effluents reach the marine water bodies, biotechnological procedures including bioremediation, probiotics, waste treatment by micro algae and seaweeds are helpful in limiting and reducing them. This article focuses on a number of aspects of marine pollution and how it affects living things.

Keywords: Oceanic pollution, biotechnology, aquatic Organisms, impact, control

Arthropod Diversity and Distribution; How Could the Agricultural Procedures Impact?

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The National Research Centre's experimental station (NRCES) locates in Wadi El Natrun, Egypt (30°29′54.22"N 30°19′10.94"E). The NRCES has various crop yields (vegetables, fruits, ornamental and field crops) for different experimental treatments. It followed conventional agricultural procedures in vegetation, fertilisation, irrigation and plant protection. Such policies have not been evaluated for their impacts on arthropod diversity and distribution. The location's structure was a desert ecosystem that has been turned into Agricultural ecosystem since the last three decades. Thus, it was hypothesised that several changes have been impacted the arthropod communities that existed due to land reclamations and agricultural procedures. Therefore, this study conclusion was aimed to sufficient mapping the arthropod species (pest/predators) distribution, measure the biodiversity indices, in order to modify the NRCES agricultural policies to support biodiversity.

Keywords: Insects, Acari, Araneae, Gastropods, Weeds, Pesticides, Fertilizers

Influence of Land Use System and Altitudinal Gradient on Soil Nutrient Status in Himalayan Region of West Bengal

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'The study on land use change in West Bengal's North-Eastern Himalayan Region, since it has a plethora of various land use practices, is mostly unexploited. Therefore, the study was conducted to determine the fate of land use changes in this region from natural undistributed forest to farmland in terms of soil nutrient status. The experiment was conducted at Kalimpong and Darjeeling district adopting 3 factor factorial experiments with more than 15 years old 5 major land use systems; 4 altitudinal gradients and 3 distinct soil depth respectively. The soils of the experimental site found moderate to strong acidic in reaction with high OC and negligible EC at surface but varies with sub-surface. There were significant variation; tea plantation registered the lowest mean value of soil pH (4.73) and EC (0.048 dSm^{-1}), whereas the highest mean value of pH and was associated with open cropped. Organic carbon showed the reverse result, highest (0.87 %) associated with tea plantation and lowest (0.61 %) with open cropped area. When we compare the mean pH, EC and OC values with regard to different altitude the pH value decreases with increase in height gradient. However, EC and OC had reverse trend. The mean value irrespective of depth observed the trend that increases in pH and EC with soil depth increases and reverse was observed for OC. The highest mean value of N (285.5), P (15.7), K (216.3) and S (48.9) in kg ha^{-1} was associated with tea plantation and lowest mean value of N (213.80), P (8.30), K (201.34) and S (33.09) in kg ha^{-1} was registered with open cropped except Ca (0.27) and Mg (0.05) values in cmol (p+) kg^{-1} which shows reverse trend. The natural trend for available macronutrient accordance to the land use are as follows, tea plantation > ginger based > large cardamom > m andarin orchard > open cropped respectively except Ca and Mg which follows the opposite trend. The mean available macronutrient values with regard to different altitude shows increasing trend with higher altitudinal except P, Ca and Mg. Again, irrespective of depth it was observed significantly that soil macronutrient decreases with increases in soil depth from surface to sub-surface. The correlation observation results revels that the available N, K and S had significant negative association with soil pH (r= 0.42, 0.34, 0.52 respectively) while phosphorus is non-significant and Ca and Mg is positively correlated with pH (r=0.42, 0.28 respectively) and available N, K and S had significant positive correlation with soil EC (r=0.36, 0.45 and 0.26 respectively) whereas, P, Ca and Mg had non-significant correlation with EC. However, OC had significant positive correlation with N, P, K and S values (r=0.83, 0.16, 0.81 and 0.68 respectively) whereas, Ca is negatively correlated and Mg is non-significant.

Keywords: macronutrient, land use system, altitudinal gradient

Evaluation of Sorghum Land Races for Carbohydrate and Protein Content

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Sorghum [*Sorghum bicolor* (L.) *Moench*] is an important staple food crop for more than 300 million people and feed for cattle in Asia and Africa. It is grown in two seasons, viz., *kharif* as rainfed crop and *rabi* with protective irrigation, there by constituting 60 and 40 per cent cultivation, respectively. Farmers are cultivating and maintaining the l andraces for specific food preparations. Many l andraces serves as a good source of different characters, may be resistant to biotic, abiotic stresses or some quality parameters. The l andraces of sorghum cultivated by the farmers are Gundu bili jola, bilijola with different local names, as kadubina jola, haralina jola and sakremukre jola. These l andraces were collected from northern Karnataka and also acquired from ICRISAT, Patancheru and evaluated them for different characters during rabi season of 2017 at College of Agriculture, Raichur. A total of 70 l andraces along with seven check varieties were evaluated for protein and carbohydrate content after harvest of the crop. These l andraces were Gundu bilijola (14 l andraces), Bilijola (12 l andraces), Mald andi (12), Haralina jola (18 l andraces), Kadubina jola (10 l andraces) and Sakremukre jola (4 l andraces) and the checks were, Mald andi (M 35-1), Muguti, BJV 44, DSV 4, GRS 1 and CSV 29. Protein content was estimated by Micro-kjeldhal method and carbohydrate content was estimated by Anthrone method. The protein content was varied from 8.0 % to 13 %. The lowest protein content (8.0 %) was recorded in the l andrace RSL 126 and the highest in the l andrace IS 37318 followed by IS 37269 (12.5 %). The carbohydrate content was varied from 64.2 % to 83.1 %. The range of carbohydrate content difference was observed among the different types of l andraces. In Kadubina jola, the carbohydrate content was ranged from 80.6 to 83.1 %, whereas in Haralina jola type, the carbohydrate content was ranged from 64.2 to 67.7 %. whereas in other types the range of carbohydrate content was almost similar i.e. Gundubili jola (71.6 %-73.6 %), Bili jola (72.2 %-74.2 %) and Mald andi (71.0 %-74.2 %). Narrow range of variation was observed among the checks for protein content and carbohydrate content. The range for protein content was 8.0 % in the check Muguti to 10.3 % in the check DSV 4. Whereas, the range for carbohydrate content was 72.3 % in Mald andi (M 35-1) to 72.3 % in the check SPV 22. This variation for protein content and carbohydrate content can be used in further breeding programme to develop varieties for high protein content.

Keywords: Sorghum, land races, Carbohydrate, Protein

Screening of Plant Growth Promoting Rhizobacteria from Rhizosphere Microbiome of Tezpur Litchi

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Tezpur Litchi (*Litchi chinensis Sonn.*) is a special type of litchi grown in 'Litchupukhuri' and 'Porowa' village of Sonitpur district of Assam which is known for its excellent quality, pleasant flavour, juicy pulp with attractive red colour and small seed with tight pulp. Bombay, Bilati, Shahi, Elaichi, Piyaji and Haldia are the common varieties grown in litchi growing areas of Tezpur. The same fruit quality cannot be retrieved even when grown under similar set of conditions in different locations of Assam. This may be attributed to various biotic and abiotic factors, including the below ground microbial diversity. The wide array of microbial diversity in the rhizosphere microbiome of Tezpur Litchi, more specifically the plant growth promoting rhizobacteria (PGPR) may play significant role in modulating the host environment and also confer requisite taste and quality to the fruit. In the present investigation, rhizosphere microbiome of Tezpur Litchi was utilized for screening of native PGPR isolates, which could play major role in fruit quality of litchi. A total of seventy-four putative isolates comprising of aerobic nitrogen fixing bacteria (16 nos.), microaerophilic nitrogen fixing bacteria (19 nos.), phosphate solubilizing bacteria (PSB) (6 nos.), potassium solubilizing bacteria (KSB) (5 nos.) and endophytic bacteria (28 nos.) were isolated in their respective media. All the isolates shown were evaluated for different plant growth promoting traits. The total N content of the isolates ranged between 4.90-12.61 mg g^{-1} sucrose consumed in N-free media. The isolates produced indole acetic acid (IAA) in the range of 3.36-42.36 µg mL^{-1} culture filtrate and gibberellic acid (GA) in the range of 4.57-32.14 µg mL^{-1} culture filtrate. 56.75 % of the isolates could solubilize tricalcium phosphate in Pikovskaya's media indicating P-solubilisation, while 60.81 % of the isolates showed halo zone in modified Pikovskaya's media indicating zinc solubilization. Nine isolates showed positive results for siderophore production as indicated by formation of a yellow halo around the colonies and hydrocyanic acid production was showed by 6.75 % of the isolates. Based on highest quantitative estimation of total N, the aerobic N fixing bacteria and microaerophilic nitrogen fixing bacteria were selected for further biochemical characterization, while the nutrient solubilizers, PSB and KSB were selected on the basis of Kh andeparkar's ratio. The endophytic bacteria were selected on the basis of antibiotic resistance profile for biochemical characterization. The twelve selected isolates were bioassayed for their carbon sources utilization, citrate, lysine and ornithine utilization, nitrate reduction, urease detection, phenylalanine deamination and H_2S production, where the varied results indicated their presence and adaptability in varied ecosystem. The selected isolates could be further validated in Tezpur Litchi and in due course of time utilized for preparation of microbial inoculants for the crop.

Keywords: Tezpur litchi, rhizosphere microbiome, nutrient solubilizer, siderophore, Kh andeparkar's ratio

Adverse Consequences of Tourism on Arasbaran Forest Soils

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Nowadays, there is more attention to forests due to their important role in different aspects of sustainable development. Soil as an important part of forestry ecosystems has special condition in stabilize of these ecosystems. Therefore, conserving of soil against environmental hazards is necessary. It seems that tourism as an environmental hazard can influence on soil health and caused to soil degradation and finally decrease stability of forest ecosystems. The aim of present research work was evaluating consequences of tourism activity on forest soils which was carried out in a part of Arasbaran forest, North-West of Iran. Soil profiles were dug, described and sampled in two neighbor sites with same environmental conditions except tourist activity. In laboratory level, behind physicochemical analysis of soils, micro morphological studies were completed to assessing soil fabric and pedofeatures by polarizing microscope. In addition, soils were classified based on soil taxonomy 2014. Genetically assessing of soils showed that the both site soils classified as Typic Haploxeralfs with Argillic diagnostic horizon, although their comparison revealed direct and indirect effect of tourism activities on soil properties. The type, depth and sequences of soil horizons influenced by tourist activities. Although all soil horizons affected by tourist activities, the surface horizons were the most influenced one which elimination of O horizons in site with recreational and tourist activities is the most indication of this fact. The results showed the change of soil structure to platy and massive types with weak and structureless grade and fine or very fine size under the influence of tourist activities. Also, predominance of irregular pores type and increasing of soil bulk density which can be confirmed by surface crust implies to soil compaction because of tourist traffic. Despite the variation of all the studied soil chemical properties in both of the sites, SOM and CEC with 54 % and 68 % variation respectively, identified as chemical properties of soil that had significantly decrease as resultant of tourist activities. Micromorphological observation of soil thin sections in along with morphological and physicochemical findings claimed the adverse consequences of tourist activities on soil quality. Reform of soil distribution pattern from chitonic and enaolic to porphyric and monic, microstructure from granular and angular blocky to massive and dominance of packing voids rather than other ones were the evidence that confirm the negative impact of tourist activities on soil fabric. Following these findings decrease of excremental pedofeatures in the soils of site under tourist activities implies that soil biodiversity is under influence of recreational activities too. Thus, negative impacts of tourist activities such as traffic and deforestation decrease soil quality and caused to soil degradation and instability of forest ecosystem, which can be leads to jeopardizing food security and sustainable development. Therefore, it is essential to control frequency and quality of tourist activities and perform improvement programs in time periods to safe soil and forest from degradation.

Keywords: Arasbaran, Forest, Micromorphology, Recreational, Soil quality

Species Composition, Forest Structure and Biomass Carbon Assessment in Subtropical Evergreen Forest of Northeast India - A Case Study in Peren District of Nagaland

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The phytosociological attributes of tree density, basal area, abundance and tree biomass carbon (above and below ground) were investigated along an altitudinal gradient in subtropical evergreen forest of Peren district, Nagaland Northeast India. Detailed sampling was carried out in five altitudinal zones (200-1800 m asl). A total of 136 trees (97 genera, 48 families) were recorded from the present study. Species such as *Alnus nepalensis, Careya arborea, Choerospondias axillaris, Duabanga gr andiflora, Garcinia pedunculata, Lagerstroemia speciosa, Phoebe lanceolata, Stereospermum chelonoid* were the dominant tree species and the most dominant families were Euphorbiaceae, Fagaceae, Lauraceae, Magnoliaceae and Moraceae. The total density (individuals ha^{-1}) of trees ranged from 340 (Zone I, 200 – 400 m) – 420 (Zone V, 1700 – 1900 m) and the total basal area (m^2ha^{-1}) ranged from 30.24 (Zone I) – 40.57 (Zone V) respectively. The dominance-diversity curve in all the zones showed high equitability and low dominance in forest communities and followed a log normal distribution pattern. The Shannon-diversity index of trees ranged from 3.40 – 3.52 indicating high species richness in the forest community. Low tree diversity was also observed in lower altitudinal zones which may be attributed to extreme anthropogenic pressures such as agriculture expansions, fuelwood collection, trampling by livestocks and road constructions. The total stand biomass ranged from 164.9 Mg ha^{-1} (Zone I) to 236.5 Mg ha^{-1} (Zone V) and the biomass carbon ranged from 74.2 Mg C ha^{-1} to 104.5 Mg C ha^{-1}, respectively. The present study showed that the tree biomass carbon was greatly affected by species composition, density, basal area and various anthropogenic disturbances in the region. Over all this study provides useful information on plant species composition and diversity of subtropical forest of Nagaland which will serve as baseline information to the forest department, policy makers and conservationist to develop management plans for the conservation of priority species in the area.

Keywords: Species composition, Biodiversity, diversity indices, biomass, carbon stock

Relevance of Soil Arthropods in Restoration of Soil Health

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Soil health is nothing but improving the soil quality and is the idea that soil containing a diversity of life will produce more vigorous plants capable of resisting insect pests or pathogen damage. Soil is multifaceted and multifunctional system that affects the structure and function of arable ecosystem through the activities of diverse soil dwelling organisms. Soil organisms are comprised of diverse taxa and one such taxa include microarthropods encompassing meso and macro fauna. Collembolans (spring tails) and Acari (mites) are ubiquitous living in the litter or humus concentrating on the top soil help in enriching the fertility of the soil. Other taxa include Isopoda, Myriapoda and Pauropoda are usually less abundant but their presence is essential in the maintenance of soil structure. Soil arthropods produce beneficial effects upon interaction with the plants cascading important events that impact above and below ground trophic levels. The ingestion of dead plant material by the micro-arthropods resulted in the unassimilated material in the faeces. The faeces chemistry of microarthropods differs from the food ingested. The faeces of collembolans contained 40 times more amounts of nitrates than the assimilated products of algae and fungi. The faeces of mite, *Scheloribates moestus* contained greater relative abundance of lignin compared to corn litter prior to assimilation. These impact shifts in the chemistry of C:N ratio in the soil. The millipedes and symphylans helped in early stages of decomposition and paved the way for other arthropods to accelerate further decomposition. The faeces of millipedes showed an increase in pH from 5.5 to 7.7, an 8 fold increase in moisture content providing a favourable substrate for increased microbial activity to accelerate the decomposition. The termite mounds provided ideal condition to support the population of variety of microbial species that are instrumental in the mineralization of litter derived nutrients. The end result of these processes is the conversion of complex organic matter into simpler inorganic molecules that can be used by the plants. The pedo-turbation activity of the termites and ants brings substantial amounts of subsoil to the surface increasing the mineral content of the top soil and provides sites for ion exchange near the root zone. Apart, soil arthropods contributed in reducing the pests or pathogens and thus played a significant role in plant protection in agricultural ecosystems. The role of soil arthropods in the maintenance of soil fertility and structure is inexplicable in the sustainable agriculture.

Keywords: Soil arthropods, Collembolans, acari, termites, ants

Lantana Camara Invasion's Effect on Stakeholders in Kanha-Pench Wildlife Corridor

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The dependency of human population upon the resources from protected areas has been known since ages. 50 million tribal households are dependent on Non-Timber Forest Produce NTFP for 10-40 % of their house-hold incomes, though 200-300 million villagers depend on NTFP to a limited degree. The Convention on Biological Diversity's CBD strategic plan 2011-2020 stressed on stopping the loss of biodiversity so that it continues to contribute to human well-being and protect ecosystems. There has been an increase of 500 % in PAs around the world in last thirty years and India comes under 17 mega diverse countries having high biological diversity and human population having 950 PAs (<300 square kms) covering <5 % of total land area which are small and fragmented. The people around PAs are being majorly affected as the specie richness is declining and changing the forest community structure. As these forest patches are fragmented and thus are more susceptible to invasion from alien species. Such invasions can lead to extinction of endemic species reducing NTFP species. Invasive alien species IAS are good indicators of land use changes and many of them belong to wastelands. Declining NTFPs and increasing attacks from wildlife has made people round PAs vulnerable. This paper throws light on the negative impacts of shrub of Lantana camara on the lives of people and livestock living nearby to such forests and on wildlife. The use of qualitative interviews was undertaken for collecting the primary data regarding this study. Respondents living around high growth of Lantana camara were chosen to conduct the interviews. The results have shown the negative impacts of increasing growth of Lantana camara like, crop depredation, attacks from wildlife, NTFP loss and commercial losses. The study at the end identifies the need for forest restoration and healthy habitat.

Keywords: *Lantana Camara*, Stakeholders, Wildlife, Biological Diversity

Diversity of Aquatic Coleoptera from Navegaon National Park, Maharashtra

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The order Coleoptera includes more species than any other order, constitutes 25 % of known life forms. Aquatic beetles are known to have diverse habitat selection and so is their adaptability and long life, due to which they are known to be the perfect biological indicators. Due to lack of basic data on their distribution, especially from protected areas, diversity of aquatic coleoptera is less known.

Previously 3 species were reported from Navegaon National Park by Bano, 2022. Therefore, The distribution and diversity of aquatic beetle from Navegaon National Park, Maharashtra was carried out. The collections were made as a part of the annual programme of Zoological Survey of India, Western Regional Centre, Pune from April, 2015 to March, 2018. A 230 of total individuals belonging to three families of order Coleoptera were recorded. Out of the three families Hydrophilidae is the most prevalent following Dytiscidae and Gyrinidae. Species richness of Family Hydrophlidae observed high.

Keywords: Systematics, Taxonomy, Hydrophilidae, Dytiscidae, Gyrinidae, Protected area

Identification of Deforestation Hotspots in Manipur, Northeast India Using Earth Observation Satellite Data

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Deforestation is the most pervasive, imminent, existential threat to tropical forests worldwide; it results in a myriad of negative environmental outcomes including biodiversity loss, ecosystem service degradation, greenhouse gas emissions and climate change. The present study focused on the identification of deforestation hotspots in the Senapati district of Manipur, Northeast using Earth Observation satellite data for the years 2009 and 2019. Advanced technology such as remote sensing and geographical information systems has been extensively used for mapping forest cover loss, deforestation and identification of hotspot areas. The identification of deforestation hotspots in the study area was done using the remote sensing satellite data Landsat Thematic Mapper (TM) for the year 2009 and Landsat Operational Land Imager (OLI) of the year 2019 with path 135 and row 42/43 were acquired from the United States Geological Survey (https://earthexplorer.usgs.gov/). The spatio-temporal analysis of forest cover for the years 2009 and 2019 found that slight increase in the study area by 2.5 %. The L andscape fragmentation tool (LFT) v2.0 was used for the classification of different categories of forest fragmentation. LFT has classified the forest cover area into six categories i.e. patch, edge, perforated, small, medium and large core. The analysis of forest fragmentation found that a large area under the core forest declined throughout the study period (2009–2019) by 1.24 %. The deforestation hotspots were analyzed using thematic forest cover maps of 2009 and 2019 as input in hotspot analysis (Getis-Ord Gi*) of ArcGIS. Arc Getis-Ord Gi* is an optimized hotspot tool in ArcGIS that was used to analyze the statistically significant spatial clusters of high-value (hotspots) and low-value (cold spots) of the study area. The total area under deforestation hotspots in 2009 and 2019 were 736.19 sq.km and 838.7 sq.km respectively. The spatial database generated in the study is a useful input for an underst anding of the impact of deforestation and fragmentation on biodiversity and land use change for the planners, policy and decision-makers.

Keywords: Satellite data, forest, Remote sensing, Geographical Information system, Arc Getis-Ord Gi

In- Situ Green Manuring with Sesbania in Cotton, A Cost-Effective Alternative for Sustainable Soil Health and Crop Productivity in Salt Affected Soils of Purna Valley in Vidarbha Region of Central India

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The present study was conducted on farmer's field to assess the effect of green manuring and crop residue management on soil health and crop productivity of salt affected soils in Purna valley of Vidarbha region, Maharashtra during 2010-11 to 2016-17. The experiment with nine treatments was replicated on three different farmers' fields. The treatments comprised of five different green manures (sesbania, sunhemp, leucaena lopping and greengram), two crop residues (cotton stalk and farm waste) and gypsum. The crop rotations were cotton-(greengram-chickpea)-cotton which is predominantly followed in the area. During first year cotton was grown in kharif and various green manuring crops were sown in between two rows of cotton which were buried at 30 DAS subsequently in soil. During the second year the residual effect of these treatments were studied in green gram –chickpea crops. The pooled results revealed that the application of in-situ green manuring of sesbania recorded significantly higher yield of crops which was on par with the application of gypsum @ 2.5 t ha^{-1}. The higher monetary returns and B: C ratio of cotton –greengram chickpea was obtained with the application of in-situ green manuring of sesbania which was on par with the soil application of gypsum. The significant reduction in pH and ESP of soil was observed with the soil application of gypsum followed by in-situ green manuring of sesbania. The application of in- situ green manuring of sesbania resulted in buildup of fertility status of soil with significant improvement in SMBC, CO_2 evolution, DHA and soil quality index over application of gypsum and control. Hence, it can be concluded that in-situ green manuring of sesbania in cotton is found beneficial and a cost-effective alternative to gypsum for improvement in soil health with sustaining the productivity of cotton- greengram-chickpea cropping sequence along with higher monetary returns in salt affected soil of Purna valley of Vidarbha region in Central India.

Keywords: In-situ, Green Manuring, Soil Health and Crop Productivity, Salt affected soils

Non Timber Forest Products (NTFP's): Benefit Sharing and Socio-Economic Status of Local Communities through Village Forest Committees (VFCs) in Uttara Kannada District

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The Joint Forest Planning and Management (JFPM) programme is one of the initiatives to conserve forests and generate money with the help of the villagers people live in and around the forest region. The Karnataka Forest Department has constituted 5200 VFCs in the Karnataka state bringing nearly 3,40,000 ha of degraded forests under JFPM. The benefit sharing among the local communities under Village Forest Committees (VFCs) and impact of VFC under JFPM on the socio-economic conditions of the local communities through Village forest Committees (VFCs) in Uttara Kannada district, Karnataka. The information was collected by administering the questionnaire and discussions with the members. The study concentrates both on primary and secondary data. The primary data thus collected were analyses to examine the people's participation and perceptional issues of the respondents towards JFPM, VFC and the forest departmental activities. Secondary Data with a view to procuring authentic information regarding JFM, various research works, articles, published brochures and Official Records were consulted. During survey the families were surveyed in each Village Forest Committee, the highest beneficiaries were found in Umbalekoppa (100 %), followed by Kalli and Gadageri having 50 % with least beneficiaries were recorded in Madankeri and Sahasrahalli (40 %).Asset Creation through utilization of Shared Money received from VFCs. The social and geographical data points to know the population of the villages, the highest families were recorded in Kalli (57) followed by Sahasrahalli (50), Halasinkoppa (45) and Madankeri(43), the least was recorded in Gadageri with 40 families. This survey indicates the Village Forest Committee's ability to raise the standard of living and quality of life for the disadvantaged residents of the forest boundary and environmental sustainability. Through the creation of income and the involvement of the local rural population, these assets have been crucial in raising the standard of living and enhancing quality of life.

Keywords: JFPM, VFCs, Beneficiaries, Benefit sharing and socio-economic Status

Comparative Assessment of Different Biochars on Soil Quality and Productivity

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In recent years, fast depletion in soil fertility due to excessive use and application of agrochemicals caused reduction of soil organic matter (SOM) and nutrient imbalances which in turn affect the agricultural productivity. Soil nutrient depletion is an important concern, directly linked to food insecurity due to unsustainable intensified land use. Also for the successful soil management and agricultural productivity strategies, appropriate level of soil organic matter and efficient biological cycling of nutrients is crucial. Biochar a carbonaceous matter prepared from pyrolysis of waste can sequester carbon and nutrient for much longer periods than it would in its original organic carbon form. Hence, it enhanced the soil quality and productivities. In presents study, seven different biochar derived from different feedstock (distilled, agricultural, animal waste) were examined improvement of soil properties and productivity of the Tomato *(Solanum lycopersicum*). Results demonstrated that biochar application improved the alkaline phosphatase activity, dehydrogenase activity and urease activity of soil. In addition, biochars not only promoted the plant and fruit yields but also enhanced the antioxidant content in tomato.

Keywords: Biochar, Soil quality, Soil enzymes, Agricultural productivity

Conservation Linkages of Natural Resources Used by the Local Agropastoral Community in Pin Valley National Park, Himachal Pradesh, India

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Natural resources have economic, ecological, scientific, aesthetic and cultural value in human society. Besides, local people in alpine meadows such as Pin Valley use and depend on such resources for use as fuelwood, fodder, medicine, grazing and farming in varying degrees. Their dependency on such resources has resulted in unsustainable pressures on alpine meadows. This study aims to assess anthropogenic pressure and resource use patterns in the Valley. Semi-structured questionnaires were used to conduct systematic surveys comprising 545 families in 13 villages of the Valley from November

2017 and December 2019. Ecological status of threatened medicinal plants used by locals was estimated by plotting 1x1 m^2 quadrats. Additionally, consumption of natural resources i.e., plants as medicine, fodder and fuelwood in relation to their status were evaluated. Three high conservation value habitats of critically threatened medicinal plant species were identified in the buffer zone areas: Gangnam, Darbak and Solokyok in the valley where conservation action is required. Overall, 47 rare and endangered plant species comprising 20 families are used to treat 27 different ailments. However, consumption pattern of plants for use as fodder and fuelwood has decreased. Although population of migratory livestock and grazing pressure has increased in the Valley. We conclude that dependency on local community has decreased over time. However, providing alternate and non conventional energy sources such as solar-based and fuel-efficient portable ovens to the inhabitants at subsidized rates could reduce the additional pressure on rangeland and natural resources in the Valley.

Keywords: Trans-Himalaya, Traditional healthcare, Livestock grazing, Threatened medicinal plants

Biological Control of Insect Pests: Pteromalidae (Hymenoptera: Pteromalidae), A Potential Biological Control Agent

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Pteromalidae is one of the largest family of superfamily Chalcidoidea. The family comprises of mostly parasitoid wasps of insect pests and some are parasitic to plants. They are parasitoids at larval (e.g., *Dinarmus basalis*), pupal (e.g., *Pteromalus puparum*) and adult (e.g., *Scutellista caerulea*) stage across Insecta attacks on: Lepidoptera- e.g.: *Mokrzeckia menzeli* as biological control of *Eutectona machralis* (Teak skeletonizer), *Hyblaea puera* (Teak defoliator), etc. Coleoptera- e.g.: *Anisopteromalus calandrae* as larval ectoparasitoid of *Sitophilus oryzae* (Stored grain pest); *Dinarmus basalis* as biocontrol of *Callosobruchus chinensis* (L.) a serious pest of pulses, etc. Diptera- e.g.: *Spalangia cameroni* as parasite of *Musca domestica*: *Musca domestica* act as a vector for many pathogens; Muscidifurax raptor for biological control of Musca autumnalis: They are pest of cattle and horses, etc. Hymenoptera- e.g.: *Pteromalus semotus* as biocontrol of *Neodiprion sertifer*: Larvae feed on old needles of Pines especially *Pinus sylvestris*, *Pinus resinosa*. Hemiptera- e.g.: *Pachyneuron aphidis* against Aphids (e. g. *Lipaphis erysimi*): Aphids remove plant nutrients and may damage plants by removing enough sap to cause withering and death; *Acroclisoides indicus* as biocontrol of Pentatomid bugs; *Scutellista caerulea* as biocontrol of Scale insects etc. Majority of Pteromalidae are Primary or Secondary parasitoids, attacking a large range of insect orders at their various stages of development, thereby playing a vital role in the control of insect pests in nature (Sureshan 2003). They were called as "SMART BOMBS" by John Werren in 2010, as they target many insects, including varied species of house flies, blow flies and flesh flies.World pteromalid fauna is represented by more than 4200 described species belonging to 640 genera and Indian pteromalid fauna is represented by 340 species belonging to 116 genera.

Keywords: Pteromalidae, Biological control, Parasitoids

Smart Fertilizers as a Strategy for Sustainable Agriculture

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Agricultural land systems (cropland, managed grassland, permanent crops including agroforestry and bioenergy crops) cover about 40%–50% of the Earth's land surface, on which humanity needs to secure food production. The global population is expected to increase from 7.2 to 9.6 billion by 2050, which will increase food demand and fodder requirements for feedstock so , In the coming decades there will be increasing pressure on global food systems and agriculture will have the challenge to provide food security for a growing world population without impacting environmental security. One option to achieve greater crop production could be the improvement of plant fertilization strategies. Nitrogen (N) and phosphorus (P) are essential nutrients for plant growth and consequently the application of these nutrients as chemical fertilizers has been growing since the green revolution in the 1960s and determines crop productivity. Continued fertilizer inputs are essential to sustain and increase food production. However, there are problems associated with mineral fertilizer use because of relatively low nutrient uptake by crops in productive systems. High fertilization rates lead to N and P losses with negative impacts on atmospheric greenhouse gas (GHG) concentrations and water quality. There is an urgent need to improve nutrient use efficiency in agricultural systems and to manage biogeochemical cycles in a sustainable way. A combination of biotechnology and nanotechnology has the potential to revolutionize agricultural systems and provide solutions for current and future problems. These include the development and use of smart fertilizers with controlled nutrient release, together with bio formulations based on bacteria or enzymes. The aim of this review is to present innovations related to smart fertilizer technology as a response to food security scenarios under growing global population and the environmental impacts of current agricultural systems. Smart fertilizers may be a solution to enhance food production and environmental quality. In the sense of a circular economy, we suggest that these smart fertilizers may be based on the innovative use of harvesting residues

Keywords: Smart fertilizer, Sustainable agriculture, Crop productivity, Food security

Biodiversity Conservation in Agriculture

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Biodiversity is the basis of agriculture. It's maintenance is essential for the production of food and other agriculture goods and the benefits these provide to humanity, including food security, nutrition and livelihoods. Biodiversity is the variety of different forms of life on earth, including the different plants, animals, micro-organisms, the genes they contain and the ecosystem variation, species variation (number of species) within an area, biome or planet. Biodiversity supports the livelihoods of food producers while also reducing negative impacts on the environment. Agriculture Biodiversity is defined as the variety and variability of animals, plants and micro-organism that used directly or indirectly for food and agriculture including crops, livestock, forestry and fisheries. Biodiversity is the source of planet and animals that forms the basis of agriculture and the immense variety within each crop and livestock species. Biodiversity is the origin of all crops and domesticated livestock and the variety within them. Biodiversity in agriculture and associated landscapes provides and maintains ecosystem service essential to agriculture. The ecosystem services of biodiversity is maintained through formation and protection of soil, conservation and purification of water, maintaining hydrological cycles, regulation of biochemical cycles, absorption and breakdown of pollutants and waste materials through decomposition, determination and regulation of natural world climate. Despite the benefits from biodiversity, today's threats to species and ecosystems are increasing day by day. To ensure intra and intergenerational equity, it is important to conserve agriculture biodiversity. The loss of biodiversity is a global crisis. Earth's rich biodiversity is vital for the very survival of Agriculture Biodiversity conservation may be in situ as well as ex situ. In in situ conservation, the endangered species are protected in their natural habitat so that the entire ecosystem is protected. Recently, 34 'biodiversity hotspots' in the world have been proposed for intensive conservation efforts. Of these, three (Western Ghats- Sri Lanka, Himalaya and Indo-Burma) cover India's rich biodiversity region. Ex situ conservation methods include protective maintenance of threatened species in zoological parks and botanical gardens, in vitro fertilization, tissue culture propagation and cryopreservation of gametes. In this abstract study about biodiversity, it's importance, conservation strategies for biodiversity.

Keywords: Agriculture Biodiversity, Conservation, Ecosystem services

Lignite-Derived Humic Acid Effect on Soil Properties, Plant Growth and Nutrient Uptake by Plant

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In arid and semi-arid regions throughout the world, soil health is being seriously affected by climate change and unsuitable conventional farming techniques involving intensive tillage, which leads to low soil fertility and unstable crop productivity compromising sustainability. Applications of biostimulants (biological amendments) such as humic amendment (HA), amino acids, chitosan and seaweed extracts have been gaining attention due to their positive effect on soil health and crop yields. Humic acid (HA), a fairly stable product of decomposed organic matter that consequently accumulates in ecological systems, enhances plant growth by chelating unavailable nutrients and buffering pH. Humic acid (HA) has been reported a promising natural resource showing persistent effects on plant growth promotion, nutrient uptake and soil nutrient status. HA, a natural organic material that is usually derived from lignites, coals and peat, is utilized for industrial and agricultural purposes. For example, HA has been used as a nutrient solution and sprayed on plant leaves to stimulate nutrient uptake required for plant growth and development. When used as a soil amendment, it has the potential to improve soil water holding capacity and stabilize soil structure. The global availability and low cost of HA and its overall positive effect on soil health and productivity indicate potential for use in arid and semi-arid regions. HA application improved agricultural productivity with effective increases in grain protein, grain yield, water use efficiency and partial factor productivity of nitrogen. It also enhanced soil health metrics including soil organic carbon, water storage and nutrient turnover in surface and subsoil layers. Overall, the annual use of HA could be a new and climatesmart, environment-friendly and low-cost strategy to cope with agricultural drought and therefore improve profitability and boost long-term sustainability of the production system in arid and semi-arid regions.

Keywords: Humic acid, lignite, environment friendly, organic material, soil health, productivity

Evaluation of Nutrient Status in Vermicompost Prepared from Different Organic Waste Using *Eisenia fetida*

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The present study was conducted in Banda University of Agriculture and Technology, Banda in the year of 2017-18 and 2018-19 with the objective of exploring the vermicomposting process, which involves different stages and production of vermicompost using wheat straw, paddy straw, moong straw, pressmud and buffalo dung. The vermicompost produced can be of significant value to the end users like farmers for replacement of chemical fertilizers and procuring better prices for the organic produce using such composting material locally available at much lower cost. Vermicomposting was done using *Eisenia foetida* using five different organic waste i.e. Buffalo dung, Pressmud, Moong straw, Paddy straw and Wheat straw. Temperature and pH were measured during the process. The temperature fluctuation, the production of vermicompost and the chemical characteristics of the vermicompost were recorded after completion of Vermicompost in the year of 2017-18 and 2018-19. The results showed that approximately 32-39 % of raw material is reduced during Vermicompost production. The maximum recovery (%) from the raw material was found in V4 (68.14) followed by V_5 (66.22), V_3 (65.80), V_2 (65.79) and V_1 (64.24). The maximum days are counted for the preparation of vermicompost in V_5 (83 days) while minimum in V1 (63). The harvested vermicompost had an excellent nutrient status, confirmed by the chemical analyses and contained all the essential macro and micronutrients. The temperature fluctuation varies from 0.3 to 8.9^{0}C in between 0-15cm and 15-30cm during both the years.

Keywords: Eisenia foetida, Buffalo dung, Paddy straw, Vermicompost, Temperature

Biodiversity Conservation and Soil Health

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Biodiversity conservation is a key to ensure good soil health and to provide food security and sustainable development for safe future. To keep soil health there are various land management practices to boost the organic matter in the soil and its biodiversity such as use of minimum tillage, careful use of fertilizers and rehabilitation of targeted earthworms. Soil biodiversity includes Rhizobia, Mycorrhizae, Azospirillum, Bacillus, Pseudomonas, Trichoderma, Streptomyces and many more species which benefits the soil health in terms of good drainage, stable soil structure and also improve the soil

productivity. For increasing organic matter in soil there are different type of cropping practices are followed such as green crop manure, crop stubble, crop rotation, reduce or minimum use of harsh fertilizers and fungicides. Intense agriculture activities are responsible for the loss of soil biodiversity and soil health. This may cause degradation and consequently to climate change problem. Switching to organic farming and traditional farming system such as Natural farming. Organic farming is a system of farming as an organism in which all the components i.e., soil minerals, organic matter, micro-organism, insects, plant, animal and human come together to create stable ecology. Natural farming is an ancient agriculture practice which promotes neither chemical nor organic fertilizers are added to the soil. Natural farming gives direct benefits to the farmers by the restoration of soil fertility. For good and safe future its mandatory to manage all the natural resources such as l and, water, soil, plants, animals and micro-organisms for focusing how to manage these things our quality of life for present and future generation is depend. Soil micro-organisms is in million in one teaspoon of fertile agriculture soil such as fungi, algae, bacteria and microscopic warms provide important ecological services such as warm casting, decomposition of organic matter to humus, breaking dawn of toxic matter, cleaning of water and soil nutrients. Biodiversity management is an fundamental key to ensure good soil health and also to maintain ecology. For good crop production the use of essential macronutrients such as nitrogen, phosphorous, potassium, sulphur, calcium and magnesium. These elements relatively crop needed in large amount for higher production rate. Use of micronutrients such as chlorine, iron, boron, manganese, zinc, copper and molybdenum. These micro nutrients elements crop needed in small amount for good quality production. proper use of crop rotation practices, use of proper drainage system and provide nutrients cycle to the soil all are the effective way to encourage good soil health. All living organisms are depended on each other weather it is plant, animals, human, insect, or micro-organism which lives inside the l and. Everyone servers an important role to the environment.

Keywords: Biodiversity, Soil health, Food Security, Ecology

Assessment of Soil Carbon Sequestration in Different Agroforestry Systems under Semi-Arid Region of Rajasthan

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To explore the ability of different tree-based agroforestry systems to carbon sequestration, the present investigation, entitled "Assessment of Soil Carbon Sequestration in Different Agroforestry Systems under Semi-Arid Region of Rajasthan" was undertaken. For this, three tree-based agroforestry systems consisting of tree species, namely *Acacia tortilis, Hardwickia binata* and *Tecomella undulata* along with fallow land maintained at ARS, Fatehpur, Sikar, Rajasthan were selected. The soil samples were collected from four different soil depths (0-15, 15-30, 30-60 and 60-90 cm) with three replications and analysed

for soil physicochemical properties, total organic carbon (TOC), soil organic carbon fractions (C_{VL}, C_L, C_{LL}, C_R, ACP and PCP), soil carbon stocks and carbon management index (CMI). The results indicated that under all agroforestry systems, lower soil pH, BD and PD were recorded as compared to fallow land at all soil depths. The *Acacia tortilis* based agroforestry system had higher soil available N, P, K and micronutrients than other agroforestry systems and fallow l and. The soil carbon pools (C_{VL}, C_L, C_{LL} and C_R) were positively correlated with TOC and decreased with an increase in soil depth under all the agroforestry systems and fallow l and. The Acacia tortilis based agroforestry system sequestrating a higher amount of total organic carbon (0-90 cm) 39.34 Mg C ha^{-1} followed by *Hardwickia binata* based agroforestry systems (37.86 Mg C ha^{-1}), *Tecomella undulata* based agroforestry systems (36.99 Mg C ha^{-1}) and fallow land (30.65 Mg C ha^{-1}). The CMI registered higher under Acacia tortilis based agroforestry system (172.65) at 0-15 cm soil depth. Based on current research findings, it may be concluded that agroforestry systems help in maintaining soil fertility and soil carbon sequestration as compared to fallow l and.

Keywords: Carbon Sequestration, Agroforestry Systems, Acacia tortilis, Hardwickia binata and Tecomella undulata

Boosting Soil Quality to Mitigate Soil Degradation

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In order to feed the world's population, which was 7.3 billion in 2015 and is expected to reach 9.5 billion by 2050, agricultural production must exp and by almost 70 % between 2005 and 2050. The process of soil degradation, which is characterized by a decline in quality and decrease in ecosystem goods and services, is a major constraint to achieving the required increase in agricultural production. soil is a non-renewable resource whose susceptibility to deterioration depends on intricate interactions between processes, factors and causes that happen at various spatial and temporal scales. Accelerated erosion, depletion of the soil organic carbon (SOC) pool, loss of biodiversity, loss of soil fertility and elemental imbalance, acidification and salinization are some of the main processes that cause soil degradation. Trends in soil degradation can be stopped by switching to a restorative land use and implementing advised management techniques. The goal is to reduce soil erosion, improve structural stability and pore geometry, produce positive SOC and N budgets, increase activity and species variety of the soil biota (micro, meso and macro) and limit soil erosion. Reducing the danger of soil deterioration (physical, chemical, biologicaland ecological) while raising soil quality can benefit the ecosystem. Examples include increasing SOC pool, enhancing soil fertility and improving soil structure. To start the restorative trends, the SOC pool must be raised over the crucial range (10 to 15 g/kg). Conservation agriculture, integrated nutrient management, continuous vegetative cover like residual mulch and cover cropping and managed grazing are site-specific methods of recovering soil quality.

Keywords: Degradation, Soil Organic carbon (SOC), Conservation Agriculture

Physiology of Fodder Sorghum with Intercropping under Different Crop Geometry and Nitrogen levels

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A field experiment was conducted at D block of central farm, Agricultural College and Research Institute, Madurai, Tamil Nadu during 2018-2019 under semiarid condition, to optimize the crop geometry and asses the nitrogen level for multicut fodder sorghum (CoFS-31) based intercropping system. The main plot treatments were divided with crop geometry of 30×15 and 45×15 cm as sole fodder sorghum, (45+15) ×15 cm and (60+30) ×15 cm as paired row system with inter crop. In sub plots nitrogen level of 75, 100 and 125 per cent RDF of N were assigned. Physiological parameters of fodder sorghum like number of leaves and crop growth rate were significantly affected by the treatments. During the first and second cutting sole fodder sorghum with 45 x 15 cm recorded higher number of leaves (58 and 74) and crop growth rate 6.32 and 8.27 g m^{-2} day^{-1}(). Where as in the third cutting (60+30) x 15 cm with intercrop registered more number of leaves of 139 and higher crop growth rate of 8.05 g m^{-2} day^{-1}. Under nitrogen levels 125 % RDF of nitrogen gave out more number of leaves (56, 77 and 120) and crop growth rate (6.71, 9.58 and 9.28 g m^{-2} day^{-1}) in all three cuttings. The interaction effect was also significant during all three cuttings. This is due to the fact that, more space leads to better spread of crop canopy, as a result in increased physiological parameters. Application of more nitrogen leads to better uptake production of vegetative growth. It can be concluded that intercropping fodder sorghum with fodder cowpea at (60+30) x 15 cm under 125% RDF of nitrogen sustains the yield of fodder and also helps to supply a balanced ration of fodder to cattle at the same time.

Keywords: Crop geometry, Fodder sorghum, intercrop, paired row system

Response of Maize under Foliar Application of Zinc Based Nanofertilizer and Varying Fertility Levels on Quality, Yield and Economics

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The study was carried out during two consecutive Kharif, seasons of 2020 and 2021 at Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan to assess the response of maize crop under foliar application of zinc based nano-

fertilizer and varying fertility levels on quality, yield and economics in Southern Rajasthan. The experiment was laid out in a factorial Randomized design with three replications comprising four foliar application of nano-fertilizer (Control, at knee high stage, at 50 % tasseling stage and both at knee high stage and at 50 % tasseling stage) and four fertility levels (100 % RDF, 90 % RDF, 80 % RDF and control). Significantly highest protein content of maize (11.13 % and 10.97 %) was found in with dual foliar application of nano-fertilizer and 90 per cent RDF, respectively. The significantly highest net return and B:C ratio were found under dual foliar application of nano-fertilizer 82956 and 3.04) and soil application of 90 per cent RDF (Rs. 86112 and 3.15) in tested maize crop.

Keywords: Nano-fertilizer , Foliar Zinc, Quality, Economics, maize

A Study on Problems of Sericulture Farmers in North India

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Sericulture is the process of cultivating silkworms and extracting silk from them. The caterpillars of the domestic silkmoth (also called 'Bombyx mori") are the most commonly used silkworm species in sericulture. Other types of silkworms (such as Eri, Muga and Tasar) are also cultivated for the production of 'wild silks." In north India, the majority of the silkworm rearers are doing single cocoon crops (spring crop) and in some parts, some farmers are doing a second crop (autumn crop), but to a very limited extent. The current study focuses on the states of Jammu and Kashmir, where approximately 27000 farmers are involved in silkworm rearing. The majority of the farmers are facing many problems these days, such as marketing problems, price fluctuation of cocoon, lack of government support like MSP, no insurance of this crop, total dependence on the government for all types of support, no private parties involved in this occupation and a low number of skilled workers available for this industry. So there is a need to address these problems for the development of the silk industry in North India.

Keywords: Sericulture, Silkworms, Silmoth, Coccon

Evaluation of Soil fertility Index of KVK and RARS Belatal, Mahoba District of Bundelkh and Region

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The experiment was conducted at Agricultural Farm of Krishi Vigyan Kendra (KVK) and Regional Agricultural Research Station (RARS) Belatal Mahoba to evaluate the spatial variability of soil parameters. The total 270 geospatial soil samples were collected from three depth i.e. 0-15 cm, 15-30 cm, 30-45 cm. Study showed that the available N, P, K, S, Mn, Cu, Zn, Fe and B were mean value of 231 kg ha^{-1}, 19 kg ha^{-1}, 229 kg ha^{-1}, 15 mg kg^{-1}, 15 mg kg^{-1}, 0.59 mg kg^{-1}, 0.45 mg kg^{-1}, 17 mg kg^{-1} and 0.59 mg kg^{-1}, respectively. Out of total 270 samples about 59 % samples were neutral and 41 % slightly alkaline in nature. All the samples fall under non saline in nature. In aspect to organic carbon and available nitrogen, majority of the samples were low in category while available phosphorous, exchangeable potassium andexchangeablesulphur lies under medium in category. Soil pH exhibited significant and positive correlation with EC ($r= 0.322^{*}$), available nitrogen ($r= 0.232^{*}$), copper ($r= 0.345^{**}$) and zinc ($r= 0.224^{*}$) and negative correlated with available sulphur ($r= -0.361^{**}$). Organic carbon exhibited significant and positive correlation with available nitrogen ($r= 0.670^{**}$), phosphorous ($r= 0.356^{**}$), potassium ($r= 0.487^{**}$) and zinc ($r= 0.211^{*}$). The Nutrient index value (NIV) for organic carbon (1.23), available nitrogen (1.23) and zinc (1) was found in low, for available phosphorus (2.06), potassium (2.19), sulphur (2.01),copper (2), boron (1.7) were found in the medium category whereas available manganese (3), iron (3) were found in the high category.

Keywords: Soil fertility, Organic matter, Nutrient Index, Soil properties, Soil testing

Agroforestry - A Way Forward for Climate Resilient Agriculture

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Variability in climate happens to be the primary concern of the entire world as it is hampering the integrity of the whole earth ecosystem. Climate change is likely to affect agricultural production at global, regional and local levels. Therefore, building the resilience of these production system is crucial.

Resilience is the ability of an ecological system to absorb disturbance and adapt to stress and change. Agroforestry, which is the intentional combination of trees and shrubs with crops or livestock is one such resilient farming practice. It contributes towards enhancing the resilience of agricultural sector through diversification of agricultural production, microclimate amelioration, efficient nutrient cycling, carbon sequestration and flood mitigation. Selection and combination of species with adaptation capacities to extreme climatic and soil conditions, arrangement and management of these species can increase the resiliency of these agroforestry systems.

Keywords: Climate change, Agriculture, Agroforestry

Charcterization of Native Rhizobia Associated with *Dalbergia sisoo*: A Potential Root Legume Tree for Thar Desert

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Establishing vegetation on degraded and desert environments is hampered by low fertility. These l ands typically lack nitrogen; by adding additional fertilisers, particularly nitrogen, one can maintain the fertility of such soils. The nitrogen fertiliser is not only expensive and rare, but it is also lost quickly through leaching, runoff and volatilization, which pollutes the air and water. Through a process called biological nitrogen fixation, specific bacteria and leguminous plants with nodules in their roots can transform nitrogen gas into a form that can be utilised by plant life. Only because of connections with these small creatures do plants fix nitrogen. The Rhizobium bacteria's symbiotic relationships with legumes are the most well-known relationships. Leguminous plants that fix nitrogen not only support plant growth independent of the mineral nitrogen in the soil but also improve the soil nitrogen status for companion crops through their leftovers. The morphological, biochemical and molecular characterization of native rhizobia associated with *Dalbergia sisoo*, however, had received less research. Because nitrogen fixation in forestry can be increased by inoculating legumes with the right rhizobia, knowledge of rhizobia biodiversity and local populations is essential to designing successful inoculation strategies.

Keywords: *Dalbergia sisoo*, Rhizobia, Bacteria, Desert and Degraded land

Green Nanoparticles Improve Plant Growth and Soil Health

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In past few years, scientist's attention has been drawn more frequently to the synthesis of green nanoparticles (NPs) originating from plants and microorganisms because of their eco-friendliness and ease of manufacturing compared to conventional methods. A variety of plant species and microorganisms, including bacteria, algae and fungi, are now used for NP synthesis in the development of green nanotechnology. In order to fulfil the rising need for food, intensive farming is being employed. However, this approach eventually creates a dangerous cycle where soil fertility is depleted and agricultural outputs fall. Due to such intense farming techniques, it has been estimated that 40% of the world's agricultural land has been badly degraded, resulting in a significant loss of soil fertility. Green nanoparticles like nano-Silicon or nano-Zinc application improve plant tolerance to extreme climate events by increasing the accumulation of free proline and amino acids, nutrient and water uptake and antioxidant enzyme activity like superoxide dismutase, catalase, peroxidase, nitrate reductase and glutathione reductase. Also, the antimicrobial effect of some nanoparticles affects plant-microbe relationships that promote soil fertility and crop growth both. Green synthesized nanoparticles can be an environment friendly approach in the way of promoting sustainable agriculture. However, relatively few studies in this field have been done. Therefore, additional study is urgently required to understand the behaviour of nanoparticles, their fate as a result of changing agricultural inputs and how they interact with the biomacromolecules found in the living systems and habitats.

Keywords: Green nanoparticles, soil fertility, antimicrobial, antioxidant, nano-Zinc, nano-Silicon, intense farming, sustainable agriculture

A Study on Grouping of Livestock Production Systems of Periurban and Rural Livestock Owners of Belgaum District of Karnataka State

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India has largest livestock population in the world. Livestock sector provides self-employment to many rural masses. Thus, livestock sector plays an important role in the national economy and in the socio-economic development of the country. This sector also plays a significant role in supplementing

family income in generating gainful employment in the rural sector particularly among the land less, marginal, small farmers and women besides providing cheap nutrition to millions of people. Many variables influence the patterns of livestock farming. Identifying the most important or crucial variables to structure the livestock farming in a homogeneous way is thus imperative. Use of logical mechanism for this is hence essential. The method of grouping these variables logically and homogeneously is called Typology. Typology is thus a logical mechanism of classifying or categorizing the full range of variation prevailing in a system. The present study concentrated on developing typology that would facilitate for more effective analysis and discussion on fodder management systems in rural and peri-urban areas. Belgaum district which has maximum number of livestock population in the state was selected for the study. Four villages that are located less than 8 kms from the district headquarter were selected as periurban areas. Another four villages which are located beyond 8 kms from the district headquarter are selected as rural areas. The study hence covered 8 villages. In each selected village 20 farmers were interviewed. Hence the study covered 80 farmers from periurban area and 80 farmers of rural area of Belgaum taluka, together formed 160 respondents. The typology considered total four variables (one basic and three identified through principle component analysis). The division of each variable was restricted to only two categories taking mean value of 160 respondents for each of the selected variable. This facilitated to simplify the final typology output. The typology so developed brought out 17 groups. Most of the respondents (41.25 %) belonged to good performing units, followed by 36.25 per cent of respondents belonged to very good performing units. While 22.50 per cent of respondents, belonged to average performing units.

Keywords: Livestock, Periurban area, Rural areas, Homogeneous

Cover Crop for Soil Health and Crop Productivity

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Agriculture in current scenario is facing new challenges like intensive cropping system practices, climate change, rapid depletion of water and nutrient resources, escalating prices of fertilizers and fossil fuel reserves, henceforth, more diverse cropping system and nutrient rich soil health enhancing crops and practices are required to make the soil more productive as well as more efficient use of natural/renewable resources. Within this context, improved integration of cover crops may become the cornerstone of sustainable agro-ecosystems. To conserve soil, better agricultural methods that sustain the soil fertility are needed. Cover crops increase soil organic matter through carbon sequestration. The roots and shoots of cover crops feed bacteria, fungi, earthworms and other soil organisms, which increases soil carbon levels over time. Cover crops control weeds through competition, allelopathy and/or physical effects due to surface residue, thereby interfering with growth, development and reproduction of weed. Cover crops suppress diseases by extending the length of a

crop rotation, improving soil structure, providing a physical barrier and enhancing suppressive effects of soil life therefore disrupting disease cycle phases. Despite so many advantages, the issue of competitiveness between cover crop and main crop for resources cannot be ignored and bypassed. Strategic planning, management and manipulation of cover crops system are essential and decisive to reduce competition with the main crop for resources. Selecting the right cover crop is critical to successful farming. Furthermore, as with cash crops, cover crops should be rotated periodically to avoid the build-up of plant-specific pests. With proper selection, use and management of cover crops, it is possible to improve productivity and could contribute to improved soil, water and environmental quality.

Keywords: Cover crop, Sustainable agro-ecosystems, Soil fertility

Interaction between Belowground and Aboveground Resources in Tree-Crop System

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Interactions are an inevitable part of the ecosystem. Multiple species coexisting in the same environment, as in agroforestry, results in a distinctive set of ecological interactions between various species. An ecological interaction occurs when one or more system components have an impact upon, how the system components and the overall system perform as a whole. In a tree crop system, which is basically an agroforestry system, there occurs several interactions like mutualism, commensalism, competition, amensalism, parasitism and predation. Interactions studies in an agroforestry system are focused on the above ground and below ground interactions point of view. The above ground interaction of the components in a system is typically focused on the microclimate and is examined in terms of the interception by foliage of sunlight (radiant energy), rainfall, temperature, humidity and wind speed surrounding the foliage. Whereas, the below ground interactions focuses on root competition, nutrient recycling, allelopathic effects, competition for water, hydraulic lift and so on. But, the main aim of the system is to optimize positive interaction between various biological components thus increasing the overall value of the system. This leads to a sustainable system with harmonious component interactions. The optimum manipulation of these interactions can fetch higher economic benefits to the farmers and other stakeholders.

Keywords: Agroforestry, Aboveground interaction, Belowground interaction, Economics

Biodiversity Conservation and Soil Health

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Just like the air we breathe or the water we drink, soil needs to be protected. Strong, rich soil gives life to the entire food chain. It helps plants create nutrients. Healthy soil defends plants from harm. and when properly managed, it can assist farmers in their efforts to help preserve the environment. Soil is the foundation figuratively and literally for life as we know it. On the surface, soil is composed of sand, clay and silt. When we look closer, however, we find an entire world of microorganisms bringing the ground beneath our feet to life. Soil hosts a quarter of our planet's biodiversity. Billions upon billions of earthworms, nematodes, insects, fungi, bacteria and other invertebrates call it home. Just one and half of soil can contain tens of thousands of different organisms. These earth-dwelling microbes use the organic material found in soil as food. They work together to break down complex materials like dead plants and animals into minerals and nutrients that support healthy growth for the rest of the ecosystem. Essentially, underground organisms aren't just evidence of healthy soil. They *are* healthy soil. They create it. By studying the life that already exists in the soil, scientists are discovering how we can help nature protect a farmer's fields. One of the ways that we do this is through a deeper understanding of biologicals. These solutions are derived from naturally occurring microorganisms, plant extracts, or other organic matter. Often described as "probiotics for plants," biologicals introduce beneficial microbes to the soil to help boost natural processes or defenses. There are three types: biopesticides, biofertilizers and biostimulants. Biopesticides help farmers target specific threats while posing minimal risk to other species. For example, a product called Bio Act contains active fungal spores that can control the population of nematodes that would otherwise wreak havoc on a farmer's fruit or vegetable crops. Meanwhile, good bacteria in biostimulants can help jumpstart a plant's own biological processes. They can increase the activity of photosynthesis and improve nutrient uptake, among other benefits. We know that consumers are increasingly interested in how their food is grown and want to know that farming practices are environmentally sustainable, states Benoit Hartmann, Head of Biologics at Bayer, Biological products particularly seed treatments already play a role in helping farmers reduce their CO_2 emissions and can help their crops use fertilizer more efficiently. By incorporating natural solutions into soil protection, farmers are able to engage in more sustainable farming methods and produce healthier harvests.

Keywords: Probiotics, Biopesticides, Biostimulants, Biodiversity and Biostimulants

Integrated Farming System: A New Holistic Approach to Double Farmer's Income

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A variety of resource-saving techniques are used in an integrated farming system to maximise productivity and profits. This practice not only reduces the harmful effect of intensive farming but also protects the natural resources. In recent years advancement in agricultural research and technology has led to the initiation of integrated farming practices. This practice increased the productivity per acre and also allows maximum use the land to meet the rising food demands of ever increasing world's population. Under monocropping system, the uncontrolled and unscientific use of both chemical pesticides and fertilisers have harmed our food and natural ecosystems. The adoption of integrated farming system (IFS) can provide adequate income, employment, nutritional security, and environmental sustainability, compared to discouraging outcomes of monoculturing farming. In IFS, several types of agriculture and allied practices, such as, cropping systems, horticulture, forestry, livestock, poultry, sericulture, duckeries, and fisheries, etc. are practices together to increase the overall productivity of land resources. In this system, several components work in concert to reduce environmental pollution by recycling the farm waste and by reducing the dependence on outside farm inputs. By products or waste from one component can serve as food or an energy source for another component (cost effective). Since a lot of farm waste will be produced in the IFS due to integration of the animal and plant and which is added to the soil directly or through composting to improve the physical, chemical, and biological health of the soil. The widespread adoption of IFS technologies throughout India will improve and sustain the livelihood of small and marginal farmers and allow them to double their income on the same plot of land, while creating more jobs and meeting the nutritional needs of their families. It is very challenging to meet the food and other basic needs of small and marginal farmers in single farm enterprises due to the decline in the per capita availability of agricultural landholdings, leading to a gradual decline in farm income. A substantial number of farmers are leaving the farming industry and engaging in non-agricultural activities, which needs to be discouraged. The possibility of expansion of cultivable area is almost meager in India, and only way to feed the increasing population is to enhance the agricultural output per unit area. So, to meet the basic requirements and to generate the farm income, it is essential to integrate the different components of agriculture (i.e. cropping system associated with livestock, apiary, horticulture, sericulture etc.) in a IFS mode.

Keywords: IFS, Productivity, Profitability, Conventional farming, Monoculturing

Renewable Energy and Sustainable Agriculture

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Sustainable agriculture involves different designs and management approaches that work in natural ways that conserve all resources and minimize environmental damage and reduces waste. However, at the same time maintaining or improving farm profitability. In this regard, agriculture serves food for human consumption. However, most farm machines utilize the fossil-fuels, which results in emission of greenhouse gases and, in turn accelerate climate change. Such an environmental damage can be mitigated by the promotion of renewable sources of energy. These renewables contribute in maintaining the balance in energy consumption as well as energy production in agriculture industry. The concept of sustainable agriculture employs the principle of maximization of profits with minimization of cost. This also maximizes the crop productivity and maintains economic stability. In addition, sustainable agriculture helps in replenishing the soil with minimum use of non-renewable sources of energy. These non-renewable sources of energy found application in utilizing the atmospheric N by converting into synthetic fertilizers and mineral ores etc. Similarly, fossil-fuel is utilized in running diesel pumps and generators for irrigation. This suggests need for promoting use of renewable sources of energy systems for sustainable agriculture. To meet these challenges, The PM has launched new mission LIFE (Life Style for Environment). This aims to promote sustainability and healthy life styles. This will set the right path for tackling the climate crisis. It is important to thick beyond policy making and encourage every individual to contribute to climate response. The mother earth planet symbolizes the fertility of land and richness of its biodiversity. To achieve all this, recently, G20 shall address global discourse around climate response with focus on mitigation and push for adaptation agenda. However, the World Economic Forum has argued that G20 must promote a sustainable blue economy also.

Keywords: Non-conventional sources of energy, Life Style for Environment, Fossil-fuel

Integrated Farming Systems for Nutritional Security and Agricultural Sustainability

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Agriculture is known as backbone of Indian economy, but the contribution of agriculture and allied sectors in recent past years in national gross domestic product is declining. Currently, water scarcity, food and nutritional security as well as environment protection and conservation of natural resources

have emerged as major issues at global level. The developing nations are struggling to deal with these challenges, and must contend with the dual burden of globalization and climate change. During green revolution era, food security ensured through use of high yielding varieties, high rate of fertiliser and pesticide application with intensive agronomic practices leads to reduce soil fertility. Green revolution also effects the sustainability of agriculture production and mark a question on national food security in long term. The size of agricultural land holding is gradually decreasing due to ever increasing population as well as the expansion of industrializations and urbanization leads to increase number of operational land holdings with the pace of time. It is very important to develop strategies that provides sufficient income and generate employment along with food and nutritional security, especially for small and marginal farmers who represent about 85% or more of the agricultural community. Horizontal extension of land is not possible due to continues decreasing size of land holding, but vertical integration of farm enterprises will ensure farming become more reliable and cost-effective. Among different approaches Integrated farming systems (IFS) demonstrated as feasible approach with an appropriate combination of farm enterprises, such as crop production, livestock, forestry, poultry, fishery, horticulture, sericulture and apiculture etc. in a particular region or farming condition to overcome the problems of declining economic growth of farming communities due to different uncertainties. IFS ensure food security, nutritional security, reduce cost of production, waste recycling, increasing the farm income and employment opening for rural population, conserve and manage natural and human resources as well as addressing socioeconomic and environmental challenges.

Keywords: Income, nutritional security, resources conservation, sustainability and waste recycling

Eco-Friendly Agricultural Practices towards Sustainable Development

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Green revolution technologies have more than doubled the yield potential of rice and wheat, especially in Asia. These high input production systems practicing massive application of fertilizers, pesticides, irrigation and machines, however, disregard the ecological integrity of land, forests and water resources, endanger the flora and fauna and cannot be sustained over generations. Crops rotation is not followed properly to replenish the soil. Manure and chemical fertilizers are used to "sustain" the soil fertility, but their excessive application has become a problem. Chemical fertilizers and pesticides not only contaminate surface water, they also affect both fish population and human health. Organic farming implies the use of organic nutrients and adoption of natural methods of plant protection in place of fertilizers and pesticides. To the maximum extent, organic farming system rely upon crop rotations, crop residues, animal manures, legumes, green manures, mineral bearing rocks and aspects of biological

pest control to maintain soil productivity and tilth to supply plant nutrients and to control insects, weeds and other pests. In this context, those eco-friendly methods are being considered as environmentally safe, selective, biodegradable, economical and renewable alternative for use in organic farming system. Indigenous agricultural practices can play a key role in the design of sustainable and eco-friendly agricultural systems, increasing the likelihood that the rural population will accept, develop and maintain innovations and interventions. To a great extent, future food security and economic independence of developing countries would depend on improving the productivity of biophysical resources through the application of sustainable production methods, by improving tolerance of crops to biotic and abiotic stresses. In a healthy farming system, agriculture works in harmony with the natural environment. This begins with healthy soil that stores water and nutrients and provides a stable base to support plant roots. In a sustainable system, soil is kept in balance. Crops are rotated in the fields to replenish nutrients in the soil. The animals graze the land, and their waste is used to improve the soil fertility. The idea is that as farmers utilizes the land resources to its full and there is a urgent need to restore soil fertility to achieve the sustainable development.

Keywords: Green revolution, Sustainable production, Biodegradable, Eco-friendly, Organic farming and Biophysical resources

Effect of Organic Treatments on Fruit Quality of Guava (*Psidium guajava L.*)

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The excessive use of chemical fertilizers, pesticides and insecticides has reduced the productivity rate of guava. Hence there is a need to find out ecologically sound and economically acceptable farming systems. Practicing natural and organic based traditional agricultural practices can maintain the agricultural productivity. The material for present study comprised of fourteen organic sources of nutrients, which were T1- FYM (100% replacement of nitrogen through FYM), T2 - Vermicompost (100% replacement of nitrogen through Vermicompost), T3 - FYM + Poultry manure (80% replacement of nitrogen through FYM + 20% replacement of nitrogen through poultry manure), T4 - FYM + Azotobacter (150 ml/plant), T5 - FYM + PSB (150 ml/plant), T6 - FYM + Azotobacter + PSB (75 ml + 75 ml/plant), T7- Vermicompost + Azotobacter (150 ml/plant), T8 - Vermicompost + PSB (150 ml/plant), T9 - Vermicompost + Azotobacter + PSB (75 ml + 75 ml/plant), T10 - FYM + Poultry manure + Azotobacter (80% replacement of nitrogen through FYM + 20% replacement of nitrogen through poultry manure), T11 - FYM + Poultry manure + PSB (80% replacement of nitrogen through FYM + 20% replacement of nitrogen through poultry manure), T12 - FYM + Poultry manure + Azotobacter + PSB (80% replacement of nitrogen through FYM + 20% replacement of nitrogen through poultry manure), T13 - 50% FYM + Jeevamrit (4 litre per plant in 21 days interval), T14 - Control (no application), and their effect were evaluated on the fruit quality of two years old guava cv. VNR bihi. It can concluded that (T12) 80%

replacement of nitrogen through FYM + 20% replacement of nitrogen through poultry manure + Azotobacter + Phosphate Solubilizing Bacteria improve the quality parameters like TSS and pectin content of guava fruits. The superiority of this treatment might be attributed to the continuous supply of nutrients, presence of greater population of microorganisms, and more friable and porous structure of the soil.

Keywords: *Psidium guajava*, poultry manure, Azotobacter, Phosphate Solubilizing Bacteria (PSB), VNR bihi

Jaivik Krishi Inputs for Better Agriculture

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Food safety and quality are two important issues that have drawn a lot of attention. Consumer confidence in food quality has dramatically declined in recent decades as a result of rising environmental consciousness and a variety of dietary risks. Intensive farming and excess use of fertilisers and pesticides has caused bio accumulation and bio magnification of toxins both in soil and food chain. So, in the quest for nutritious food and heathy soil, a search for safer and healthier options is emerging. Using jaivik krishi inputs to regulate nutrients can meet the challenge in agriculture. With the use of jaivik or organic inputs, and managing the amount, source, placement, form, and timing of their application, the task of plant nutrients and soil amendments can be accomplished. They can be prepared from animals and plants and their application will have minimum negative impact on the soil and environment and food. These inputs are concentrated manure bio-products either in liquid or powder form which is prepared after fermenting the animal and plant residues. They are rich sources of microbial consortiums, macro- and micronutrients, and plant growth-promoting substances, including immunity enhancers. They are utilised to treat the seeds and seedlings, enhance the decomposition of organic materials, enrich the soil, and induce better plant vigour. They include amrit mitti, amrit pani, panchagavya, dasagavya, jeevamrit, biodigester extract, vermi wash, bio enhancers with agnihotra ash, biosol, kunapajalam. The given jaivik inputs are be applied to soil which not only help in maintaining environment health by reducing the level of pollution, but also reduce hazards to human and animal by reducing the level of toxicant in the product. This keeps the agricultural production at a higher level and makes it sustainable. Other advantages, such as, reduction in the cost of agricultural production, improvement in soil health, optimum utilization of natural resources for short-term benefit and conserving them for future generation will not only saves energy for both animals and machine but also reduces the risk of the crop failure.

Keywords: Jaivik inputs, food safety, soil health

Rice-fish-duck based Integrated Farming System: A Sustainable Way for Doubling the Farmers' Income

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In the current scenario, the world population is rising at an alarming rate. On the other hand, small and marginal land holdings become a major challenge because most of the farmers own less than 2 hectares of land leading to the reduced agricultural income. Additionally, the majority of farmers use monocrop cultivation which results in the groundwater pollution, natural ecosystem imbalance, and the increased risk of plant disease and pest outbreaks. To overcome these problems, an integrated farming system (IFS) could be a viable option. IFS approach which can provide the additional income, employment, nutritional security, and environmental sustainability to the farmers. IFS is the most practical alternative for combining several types of agriculture and related industries, such as cropping systems, horticulture, forestry, livestock, poultry, sericulture, duckeries, and fisheries to increase per unit productivity and profitability. Moreover, nowadays a rice-fish-duck integration system is adopted widely to reduces environmental pollution by recycling farm waste produced on the farm itself and by reducing the reliance on outside farm inputs. The waste is mixed into the soil directly which improves the physical, chemical, and biological health of the soil. The widespread use of this technology throughout India would enhance and sustain the livelihood of small and marginal farmers and allow them to double their income from the same piece of land, while creating more jobs and satisfying the nutritional needs of their families. Ecosystems in rice fields offer a great setting for integrating compatible species like fish and duck, which boosts overall productivity through efficient nutrient recycling. The rice-fish-duck integration makes the most of ecological niches and converts them into potential production processes, improving farm output, farmer income, and soil health through efficient nutrient recycling in the rice ecologies.

Keywords: Ecosystems, Integrated Farming System, Nutritional Security, Rice-Fish-Duck Integration, Sustainability

Feasibility of Crop Intensification through Intercropping of Legumes in FCV Tobacco

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FCV tobacco is one of the commercial crops grown in southern transitional zone of Karnataka. The crop is grown during *Kharif* season as *rainfed* crop in the light soil area, popularly known as Karnataka Light Soils (KLS). It is planted at a distance of 90 cm between rows and 60 cm between two plants. Generally, this crop is grown as a sole crop in *Kharif* season. However, due to initial slow growth and wide spacing, the inter row spacing can be utilized by taking short duration legumes to get more benefit and productivity per unit areas without any negative effect on growth, yield and quality of FCV tobacco. A field experiment was carried out at Zonal Agricultural and Horticultural Research Station, Navile, Shivamogga during *Kharif* season of 2021. The soil of the experimental site was sandy loam in texture and considered as *Typic Haplustalf* as per USDA system of soil classification. The experiment was laid out in RCBD with eleven treatments involving FCV tobacco intercropped in skip rows by maintaining 50 % of the plant population compared to its cultivation as sole crop with greengram, blackgram, cowpea, fieldbean, groundnut and sole FCV tobacco replicated four times. The results revealed that FCV tobacco + ground nut recorded significantly higher cured leaf yield of FCV tobacco (1771 kg ha^{-1}) as compared to sole FCV tobacco. Also, the better values of intercrop indices were observed in FCV tobacco + ground nut in term of higher tobacco equivalent yield (2124 kg ha^{-1}), land equivalent ratio (1.62) and monetary advantage index (^{1} 147472) and B: C (2.36) compared to sole FCV tobacco. However, highest area time equivalent ratio (1.51) was observed in FCV tobacco + black gram followed by FCV tobacco + green gram (1.47) and FCV tobacco + groundnut (1.43). Further, FCV tobacco + Black gram showed higher uptake of N (40.28 kg ha^{-1}) and K (114.14 kg ha^{-1}), whereas, significantly higher uptake of P (7.68 kg ha^{-1}) was observed in FCV tobacco + Groundnut intercropping system. Further, the chemical quality parameters, *viz.*, nicotine, reducing sugars and chloride in leaf lamina were within the acceptable limits.

Keywords: Crop intensification, intercropping, FCV Tobacco

Natural Farming - A Stairway to Sustainable Agriculture Development and Prosperity

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India has moved from food deficiency to food surplus mainly on account of the Green Revolution. Food production in the country reached 303.34 million tonnes during 2020-21 ensuring the national food security and poverty reduced from 70 to 20%. However, the self-sufficiency through Green Revolution was achieved at the expense of polluting soil, water and air due to the continuous and indiscriminate use of fertilizers and pesticides for cultivating crops which overall decreased the crop productivity. To increase the yields, the farmers have to buy ever-increasing costly external inputs which have pushed many farmers into the vicious cycle of poverty and led to farmers' being distress. Apart from this, farming has become further challenging due to the rapidly changing climate and its impact on agriculture. Green House Gases (GHGs) emission from agriculture is increasing due to the unsustainable management of crops and livestock and if happens continuously the countries food grain production will be declined. However, to feed the growing population, there is a need for producing 70 million more food grains by 2030. Hence, there is a need for a developing the sustainable production system. Thus, among many models, natural farming is one of the options to produce crops sustainably because it is an agro-ecology-based diversified farming system that incorporates crops, trees, and livestock, permits functional biodiversity and reduces the detrimental effects of chemical farming on the soil. It also aims to reduce farmers' costs by excluding external inputs and consuming in-situ resources to restore soils, while at the same time increasing incomes, and renovating ecosystem health through diverse multilayered cropping systems and thereby providing high-quality healthy food at the best price. Natural farming might help the country to move from the green revolution to an evergreen revolution, without deteriorating soil health, water and the environment, while ensuring the farm productivity, profitability, social and economic security.

Keywords: Farmers, Green revolution, Natural farming, Sustainable agriculture

Integrated and Nature Friendly Farming

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Integrated farming system (IFS) is based on ecological principle where not only crops but various plants, animals, poultry form a diverse ecological system which in turn helps to improve the productivity and sustainability. The fundamental idea of this practice is to increase ecological diversity

by using mixed cropping, crop rotation, crop combination and intercropping as acceptable cropping methodologies to reduce competition for water, food, and space. IFS is a labour- intensive system that create employment to the farmers throughout the year. IFS induces collective purchasing of inputs and collective marketing of produce among farmers which in turn leads to good productivity and profit margins. It takes 3-4 years to establish a well-integrated farm with market linkages to ensure the livelihood of a family. If large numbers in a village adopt this practice then plenty of business and employment opportunities can be created. *Three major components of the IFS are crops, livestock, birds, and trees.* One of the major benefits of an IFS is it helps to reduce the risk involved in farming especially due to fall market price as well as adverse effect of natural calamities. Natural farming was first coined by **"Masanobu Fukuoka"** in his book "The One-Straw Revolution". He describes it as" the natural way of farming" or "do-nothing farming". Natural farming is the farming technique that involves less human interference and sole depends on natural processes and is considered an environmentally sustainable way of growing food. Natural farming doesn't involve any man-made inputs like machinery, fertilizers, or pesticides etc. for growing plants, but adopts zero budget principle and encourages to grow healthy soil with friendly earthworms and thereby grow healthy plants. All the essentials nutrients for the plants are supplied by only natural means. Crop rotation, green manures and compost, biological pest management, and mechanical cultivation are the main techniques used in the nature farming. Natural insect predators are promoted, crops are rotated to confuse pests and refresh soil, and natural materials like potassium bicarbonate and mulches are utilized to manage disease and weeds. These strategies use the natural environment to increase agricultural productivity. Natural Farming is also called as spiritual farming. It is the way of life. Natural farmers will not just think about the yield of the crop, but thinks beyond about the bio-diversity and symbiotic relationship between plants and animals. He will be connected to nature and thinks inclusive about all the creatures. Eventually, a natural farmer will have a good health and will provide healthy food to the society.

Keywords: Integrated farming, Natural farming, healthy soil, bio-diversity

Studies on Organic Farming in Radish [*Raphanus sativus* (L.)] under Coastal Region of Karaikal

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A field experiment was conducted at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puducherry, India during 2017-20 to compare the sole organic and it's combination with inorganic sources of nutrients management in radish (var. Pusa Chetki). The seven treatments includes T_1: conventional practices (recommended FYM + fertilizer + plant protection with chemicals) + fertilizers; T_2: vermicompost equivalent to 100% N recommended for each of the crop (plant protection

with organic methods); T_3: FYM equivalent to 100% N recommended for each of the crop (plant protection with organic methods); T_4: conventional practices (recommended FYM + fertilizer + plant protection with chemicals) + IIHR microbial consortium @ 12.5 kg ha^{-1}; T_5: vermicompost equivalent to 100 % N recommended for each of the crop + IIHR microbial consortium @ 12.5 kg ha^{-1} (plant protection with organic methods); T_6: FYM equivalent to 100 % N recommended for each of the crop + IIHR microbial consortium @ 12.5 kg ha^{-1} (plant protection with organic methods); and T_7: safe production practices (recommended FYM + fertilizer + plant protection with organic methods) + IIHR microbial consortium @ 12.5 kg ha^{-1}. Among the 7 treatments, the conventional practices (recommended FYM + fertilizer + plant protection with chemicals) + IIHR microbial consortium @ 12.5 kg ha^{-1}[T_4] registered the highest leaf fresh weight $plant^{-1}$(130.80 g), root length (20.81 cm), root diameter (5.11 cm) individual root weight (312.06 g) with highest yield (348.73 q ha^{-1}) in radish. It will ensure the sustainability in production and maintaining soil health along with pollution free environment.

Keywords: Organic farming, Radish, IIHR microbial consortium, Vermicompost

Effect of *Salvinia molesta* Vermicompost on Soil Fertility and Crop Productivity on Paddy-groundnut Cropping System in Udupi District of Coastal Karnataka

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A field experiment was conducted during the *kharif* and *rabi* 2021-22 on sandy loam soil at Zonal Agricultural and Horticultural Research Station, Brahmavara, Udupi, to evaluate the "Effect of *Salvinia molesta* Vermicompost on Soil Fertility and Crop Productivity on Paddy-Groundnut Cropping System in Udupi District of Coastal Karnataka. The treatments comprised of application of *Salvinia molesta* vermicompost at 3.3, 6.6, 9.9 and 13.2 t ha^{-1} + 45: 30: 75 kg N: P_2O_5: K_2O ha^{-1}, which was tested against RDF (Recommended dose of fertilizer) for comparison. The study revealed that application of 13.2 t ha^{-1} *Salvinia molesta* vermicompost + 45: 30: 75 kg N: P_2O_5: K_2O ha^{-1} recorded significantly higher plant height (89.54 cm), total number of tillers m^{-2} (520.24), total dry matter production (77.52 g $plant^{-1}$), number of productive tillers m^{-2} (499.95) and panicle length (21.86 cm), compared to other treatments, and however, was at par with the application of 9.9 t ha^{-1} *Salvinia molesta* vermicompost + 45: 30: 75 kg N: P_2O_5: K_2O ha^{-1}. Due to the impact of the above parameters mentioned treatments the maximum grain yield (5231 kg ha^{-1}) and straw yield (6657 kg ha^{-1}) achieved, as well as it also enhanced the

nutrient uptake (119.7 kg ha^{-1} of N, 35.80 kg ha^{-1} of P, 106.98 kg ha^{-1} of K) in the paddy. The mentioned treatment recorded significantly higher pod yield (1598 kg ha^{-1}) and kernel yield (1134 kg ha^{-1}) in groundnut due to the residual effect of application of 13.2 t ha^{-1} *Salvinia molesta* vermicompost + 45: 30: 75 kg N: P_2O_5: K_2O ha^{-1} and was at par with application of 9.9 t ha^{-1} *Salvinia molesta* vermicompost + 45: 30: 75 kg N: P_2O_5: K_2O ha^{-1}. Based on economics, it was observed that application of 9.9 t ha^{-1} *Salvinia molesta* vermicompost + 45: 30: 75 kg N: P_2O_5: K_2O ha^{-1} recorded maximum net returns (₹ 113511 ha^{-1}), B: C ratio (3.48) and economic efficiency (₹ 732 ha^{-1} day^{-1}) in paddy-groundnut cropping system under coastal conditions of Udupi, Karnataka.

Keywords: *Salvinia molesta* Vermicompost, Soil Fertility, Cropping system, Paddy-groundnut

Exploitation of Actinobacterial Isolates for Eco-friendly Management of Insect Pests

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In present days, crop protection is becoming an unavoidable event in order to maintain productivity. Enhancing biocontrol approaches in pest management over chemical method is gaining much importance. Many microorganisms have been found to be effective in protecting crops against insect pests. Microbial pesticides are derived from living organisms like bacteria, fungi, protozoa, viruses etc those are environment friendly and safe. Among them, gram positive bacteria such as actinomycetes and Bt are widely used. Among the microbes, actinomycetes are reported to produce about 45 per cent of the bioactive compounds and 80 per cent of antibiotics are available in the genera Micromonospora and Streptomyces sp. These are capable of producing antibiotics, secondary metabolites and bioactive compounds like lomofungin, spoaxmicin, sclerothricin, antimycin, rosamicin, avermectin, validamycin and rifamycin. Several Streptomyces metabolites have been identified as possible protective agents against a variety of insect pests such as ivermectin, emamectin benzoate, polynactin, milbemycin and spinosad. We have evaluated five different actinobacterial isolates viz. DBT-64, DBT-80, DBT-59, DBT-209 and neem leaf -1 @ 500, 1000, 1500 and 2000 ppm along with one biocontrol agent i.e. Metarhizium rileyi from Institute of Organic Farming (IOF), UAS Dharwad as a reference strain and one microbial based insecticide, spinosad 45 SC @ 0.2 ml/l used as a standard check and water treatment was used as untreated control were screened for their bio-efficacy against tobacco caterpiller, *Spodoptera litura*. These Actinomycetes could cause significant mortality in 3rd and 4^{th} instar larvae and also caused deformity in pupa and adult moths. Actinomycetes play an important role in the biological control of insects through the production of a large variety of insecticidal active compounds against different order of insects. Hence, actinomycetes can be exploited as a biocontrol agent alternative to chemical insecticides which is environmentally safe and eco-friendly in nature.

Keywords: Actinomycetes, biocontrol, pest management

Effects of Conservation Agriculture in Rice-based Cropping Systems on Soil Aggregation and Crop Yields in Bangladesh

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Although the rice-based cropping systems are the major food supplier to the Eastern Indo-Gangetic Plain (EIGP), they have negative effects on soil physical properties, and that constrains rabi crop yield. Conservation agriculture (CA) is being introduced to overcome these problems. A 5-yr permanent plot study evaluated effects of three types of crop establishment (CE)– strip planting of non-rice crops and non-puddled of rice crops (SP), no-tillage of non-rice crops and non-puddled of rice crops (NT) and conventional tillage of non-rice crops and soil puddling for rice crops (CT); and two levels of crop residue retention – high residue retention (HR) and low residue retention (LR) on soil physical properties and crop yield. Bulk density of the 0-7.5 cm soil layer was higher under CT treatment (1.33 g/cc) than under SP and NT (1.29 g/cc). The gravimetric soil water content of the 0-7.5 cm soil layer was higher under CT and SP treatments (34.6-34.7 %) but lower under NT treatment (33.1 %). By contrast, the gravimetric soil water content at 7.5-15 cm soil depth was higher in CT than NT and SP treatments. At 0-7.5 cm soil depth, the plot under NT had higher percentage of the water stable aggregates (WSAs) > 2 mm followed by the plot under SP and the lowest under CT, while the percentage of small-size WSAs (0.053-0.25 and <0.053 mm) were higher in CT than SP and NT. On average, about 14 % higher water stable macro-aggregates (MacA) was observed in SP and NT, while the micro-aggregates of SP and NT were lower by 20-25 % than CT. The mean weight diameter (MWD) was higher in NT and SP by 21 % and 16 %, respectively. Likewise, GMD (Geometric Mean Diameter) and AR (Aggregate Ratio) also showed similar trend. Compared with LR, on average, the WSAs > 2 mm, MacA, MWD, GMD and AR was higher in HR at 0-7.5 cm soil depth. At 7.5-15 cm soil depth, WSAs > 2 mm and MWD were higher in CT than SP and NT: WSAs > 2-0.25 mm (medium and small aggregates) under SP and NT, however, was higher than CT. After five years of the experiment, the seed and straw yield of mustard increased by 16 % and 24 % in SP over CT, and the HR increased seed and straw yield by 6 % and 11 % over LR, respectively. However, further research is required to assess the effects of changed aggregate size distribution on associated carbon and other nutrients in soils of the EIGP.

Keywords: Conservation agriculture, soil properties, crop yield

Effect of Different Dosage and Frequency of Liquid Jeevamrutha on Soil Microbial Population and Yield of Marigold (*Tagetes erecta* L.) cv. Calcutta Orange

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The field experiment was conducted at Horticultural Research and Extension Centre, Kanabargi Tq&Dist: Belagavi, Karnataka during 2019-20 and 2020-21 with an objective to study the influence of different dosage and frequency of liquid jeevamrutha application on soil microbial population (bacteria, fungi and actinomycetes) and yield of marigold. The experiment consisted of ten treatments combination of different dosage (@ 500, 750 and 1000 l/ha) and frequency of liquid jeevamrutha application (at 15, 21 and 30 days intervals) and were compared with control (RPP: recommended package of practice). The pooled analysis of the two years data revealed that, significantly higher bacterial (15.77 X 10^6CFU/g of soil and 11.64 X 10^6 CFU/g of soil at flowering stage and after harvest, respectively), fungal (3.78 X 10^3 CFU/g of soil at flowering stage) and also actinomycetes population (4.94 X 10^3CFU/g of soil and 4.03 X 10^3 CFU/g of soil at flowering stage and after harvest, respectively) was recorded when higher dosage (1000 l/ha) of liquid jeevamrutha was applied at 15 days interval as compared to other treatments. Significantly highest marigold yield (9.59 t/ha) was recorded when liquid jeevamrutha applied @ 1000 l/ha at 15 days interval as compared to other interaction treatments. However, RPP recorded significantly highest marigold yield (10.71 t/ha) as compared to all other treatments.

Keywords: Marigold, Microbial population, Liquid jeevamrutha, Dosage, Yield

Socio-economic Status of Natural Farming Farmers in Mandi district of Himachal Pradesh

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Natural farming is eco-friendly and cost-effective traditional farming method. To fulfill the food grain demand of growing population the traditional farming is now replaced by modern chemical farming approach with high yielding varieties, chemical fertilizers and pesticides. This posses a negative impact on soil health, human health and environmental health. Beside this, the conventionally grown food

depends upon market inputs which also raise the input cost to farmers. Recently, this natural farming approach again become popular in India as it is considered to be cost effective and climate resilient farming approach compared to conventional farming. Himachal Pradesh state government has launched Prakritik Kheti Khushal Kissan yojna in the year 2018. Based on this, the present study was conducted in Mandi district of Himachal Pradesh with the objective to study the socio-economic status of natural farmers in the state. A sample of 60 farmers was selected through simple random sampling from a secondary list of farmers practicing natural farming were obtained from Projector Director ATMA, Mandi. The study highlighted that the majority of farmers were marginal and small and were categorized based on their land holding and were dependent on agriculture as income source for their livelihood. The concept of natural farming relies on the use of natural amendments made from local cow dung and cow urine. Therefore, the maximum livestock inventory in the study area was of indigenous cow which help the farmers to reduce their input cost and also increase their source of income. Further, the study highlighted that under natural farming, farmers adopted various crop combinations such as Cereal-Pulses, Cereal-Vegetables, Vegetables-Pulses and Cereals-Vegetable-Pulses in both Kharif and Rabi season. The findings also showed that the agriculture sector generate maximum income to the farmers in the study area. Thus, it can be concluded that natural farming is a sustainable farming approach which can be generate large number of benefits to the farmers if continuously adopted in the long-run.

Keywords: Natural farming, Conventional farming, sustainable farming, Mixed cropping

Standardization of Organic Nutrient Management Practices for Bhendi

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A field experiment was carried out at organic farming research centre, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, during Kharif season of 2020-21 to evaluate suitable organic nutrient management practices in Bhendi crop (Arka Anamika Variety). The experiment was conducted in Randamized Block Design comprising of nine treatments involving different levels of FYM, Vermicompost and combinations of both FYM and Vermicompost. Among the different treatments, application of recommended dose of FYM (25 t/ha) along with 100% N equivalent vermicompost (T5) recorded significantly highest number of fruits per plant (10.4) and fruit yield (7.6 t/ha) and the treatment was on par to FYM (25 t/ha) along with 100% N equivalent FYM (T1). Both T5 and T1 treatments were significantly superior over other treatments, the significant variation was observed among the treatments for available nitrogen, phosphorus potash in soil. Organic nutrient management practices significantly enhance the availability of calcium, iron, copper, manganese and zinc status in the soil. The soil microbial population such as bacteria, fungi,

actinomycetes, P solubilizers and nitrogen fixers were estimated at initial 30, 60 days of sowing and at harvest and their population was also observed maximum in the same treatment.

Keywords: FYM, Vermicompost, Organic nutrient management, Bhendi

Effect of Management Practices on Productivity and Nutrient Uptake in Paddy

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A field experiment was carried out at Organic Farming Research Centre, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, during kharif seasons of 2021-22, to find out the suitable organic nutrient management practices for higher productivity and maintenance of soil fertility in paddy variety Siddasanna. The experiment was comprised of application of different liquid organic manures such as Jeevamruta, Cowurine, Bio-digester liquid and Vermiwash@ 200 l / ha at 25,50 and 75 days after transplanting. The rice grain (5623 Kg/ha) and straw yield (7255 Kg / ha) was significantly higher with the application of Jeevamrutha, similarly the maximum organic carbon (7.58 g Kg^{-1}) and N (150.43 Kg ha^{-1}), P (26.73 Kg ha^{-1}) K (135.62 Kg ha^{-1}) uptake. The soil microbial population such as bacteria, fungi, actinomycetes, P solubilizers and nitrogen fixers were also maximum in the same treatment. Different source of liquid organic manures seemed to have differential effects on growth, yield and soil health of paddy. Application of jeevamrutha helps in sustaining crop productivity and maintaining soil health.

Keywords: Jeevamruta, crop productivity, soil health

Effect of Different Dosage of Liquid Jeevamrutha and Ghanajeevamrutha on Soil Physical Parameters and Yield of Guava (*Psidium guajava* L.) cv. L-49

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The present study was conducted at Regional Horticulture Research and Extension Center, Kumbapur, Dharwad during 2019-20 and 2020-2021 with an objective to study the influence of application of

different dosage of liquid jeevamrutha and ghanajeeva mrutha on soil physical parameters (soil moisture and bulk density) and yield of guava. The experiment consists of twelve treatment combination of different dosage of liquid jeevamrutha (500, 750 and 1000 l/ha) and ghanajeevamrutha (1000, 1250 and 1500 kg/ha) and were compared with control treatment (recommended package of practice). Organic mulching in the form of paddy straw was applied to all the treatments except control. The results of the pooled data of two years data revealed that, there was no significant difference among the interaction treatments but, significantly highest (9.42 %) soil moisture was recorded with application of higher dosage of liquid jeevamrutha (1000 l/ha) and ghanajeevamrutha (1500 kg/ha) and significantly lowest (6.22 %) was recorded in control treatment (mulching was not applied). Bulk density was affected by different interactions treatments and also when interactions compared with control treatment. But, there was a slight decrease in bulk density with the application of higher dosage of liquid jeevamrutha and ghanajeevamrutha with numerically lowest (1.22 g/cc) bulk density recorded with application of higher dosage of liquid jeevamrutha (1000 l/ha) and ghanajeevamrutha (1500 kg/ha). With respect to yield, significantly highest yield (20.08 t/ha) was recorded in RPP (recommended package of practice) in pooled data. Among the interaction treatments, significantly highest yield (18.43 t/ha) was recorded with application of higher dosage of liquid jeevamrutha (1000 l/ha) and ghanajeevamrutha (1500 kg/ha).

Keywords: Guava, Liquid jeevamrutha, Ghanajeevamrutha, Soil moisture, Bulk density

Agronomic Management Practises for Enhancing Carbon Sequestration in Soil

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Climate change in India is threatening food security due to the tropical monsoon climate and the poor coping capacity of small and marginal farmers. The Inter-Governmental Panel on Climate Change (IPCC) has projected a rise in the global mean surface temperature of 1.1–6.4°C by 2100. There remain two serious but inter-related problems: (i) expected food demand to feed rapid growing population and must be met from the shrinking land resource base and (ii) severe problems of degradation of soil and water resources, leading to a reduction in the use efficiency of inputs, pollution of surface and ground waters, and the emission of greenhouse gases (GHGs) from terrestrial ecosystems into the atmosphere. Soil carbon sequestration refers to the capacity of agriculture lands and forests to remove carbon dioxide from the atmosphere. Carbon dioxide is absorbed by trees, plants and crops through photosynthesis and stored as carbon in biomass in tree trunks, branches, foliage and roots and soils. Sequestration of atmospheric carbon both in the vegetation and soil might be an effective means of mitigating the aforementioned feathers. On the other hand, decreasing CO_2 emissions from soil to the atmosphere means returning the exceeding atmospheric C into the terrestrial pool, and sequestering carbon in soil turns soils from sources to sinks of carbon. The continuous vegetation on soil surface

ensures good soil health and soil C concentration at variable depth as per the specific crop. The C sequestration potential and the amount of organic C returned by crop plants rest on specific plant species, depending on the nature of growth, root morphology and physiology, leaf morphology, climatic conditions, soil texture, structure and aggregation, prevailing cropping system, and agronomic interventions during crop growth period. The above-ground plant biomass, e.g. plant leaves, branches, stem, foliage, fruits, wood, litter-fall, etc., and below-ground plant biomass directly contribute to the SOC buildup. Several agronomical management practices help to increase the sequestration of carbon by increasing carbon inputs to the soil and enhancing various soil processes that protect the carbon from microbial mineralization. An increase in soil carbon leads to improvements in soil structure and fertility. Soil organic carbon stock can be increased by proper adoption of tillage operation, retention of crop residues and through proper nutrient management. Therefore, practicing conservational agriculture that focuses on crop residue management, zero tillage and integrated nutrient management, encompassing manures and other C-rich resources sustains soil health and increases SOC sequestration. Moreover, location-specific scientific research is needed to point out the best management practices that enhance improve soil health, boost crop production and SOC sequestration, and minimize greenhouse gas release in the biosphere. In fact, more research to quantify the C sequestration potential with a higher degree of confidence is required under different soil management situations.

Keywords: Soil organic carbon, Sequestration, Environment, Soil health, CO_2

Importance of Sustainable Agriculture Practices for Environment

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Over centuries, farmers in India devised practices to keep our farms sustainable. Practices like mixed cropping, crop rotation using organic manure and pest management kept our agriculture sustainable. Soon after green revolution in 1965 has changed the things and made the farming more chemical friendly. The chemical friendly farming has created lots many problems for the ecosystem, and to reduce the burden of chemical in agriculture it is a need of time to switch towards sustainable agriculture. Sustainable agriculture offers a high yield production without any destruction to our natural environment. Sustainable the word itself means to last for a long-time involving methods or practices that do not use up or destroy our natural resources. Sustainable agriculture integrates three main goals i.e., environmental health, economic profitability and social and economic equity. Sustainable agriculture involves such practices and techniques that would produce healthy crops. Sustainability based on the principle that we must meet the needs of the present without compromising the ability

of future generations to meet their own needs. Both natural and human resources are of prime importance. It has several benefits over conventional agriculture practices as it preserves our environment, protect human health and uphold animal welfare. Most important benefit of sustainable agriculture is minimized use of chemical pesticides and fertilizers with good crop yield.

Keywords: Sustainable, Fertilizer, Pesticides, Agriculture, Resource

Integrated and Nature Friendly farming in Agriculture and Moriculture as a Substitute to Chemical fertilizers: A Review

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Fertilizers supply fundamental plant supplements, such as, nitrogen (N), potassium (K), phosphorous (P) to the palnts. These fertilizers increment the yield of the harvest yet they cause a several health hazards. Because of these health hazards, the preference of consumers is shifting towards organic farming which utilizes the organic manure and organic fertilizers. In recent years, organic manures along with biofertilizers has gain much attend due their biological nitrogen fixation ability. They offer an economically attractive and ecologically stable foundation of providing supplements to the plants. Biofertilizers are low cost renewable source of nutrients that supplement the chemical fertilizers to the plants. Biofertilizers also gained importance because of its low cost amongst small and marginal farmers.

Keywords: Biofertilizers, Fertilizers, Organic Manures

Conservation Agriculture: Problems, Prospects, and Issues

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Minimal soil disturbance, crop leftovers or cover crops to keep the soil covered, and crop rotation with pulse crops are all examples of conservation agriculture. Even though there are numerous barriers to the effective adoption of CA, initiatives to create, improve, and spread conservation technology

have been ongoing in India over the past 20 years and have achieved notable progress since then. Adoption of CA has more benefits than drawbacks, but both adopters and promoters are aware of how the two factors must balance one another. Through the use of CA technology, it is possible to lower production costs, conserve water and nutrients, boost yields, diversify crops, optimize resource utilization, and protect the environment. However, there are still barriers to the promotion of CA technologies. These include the lack of suitable seeders, particularly for small and medium-sized farmers, the conflict between CA use and livestock feeding over crop residues, the burning of crop residues, the lack of skilled and scientific labor, and the need to change people's perceptions about tillage. The need to develop the policy frame and strategies is urgent to promote CA in the region. This paper reviews the emerging concerns due to continuous adoption of conventional agriculture systems, and analyses the constraints, prospects, policy issues and research needs for conservation agriculture in India.

Keywords: Conservation agriculture, Conventional agriculture, Constraints, Prospects and policy of CA adoption, Resource use efficiency

Effect of Carbon Sequestration on Agriculture, Soil and Environment

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Carbon sequestration is defined as the process of capture and long-term storage of atmospheric carbon dioxide (CO_2) in a stable state. This process can be direct or indirect, and can be biological, chemical, geological, or physical in nature. When inorganic CO_2 is sequestered directly by plants through photosynthesis or through chemical reactions in the soil, this process is often called "carbon fixation". Biological processes that occur in soils, wetlands, forests, oceans, and other ecosystems can store CO_2. These uptake mechanisms are sometimes called "carbon sinks." Before the dramatic increase in carbon emissions during the Industrial Revolution, global carbon cycle, or "carbon flux" maintained a near balance between uptake of CO_2 (sinks) and its release back into the atmosphere (sources). Today existing uptake mechanisms are insufficient to offset accelerating emissions – for example, USGS reports the United States emits about 1.6 gigatons (billion metric tons) of carbon but uptakes only about 0.5 gigatons, resulting in a net release of about 1.1 gigatons per year. You can learn more about global, national, and state emission trends from the Carbon Dioxide Information Analysis Center here. By applying best management practices to existing systems additional carbon inputs can be stored through activities such as peat production, reforestation, and wetland restoration. Non-biological processes are not detailed in this resource summary, which focuses on terrestrial and aquatic processes

relevant to the conservation sector, but you can learn more about point source capture and geological storage processes here. The IPCC offers detailed guidance on the mitigating potential of carbon sequestration and storage interventions for the energy sector here.

Keywords: Carbon sequestration, biomass, soil organic carbon, carbon dioxide

Resource Conservation Technologies: A Way Forward to Restore Productivity and Profitability of Rice-wheat system of IGP Belt under Changing Climate

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The success of crop production in a particular region is chiefly governed by the availability of various natural resources viz., soil, water, vegetation and climate. Boundless increase in population and their standard of living place huge pressure on these nature-gifted resources. In fact, the increase in productivity is at the expense of deterioration in the natural resource base. The major reason behind this is the adoption of faulty production practices like intensive tillage, improper method of crop establishment, poor nutrient, water and weed management, and non-adoptability of modern techniques in raising crops. Resource conservation is a concept that deals with resource-saving agricultural crop production, and strives to achieve acceptable profits with sustained higher production levels and improved livelihood while conserving the environment and maintaining soil fertility. Resources conservation technologies (RCTs) refers to those management practices or techniques which conserve and ensure optimal utilization of various on-farm resources (soil, seed, water, nutrient and energy) and thereby increase factor productivity including land, labor, capital and inputs. RCTs primarily focus on resource saving through minimal tillage, ensuring soil nutrients and moisture conservation through crop residues, cover crops and adoption of spatial and temporal crop sequencing. Furthermore, RCTs are cost-effective technologies easily adoptable by the small and marginal farmers of the country. Apart from this most of these technologies are eco-friendly in nature and effectively reduce the green hose gas load in the atmosphere and thereby helping us to promote climate-resilient agriculture. Thus, the identification and adoption of appropriate RCTs suitable to a particular cropping system (Rice-Wheat) is the urgent need of the hour as a method of 'low-input agriculture' to reduce costs and achieve sustainability in Indian agriculture.

Keywords: RCTs, R-W System, productivity, profitability and climate change

Surface Runoff Estimation using Google Earth Engine for Lower Bhavani Basin, Tamil Nadu

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Water is one of the most valuable assets of the earth, which has been considered the supreme natural resource and an essential commodity for the socio-economic development of any country. The most important step in managing water resources is estimating watershed runoff generated from rainfall, as the runoff and rainfall are the key factors in determining water availability for surface storage and groundwater recharge. Conventional methods of runoff estimation are expensive, time consuming and difficult process and these methods of runoff measurements are not easy for hilly and inaccessible terrains. Remote sensing technology can augment the conventional methods to a great extent in rainfall-runoff studies, plays a vital role in acquisition of data in the different aspects of land use and soil cover, which are essential parameters in the field of watershed runoff estimation. So, this study focused on estimating the surface runoff generated from lower Bhavani basin, Tamil Nadu, India, utilizing open-data sources and cloud computing platform for the span of 4 years (2019–2022) through the Soil Conservation Services curve number (SCS CN) model. It was inferred that the runoff during November 2021 was maximum in comparison with the rest of the years followed by October, 2019 in the study area. GEE showed significant versatility and proved to be an effective platform for rainfall-runoff estimation.

Keywords: Google earth engine,Rainfall,Remote Sensing, Runoff

Climate Smart Agriculture: An Approach to Sustainable Agriculture

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The agriculture sector faces quite some challenges in the future as it has to address the fact that almost one billion people go to bed hungry every day, while more than two billion people will be added to the global population by 2050. Agricultural issues are exacerbated by climate change, particularly in

developing nations. Climate change's negative impacts are already being felt, in the form of increasing temperatures, weather variability, shifting agro-ecosystem boundaries, invasive crops and pests, and more frequent extreme weather events. On farms, climate change is reducing crop yields, the nutritional quality of major cereals, and lowering livestock productivity. Unless we modify our approach towards planning and investment for agricultural growth and development, we risk misallocating human and financial resources, generating agricultural systems incapable of supporting food security and accelerating climate change. Climate-smart agriculture (CSA) can avoid this 'lose–lose' outcome by integrating change in climate into the look and implementation of sustainable agricultural strategies, by simultaneously tackling three challenges: enhanced climate change adaptation, mitigation, and global food security - through novel policies, practices, and finance. Climate smart agriculture is not a set of practices that can be universally applied but rather an approach that involves different elements embedded in local context. CSA promotes coordinated actions by farmers, researchers, private sector, civil society and policymakers towards climate-resilient pathways through four main action areas: (1) building evidence; (2) increasing local institutional effectiveness; (3) fostering coherence between climate and agricultural policies and (4) linking climate and agricultural financing. Coordination across agricultural sectors (e.g. crops, livestock, forestry and fisheries) as any other sector is essential to maximize possible synergies, minimize trade-offs, and maximize the use of natural resources and ecosystem services, to strengthen livelihoods and food security, especially of smallholders, and to adopt appropriate methods and technologies for the assembly, processing and marketing of agricultural goods. CSA differs from 'business-as-usual' approaches by emphasizing the capacity to implement flexible, context-specific solutions, supported by innovative policy and financing actions. CSA takes into consideration the social, economic, and environmental context where it'll be applied. Thus, identifying appropriate ways to incentivize the uptake of climate smart alternatives is a key priority.

Keywords: Climate-smart agriculture, climate change, Food security

Climate Smart Agriculture

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As a means of adapting to climate change, boosting agricultural output and incomes while lowering greenhouse gas emissions, climate smart agriculture (CSA) can be described as a strategy for changing and reorienting agricultural systems to enhance food security in light of the new climate change realities. The majority of the world's poor, who depend on agriculture for their livelihoods, are made more vulnerable by widespread changes in rainfall and temperature patterns that endanger agricultural production. Market disruptions caused by climate change put the availability of food at risk for the entire population. By enhancing farmers' adaptive capacity as well as agricultural production systems' resilience and resource use efficiency, threats can be lessened. CSA is a strategy to boost environmental investment, environmental policy, and environmental technology to achieve sustainable agricultural expansion for the protection of food under climate change. A variety of tactics can be used to accomplish

the goals of climate aware agriculture. Energy-smart food systems, for instance, depend heavily on the utilization of integrated renewable energy technology for farming, such as wind turbines, solar panels, pyrolysis units, and bioenergy-powered water pumps. In order to avoid warm weather that is bad for grain filling, resource-conserving technologies (RCTs) like zero tillage allow farmers to sow wheat shortly after rice or cotton harvest. A more effective CSA technique is the introduction of recently produced cultivars that are tolerant of heat, drought, and salinity. Regions and crops that are particularly vulnerable to climate change must be distinguished in order to be relocated to better locations. To reduce the risks of climate losses, the weather forecast and early warning systems will be highly beneficial. Administrators and academics can effectively use information and communications technology (ICT) to create contingency strategies. Computer-aided crop simulation models can help determine the potential impact of climate change on future crop yields, as well as the development of climate-smart agriculture practices and mitigation strategies.

Keywords: climate smart agriculture, Computer-aided crop, smart food systems, communications technology

Multitemporal Analysis of South Delhi using Geospatial Techniques

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Urbanization and industrialization have altered the landscape of South Delhi through developmental processes, which resulted in the widespread expansion of infrastructure and the decline in vegetation cover. The land use and land cover of South Delhi has been significantly impacted by these changes in the vegetation and infrastructure. South Delhi district is one of the 11 Districts of the NCT of Delhi. South District, having its District Head Quarter at M.B. Road, Saket, has great historical, social, economic & cultural importance. South District of Delhi spread over 247 Sq. Km & covering 16.65% of the total area of the NCT of Delhi. The climate is hot in summer and cold in winter. The rainfall varies from 400 mm to 600 mm. The average temperature of the city varies from 25°C to 45°C from April to July and drops from 22°C to 5°C in December and January. Using geographic information systems (GIS) and remote sensing, the current research work makes an effort to examine the spatial and multitemporal land use and land cover change in South Delhi. The present research study is based on the remote sensing data of Landsat – 7 (ETM+) and Landsat 9 (OLI) of 2002 and 2022, respectively. The data interpretation and analysis of LULCC in South Delhi help us understand the changes in LULCC, their causes, and their impact on the urban environment. A significant change was detected in land use and land cover in South Delhi during the last 20 years (2002-2022). The changes occurred in different land covers like the forest, built-up, and vegetation. All of these changes were due to the increase in population or unplanned urbanization.

Keywords: Urbanization, Infrastructure, Land Use, Land Cover, Urban Environment

Role of Artificial Intelligence (AI) in Sustainable Agriculture

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The population is growing rapidly, and with it, there is a need for food and work. A revolution in agriculture has been sparked by artificial intelligence. The agricultural output has been shielded by this technique from a number of circumstances, including population expansion, job issues, and food security concerns. Artificial intelligence is being used in agriculture for tasks like irrigation, weeding, and spraying using sensors and other tools built into robots and drones. AI in agriculture helps farmers automate their farming practices but also transitions to precise cultivation for higher crop production and better quality while using fewer resources. AI in agriculture enables farmers to increase productivity, lessen adverse environmental effects, and manage any unforeseen natural circumstances. The majority of agricultural startups have adopted enabled methods to boost the productivity of their fields. Approaches enabled by AI could identify diseases or climatic problems earlier and take intelligent action. By emphasizing three significant factors and accomplishments soil management, weed control, and the utilization of the Internet of Things (IoT) this review attempts to describe the current state of artificial intelligence in agriculture. It also assesses the urgent issues that this profession faces, such as the predicted uneven distribution of mechanization in various places, when processing big data sets and other aspects in actual applications and plants are physically heterogeneous, security and privacy challenges, as well as the flexibility of algorithms, come into play. Last but not least, this technology stresses the development of weather forecasting, reducing risk to farmers and making crop and soil health monitoring an effective process. describes potential flaws and nutritional deficits in the soil, the creation of agricultural robots, and the history of this particular field, provides specific instances, and then highlights significant problems. determines the potential applications in the future while also taking distinct national conditions into account.

Keywords: Artificial intelligence, food security, Mechanization

Green House Effect on Crop Growth and Productivity

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Green house gases form a blanket around the earth, trapping heat and raising temperature on the earth surface causing overall warming of earth. Atmospheric gases like water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) etc, have the potential to trap the part of long wave

radiation from the earth surface. These trace anthropogenic gases keep the earth warm and cause global warming or green house effect. (Adger W. N. et. al. 2005). This "fertilization" effect is due to CO_2's influence on water use and photosynthesis. That is, the higher the level of CO_2, the smaller the stomatal openings and the slower the rate of transpiration. Elevated CO_2 increases water use efficiency of plants per unit of leaf area, which tends to reduce water requirements and yield loss due to water stress (Alexandrov, V.A., & Hoogenboom, G., 2000). An increase in atmospheric CO2 enhances the agricultural productivity of land resources because of its direct beneficial effects on crop growth however, increasing concentrations of greenhouse gases warm Earth's climate and thereby modify the potential extent and productivity of agriculture. (Atkin, O.K., & Tjoelker, M. G. 2003).

Keywords: Green house effect, Fertilization, Global warming

Joint Forest Management Programme in Jammu and Kashmir: Socio-Economic Analysis

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Over the last two decades, the Joint Forest Management Programme (JFM) has been a key focus of forest management. The programme is operating with main objective of forest management and empowerment of local livelihoods through sustainable resource utilization and income generation opportunities. JFM involves sharing of responsibilities and rights of local communities and forest department as primary stakeholders in forest management system. It is also supposed to invoke active participation of local people and application of their traditional wisdom and knowledge in countering ecological and economic vulnerabilities in the form of soil erosion, drought condition, loss of soil productivity and scarcity of timber, fuel wood, fodder, plant leaves etc. Keeping in view the importance of JFM Programme, a study entitled "Joint Forest Management Programme in Jammu and Kashmir: Socio-economic analysis" was conducted. The study was conducted in purposively selected "East Forest Circle" of Jammu division. Multistage sampling plan was followed for the selection of respondents. Six forest ranges from East circle having maximum number of JFMCs were selected purposively. Twenty-four committees, four from each selected ranges of East circle were selected through random sampling technique. Eight members from each selected JFMC were selected randomly as treatment group for the study making the sample size to 192 respondents. Two villages from each range (12 villages in total) were also selected through simple random sampling technique. From each selected village nine non- JFMC members were randomly selected. Thus, a total sample of 108 non-JFMC members was selected as control group from these villages. Thereby making a grand sample of 300 respondent including both JFM and Non-JFM respondents were interviewed for assessing the Socio-economic status of Joint Forest Management Programme. Findings of research showed that

JFM programme played crucial role in conservation of forest resources. There was good network of JFMC in different forest divisions of Jammu, which are functioning successfully with certain exceptions. Education level of participants was very low and majority of respondents belongs to marginal category. Agriculture is still as major source of income of communities living in or close the forests. In addition to agriculture daily wage labour was the second best source of income after agriculture. Majority of the respondents had exposure of different training under joint forest management programme. Significant improvement was observed after the successive execution of JFM programme with respect to total number of trees planted, increase in forest cover and increase in different plant species. JFM programme had great impact on community asset creation in the rural areas which is indicated by the construction of Bowalies, Ponds, and Community halls. JFM programme also shown noticeable impact on social participation, extension contact established with field functionaries and livestock possession

Keywords: Joint Forest Management, Ranges, Impact, Livelihood, Production, Fodder

Information and Communication Technology (ICT) for Sustainable Development

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ICT is the convergence of computing, telecommunication and governance policies for how information should be accessed, secured, processed, transmitted and stored. It can be considered to be built on the 4 C's – Computing, Communications, Content and human Capacity. It helps in assessing supply adequacy, modeling different supply and technology alternatives, and factor in different usage technologies. It helps to attain sustainability in infrastructure development (energy, water, and transportation), basic human needs and development (food, health care), economic growth and poverty reduction (agriculture, education) and governance. This can include the development of dynamic Geographic Information Systems (GIS) for identifying water availability, storage, transmission and distribution, Quality monitoring, especially through low-cost sensors. Quality of water impacts healthcare, agriculture and industry are also included. ICT can play an important role in healthcare around the world, both in developing and developed countries. Healthcare can be 10% of the GDP in some countries, and simply using ICT for streamlining logistics and operations alone can lead to significant returns. It can help education and literacy, as it has the technological prowess of extensive reach, and provides options to tailor the output to meet individual needs at anytime of his or her choosing. It can also helps in increasing connections between citizens and citizens to institutions (including the government and improving governance through streamlined, hassle-free interactions, with transparency in decision-making. Thus, ICT has important role in attaining Sustainable Developmental Goals (SDG).

Keywords: Communication, Development, GIS, ICT, SDG, Sustainability

Characterization and Classification of Soil for Suitability and Alternate Land Use Planning in Dharni Tahasil of Melghat

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The present study was carried for characterization and classification of soils for suitability and alternate land use planning in tribal area of Dharni tehsil of Melghat in Amravati district of Maharashtra state. Sentinel-2A satellite data of study area obtained from Maharashtra Remote Sensing Center, Nagpur was used to identify probable profile sampling sites. However, profile sampling sites were finalized with help of ground truth and based on the variation in soil-site characteristics and different land use systems. Twenty Four (24) representative spot were selected on different land use system and the study area classify into three broad categories of land use *viz.*, agricultural crop land, forest land and scrub land, respectively. The agricultural crop land was further divided into I) single cropping II) double cropping and III) triple cropping. The soil occurring on very gently to gently sloping undulating land, plains and lower topographic position are moderately deep to very deep, moderately well drained to well drained, very dark greyish brown to light brownish grey in colour, and have clay to clay loam textural class and classified as Typic Haplusterts and Typic/Vertic Hapulsteps. The soils occurring on very gently sloping and moderate to moderately steeply sloping landscapes and isolated hillocks are very shallow, somewhat excessively drained, reddish brown in colour, and have clay loam to sandy clay loam textural class and classified as Typic Ustorthents. Soils were evaluated for, land capability, irrigability and suitability classes for the crops grown in the area. The soils are grouped into land capability class III, IV,VI, VIII and) land irrigability classes B(2),C(3),D(4) and E(5. The soil suitability evaluation indicates that, the Dharni tehsil soils are highly suitable for sorghum and soybean/ green gram-based cropping system with cultivation of wheat and chickpea as a double crop and cultivation of summer groundnut, summer green gram as triple crop based on availability of irrigation. Suggested land use plan of the Dharni tehsil has been prepared considering available natural resources and their evaluation for optimum utilization and management. This developed land use plan may be helpful in better agro technology transfer on similar soils under similar agro climatic conditions elsewhere.

Keywords: Melghat, capability, suitability, resources, cropping system

Agricultural Waste Based Low-cost Adsorbents for Sustainable Wastewater Treatment

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At the present time with development, pollution is also increasing, and the many organic pollutants from chemical, industries, and agricultural sectors are directly discharged into the water sources, which becomes pollution in aquatic bodies. Cation exchange, Ozonation, Coagulation, filtration, Flotation and skimming, advanced oxidation, Neutralization, employing hydrogen peroxides, photocatalytic degradation, oxides like TiO_2, carbon nanotubes, and other techniques exist, however, they are very expensive and cannot be repeatedly recycled. Therefore, there is a great demand for alternative methods that can address all of these problems and handle the effluent in an appropriate manner. Therefore, using inexpensive agro-waste sorbents offers an effective way to remove contaminants from effluents without contaminating groundwater. This approach is efficient in terms of money and resources needed, and it also takes less work and investment. The objective of this study is to highlight the exploration of all possible sources of low costs adsorbents for wastewater treatment.

Keywords: low-cost adsorbents, agro-waste, wastewater, metal ions, pesticides, dyes, Environmental remediation

Harnessing Digital Technologies in Agriculture for Sustainable Food Production

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According to United Nations estimates the global population will reach 9.8 billion by 2050, an increase of around 3 billion from now. Feeding this global population in 2050 would require raising overall food production by some 70 percent between 2005/07 and 2050. Production in the developing countries like India would need to almost double. This implies significant increases in the production of several key commodities. Digital technologies, such as artificial intelligence (AI) and machine learning (ML), remote sensing, big data, block chain and IoT, have significant potential to improve efficiency, equity, and environmental sustainability in the food system. Technological interventions based on remote

sensing, soil sensors, unmanned aerial surveying and market insights, etc., permit farmers to gather, visualise and assess crop and soil health conditions at different stages of production, in a convenient and cost-effective approach. They can act as an initial indicator to identify potential challenges and provide options to deal with them in a timely manner. Artificial Intelligence/Machine Learning (AI/ML) algorithms can generate real-time actionable insights to help improve crop yield, control pests, assist in soil screening, provide actionable data for farmers and reduce their workload. Block chain technology offers tamper-proof and precise data about farms, inventories, quick and secure transactions and food tracking. Thus, farmers don't have to be dependent on paperwork or files to record and store important data. Every passing day, the use of internet and smart phones is enhancing rapidly. The cloud-based services for big data analytics in agriculture and data sharing apps with linkages to integrated platforms and models are the future of farming in both modern and developing world. Implementing these technological solutions enable reliable management and monitoring of farms and thus resulting in increase in agriculture productivity, lower production cost through lesser and need based use of chemicals and fertilizers, Inhibits soil degradation, promotes effective and efficient use of water resource. Countries such as the Netherlands, the US, Australia and Israel, have successfully adopted and exploited digital solutions to revolutionise agriculture, their adoption in India is still in its infancy. The future adoption of digital agriculture in India is anticipated to nurture under the Public-Private Partnership (PPP) mode. However, influential factors that will define the success of digital agriculture in India are technology affordability, ease of access and operations, easy maintenance of systems and supportive government policies.

Keywords: ICT in Agriculture, Digital technologies, artificial intelligence (AI), Machine Learning (ML), Remote Sensing, Big Data, Block Chain, IoT

A New Model for the Photosynthetic Performance of Finger Millet in Response to Nitrogen Application

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This study was aimed to explain the physiological response of ragi against applied levels of nitrogen levels through an analytical model. The developed model combines linearly accelerating physiological response with physiological response retarding index function. The proposed model explains the variations of the photosynthetic pigments, SPAD value, Fv/Fm, net photosynthetic rate, transpiration rate, and stomatal conductance with respect to different nitrogen dosages in a perfect way with r=1

and S=0. Since the correlation coefficients for the parameters are unity and the standard error is zero, meaning thereby the perfect validity of the hypothesis and the developed model. This new model allows us to estimate photosynthetic performance that leads to a highest yield for a specific fertilizer dose that might be applied by agricultural technology. Under common agronomic practices in a specific agro-climate zone with more or less similar soil-water management practices the model could be useful for forecasting yield, determining specific economic indicators, and optimization of nitrogen yield response levels.

Keywords: Chlorophyll, Fv/Fm, nitrogen, mathematical model, photosynthetic performance, ragi

An Advanced Technique for Weed Classification using Deep Learning Techniques

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Weeds are one of the important variables that can reduce agricultural productivity by encroaching on pastures, smothering crops, and drastically lowering the quality of the harvested crops. Herbicides are frequently used in agriculture to control weeds, but overuse of these chemicals can also reduce crop yields and pollute the environment. Precision agriculture's site-specific weed management is growing in popularity among academics and farmers. Machine learning and Deep learning techniques have been used effectively for data processing and mapping tasks across a variety of industries. Here, we studied to classify publically available benchmark weed images using RGB image texture for feature extraction. The hybrid of CNN+LSTM model shows promising results when compared to CNN and LSTM where the accuracy of these are 97.23% for the hybrid of CNN+LSTM, 96.22% for CNN, and 91.10% for LSTM model.

Keywords: Classification, Deep learning, Machine learning, and Weeds

Automated Solar Powered Seed Sowing Agribot – A Boon to Save Electrical Energy

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Human effort in the agricultural process, can be reduced by mechanization of agriculture. But performing the field operations like sowing of seeds with machineries require complete human interaction. Sowing of seeds can be performed by the application of automation and robotics without any human intervention. The seed sowing operation may be carried out by utilizing solar energy to run the agribot. This machine may helps in saving, cost of operation time and energy. The automated solar powered seed sowing agribot may contains components like wheels, motor, seed container, microcontroller, battery, motor driver, ultrasonic sensor etc. The solar panel can be used to capture solar energy and then it is converted into electrical energy which may be used to charge battery. The agribot is capable of making a hole in the soil up to certain depth, placing the seed accurately in the same hole and closing the mud. The entire process is controlled by a microcontroller or the controlling of the robot can be made via mobile by using bluetooth or wifi module. From the reviews it is found that apart from ploughing and seed dispensing, this agribot can be used in spraying of pesticides, fruit picking and other farming process like harvesting, irrigation.

Keywords: Agribot, Automation, Microcontroller, Sowing

A Study of Smart Technical Assistance for Increase Productivity in Kitchen Garden Using IOT and Blank Kit App

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The IoT (Internet of Things) is set to push the future of farming to the next level of agrotechnomy. Here in the field section, various sensors are deployed in the field eg. Temperature sensor, moisture sensor and PIR sensor. The data collected from these sensors are connected to the microcontroller through ESP8266 sensor. The advancement in the technology ensures that the sensors are getting smaller, sophisticated, and more cost efficient. Now the web of services is also easily accessible globally so that smart farming can be achieved with full pledge. Focusing on encouraging innovation in agriculture, smart farming is the answer to the problems that agriculture industry is currently facing. All this can be done using smart phones and IoT devices easily. Farmer can get any required data or

information as well can monitor his agricultural sector. In automatic mode, the microcontroller gets switched ON and OFF automatically if the value exceeds the threshold point. Soon after the microcontroller is started, automatically an alert must be sent to the user for acknowledgement. This is achieved by sending a message to the user through an Android Blank Kit app. Other parameters like the temperature, humidity, moisture and the PIR sensors shows the threshold value and the water level sensor is used just to indicate the level of water inside a tank or the water resource. The hardware is interfaced with all the sensors in the board. The hardware components include the microcontroller, relay, ADC converter, Blank Kit app and all the sensors interfaced. Soil Moisture Sensor is A sensor that will sense the moisture level in the land (sand) called SOIL MOISTURE SENSOR. SOIL MOISTURE SENSOR are connected to the Arduino to perform an action. Arduino will send the data to the Thing speak server using Wi-Fi. If emergency it also sends message and Alarm to the user by using Blank kit app. This is a complete solution to monitor garden activities and irrigation problems using sensors and microcontrollers respectively. Implementation of such a system in the garden can definitely help to improve the yield of the garden products and overall production.

Keywords: Vegetables, kitchen garden, urban areas, Arduino and ESP8266 Agrotechnomy, smart farming

A Spatial Analysis of Land Surface Temperature using Google Earth Engine and Quantification of its Driving Factors

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The most significant factor influencing the surface energy and water balance both locally and globally was the land surface temperature (LST). The long-term LST data assists in identifying trends over time and their respective affecting elements. In this study, LST was calculated for the Coimbatore district of Tamil Nadu for the years 2015 to 2021 using MODIS satellite data on the Google Earth Engine platform. The highest and lowest recorded temperatures were in April and December, respectively. There was seasonal change in the temperature. The spatial heterogeneity and major factors affecting LST were expressed using the geographical detector. Using the Geographical Detector Method, the values of LST were compared with the explanatory variables such as Normalized Difference Vegetation Index (NDVI), Surface Soil Wetness, and Precipitation. The q statistic value for NDVI (0.94) was higher, showing that NDVI has a stronger impact on LST than other contributing factors. Modifications in NDVI values have an impact on LST fluctuation. Additionally, the coefficient of determination (R^2) values between LST and variables like NDVI, Surface Soil Wetness, and Precipitation were determined. The findings in this paper can be generally applied for planning purposes for broader areas because LST monitoring is a vital part of managing natural resources.

Keywords: Land Surface Temperature, Google Earth Engine, Geographical Detector Method

Effect of Urban Compost on Wheat-Maize (Fodder) Cropping Sequence on Soil Quality, Residual Effect, Yield under Climate Smart Agriculture

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The field experiment entitled "Effect of urban compost on wheat-maize (fodder) cropping sequence on soil quality, residual effect, yield under climate smart agriculture" was conducted during 2019-20 at Post Graduate Institute, Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri. The experiment was laid out in randomized block design comprising of eight treatments and three replications for wheat crop. The treatments comprised of T1: Absolute control – No fertilizer, T2: GRDF @ 120:60:40 N, P2O5, K2O kg ha-1 + FYM 10 t ha-1 , T3: Only urban compost @ 10 t ha-1 , T4: 100% N through vermicompost, T5: 100% N through urban compost, T6: 75% N through urban compost + 25% N through urea, T7: 50% N through urban compost + 50% N through urea, T8: 25% N through urban compost + 75% N through urea. For maize (fodder), experiment was laid out in split plot design superimposed on the treatments of preceding crop wheat as sub plot comprising eight main plot and five sub plot treatments (i.e total 40 treatment combinations), comprising of U1: Residue of 100% N through vermicompost, U2:75% N through urban compost (residual) + 25% N through urea,U3:50% N through urban compost (residual) + 50% N through urea,U4:25% N through urban compost (residual) + 75% N through urea,U5:100% N through urban compost and one treatment taken outside of the plot as control i.e GRDF @ 100:50:50 N, P2O5, K2O kg ha^{-1} + FYM 10 t ha^{-1}.For wheat crop, the yield attributing characters, total chlorophyll content, grain (47.25 q ha^{-1}) and straw yield (69.09 q ha^{-1}) recorded significantly the highest in the GRDF treatment. The soil organic carbon found highest in the treatment T5- 100% N through urban compost treatment (0.62%). The available N, P and K status of soil at harvest was found to be significantly improved due to application GRDF treatment. Total uptake of nitrogen and potassium by wheat crop was found significantly increased due to application of 25% N through urban compost + 75% N through urea. For maize (fodder) the GRDF treatment significantly highest soil properties, yield in main plot while, in sub plot application of 25% N through urban compost (residual) + 75% N through urea showed highest soil properties, yield. The study concluded that application of General Recommended Dose of Fertilizer (GRDF) or 25% N through urban compost alongwith 75% N through urea or 100% N through vermicompost alongwith recommended dose of P and K can be applied to wheat crop, however, residue of 25% N through urban compost alongwith 75% N urea or residue of 100% N through vermicompost alongwith recommended dose of P and K can be applied to maize fodder crop for getting higher yields, improving soil properties, increasing uptake in soil in wheat-maize fodder crop sequence under climate smart agriculture.

Keywords: urban compost, soil quality, yield

Time Series Prediction Analysis of Rice Production using Artificial Neural Networks for Jammu and Kashmir

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Rice is the first widely consumed, second largely produced, and third widely grown food crop in the world and about 90% of the total rice is produced in Asia. China and India are the biggest rice producers which accounts for over half of the world's rice production. In India, rice is grown in 43.82 million ha with the production of 112.44 million tones and the productivity of 2566 kg/ha. In the Union territory of Jammu and Kashmir rice is grown in 0.267 million ha with the production of 0.58 million tones and productivity of 2559 kg/ha for year 2020- 21. The population of India is growing at rapid rate and the demand for rice is increasing but production of rice rising is not fast enough to meet the future demands. In order to ascertain the production and productivity rate of the rice in India, a reliable forecasting is essential for decision-makers to plan adequate policies for this important commodity and to establish the necessary logistical resources. A study was undertaken to predict the cultivable area, yield, and production of rice in the UT of J&K using Artificial Neural Networks (ANN) and compared same with traditional equations i.e., Linear, exponential, logarithm, polynomial and power function. The time series data was collected from the Digest of Statistics, J&K regarding rice area (million hectares), yield (tons per hectare), and production (million tons) between the years 1999–2021. The appropriate model/ equation among the traditional and Artificial neural network model was derived on the basis of coefficient of determination (R), mean absolute error (MAE) and mean standard error (MSE). The results revealed that the ANN is the best approach to predict the area, yield and production with the values of coefficient of determination as 0.85, 0.89 and 0.95 respectively. The traditional equations i.e., linear, exponential etc. were unable to give satisfactory results (R value greater than 0.7) whereas for ANN all R values were above 0.85. However, in case of an area the R values of 0.78, 0.77, 0.70, 0.78, 0.71 were obtained for linear, exponential, logarithm, polynomial and power function. The only R values greater than 0.8 i.e., 0.82 and 0.86 for area were obtained using 4^{th} order and 6^{th} order polynomial which itself forms a complex function whereas the ANN approach provides a R value greater than 0.9 without such complex equation or function.

Keywords: Rice, Artificial Neural Network, Coefficient of Determination, Yield, Production

Building and Adaptation of Narrow-window Flowering and Early-maturing Zeromonopodial Cotton (*Gossypium hirsutum* L.) for Climate Change, and Monsoon Vagaries

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Narrow-rows have the potential to increase boll numbers, and lint yield of cotton compared with conventional row spacing. To optimize production in this system, we carried selected crossings among four genotypes namely TVH002, CO17, Suraksha and NDLH1938, first two are zeromonopodial (ZM), short noded sympodial (SNS) and moderately resistance to jassids used as female and remaining are monopodial and resistance (R) to jassids used as male, respectively to know whether narrow-row-induced boll number increases are a result of increased seasonal flowering or increased boll retention. The single crossed F_1 hybrids viz., TVH002 × NDLH1938, TVH002 × Suraksha, CO17 × NDLH1938 and CO17 × Suraksha evaluated at department of cotton, CPBG, TNAU, Coimbatore and recorded all four crosses possess ZM and SNS (16 ± 2.0 to 21 ± 1.0 SNS/plant with a length of 11.5 ± 1.5 to 14.2 ± 0.5 cm) geometry to accommodates plant densities varying from 75000 to l lakh plants/ha with using narrow and ultra-narrow row spacing (60×20), which suited to high density planting system (HDPS). The specification of this cultures are compact, narrow window flowering (NWF), early maturing genotypes with ZM, and SNS branching suited to HDPS and machine harvesting. However, the results suggest that, narrow-row spacing habituate of more number of NWF; it directly causes more number of boll formation and retention. Higher plant densities tended to reduce the number of main stem nods per plant; it is suited to narrow-spacing system. It has demonstrated that increased boll retention was responsible for the small narrow-row yield increase. In contrast, this early-maturing cotton cultures are desirable for a number of reasons as they require relatively less inputs and escapes from climate change barriers like, water, and heat stress and also bear more number of bolls with high boll weight as compared to late maturing genotypes and this field data validated by cropping system model (CSM-CROPGRO-Cotton) and decision support system for agro-technology transfer (DSSAT). However, this study identified that NWF promotes early-maturity, thus it relies less prone to subnormal and abnormal activities of the monsoon affecting the seasonal pattern of rainfall (i.e. Monsoon vagaries). It concluded that, ZM and NWF cotton cultures identified that are easily adoptable to high temperature, and water stress.

Keywords: Climate change, cotton, early maturity, narrows window flowering, monsoon vagaries, zeromonopodia, short sympodia

Assessment of Soil Carbon Sequestration in Different Agroforestry Systems under Semi-Arid Region of Rajasthan

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To explore the ability of different tree-based agroforestry systems to carbon sequestration, the present investigation, entitled "Assessment of Soil Carbon Sequestration in Different Agroforestry Systems under Semi-Arid Region of Rajasthan" was undertaken. For this, three tree-based agroforestry systems consisting of tree species, namely *Acacia tortilis*, *Hardwickia binata* and *Tecomella undulata* along with fallow land maintained at ARS, Fatehpur, Sikar, Rajasthan were selected. The soil samples were collected from four different soil depths (0-15, 15-30, 30-60 and 60-90 cm) with three replications and analyzed for soil physicochemical properties, total organic carbon (TOC), soil organic carbon fractions (C_{VL}, C_L, C_{LL}, C_R, ACP and PCP), soil carbon stocks and carbon management index (CMI). The results indicated that under all agroforestry systems, lower soil pH, BD and PD were recorded as compared to fallow land at all soil depths. The *Acacia tortilis* based agroforestry system had higher soil available N, P, K and micronutrients than other agroforestry systems and fallow land. The soil carbon pools (C_{VL}, C_L, C_{LL} and C_R) were positively correlated with TOC and decreased with an increase in soil depth under all the agroforestry systems and fallow land. The *Acacia tortilis* based agroforestry system sequestrating a higher amount of total organic carbon (0-90 cm) 39.34 Mg C ha^{-1} followed by *Hardwickia binata* based agroforestry systems (37.86 Mg C ha^{-1}), *Tecomella undulata* based agroforestry systems (36.99 Mg C ha^{-1}) and fallow land (30.65 Mg C ha^{-1}). The CMI registered higher under *Acacia tortilis* based agroforestry system (172.65) at 0-15 cm soil depth. Based on current research findings, it may be concluded that agroforestry systems help in maintaining soil fertility and soil carbon sequestration as compared to fallow land.

Keywords: Carbon Sequestration, Agroforestry Systems, *Acacia tortilis*, *Hardwickia binata* and *Tecomella undulata*

Evaluation of Satellite Remote Sensing based Crop Evapotranspiration Models over a Semi-arid Irrigated Agricultural Farm

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Spatiotemporal coverage of crop evapotranspiration (ET) can be best used for irrigation water management over an agricultural farm. With the availability of multi-temporal high-resolution satellite datasets and remote sensing-based surface energy balance models, near-real-time estimation of ET becomes a reality. This paper evaluates five energy balance models viz., Surface Energy Balance Algorithm for Land (SEBAL), Surface Energy Balance Index (SEBI), Simplified Surface Energy Balance (SSEB), Surface Energy Balance System (SEBS), and Two-Source Energy Balance (TSEB) with inputs from LANDSAT-8 (12 cloud-free dates) to estimate ET at 30 m spatial resolution over the post-monsoon period (2021-22) agricultural farm at ICAR-IARI, New Delhi. and the models were validated with Bowen-ratio ET estimates from MICROMET tower datasets. Remote sensing-based ET estimates were satisfactorily correlated with observed ET. The SSEB model (r = 0.887, RMSE = 0.732 mm/day, nRMSE = 35.71%) performed the best followed by TSEB (r = 0.863, RMSE = 0.997 mm/day, nRMSE = 48.67%), SEBI (r = 0.837, RMSE = 0.878 mm/day, nRMSE = 72.87%), SEBAL (r = 0.834, RMSE = 2.043 mm/day, nRMSE = 99.75%), and SEBS (r = 0.755, RMSE=0.792 mm/day, nRMSE = 38.65%), respectively. Spatiotemporal ET maps were generated and the areas with high, moderate, and low irrigation water requirements were delineated. Our findings suggested that the remote sensing-based models have the potential for accurate estimation of ET leading to improved water use efficiency.

Keywords: Evapotranspiration, Surface Energy Balance, Wheat, Satellite remote sensing

Prevalence of Pathogens Associated with Root Rot Disease of Lentil under different Tillage System in Rice based Croppig Pattern

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The major threats for production of the lentil in Bangladesh are root rots diseases. To identify which soilborne pathogens are associated with root rot disease complex on lentil and to determine their prevalence. A survey was conducted from October, 2021 to March 2022 at Pulses research center (PRC) Ishurdi, Pabna. Lentils root rot symptoms were obtained from 5 Research plot in PRC. Rotted roots were washed, potential pathogens were cultured, and isolates were putatively identified into the major pathogen groups based on morphology. Among the 88 isolates obtained, *Fusarium* (46.6%) was recovered at the highest prevalence and *Rhizoctonia* and *Sclerotium* exhibited a consistent presence, ranging from 30.6% and 22.7% respectively. This survey provided baseline information on the prevalence of critical soilborne pathogens of lentil in Ishurdi region. In the future, additional genetic markers will be utilized to further identify organisms, a species characterization will be conducted to assess pathogenicity and lentil germplasm will be screened for resistance.

Keywords: Lentil, soilborne pathogens, Resistance

Climate Smart Agriculture & Innovative Strategies for Achieving SDGs

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Climate Smart Agriculture (CSA) is an approach to guide the management of agriculture in the era of climate change. Climate smart agriculture is a relatively new concept which was launched in 2009 advocating for better integration of adaptation and mitigation actions in agriculture to capture synergies between them and to support sustainable agricultural development for food security under climate change. Agricultural production will manifest large climate change impacts. There is pressing need to improve agricultural productivity for food security while simultaneously protecting the environment. The main goal is to Increase productivity (sustainably intensifying agriculture), Enhanced resilience

(adapting to climate change), Reduced emissions (mitigating greenhouse gas emissions). This goal can be implemented through climate smart agricultural practices aimed at intensifying and sustaining agricultural production. We must take action to reduce the basic root cause; the high rate of greenhouse gas (GHG) emissions. Thus, there is urgent need to reduce GHG emissions, improving sequestration of carbon in soils and aversion of factors that limit agricultural production. Therefore, climate smart agricultural practices like conservation agriculture, agroforestry, moisture conservation, recycling of nutrients through crop residue, system of rice intensification etc., must be practiced to mitigate the climate change, so as to ensure adequate production of food, feed, fiber and bioenergy, as well as protection of natural resources. Climate change is reality. Costs of inaction would be higher than adaptation and mitigation costs. So, we have to act proactively. Improved agronomic practices helps in mitigating climate change by reducing greenhouse gas emissions, improving C sequestration in soil. Climate smart agricultural practices such as conservation agriculture, agroforestry, nutrient recycling, moisture conservation, SRI *etc.,* help in improving productivity of crops.

Keywords: Conservation Agriculture, Sequestration, Agroforestry, GHG emissions, Climate change

Non-linear Regression Analysis for Reactive Blue-19 Dye Adsorption on Maize Cob

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The presence of toxic dyes in water bodies are attributed to textile, pulp, tannery, paper, and paint industries, of which, textile industries contribute an estimated 70-90% of dye (majorly reactive dyes) effluents discharged into the environment. The unaltered dye-contaminated water affects the aquatic environment through change in colour, nature, temperature, and pH of the water bodies. In addition, it affects the crop produce adversely as the untreated effluents are used to irrigate crops due to diminishing source of fresh water. India generates approximately 71 Mt of maize crop residue on-farm and off-farm annually (Devi et al.,2017). As a strategy for alternative residue management to remediate dye pollution, this study was undertaken to explore the potential of maize cob as an adsorbent for the removal of Reactive Blue-19 (RB-19) from simulated aqueous solutions. Morphology and functional groups present in the adsorbent were characterized using Scanning Electron Microscopy (SEM) and Fourier Transform Infrared (FTIR) Microscopy. Batch adsorption experiments were carried out to optimize various parameters *viz.*, pH, initial dye concentration, adsorbent dosage, and contact time for maximum removal of the dye from simulated dye effluent. Maximum adsorption was achieved at pH 3 with an equilibrium time of 60 minutes. A decrease in initial dye concentration resulted in increased dye removal. The adsorption equilibrium data were fitted on two-parameter non-linear isotherm models *viz.* Langmuir, Freundlich and Temkin models and values of their constants were

also obtained. Adsorption equilibrium data were best described by the Freundlich model. The maximum dye uptake of the Reactive Blue-19 on maize cob was 12.91 mg/g. Adsorption kinetic modelling was also done using pseudo-first-order, pseudo-second-order, and intraparticle diffusion models. The adsorption kinetic data showed excellent correlation with the pseudo-second-order model with R^2 value of 0.99. In order to enhance the adsorption capacity of agricultural waste and commercialize the technology, further studies need to be carried out.

Keywords: Non-linear kinetic modelling, Reactive Blue-19, adsorption isotherm, maize cob

Use of E-resources by the Students and Researchers of Faculty of SKRAU, Bikaner

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The study aimed at finding the use of e-resources by the post graduate students and research scholars of Faculty of Swami keshwanand Rajasthan Agriculture University Bikaner. A questionnaire was distributed among the Research scholars and Post-Graduate Students to collect desired data. A total of 200 questionnaires were distributed to the selected sample of Faculty of agriculture 180 Valid samples were collected. The study found that the majority of users are aware about the availability of e-resources. The Result reveals that 47.78 % of respondents want to access only electronic version whereas only 32.78% users want to read the Printed journals but 19.44% respondents want to use both electronic and printed version. Majority of the respondents 76.66% Use e-resources for writing papers. The analysis reveals that many of the respondents search e-resources through linking Facility available on the library website.

Keywords: Faculty of Arts, E-resources, Internet, E-mail, Library website, Search Engines, File Format, User study

Crop Residue Assimilation as an Alternative to Minimize the Deleterious Effects of Burning Straw

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With year-round crop cultivation, India is the second-largest agro-based economy and produces a lot of agricultural waste, including crop residues. The estimated annual production of crop residue in India is 350 x 106 kg, with rice and wheat residue accounting for roughly 51% and 27% of that total. Farmers burn this crop residue, also known as stubble burning, to get rid of the residue and prepare the ground for subsequent cultivation. After harvesting the winter rice, farmers in Punjab annually burn 7 to 8 million metric tonnes of crop leftover. Burning husk produces dangerous pollutants that include carcinogenic polycyclic aromatic hydrocarbons and hazardous gases like CH_4, CO, and volatile organic compounds (VOC). Not only this, stubble burning is also a reason for the loss of precious nutrients. Straw burning, which results in substantial nutrient losses, N (up to 80%), P (25%), K (21%) and S (40-60%) depriving the soil of its valuable organic matter and fertility. As Crop residues of previously harvested crops are easily available on field and are comparatively economical, incorporation of residue in the soil prior to sowing of next crop could be an effective management strategy. Approximately 1.5pg (1pg=10^{15}g) of carbon is stored in the crop residues produced in the world, which could be an important source of OM which can be added to the soil. Returning crop leftovers to the soil can enhance its physical characteristics by boosting aggregate stability, reducing bulk density, and improving total porosity. Crop wastes can increase the level of organic matter in the soil, lower evaporation, and aid in the fixation of CO_2 in the soil. By encouraging the free passage of gases between the soil and the atmosphere, crop residue mulch enhances soil aeration. Therefore, rather than burning crop residue, farmers should choose crop residue incorporation, which not only lowers the release of hazardous gases to the atmosphere but also enhances the overall health of the soil by restoring a significant amount of nutrients.

Keywords: crop residue, straw burning, nutrients

Influence of Climate Change on Quality of Food and it's impact on Food Safety

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Climate change have a significant impact on a variety of foods, which in turn leads to the effect on the occurrence of food safety hazards during any stage of the food chain like harvesting, processing, storage etc. Temperature, humidity, and pH changes are some of the factors causing the variety of food hazards, food-borne diseases, and health issues, and thus rendering the food unsafe for consumption. These elements have both direct and indirect effects on food. Changes in temperature and precipitation patterns, increasing frequency and intensity of extreme weather events, ocean warming and acidification, and changes in complex contaminant transport pathways are all factors that have an impact on food safety. Temperature increases and changes in rainfall patterns can promote the growth of bacteria, viruses, fungi, and parasites, as well as cause food-borne diseases. Floods and droughts, for example, can contaminate soil, water, agricultural land, food, and animal feed with pathogens, chemicals, and hazardous substances originating in sewage, agricultural system. Food security and safety are critical considerations. If the food is safe, it provides various nutritive value, increases demand, maintains health, and provides many other benefits; if the food is unsafe, it causes many health problems. The changing climate may have many effects on the packed food products and stored products as well. Food waste and packaging contributes approximately 50% of greenhouse gas emissions to the environment. Food security and safety are currently important in a variety of sectors. Thus, the impact of climate change on various crops, processing fruits and vegetables, food products, and so on reduces productivity, demand, and lowers the value of a particular food.

Keywords: climate, food safety, environment, food security

Agricultural Greenhouse Gases Emission: Current Understanding and Future Research Directions

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Agriculture is strongly affected by climate change, but is itself a driver of climate change: it contributes significantly to key greenhouse gases (GHGs) emissions primarily in the form of methane (CH_4) and

nitrous oxide (N_2O). For these reasons, international efforts are currently in progress to curbing the emissions. The main contribution to GHG emissions from agriculture is given by animal husbandry; however, crops provide a relevant contribution to the agricultural emissions, both at the national and global level. GHGs are emitted directly from managed soils: as respiration, through microbial activity, and from cultivated wet lands under anaerobic soil conditions, typical of the rice cultivations; the use of synthetic and organic nitrogen fertilizers plays a major role in driving the emissions of N_2O. To date, the understanding of the spatio-temporal dynamics of agricultural GHGs emission in relation to microbial diversity and agronomic management is still very limited. Moreover, recent evidence indicated that soils are a huge reservoir and source of biogenic volatile organic compounds (bVOCs), originating from roots, and soil organic matter(SOM): indeed, the quantification of the decomposition processes by soil microorganisms, their temporal dynamics, and the agronomic impact on them are still poorly understood. Future research direction should aim to clarify the above-mentioned shortcomings by considering the importance of the soil microbial population abundance, and its dynamics, responsible of the two main agricultural GHGs as well as the bVOCs emission from the soil, as well as, develop novel application for data-driven machine learning (ML) models able to predict the GHGs and bVOCs.

Keywords: Greenhouse gases, Soil organic matter, Nitrogen fertilizer

Seed Germination and Initial Growth Performance in *Toona ciliate* under Different pH Conditions

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Toona ciliata belongs to the Meliaceae family and is a precious timber species which is primarily distributed in South Asia. The tree has a straight bole and produces red wood with desirable grain. It has high economic value in wood industry. But this species face impacts of environmental changes, low population renewal rates and over-harvesting. Sustainability of these species has to be achieved but it has challenges owing to its growth characteristics and natural environmental impacts. Due to straight and tall tree, artificial seed harvesting is more difficult and the viability of the seeds decline in short time. Seed is a morphologically complex organism provides an imperative link in population dynamics by allowing the establishment of new individuals. Occurrence of growth cessation is a seed dormancy which has become problematic for maintaining a good rate of tree growth. Therefore, the study was conducted on efficient, stable shoot regeneration system and germination studies in *T. ciliata* using different pH levels in soil. Such an approach provided the necessary technical support to achieve rapid seed propagation, which allowed identification and isolation of the desirable pH concentration of soil for regeneration and initial growth performance of *T. ciliata*. The study finally

concluded that, *T. ciliata* was found to have high germination and initial growth performance @ pH 7 followed by @ pH 6 and the rate of germination is higher in acidic conditions compared to alkaline conditions.

Keywords: pH levels, seed germination, growth and *Toona ciliate*

Role of Agronomic Practices in Improving Soil Health for Sustainable Crop Production

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As the world's population grows to 8.9 billion by 2050, there will be greater demand for agricultural products, which are heavily reliant on the soil's living system. A healthy soil acts as a dynamic living system that provides multiple ecosystem services such as maintaining water quality and plant productivity, controlling soil nutrient recycling decomposition, and removing greenhouse gases from the atmosphere. Soil health is closely related to sustainable agriculture because soil microorganism diversity and activity are the primary components of soil health. The soil is the medium for agricultural production; in fact, it is estimated that 95% of our food is directly or indirectly produced from soil. Recently soil health deteriorates due to both natural and anthropogenic activities. Natural causes include earthquakes, tsunamis, droughts, avalanches, landslides, volcanic eruptions, floods, tornadoes, and wildfires. Anthropogenic soil degradation results from land clearing and deforestation, inappropriate agricultural practices, improper management of industrial effluents and wastes, over-grazing, careless management of forests, surface mining, urban sprawl, and industrial development. Inappropriate agricultural practices include excessive tillage and use of heavy machinery, excessive and unbalanced use of inorganic fertilizers, poor irrigation and water management techniques, pesticide overuse and poor crop cycle planning. Due to all the practices soil health gradually decreases and its effects on soil microbial activity, ultimately impact soil productivity. Farming practices have shown that organic farming and tillage improve soil health by increasing the abundance, diversity, and activity of microorganisms. Conservation tillage, avoiding soil compaction, agroforestry, cover crops, crop rotation with legume crops, organic amendments, reduce pesticide usage, etc. these agronomic ways improve the soil organic carbon which will improve the microbial biomass in the soil. Microbial activity in the soil helps in nutrient transformation and helps to sequestration of atmospheric CO_2 which helps in biodiversity of the soil. Therefore, maintain soil health and biodiversity through various agronomic practices will enhance productivity and achieve sustainability.

Keywords: Soil health, Conservation tillage, Agroforestry, microbial biomass

Comparative Studies of Conventional, Organic and Natural Farming Types for Their Efficiency, Productivity and Profitability in Paddy

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Field experiment was conducted at Agricultural and Horticultural Research Station, Honnavile, KSNUAHS Shivamogga during Kharif 2019-20, 2020-21 and 2021-22. The yield of paddy was higher in package of practices followed by farmer's practice treatment and lower yield was recorded in natural farming treatment. The pooled results of three years revealed that paddy grain yield (54.27 q ha^{-1}), nutrient uptake (N- 156.82, P- 35.73, K – 171.25 kg/ha) and soil nutrient status (P_2O_5- 71.89, K_2O – 270.33 kg/ha) were significantly higher in package of practice treatment. Soil nutrient status of nitrogen was higher in farmer's practice (251.11 kg/ha). The lower yield (36.35 q ha^{-1}), lower nutrient uptake and lesser soil nutrient status was recorded in natural farming treatment. Maximum enzymatic activities of dehydrogenase (7.41 µgTPF/g soil/day), urease (5.51 µg NH_4-N/ g soil/ 2 hrs), were observed in organic farming treatment followed by natural farming treatment. Acid phosphatise (6.11 µg p-nitrophenol/g soil/hr) and alkaline (3.59 µg p-nitrophenol/g soil/hr) phosphatase were observed in natural farming treatment followed by organic farming treatment. Less enzyme activities were recorded in farmers' practice treatment. The B:C (1.90) was higher in package of practice treatment and lowest (1.08) in organic farming treatment.

Keywords: Paddy, grain yield, enzyme, natural farming, nutrient uptake

Development and Evaluation of Physico-chemical Properties of Moringa-Aonla-Aloe Vera Blended Ready-to-Serve (RTS)

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In the present investigation the efforts have been developed Moringa leaves based RTS with the blend of moringa leaves: Aonla: Aloe vera. The formulation of blend containing 65% Aonla + Aloe vera (70:30) and 35% MLJ has highest overall acceptability score. The different formulations of moringa leaves, aonla and aloe vera blends were stored for six months and physico-chemical attributes were studied during the storage period. TSS, acidity, total sugar and reducing sugar was found to be increased during the storage period, while pH, protein, ascorbic acid, non-reducing sugar and total phenol

content observed to be decreased as the storage period progressed. Among the formulation of blended beverage, T_3 (55% Aonla + Aloe vera and 45% MLJ) was found to be stable and also had good organoleptic score at the end of storage period.

Key words: Physico-chemical Properties, Moringa-Aonla-Aloe Vera

Impact on Yield of Coriander by Different Sowing Dates and Cutting Levels

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Coriander is annual plant belongs to Apiaceae family. It is a native of Mediterranean region. Coriander is dual purpose crop as it can be use as leaf and seed. Coriander is used as spice and it also has pharmaceutical values. Growth and yield of plants is affected by genetic and agronomic factors. Optimum combination of these factor helps to produce more yield. Coriander is one of the sensitive crops which can be affected by climatic condition A field experiment on coriander was conducted during Rabi 2021-22 at Vegetable Research Centre, College of Agriculture, Jabalpur, Jawaharlal Nehru Agriculture University, Jabalpur, M.P., India to study the effect of sowing dates and cutting management on yield and yield attributes of coriander. The experiment was laid out in factorial randomized block design with five sowing dates (20 October, 30 October, 9 November, 19 November and 29 November) as one factor and four cutting level (0 cutting, 1 cutting, 2 cutting and 3 cutting) as other factor. It was observed that interaction of 19 November sowing with 3 cutting recorded highest herbage yield per plant (22.94 g), herbage yield per hectare (7645.50 kg/ha), while interaction of 9 November sowing with 0 cutting recorded highest seed yield per plant (4.70 g) and highest seed yield per quintal (15.65 q/ha).

Keywords: Coriander, Cutting levels, Yield, Sowing dates

Productivity Enhancement in Little Millet (Saame) through Front Line Demonstration on Yield and Economics on Farmers in Tiptur Taluk of Tumkur District, Karnataka, India

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Millets has emerged as one of the most suitable alternatives to minor millet and minor pulses which provide much needed food and fodder security of the nation. One of the major constraints of traditional millet farming is low productivity due to lack of recommended package of practices and high yielding varieties as well as unorganized seed system. To replace this inconsistency of practices, a present study was carried out to know the yield gaps between improved practices and farmer's practices under Front Line Demonstrations (FLDs) of little millet under rainfed conditions of Tiptur Taluk, Tumkur District. A total of 20 farmers were selected for FLD's in the Taluka, of which 10 ha land was covered by high yielding little millet (OLM 203) varieties over the last two years (2019 and 2020). The conducted FLDs made a very positive and significant impact on grain as well as on fodder yield of little millet ranged 29.58 and 13.09 per cent overall increase respectively during the last two years. The higher technological gap (5.05 q/ha), extension gap (2.27 q/ha) and technological index (33.66 %) in the crop indicating that there is an urgent need of dissemination of location specific suitable package of practices. The data revealed that the conducted FLDs also enhanced the farmer's income by increasing B: C ratio that ranged from 2.07 to 2.39. The impact of such demonstrations are quite strong as it is also visible from the fact that little millet variety OLM 203 has been one of the most accepted varieties by farmers of Tumkur District and has been constantly under FLD programme.

Keywords: Little millets, Frontline demonstration, Technology gap, B : C ratio

Soil Fertility Mapping of Guntur District using QGIS

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The study area covered entire administrative boundary (16°18′ 51.1524′′ N latitude and 80°26′ 6.1008′′ E longitude) of Guntur district (11,391 km^2) of Andhra Pradesh. A ground truth survey was conducted during April and May of 2018 using Global positioning system in all mandals of Guntur district and collected a total of 285 soil samples from 0-15 cm depth. The cloud free satellite remote sensing data of

Landsat OLI 8 (Table 1) was referred for image interpretation. False Color Composite (FCC) of Landsat image was acquired for visual interpretation and digital image processing of the study area. QGIS v 3.14 are adopted as software tool for analyzing, integrating the baseline information database. Soils of Tenali and Guntur revenue division were analyzed for their available nitrogen content. The highest nitrogen (1066.24 kg/ha) content was recorded in Emani village of Duggirala mandal while the lowest (100.35 kg/ha) was recorded in Kancherlapalem village of Tenali mandal. The highest nitrogen (1016 kg/ha) content was recorded in Guntavaripalem village of Edlapadu mandal while the lowest (125.44 kg/ha) was recorded in Rompicherla village of Rompicherla mandal and Sanampadu village of Savalyapuram mandal. Soil samples collected from various mandals of Guntur revenue division were analyzed for soil reaction (pH) and electrical conductivity (EC). From the results it was observed that 70 per cent of the samples were moderately alkaline in nature. The highest pH (8.88) was recorded in Pedakurapadu mandal and lowest (6.15) was recorded in Pedakakani mandal. More than 85 per cent of the samples were non-saline in nature. The highest electrical conductivity was in Thulluru and Tadepalle mandal (2.00) whereas, the lowest was in Krosuru (0.12) mandal (Table 1). Soil samples collected from various mandals of Guntur revenue division were analyzed for available soil potassium content. From the results it was observed that all the soil samples were high in potassium content. The highest potassium (3427 kg/ha) was recorded in Achampeta mandal and lowest (202 kg/ha) was recorded in Bellamkonda mandal.

Keywords: QGIS, Soil Fertility and Mapping

Modern Information Technological Tools towards Sustainable Development

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Nanotechnology involves the ability to see and to control individual atoms and molecules. It involves the understanding of the fundamental physics, chemistry, biology and technology of nanometer-scale objects. The use of nanotechnology for sustainable agriculture is of utmost importance as it combats with different global challenges such as population growth, climate change and limited availability of important plant nutrients. The potential applications of nanotechnology include increasing the productivity using nano-pesticide and nano-fertilisers, improving the soil quality using nano-zeolites and hydrogels, stimulate crop growth using nanomaterials (SiO_2, TiO_2 and carbon nanotubes), provide smart monitoring using nano-sensors by wireless communication devices. Nanotechnologies not only help in improving food security and productivity but also minimize adverse effect of faulty agricultural practices on environment and human health. To increase sustainability in agriculture nanotechnologies could be used in every agriculture practice. It could be used to produce smart seed imbibed with nano encapsulations with specific strain of bacteria which ensures it's germination only when adequate

amount of moisture is available. Application of materials such as hydrogels, nano-clays and nano-zeolities helps in improving the quality of soil by improving water holding capacity of soil. The use of target-specific nanoparticles can reduce the damage to non-target plant plant tissues and the amount of chemicals released into the environment. Many nanoparticles (Ag, Fe, Cu, Si, Al, Zn, ZnO, TiO_2, CeO_2, Al_2O_3 and carbon nanotubes) have been reported to have some adverse effect on plant growth apart from antimicrobial. Nanotechnology helped in the formation of smart fertiliser, which enhance the nutrient use efficiency and reduce the environmental pollution. Nutrients either applied alone or in combination if bound to nano-dimensional adsorbents tend to release nutrients slowly as compared to conventional fertilizer. These new inventions in the field of nanotechnology pave new way towards sustainable agriculture, which not only fulfill the demand of present generation, also conserve it for the future generation. Likewise nano-fertiliser, nano-pesticide are used in minute amounts thus enable sustainable use and are eco-friendly in nature. Nanotechnology may act as sensors for monitoring soil quality of agricultural fields and thus maintain the health of agricultural plants. Thus, we can say that the use of nanotechnology provides new approach towards sustainable agriculture particularly at that time when world is facing problem such as growing population and climate change.

Keywords: Nano-zeolites, Nano-sensors, Hydrogels, Eco-friendly, Nano-fertiliser

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