



ICAR-IISS Newsletter



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Forthcoming Events

- ICAR Winter School on 'Advance microbial technologies to improve NUE and mitigation of GHG emission from agriculture' during 4-24 Sep., 2018.
- SAARC Regional Training on 'Integrated nutrient management for improving soil health and crop productivity' during 5-10 Sep., 2018.
- NICRA sponsored Training on 'Linking geospatial technologies and agricultural system models to assess impact of climate change on NRM' during 24 Oct. - 2 Nov., 2018.
- The 2nd SEALNET Meeting on 'Quality improvement in Asian soil laboratories' during 19-23 Nov., 2018.
- The XXIV RAC Meeting on 3-4 Dec., 2018.
- World Soil Day Celebration on 5 Dec., 2018.
- Short Course Training on 'Physiological approaches to phytoremediation: Advances, impacts and prospects' during 10 - 19 Dec., 2018

Editors

R.H. Wanjari
J. Somasundaram
Asit Mandal
Hiranmoy Das

Director's Desk

Long Term Fertilizer Experiment: A Cornerstone of Soil Research

SUSTAINING SOIL HEALTH is the key for food and nutritional security. In this respect, long term fertilizer experiments (LTFEs) are widely known for its importance and necessity for arriving at decision on soil management of any country. One such worldwide example is the 'Rothamsted Classical Experiments' initiated by J.B. Lawes and J.H. Gilbert, in United Kingdom in 1843. These are known for their innovativeness and uniqueness for researchable issues and challenges with in-built scientific inquisitiveness *per se*. In a similar fashion, a series of long-term fertilizer experiments were established in India at different locations at the beginning of 20th century, and some of them are still continued. Indian Council of Agricultural Research (ICAR), New Delhi initiated All India Coordinated Research Project on Long Term Fertilizer Experiments (AICRP LTFE) in September 1970 just after the beginning of green revolution. These experiments are representing eleven agro-ecological zones covering seven major cropping systems under four dominant soil types across the length and breadth of the country. These experiments are spanning five decades of existence with suitable combinations of nutrient management options in major agricultural production zones with emphasis on enhancing soil health and nutrient recommendation. The outcome from basic and strategic research emanated from these LTFEs is enormous.



It has been proved that balanced nutrient supply is vital for proper maintenance and improvement of carbon in soil. It is evident that soil organic carbon (SOC) content enhanced by 47% in Vertisols, 50% in Alfisols, 55% in Inceptisols and remarkably higher by 155% in Mollisols with NPK + FYM compared to no manure and fertilizer application. These experiments shed lights on nutrient pools, which are adequately maintained and sustained with balanced and integrated nutrient management practices. The physico-chemical properties and biological state of soil are improved with the conjoint use of organics and inorganics. The principal component analysis (PCA) indicated that the soils having optimum status of key indicators recorded high soil quality and sustainable yield indices as well. Further, LTFEs involving intensive cropping systems revealed a declining trend in productivity despite

the application of recommended levels of N, P and K fertilizers. This is mainly due to over mining of nutrients from soil that resulted in deficiency of micronutrients especially zinc (Zn). Studies revealed that Zn is one of the key micronutrients to achieve the optimum yields of rice in many soils. It has also been observed in LTFEs that continuous use of phosphatic fertilizers resulted in P build up in Inceptisols of Ludhiana and Delhi. From this study, recommendation has come up that P fertilizer application can be reduced by 50% (from 26 to 13 kg ha⁻¹) in maize and wheat without compromising crop yield. In this way, by utilizing accumulated soil P, fertilizer-P could be saved to the extent of 13 kg P ha⁻¹ per crop season, which means 60 kg P₂O₅ ha⁻¹ in a year (370 kg ha⁻¹ SSP per year). This recommendation emanated from LTFEs is being practiced in Punjab, Haryana and western parts of Uttar Pradesh. Another important outcome is that

application of N alone is unsustainable in most of the soils especially in Alfisols. Such adverse soil condition can be rectified either with application of lime or combined use of organics and inorganics.

Also, results of LTFEs strongly disproved the notion that application of fertilizers degrade soil quality. In order to sustain crop productivity and soil health, the fertilizer should be applied in balanced and integrated manner. Thus, over the years the LTFEs has been recognized as cornerstone to monitor soil health on a long term basis and provided information necessary for formulation of policies and strategies on soil health management at national level.



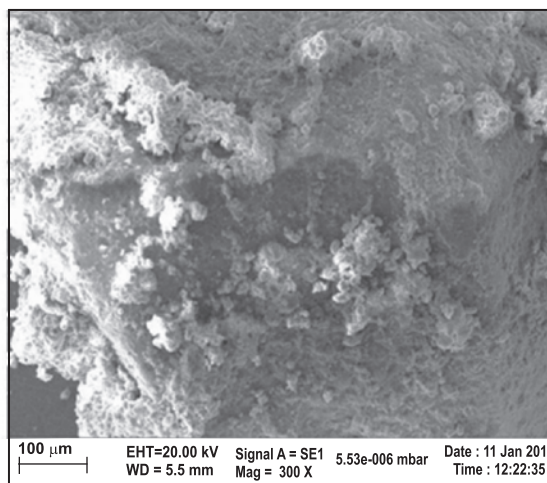
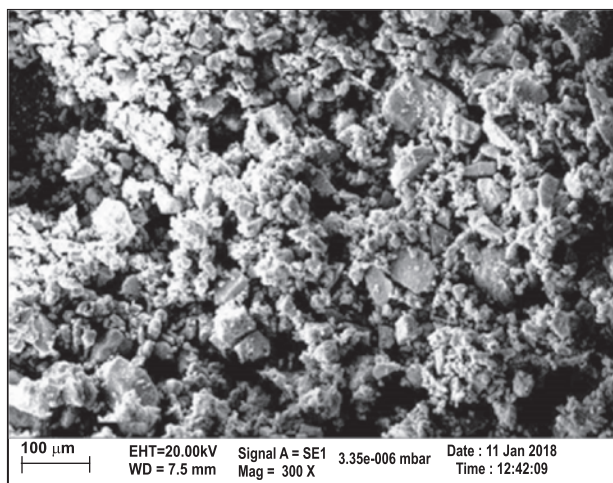
(Ashok K. Patra)

Research Highlights

Iron exchanged nanobentonite and Fe₃O₄ nano-materials for decontamination of waste water

In our country due to water scarcity, utilization of industrial waste water for irrigation in agricultural field is very common. The inorganic anions like nitrate (NO₃⁻) and bicarbonate (HCO₃⁻) present in the waste water are potentially harmful to the soil

and ground water quality. Two nano products such as Fe-exchanged nanobentonite clay and Fe₃O₄ nano-materials were used for decontamination of waste water. Fe-exchanged nanobentonite clay had the highest NO₃⁻ adsorption capacity with a potential of 129.70 mg g⁻¹, while the corresponding value was 9.73 meq g⁻¹ for HCO₃⁻. Langmuir and



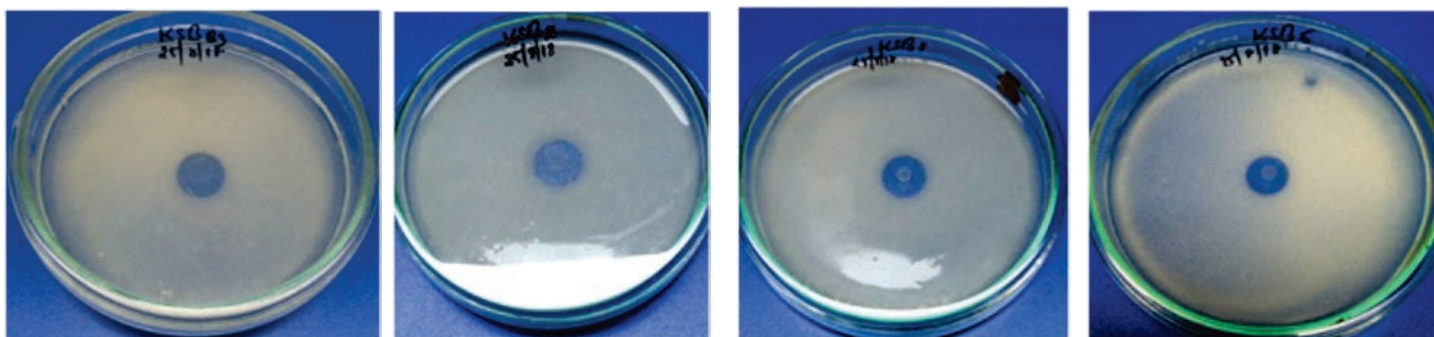
SEM images of (a) Fe₃O₄ nanomaterial, (b) Fe-exchanged nanobentonite clay product

Sips model were found best fitted for NO_3^- and HCO_3^- sorption, respectively. The Fe-exchanged nanobentonite clay may be advocated as a potential amendment for NO_3^- and HCO_3^- removal from contaminated waste water.

Potash solubilizing bacteria for maximizing K solubility

Under ICAR-All India Network Project on Soil Biodiversity Biofertilizer (AINP SBB), potassium

solubilising bacteria (KSB) were evaluated for their K solubilising potential. Aleksandrov solid medium containing mica as insoluble source of K was used for isolation of prospective KSB. The waste mica was collected from the dumping sites of mica mines in Koderma district of Jharkhand. Based on clear zone formation and Khandeparkar's selection 5 bacterial isolates were screened from the rhizospheres of banana and chilli.



Potassium solubilising bacteria with clear zone formation by KSB in Aleksandrov medium

Potassium solubilising potential estimated using mica as K source. Potassium release kinetics estimated by best fitted first-order kinetics ($M_{\min} = K_0 (1 - e^{-kt})$). The potentially mineralizable K (K_0), the mineralized K (K_{\min}) as well as the rate constants for K mineralization (k) from the waste mica was estimated.

Rate constant for the K mineralization differed among the isolates. It was observed that a significantly higher release rate was found in case of mica inoculated with the isolate KSB9 as compared

to the rest of the isolates. The 16S rRNA gene sequence of the isolates were phylogenetically matched with known 16S rDNA sequences. The results showed that the KSB3 possessed 100% similarity with its close species strain BRL02-31. Four isolates (KSB8, KSB9, KSB5 and KSB6) were found to be closely phylogenetically related to *klebsiella*, showing with 96-100% similarity in their 16S rDNA sequences. The isolate KSB9 closely related to *klebsiella variicola* strain kms0422, isolate KSBC5 was similar to *klebsiella* sp.2009I10.

Potentially mineralizable K (K_0), mineralized K and K rate constants

Isolate No.	Potentially mineralizable $\text{NH}_4\text{OAc-K}$ ($\mu\text{g mL}^{-1}$) (K_0)	Mineralized K ($\mu\text{g mL}^{-1}$) (K_{\min})	Rate constant day^{-1} (k)
Control	18.26 ^f	16.15 (± 5.12)	0.054 ^{bc}
KSB5	61.40 ^e	55.12 ^e (± 0.11)	0.057 ^b
KSB8	85.22 ^c	69.96 ^c (± 0.57)	0.043 ^d
KSB3	88.32 ^b	74.85 ^b (± 0.69)	0.047 ^{cd}
KSB9	74.70 ^d	68.19 ^{cd} (± 0.17)	0.061 ^a
KSB6	91.11 ^a	78.33 ^a (± 0.49)	0.049 ^c

Different lower case letters within each column indicate significant differences (at $p = 0.05$) between KSB isolates

Impact of conservation agriculture (CA) on soil properties

Conservation agriculture (CA) management had a positive effect on soil aggregation, aggregate stability (WSA) and also increased soil organic carbon (SOC) content. Tillage practices i.e. reduced tillage (RT) and no tillage (NT) with crop residue retention and cropping system had a significant effect on aggregate-associated C for large macro-aggregates at 0–5 and 5–15 cm depths after four cropping cycles. Higher aggregate C in large and small macro-aggregates favoured better aggregation under NT and RT with crop residue retention than with conventional tillage practices (CT). The SOC concentration increases with aggregate size and provides physical protection and stabilization of carbon. Less labile and non-labile C fractions contribute more than 50% TOC in the rainfed Vertisols of Central India. Tillage practices and cropping systems had no significant effect on soil temperature recorded during *rabi* season. It was observed that tillage system, depth and its interaction (tillage x depth) had a significant effect on volumetric heat capacity in dry as well as saturated soil. Volumetric heat capacity (dry soil) was ranged from 1.0 to 1.20, 0.97 to 1.20, 0.92 to 1.08 J m⁻³ deg × 10⁶ for CT, NT and RT, respectively. Similarly, volumetric heat capacity (saturated soil) was ranged from 2.86 to 3.11, 2.89 to 3.15, 2.82 to 3.19 J m⁻³ deg × 10⁶ for CT, NT and RT, respectively. Soil moisture status recorded under different tillage system showed that conservation tillage practices (RT and NT) with crop residue retention recorded relatively higher soil moisture content (8-18%) compared to CT. In addition, CA practices not only improved aggregation and maintenance of SOC,



but also increased crop yields after a few years of continuous practice/implementation. Tillage modules were tested through demonstrations in farmer field in a participatory mode and results revealed that zero tillage found as the best among various modules with soybean.



Crop establishment under crop residue retention in soybean-wheat system

Assessment of Alfisols using Mid-Infrared Spectroscopy (MIR)

To develop chemometric models for prediction of properties of Alfisols, soil samples were collected from the arable land under diverse management practices from the states of Karnataka and Kerala. These samples were processed and different soil properties i.e. EC, pH, SOC, available nutrients concentration, textural composition were estimated using standard laboratory procedures. Chemometric models were developed using seventy per cent of the MIR spectra, and 30% of soil sub-samples were used for the model validation with independent data set. Validation of the model with independent data set showed that the predictability as expressed through coefficient of determination (R²) varied markedly among the different soil properties tested. The models developed could predict reasonably well the SOC (0.88) and pH (0.72) of the soil. The R² values of the validation dataset for the available N and P were 0.56 and 0.53, respectively while they were as low as 0.19 and 0.23 for the EC and available K, respectively. For development of more robust prediction models about 600 more samples were collected from Alfisols of Orissa, Jharkhand, Karnataka and Tamil

Nadu. The soil samples were processed and analyzed for soil properties to develop prediction models.

Integrated assessment of soils and crops for enhancing productivity and C-sequestration potential of Vertisols under changing climatic scenarios

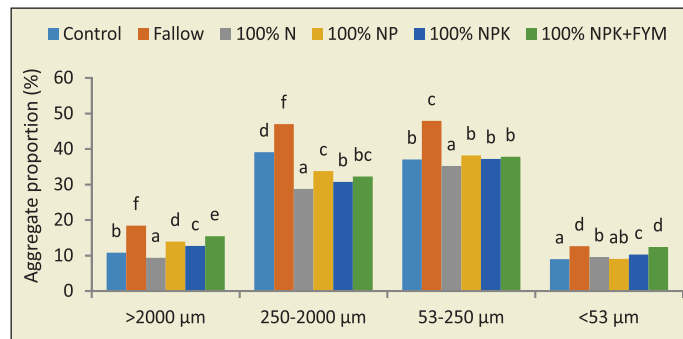
More than 15,000 soil samples were collected from agricultural and horticultural fields, agro-forestry, forest and orchards. The optimum N dose for maximum soil C sequestration was estimated to be 155 kg N ha⁻¹ yr⁻¹ to wheat and 20 kg N ha⁻¹ to soybean in soybean-wheat cropping system for the central Indian Vertisol. Under optimal N additions, soil C increased to 24.14 t ha⁻¹ that is equivalent to 28.6% of the initial soil C. Soil organic C sequestration potential for Vertisols under soybean-wheat cropping system was found to be the highest in integrated treatment followed by recommended inorganic application. Time to reach equilibrium C concentration was also highest in NPK + FYM treatment followed by NPK.

Long term use of fertilizer and manure impacts soil aggregate, nitrogen mineralization potential and arginine ammonification

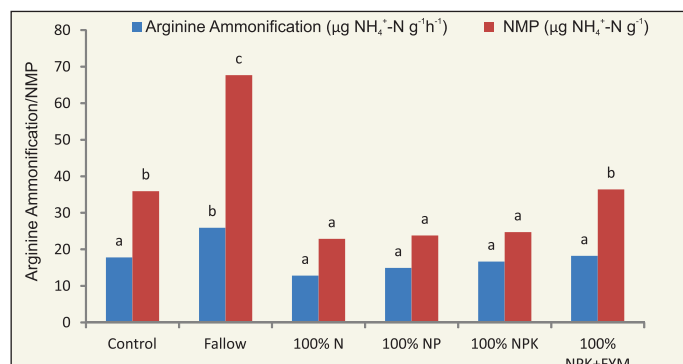
Significant variations in aggregate size distribution were noticed among different treatments in LTFE Barrackpore. Both the macroaggregates (250–2000 µm) and microaggregates (53–250 µm) contributed almost equally in aggregate size distribution, which accounted for 28.7 to 47.01% and 35.2 to 47.9% of the dry weight of soil, respectively. Among all the treatments, fallow had the highest percentage contribution to each aggregate size class except for more than 2000 µm macroaggregates and it was followed by the 100% NPK+FYM treatment. Nevertheless, irrespective of aggregate size classes, the concentration of carbon was the highest in 100% NPK+FYM treatment.

Nitrogen mineralization potential (NMP) and arginine ammonification were found to be highest under 100% NPK + FYM and were significantly higher as compared to all other treatments. In case of NMP, 100% NPK + FYM and control

recorded statistically similar results. However, both NMP and arginine ammonification found significantly higher with 100% NPK + FYM compared to 100% N, 100% NP and 100% NPK treatments.



Aggregate size distribution



Arginine ammonification and N mineralization potential

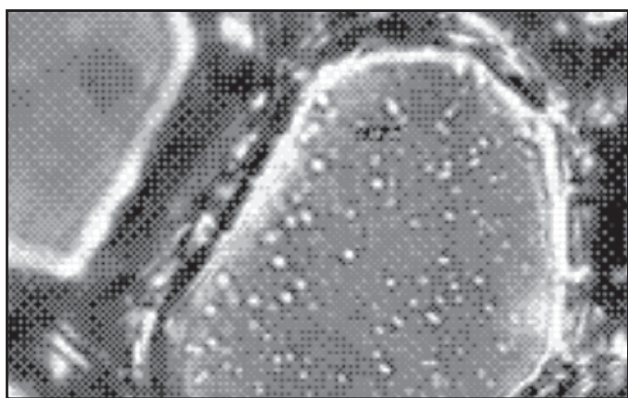
Hyperspectral remote sensing approaches to evaluate soil quality and crop productivity

There is an urgent need to have rapid, effective, non-destructive and sensitive methods to monitor and evaluate soil quality in order to understand their potential effects on crop production. The rapid assessment of soil quality can provide an opportunity for site-specific resource allocation and helps in developing location-specific better management practices. The hyperspectral remote sensing (HSRS) approaches have shown the capability for rapid estimation of soil properties under the diverse agroecosystem. Therefore, soil quality for central Indian Vertisols has been evaluated for both laboratory and spectral based techniques using HSRS approaches. Results indicated that there was a good correlation between both the techniques ($R^2 = 0.89$). Hence, HSRS

technique has the potential to evaluate soil quality for central Indian Vertisols.

Plant growth promotion by corn root endophyte

Corn plant grown under organic system was selected for studying endophytic bacterial flora. The internal tissues of roots were found to be colonized by bacterial endophyte. Morphologically different colonies obtained were purified and evaluated for plant growth promoting attributes. Isolate MER4 was able to solubilize phosphate, potassium and produced phytohormone IAA *in vitro*. The isolate alone and also in combination with soil diazotrophic isolate JS1 could improve seed germination and seedling elongation. The study showed the promise in bacterial endophyte for plant growth promotion.

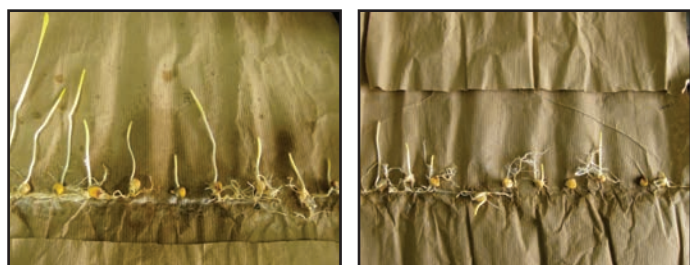


Light micrograph of bacterial endophyte of corn root (100X)



MER4

JS1+ MER4



JS1

Uninoculated

Corn seed inoculation with different isolates

In-situ residue decomposition technique to enhance soil health and crop productivity

An experiment on *in-situ* decomposition techniques was carried out to study effect on soil health parameters with the use of rice and wheat residues by mixing consortia of ligno-cellulolytic microorganisms. This consortium includes four species of each namely fungi, bacteria and actinomycetes which were isolated, identified and multiplied at ICAR-IISS, Bhopal. About 34-38 q ha⁻¹ of post-harvest crop residues were generated under rice-wheat production systems with the use of combined harvester. During this *in-situ* decomposition processes, a slurry of fresh cowdung (4000 kg on dry weight basis) was prepared by thoroughly mixing with water followed by addition of 37 kg urea, 50 kg molasses, 25 kg curd, 1.7 kg mycelial mat (cellulolytic fungi) and 34 litre of microbial inoculum (ligno-cellulolytic bacteria and actinomycetes) and this mixture was spread over the residues in the fields. The first irrigation was given just after spreading the mixture including the consortia. All the ingredients were then applied on crop residues in the field and incorporated in the soil with a tractor drawn rotavator. The next irrigation was given after 15 days of *in-situ* decomposition and rice was grown thereafter one month. Rice cv Basmati was grown in Gyong and CSSRI farm, whereas cv Pusa 1121 was grown in Bahupur. Likewise, stepwise process was also followed for wheat crop after harvest of rice for *in-situ* decomposition of crop residues. Crop yields were relatively better in *in-situ* decomposition field as compared to burning of residues for both rice and wheat. Soil health parameters i.e. soil organic C, available N, P, K and soil respiration were relatively higher in *in-situ* composting plots as compared to burning of residues under rice-wheat system.

Elevated CO₂, chlorpyrifos and biochar influence on nitrification and microbial abundance in the rhizosphere of wheat

Experiments were carried out to study nitrification in the rhizosphere of wheat under the influence of elevated CO₂, chlorpyrifos and biochar. Wheat was grown under different concentration of CO₂ (400 ppm, 800 ppm), biochar (0%, 1%), and chlorpyrifos

(0 ppm, 10 ppm). Nitrification rate was the lowest (0.66 ± 0.15 mg $\text{NO}_3\text{-N}$ produced g^{-1} soil d^{-1}) in soil under 400 ppm CO_2 + 0% biochar + 10 ppm chlorpyrifos. Whereas nitrification rate was (4.53 ± 0.59 mg $\text{NO}_3\text{-N}$ produced g^{-1} soil d^{-1}) was in the treatment of 800 ppm CO_2 + 1% biochar + 0 ppm chlorpyrifos. Abundance of 16S rRNA gene copies ($\times 10^6$ cells g^{-1} soil) of eubacteria varied from 25 ± 3.0 to 75 ± 4.04 . Abundance of ammonia oxidizing bacteria ($\times 10^5$ cells g^{-1} soil) varied from 1.43 ± 0.40 to 8.33 ± 0.58 . Shoot weight (g) of wheat varied from 23.0 ± 2.0 to 43.0 ± 3.7 . Similarly root weight of wheat varied from 9.6 ± 0.58 to 25.4 ± 2.34 . Result exhibited that elevated CO_2 and biochar stimulated nitrification, microbial abundance and plant growth while the chlorpyrifos inhibited. The impact of elevated CO_2 was highest followed by chlorpyrifos and biochar. Results indicated that the rise in atmospheric CO_2 may have severe negative impact on nitrification and soil microbial abundance. However, the use of biochar may alleviate these negative impacts and also aid in maintaining soil function.

Application of hydrogel for augmenting water and nutrient use efficiency and crop productivity of tomato

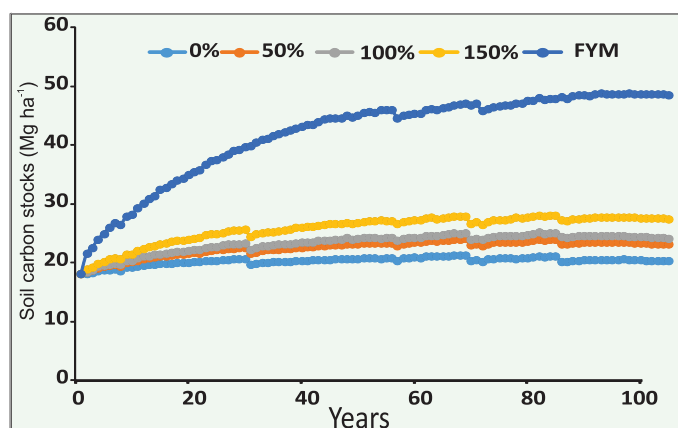
Water retention in all texturally contrasting soils was augmented by hydrogel to variable but small extents between 0.3 and 1 bar which is a narrow range especially for rainfed crops where the irrigation water is scarce and a farmer may re-irrigate the crops even at 10 bar moisture content. The number of grains per plant and grain yield per ha did not show any significant variation due to hydrogel



treatment in soybean. Tomato fruit yield and water use efficiency (WUE) did not increase significantly with the increasing doses of hydrogel. Similarly, the growth parameters, fruit weight and WUE did not influence with increase in hydrogel levels in sandy loam and silty clay loam soils. In both soil types, the cumulative evapotranspiration losses varied from 7 to 44 cm and no significant difference was recorded due to hydrogel rate variation under any single irrigation treatment.

Long-term application of FYM alongwith N fertilizer on equilibrium concentration of SOC in a Vertisol

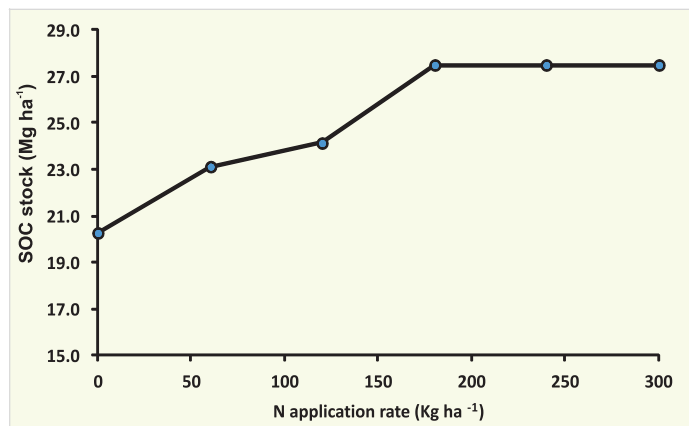
Long-term soil organic carbon (SOC) data available in LTFE Jabalpur was used to simulate the equilibrium C concentration for suboptimal, balanced and integrated nutrient management treatments including FYM. The simulation results revealed that long-term measured SOC stock was satisfactorily simulated by the APSIM model. The steady state in SOC stock at 0-30 cm depth under balanced fertilization varied from 62 to 86 years. The SOC saturation level reached 46.50 Mg ha^{-1} in 100% NPK + FYM (10 Mg ha^{-1}).



Optimisation of N application rate for maximum SOC sequestration using APSIM model

Identified the optimum nitrogen (N) application rate for maximum soil carbon (C) sequestration in soybean-wheat system in a Vertisol. Balanced fertilization and integrated nutrient management with FYM enhanced C sequestration potential in these soils. From the long-term simulation study using APSIM model for soybean-wheat system revealed that the N_{opt} for maximum soil C

sequestration was $153 \text{ kg N ha}^{-1} \text{ yr}^{-1}$ to wheat and 20 kg N ha^{-1} to soybean in soybean-wheat cropping system in a Vertisol. Under optimal N additions, soil C increased to 26.12 t ha^{-1} which is equivalent to 28.6% of the initial soil C.



Evaluation of IPNS modules for sustainable productivity in a Vertisol

Different integrated nutrient management modules comprising of various combinations of chemical fertilizers, FYM, poultry manure, urban compost and glyricidia loppings were evaluated in maize-chickpea cropping system in Vertisol. The highest grain yield of chickpea was observed in treatment with 5 t FYM applied in every rabi season. Thus, an application of FYM @ 20 t ha^{-1} in kharif and 5 t ha^{-1} in rabi seasons improved the grain yield of chickpea due to residual fertility as compared to maize residues mulching. Further, the grain yield found to be almost equal with the application of general recommended dose (i.e. 120-60-30 for maize and 20-60-20 for chickpea, N-P₂O₅-K₂O kg ha⁻¹) and STCR based recommended dose of fertilizers.

Exploring Glaucanite as a source of potassium

The Glaucanite (K bearing mineral) material was collected from Singrauli district (Madhya Pradesh). The samples were brought and ground to pass through 2.0 mm, 0.5 mm, 0.25 mm and 0.125 mm size. These size fractions were subjected to analysis of various properties and nutrient content i.e. forms of K (total, water soluble, exchangeable and non-exchangeable), cation exchange capacity, pH and electrical conductivity. The total K₂O content in Glaucanite samples ranges from 7.1 to 12.6%. Irrespective of different extractants, the amount of K

release was more with decreasing size of Glaucanite.

Calcium and Na ions concentration effects on chromium uptake in spinach grown in Vertisol

Industrial and municipal wastewater is being used by the farmers for the cultivation of crops in peri-urban areas. The small scale leather industries are contributing significant amount of chromium (Cr) in the effluent water from cities, where wastewater from municipal and other industries discharge significant salt load. These are likely to interfere with the Cr uptake by plants. To understand interactions of these cations with Cr uptake, a pot culture experiment was conducted at ICAR-Indian Institute of Soil Science, Bhopal with spinach as test crop in Vertisol of central India. Each of three levels of Cr (0, 50, 100 mg kg⁻¹), calcium (Ca @ 0, 2, 4 mM) and sodium (Na @ 0, 40, 80 mM) were applied as a treatment to synchronize the metal and cations concentration in wastewater. The spinach (cv All Green) was harvested at full maturity. Result showed that application of Ca and Na reduced the Cr uptake in spinach crop. The Cr reduction rate is more in the root than shoot part. Calcium applications act as an essential plant nutrient and enhanced the crop biomass. Sole applications of sodium adversely affect the crop biomass and Cr uptake in both root and shoot of spinach. It was found that application of Ca fertilizers reduces the Cr toxicity in tannery irrigated agriculture crop production system and can be used as a strategy for the safe utilization of different industrial effluent for crop production.



High Cr affected plant growth



Strategies to enhance rice and wheat productivity by Zn and S application in Mollisols

Highly intensive and irrigated system has accelerated mining of all the essential plant nutrients which resulted in deficiency of secondary and micronutrients those were not supplied to soil. In long term fertilizer experiment is in progress at Mollisols of Pantnagar revealed deficiency of zinc (Zn) and sulphur (S). In order to confirm further through field experiments the treatments were superimposed with Zn and S. The results indicated that application of Zn and S even though resulted increase in yield of both rice and wheat but found statistically at par. Application of Zn resulted in relatively more increase in yield of rice in comparison to NPK without Zn and S but their additive effect is more pronounced. Thus, the result indicated that both Zn and S should be supplied simultaneously to rice to sustain crop productivity in Mollisols. Incorporation of organic manure over and above NPK further enhanced the productivity.



Application of Ca and Na improved plant growth

Reclamation and rehabilitation of copper mining affected land

The reclamation and rehabilitation of copper mining affected land in Malanjkhand (M.P.) was done by establishing multitier green cover of plantation crops viz., grass-shrubs-small trees-tall trees. Similarly, for rejuvenation of the soil system in terms of soil fertility and microbial growth. Initially, vetiver grass (*Chrysopogon zizanioides*) was planted in the experimental site after top-soiling (~15 cm depth) and FYM application @ 10 t ha⁻¹. The growth of vetiver was satisfactory with survival percentage of about 90%. There was profuse root growth and thereby consequent root exudation below the soil layer. It would help to enhance microbiological activities in mine-tailing sand zone and phyto-remediation process. Therefore, frequent irrigation is important for vetiver establishment in the tailing dam embankment.



Vetiver plantation on mine-tailing dumpsite



Application of 150% NPK-S



Application of 150% NPK+S+Zn+FYM

The STCR-IPNS experiment on long term rice - rice sequence

A twenty years old STCR-IPNS long term experiment (since kharif 1998) with rice-rice sequence on Alfisol at TNAU Farm, Coimbatore revealed that application of STCR-IPNS based fertilizer recommendation along with FYM @ 12.5 t ha⁻¹ and *Azospirillum* and Phosphobacteria each @ 2 kg ha⁻¹ + fertilizers (91, 25 and 25 kg of N, P₂O₅ and K₂O ha⁻¹) for soil test value of 262, 30.3 and 587 kg ha⁻¹ of available N, P and K has recorded the highest grain yield of 5890 kg ha⁻¹ and response ratio of 19.20 kg grain yield per kg of nutrient applied. After 19 years of rice-rice sequence, as compared to the initial status, in STCR-IPNS treatment status of available N (280 to 265 kg ha⁻¹) was maintained but there was built up in available P (20.2 to 30.3 kg ha⁻¹). However, status of available K, the magnitude of depletion was low (670 to 586 kg ha⁻¹) as compared to blanket and STCR-NPK alone treatments. Soil organic carbon status was improved partially as compared to the initial status and the highest OC status (8.7 g kg⁻¹) was observed in STCR-IPNS. Therefore, soil test and yield target based fertiliser prescriptions under IPNS was recommended for rice-rice sequence on Noyyal soil series (*Typic Haplustalf*) and allied soil types.

Awards/Honours/Recognitions

- Dr. Brij Lal Lakaria, Pr. Scientist received IASWC Fellow-2017 from the Indian Association of Soil and Water Conservationists held at AAU, Anand on 01 February 2018.



- Dr. A.K. Patra, Director received Prof. Sushil Kumar Mukherjee Commemoration Lecture

Award 2017-18 by The Indian Science Congress Association, Kolkata on 17 March 2018.



- Dr. Asha Sahu, Scientist received the 1st and Dr. Sudeshna Bhattacharjya, Scientist received 3rd Best Oral Presentation Award in National Conference on 'Organic Waste Management for Food and Environmental Security' at ICAR-IISS, Bhopal (08-10, February 2018).
- Drs. B.P. Meena, A.K. Biswas, Muneshwar Singh, A.B. Singh R.S. Chaudhary, A.K. Patra received 'Best Poster Award' in National Conference on 'Organic Waste Management for Food and Environmental Security' at ICAR-IISS, Bhopal (08-10, February 2018).

International Co-operation/Deputation

- Dr. A.K. Biswas, Head (SCF) and Pr. Scientist participated in 3rd Knowledge Exchange Workshop on 'Soil Protection and Rehabilitation' at Ethiopia during 18-22 February, 2018.
- Dr. J. Somasundaram, Pr. Scientist, participated GCRF collaboration project preparation workshop at University of Reading, United Kingdom during 13-14 March, 2018.
- Dr. A.K. Patra, Director participated in the Interest Group on Agricultural Data (IGAD) and GODAN pre-plenary meeting to 11th Research Data Alliance (RDA) and IGAD/RDA Plenary Session in Berlin, Germany during 19-23 March, 2018.
- Dr. A.K. Biswas, Head (SCF) and Pr. Scientist



participated in exposure visit on 'Conservation agriculture, commercial vegetable production and rural development in Bangladesh for the Heads of NARES of SAARC countries' at Bangladesh during 26-31 March, 2018.

- Dr. K.M. Hati, Pr. Scientist deputed for Post-Doctoral Fellowship under 'Endeavour Research Fellowship-2018' at The University of Queensland, St. Lucia, Queensland during 01 May - 02 October, 2018.
- Dr. Pramod Jha, Pr. Scientist deputed for Post-Doctoral Fellowship under 'Endeavour Research Fellowship-2018' at The University of Queensland, St. Lucia, Queensland during 08 May - 02 November, 2018.

Extension Activities

- A video film was prepared in English showcasing the institute establishment and technologies. The film depicts the institute's mandate, programme wise achievements, awards and honours, demonstrations on farmers' field, Mera Gaon Mera Gaurav, Swachh Bharat Mission activities. The film was directed and edited by Drs. Sanjay Srivastava, Shinogi K.C., Jyoti Kumar Thakur, M. Vassanda Coumar, J. Somasundaram and Ashok K. Patra.
- Organised skill development programme on soil health by AICRP STCR at Pedda Golkonda village (Dist. Rangareddy, Telangana) on 16 May, 2018. On this occasion, the basic emphasis was given to the importance of soil



testing and STCR based nutrient management, soil health card scheme and targeted yield approach for improving crop productivity and maintaining soil health. A scientist-farmer interaction meeting was also organised on this day.

- Organised skill development programme on soil health by AICRP STCR at Sadalpur, (Haryana) on 29th June, 2018. A farmer-scientist interaction meet was jointly organised by AICRP-STCR and AICRP (Dryland Agriculture) to impart scientific knowledge among the farmers on soil test based nutrient management, use of soil health card, etc. Dr Pradip Dey, PC (STCR) also highlighted the preparedness for agricultural contingencies, adoption of targeted yield approach for plant nutrient management, role of potassium for maintaining sustainable production during deficit monsoon.



Distinguished Visitors

- Dr. Prem Kumar, Hon'ble Minister of Agriculture, Government of Bihar visited on 03 February, 2018.
- Shri Vishvas Sarang, Hon'ble Minister of Co-operation, Bhopal Gas Tragedy Relief and Rehabilitation (Independent Charges), Panchayat and Rural Development, Govt. of Madhya Pradesh inaugurated National Conference on 'Organic Waste Management for Food and Environmental Security' on 08 February 2018.



Mr. Vishvas Sarang, Hon'ble Minister inaugurates National Conference on 08 February 2018

- Dr. S.K. Chaudhary (ADG SWM), Dr. S.S. Khanna (Former VC, NDUAT, Faizabad & Advisor, Planning Commission) and Former Directors of ICAR-IISS, Bhopal namely Dr. P.N. Takkar, Dr. C.L. Acharya, Dr. A. Subba Rao visited on 08 February 2018. Dr. A.K. Singh (Ex-VC, RVSKVV, Gwalior and Ex-DDG NRM) and Dr. M. Velayutham (Former Director, NBSS&LUP, Nagpur) also graced the occasion.
- Shri Vishvas Sarang, Hon'ble Minister of Co-operation, Bhopal Gas Tragedy Relief and Rehabilitation (Independent Charges), Panchayat and Rural Development, Govt. of Madhya Pradesh and Dr. Sasikala Pushpa, Hon'ble Member of Parliament of Rajya Sabha participated in the Live Webcast Programme on Kishi Unnati Mela on 17 March, 2018.
- Dr. Tejinder Singh (IFS, Additional Principal Chief Conservator of Forests of the Western Zone, Bhopal), Dr. Surendra Kumar Singh, (Director, ICAR-NBSS & LUP, Nagpur), Dr. V.P. Singh (Director, ICAR-NIHSAD, Bhopal) and Dr. A. Subba Rao (Ex-Director, ICAR-IISS, Bhopal) visited on 16 April, 2018 (31st Foundation Day).
- Shri Radha Mohan Singh, Hon'ble Minister of Agriculture and Farmers' Welfare, Govt. of India and President, ICAR visited on May 18, 2018. The Hon'ble Minister emphasized on future challenges and priorities for doubling farmer's income. Dr. Ashok K. Patra, Director, IISS apprised the Hon'ble Minister about the

achievements and on-going activities of the institute.



Staff News

Staff Promoted

- Dr. R.H. Wanjari, Sr. Scientist promoted to Pr. Scientist under CAS w.e.f. 07.01.2014.
- Mrs. Babita Tiwari, Assistant got Financial Upgradation (Pay Matrix Level 6 to Level 7) w.e.f. 15.05.2018.

New Staff Joined

- Mr. Abhijit Sarkar, Scientist joined the Institute on 29.06.2018.
- Mrs. Madhumonti Saha, Scientist joined the Institute on 29.06.2018.

Staff Transferred

- Dr. M.L. Dotaniya, Scientist transferred to ICAR-DRMR, Bharatpur on 27.06.2018.
- Dr. Sonalika Sahoo, Scientist transferred to ICAR-NBSS&LUP, Nagpur on 28.06.2018.

Seminar/ /Training / Workshop Organised

National Seminar

- National Seminar on 'Organic Waste Management for Food and Environmental Security' was organised by Drs. M.C. Manna (Organizing Secretary), A B. Singh and R.S. Chaudhary (Co-organizing Secretary) at ICAR-Indian Institute of Soil Science, Bhopal on 08-10 February 2018. Scientist from the Institute also participated in the seminar.



National Seminar on 'Organic Waste Management for Food and Environmental Security'

International Training Programme

Indo-US Collaborative Feed the Future - India Triangular Training (FTF-ITT) Programme Organized: An international training on 'Management of Technology and Extension for Soil Testing based advisory Services to Farmers' under Feed the Future India Triangular Training (FTF ITT) of USAID and MEA, Govt. of India was organized in Collaboration with National Institute of Agricultural Extension Management (MANAGE), Hyderabad at ICAR-Indian Institute of Soil Science, Bhopal during 31 January to 13 February, 2018. About 21

Executives from seven countries viz., Afghanistan, Myanmar (Asia), Kenya, Ghana, Malawi, Liberia, and Uganda (Africa) participated in this training. Prof. V.S. Tomar, Former Vice Chancellor, JNKVV, Jabalpur graced the function as the Chief Guest. The programme includes triangular cooperation adapting technological advances and innovative solutions to address food security challenges in Africa and Asia. It was sponsored by USAID. Dr. Ashok K. Patra was the Course Director and co-coordinated by Drs. Sanjay Srivastava, Pradip Dey, A.K. Biswas, Pramod Jha and Shinogi, K.C.



Indo-US Collaborative FTF-ITT International Programme

National Training Programme

- Training for ICAR Technical Staff was organized by Dr. J.K. Saha during 22 – 27 January, 2018 at ICAR-Indian Institute of Soil Science, Bhopal.

- ICAR-NICRA sponsored Training Programme on 'Agricultural system modelling to assess climate change impacts on soils and crops' was organised by Dr. M. Mohanty (Course Director) and Dr. N.K. Sinha (Course Co-

Director), ICAR-Indian Institute of Soil Science, Bhopal during 16-25 January, 2018.



- Training Programme on 'Soil Health Assessment and Soil Health Card Preparation' was organised by Dr. Brij Lal Lakaria (Course Director) and Priya Gurav (Course Co-Director) at ICAR-Indian Institute of Soil Science, Bhopal on 19-23 March, 2018. Nineteen participants including ADO, AEO and Laboratory officers from State Department of Agriculture, Badwani, MP took part and it was sponsored by State Department of Agriculture, Govt. of Madhya Pradesh.



Workshop

- Organized a one-day Workshop under Farmer FIRST Project on 8th March 2018 to commemorate International Women's Day at Khamkheda (Dist. Bhopal) with a focus on 'Role of rural women in doubling farmers' income'.
- Organized concluding Workshop of Contractual projects (i) 'Evaluation of efficacy of sulphur and zinc containing complex fertilizers for maximizing yield through balanced nutrition of different crops in India' funded by M/s Zuari Agro Chemicals Ltd., Goa and (ii) 'Evaluation of efficacy of zinc and boron foliar supplements for maximizing yield through balanced nutrition of important crops grown in India' funded by M/s Indofil Industries Ltd., Mumbai at CSKHPKV, Palampur during 28-29 June, 2018.

Programmes Held

Republic Day (26 January, 2018)

Institute celebrated 69th Republic Day. On this occasion various competitive events viz., race, drawing, dance, lemon spoon race, vollyball shooting/smashing and spot the city were organized for the Institute's staff and their family members. It was followed by the cultural programme, prize distribution and remarks by Dr. Ashok K. Patra, Director.



National Productivity Week (12-18 Feb., 2018)

National Productivity Week (NPW) was celebrated at ICAR-IISS, Bhopal during 12-18 February, 2018 under the theme 'Industry 4.0, Leapfrog Opportunity for India'. Dr. Ashok K. Patra, Director, ICAR-IISS highlighted the importance of NPW and gave his insightful thoughts on productivity enhancement in agriculture and sustainable soil management practices.

International Women's Day (08 March, 2018)

One-day workshop was organized on 8th March 2018, commemorating International Women's Day on 'Role of rural women for doubling farmers' income' at the village Khamkheda, Bhopal sponsored by Farmers FIRST programme which was in accordance with theme of this year 'Press for progress'. Farm women were given various training-cum-demonstration on post-harvest fruits and vegetable processing and preservation techniques.



A workshop on the occasion of International Women's Day

Kisan Sangoshthi

- Workshop was organized on "Climate change: adaptation and mitigation strategies in agriculture" sponsored by UNDP-GEF-MOEFCC project at village Shagonia, one of MGMG adopted village in Bhopal on 26 March, 2018. The focus of workshop was to create awareness among farming community about the impact of climate variability such as temperature and rainfall and possible adaptation strategies for different regions of Madhya Pradesh.

- Organized one day farmers–scientist interaction meeting held under NICRA & MGMG Programme at Badharka (Dist. Bhopal) on 15 March, 2018.
- Organized one day farmers–scientist interaction meeting held under Farmer FIRST & MGMG programme at Bhairoपुरa (Dist. Bhopal) on 17 March, 2018 and at Khamkheda (Dist. Bhopal) on 26 March, 2018.

Foundation Day (16 April, 2018)

The ICAR-Indian Institute of Soil Science, Bhopal celebrated its 31st Foundation Day at the Institute campus. Dr. Tejinder Singh, IFS, Additional Principal Chief Conservator of Forests of the Western Zone graced the function as the Chief Guest. He emphasized on key issues such as the role of natural resources in the survival of the mankind, soil degradation, deterioration of natural resources, increasing trend of consumerism in the human society, deforestation and pollution of soil and water resources. He suggested remedial measures and concluded with the statement 'A balanced and modest life is the need of the hour' as preached by Lord Buddha. Dr. S.K. Singh (Director, NBSS & LUP, Nagpur) and Dr. V.P. Singh (Director, NIHSAD, Bhopal) graced the function. Dr. S.K. Singh delivered foundation day lecture by highlighting the problem of soil degradation and its remedial measures. Dr. V.P. Singh emphasized the importance of critical linkages between the soil, animal and human health. On this occasion, the progressive farmers were felicitated and Institute's publications including 'Success Story' were released. Farmers from different villages under MGMG attended the function and a farmer-scientist interaction was also organized to discuss their problems and solutions related to soil and nutrient management.



Swachhta Pakhwada (16-31 May, 2018)

Activities were organised in the Institute premises and nearby public places under the Swachh Bharat Mission. The activities comprised of cleaning of surrounding areas, road side cleaning, vermicomposting, removal of weeds, biodegradable waste management etc.



Mera Gaon Mera Gaurav

Activities were carried out to create awareness to recycle or reuse the crop residues, agro-advisories for various aspects of soil health as well as field crops and sensitized farmers about not to burn crop residue in fields. Method demonstrations were also carried out on post-harvest fruits and vegetable processing and preservation techniques. A pre-kharif sangoshthi was organized on 'Integrated nutrient management practices for doubling the farm income'. Field demonstrations were conducted on organic farming and composting in the identified villages under MGGM. Kisan sangoshthi and capacity building programmes such as training on organic farming and soil health were organized. Besides mobile based advisory to farmers was given on crop variety, market price of commodities, fertilizer recommendation etc. The teams con-

ducted interface meetings with the farmers. Linkages were also made with other government agencies like M.P. State Department of Agriculture, Krishi Vigyan Kendra at Raisen, ICAR-CIAE, ATMA Bhopal and farmer FIRST project at ICAR-IISS, Bhopal.



International Yoga Day (21 June 2018)

An International Yoga Day (IYD) was celebrated at ICAR-Indian Institute of Soil Science, Bhopal on 21 June, 2018 as per the joint instructions of the ICAR and Ministry of AYUSH, Govt of India. It comprised of *yogasanas* and *pranayam*. The staff of the Institute participated in this health awakening programme with enthusiasm.





Krishi Unnati Mela (16-19 March, 2018)

ICAR-Indian Institute of Soil Science, Bhopal participated in the 'Krishi Unnati Mela' at ICAR-IARI, New Delhi during 16-19 March 2018. The Institute technologies were displayed and interacted with the dignitaries, farmers, students, staff and other visitors. About 3000 pamphlets were distributed to the farmers depicting two technologies i.e. 'Mridaparikshak: A Mini-lab for Soil Testing and Fertilizer Recommendation' and 'Rapo-composting Technology for Recycling of Biodegradable Waste'. Under Farmer FIRST



Project, Institute also gave exposure visit to farmers to modern technologies in agriculture during the exhibition.

QRT Meeting (23-25 June, 2018)

Final meeting of the 5th Quinquennial Review Team (QRT) was held at IISS, Bhopal on June 23-25, 2018 to finalize the draft report to review the programmes of IISS, Bhopal including three AICRPs (AICRP on Long Term Fertilizer Experiments, Micro- and Secondary- Nutrients and Pollutant Elements in Soils and Plants, Soil Test Crop Response) and one AINP on Soil Biodiversity-Biofertilizers during the period April 2012 to March 2017. The 5th QRT consisted of Dr. V.S. Tomar (Chairman), and Dr. Masood Ali, Dr. H.K. Senapati, Dr. Biswapati Mandal, Dr. A.L. Pharande, Dr. K. Chinnadurai (Members) and Dr. J.K. Saha (Member Secretary).



RECENT PUBLICATIONS



Scientist's Participation in Conferences/ Seminars/ Trainings/ Workshops

Name	Programme attended/ participated	Venue	Date
Dr. Dolamani Amat	Training on 'Analysis of microbial diversity and polyphasic characterization of bacteria (MICRO)'	CSIR-CCMB, Hyderabad	08 January - 03 February, 2018
Dr. Pradip Dey	First Farm Innovation Congress (FIC) 2018 and National Conference on 'Innovative farming for food and livelihood security in changing climate'	BCKV, Kalyani	12-13 January, 2018
Drs. Hiranmoy Das & Priya Gurav	Training on 'Agricultural system modelling to assess climate change impact on soils and crops'	ICAR-IISS, Bhopal	16- 25 January, 2018
Dr. N.K. Lenka	Review Workshop of the National Agricultural Science Fund (NASF)	New Delhi	18 January, 2018
Dr. A.K. Patra	Meeting to review NICRA project	CRIDA Hyderabad	23 January, 2018
Dr. A.K. Patra	FICCI-NITI Aayog Regional Meeting 'To promote awareness and usage of steel slag across the country	Bellary (Karnataka)	24 January, 2018
Dr. Pradip Dey	CAFT Programme on 'Soil management approaches for climate mitigation in sustainable agriculture system'	JNKVV, Jabalpur	27 January, 2018

Scientist's Participation in Conferences/ Seminars/ Trainings/ Workshops

Name	Programme attended/ participated	Venue	Date
Drs. B.L. Lakaria & Anand Vishwakarma	National Conference on 'Farmers FIRST for conserving soil and water resources in western region (FFCSWR-2018)'	AAU Anand	01-03 February, 2018
Dr. A.K. Patra	Jury Panellist for Mahindra Samridhi India Agri Awards (MSIAA)	New Delhi	02 February, 2018
Dr. Pradip Dey	2 nd National Level Programme Management and Review Committee Meeting of KFW Project on 'Integrated watershed development for rehabilitation of degraded soils and climate change adaption' and GIZ Project on 'Soil protection and rehabilitation for food security in India'	NABARD, Mumbai	06 February, 2018
Dr. A.K. Patra & All Scientists	National Conference on 'Organic waste management for food and environmental security'	ICAR-IISS, Bhopal	08-10 February, 2018
Drs. M.C. Manna & A.B. Singh	ATMA-KVK State Level Organic Expo-2018 Mela on 'Organic Farming'	Balaghat, Madhya Pradesh	07-08 March, 2018
Dr. Priya Gurav	National Conference on 'Technological empowerment of women'	Vigyan Bhawan, New Delhi	07-08 March, 2018
Dr. Priya Gurav	National Workshop on 'Revisiting foundation course for agriculture research services (FOCARS): Reflections and feedback of trained scientists'	ICAR-NAARM, Hyderabad	15-16 March, 2018
Dr. A.K. Patra	105 th Indian Science Congress organised by ISCA	Central University, Imphal	16-18, March, 2018
Dr. R.H. Wanjari, Mr. Deepak Kaul & Mr. Jai Singh	Krishi Unnati Mela 2018	ICAR-IARI, New Delhi	16-18 March, 2018
Dr. A.K. Patra	Interest Group on Agricultural Data (IGAD) and GODAN pre-plenary Meeting to 11 th Research Data Alliance (RDA) and IGAD / RDA Plenary Session	Berlin, Germany	19-23 March, 2018
Dr. Sangeeta Lenka	National Seminar on 'Potential impact of climate change on soil properties developed under similar parent material in Madhya Pradesh'	EPCO, Bhopal	22-24 March, 2018
Dr. J.K. Saha	National Seminar on 'Water and soil management approaches for climate smart agriculture (WASMACS, 2018)'	BHU, Varanasi	23- 24 March, 2018
Dr. Pradip Dey	National Round Table on 'Minimum support price for farmers' and National Consultation on 'Agri Export Policy'	Habitat Centre, New Delhi	03 April, 2018
Dr. Sangeeta Lenka	SAARC Regional Consultation Meeting on 'Climate resilient agricultural policies, strategies and programmes'	ICAR-NAARM, Hyderabad	17-19 April, 2018
Dr. A.B. Singh	National Workshop on 'Establishing benchmarks for state level training institutions'	WALMI Bhopal	24-25 April, 2018
Drs. A.K. Patra & Pradip Dey	National Conference on 'Double the farmers' income through technologies and management interventions'	Dehradun, Uttarakhand	18-19 May, 2018
Dr. A.K. Patra	Workshop on 'Microbe based technologies for soil health and plant nutrition' organized by ICAR-NBAIM, Mau	NASC, New Delhi	24-25 May, 2018

Scientist's Participation in Conferences/ Seminars/ Trainings/ Workshops

Name	Programme attended/ participated	Venue	Date
Drs. N.K. Lenka & R.H. Wanjari	National Dialogue on 'Artificial intelligence and IoT applications in agriculture'	ICAR-NAARM, Hyderabad	01-02 June, 2018
Drs. A.K. Patra, S. Kundu & N.K. Lenka	25 th AGM and Foundation Day of NAAS	NASC, New Delhi	04-05 June, 2018
Drs. A.K. Patra, Pradip Dey & Sanjay Srivastava	Brainstorming Session on 'Holistic strategy for assessment of soil health'	NASC, New Delhi	25-26 June, 2018
Drs. A.K. Shukla & S.K. Behera	Workshop on (i) 'Evaluation of efficacy of sulphur and zinc containing complex fertilizers for maximizing yield through balanced nutrition of different crops in India' & (ii) 'Evaluation of efficacy of zinc and boron foliar supplements for maximizing yield through balanced nutrition of important crops grown in India'	CSKHPKV, Palampur	28-29 June, 2018

Cultivation of Sponge Gourd Using Trellis System: A Success Story

FARMER SHRI AZAD YADAV from village Khamkheda (Near Bhopal) normally used to take different crops during kharif and rabi seasons. He generally used to grow soybean, paddy during kharif and also wheat, chickpea in rabi season by usually applying fertilizer and pesticides in traditional ways. In the meantime, he attended a training programme on 'Organic farming, soil health, conservation agriculture and balance nutrient management' under Farmer FIRST Project (FFP) organized by ICAR-Indian Institute of Soil Science, Bhopal. Through this training programme he came to know the advantages of organic farming, vermicomposting, balance and integrated fertilizer use etc. Similarly, during the exposure visit of FFP Team of our Institute to the cluster village, he learnt technique of growing sponge gourd by Trellis System. In this direction, he planned to set up trellis of wood, ropes and wires to cultivate sponge gourd in his one acre of land. He cultivated hybrid variety of sponge gourd under Trellis System using vermicompost and cow dung manure. The use of these manures helped him in saving the expenses incurred on chemical fertilizers. As a result, this farmer started adopting Trellis System to grow sponge gourd. He gradually realized the importance of Trellis in sponge gourd cultivation by many ways such as quality of gourd (development and retention for longer period, easy plucking), spraying of pesticides, relatively less use of fertilizers and pesticides etc. This resulted in reduction of cost of cultivation thereby increase in the overall income from the gourd cultivation under Trellis System with net profit of Rs. 39,000 (2016–17) to Rs. 62,000 (2017–18) from one acre of land.



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