Training imparted to students as part of their Master's Programme

Name of the Institution / College	Name of the Trainee	Coordinator	Duration	Nature of Training Imparted
Jawahar Lal Nehru PG College, Bhopal (Barkatullah University, Bhopal)	Miss Megha Yadav	Dr. N.R. Panwar	Three months	Effect of different land management practices on soil enzymatic activity in Sehore district of central Madhya Pradesh
	Miss Humera Khanam	Dr. N.R. Panwar	Three months	Effect of different land management practices on soil enzymatic activity in Vidisha district of central Madhya Pradesh

Personnel

New Appointments

Dr A.K. Biswas, joined the Division of Soil Chemistry and Fertility as Head on 2nd July, 2009.

Dr Pramod Jha, joined the Institute in the Division of Soil Chemistry and Fertility as Senior Scientist on 17th July, 2009.

Dr. Ritesh Saha, joined the Institute in the Division of Environmental Soil Science as Senior Scientist on 24th August, 2009.

Miss Rashmi I., joined the Institute in the Division of Soil Chemistry and Fertility as Scientist on 27th August, 2009.

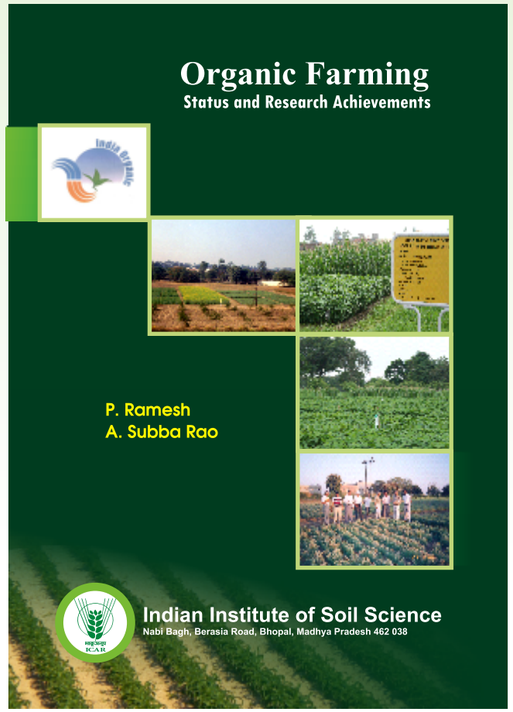
Miss Neenu S., joined the Institute in the Division of Soil Chemistry and Fertility as Scientist on 27th August, 2009.

Dr. Asit Mandal, joined the Institute in the Division of Soil Biology as Scientist on 30th October, 2009.

Joining

Dr. N.K. Lenka, Senior Scientist from ICAR Research Complex for NEH Region, Umiam, Barapani transferred to Indian Institute of Soil Science, Bhopal and got posted in the division of Soil Chemistry and Fertility on 9th October, 2009.

New Publication



Editors: Dr. Ranjit Kumar and Dr. Asit Mandal

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IISS Newsletter

Volume 12, Number 2 JULY - DECEMBER 2009

Our New DG (ICAR)

After serving at different levels in the ICAR- as DDG (Fisharies) and as Director, CIFE, Mumbai and CIFA, Bhubaneswar, Dr. S. Ayappan joined as Secretary, DARE and Director General, ICAR on 01.01.2010.
He, as a Founder Chief Executive, established National Fisharies Development Board, Hyderabad. He received several prestigious national and international awards and honours. He has represented the country in several international fora and served on the Boards of Network of Aquaculture Centres in Asia-Pacific (NACA), Bangkok, Thailand and World Fish Centre, Penang, Malyasia. He is a Fellow and Vice-President of National Academy of Agricultural Sciences, India and Asian Fisharies Sciences, Manila, Philippines. We the family members of IISS, Bhopal heartily congratulate him for his achievement and promise to fulfill his expectations from our Institute.

In This Issue

From the Director's Desk

Exploring root traits for managing the impact of climate change on soil fertility and crop nutrition

It is anticipated that the climate change variables such as aberration in temperature, frequent occurrence of droughts and/or floods would have greater impact on soil related problems like moisture deficit and mineral stresses (suboptimal availability of mineral nutrients). Plants response to these stresses is complex because it involves the interaction of soil, plant and climatic variables. Many crops in developing countries are supported by weathered soils in which either nutrient deficiencies or ion toxicities are common. Many systems have declining soil fertility due to inadequate use of fertility restoring inputs, ongoing soil degradation, and increasingly intense resource use. For example, most of the tropical vegetation is supported by weathered soils with some combinations of low N, P, K or micro-nutrients or toxicity of Al, Mn, etc. Each of these stresses has complex yet, distinct interaction with climate change variables, making it very difficult to predict how plants in such environments will respond to future climate change scenarios. Potential effect of climate change on soil fertility and the ability of crops to acquire and utilize soil nutrients are hitherto poorly understood though, are essential for understanding the future of agriculture.

Plant's ability to survive and produce under these conditions depends on their ability to mine and utilize the water and nutrients efficiently. A very invasive root system in an infertile, loose, friable soil can give good growth similar to a more restrictive root system in a fertile soil. Low level of nutrients over a large root system is just as effective as high level of nutrients in a smaller system. For successful exploitation of such an approach, the knowledge on the extent of genetic variation among the existing genotypes appears to be the primary step.

Mineral stresses arise as a result of soil physical factors such as shallow depth, poor drainage and poor moisture retention as well as soil chemical factors such as suboptimal availability of mineral nutrients, acidity, alkalinity, salinity and metal toxicity. Suboptimal availability of N and P are nearly universal. Imbalance of base cations (K, Ca and Mg) and micronutrient deficiencies affect large areas.

Plants display a remarkable array of physiological adaptations to mineral stresses. Some traits permit conservative use of all nutrients such as slow growth, while other

traits represent adaptations to specific stresses such as induction of organic exudation to protect root tips exposed to Al stress, the induction of mechanisms to mobilise rhizosphere Fe in response to Fe-deficiency and the regulation of root architecture to optimize soil exploration in response to nutrient deficiency. Root traits are particularly important adaptations to mineral stress, since roots explore the soil, acquire nutrients and water, and interact with symbionts and soil biota.

Soil temperature, which is expected to increase under climate change, has a marked effect on root characters which influence plant nutrient acquisition efficiency. In general, the influence of temperature on plant-nutrient interactions in a changing environment is little known area. The most notable are the direct effect of soil temperature on bio-geo-chemical processes that regulate nutrients and water availability in the soil, root growth and morphology, root respiration, root transport properties etc. Similarly, soil moisture depletion, which affect transpiration, should also affect the acquisition of water soluble nutrients such as nitrate, sulphate, Ca, Mg, and Si which are primarily determined by mass flow of soil water to roots as a result of shoot transpiration.

Root responses to global change often focus on root growth and morphological characteristics, seldom addressing changes in physiological characteristics such as hydraulic conductivity and kinetics of ion uptake. Active root nutrient absorption is a highly adaptive plant characteristic that influences acquisition of nutrients in response to environmental factors. Therefore, knowledge of changes in the kinetics of nutrient uptake and the relative species difference is critical in predicting crop response to global change.

Thus, the future research should aim at identifying the following traits in crop plants so as to make them better tolerate for the future climate:

- *Slow growth for conservative use of all nutrients*
- *Induction of organic acid exudation to protect root tips exposed to stress*
- *Induction of strategy I and II mechanisms to mobilize rhizosphere Fe in response to Fe-deficiency*
- *Screening the lines for variation in root length density, depth and better regulation of root hair architecture to optimize soil exploration*
- *Development of new variety with better water and nutrient extraction ability, nutrient and water use efficiency*
- *Induction of deep root and more fine roots under stress*

At IISS Bhopal, we have initiated a program to screen the germplasm lines and advanced breeding material of major field crops for diversity in root systems and their nutrient uptake capacity so as to identify genotypes with improved adaptability to the soils of different agro- climatic conditions and rainfall variability, with respect to expected climatic changes.

Research Highlights

Compost production from Municipal Solid Waste

Biodegradable waste was collected from Bhopal's Municipal Solid Waste (MSW) Yard and used for the production of microbial enriched compost and vermi-compost. For production of microbial enriched phospho-compost, the material was mixed with fresh cow dung in the ratio of 1:0.2 (W/W) using 40 kg of fresh cow dung as slurry with water and mixing with 200 kg of waste. Selected fungal bioinoculum such as *Aspergillus heteromorphus, Aspergillus terrus, Aspergillus flavus and Rhizomucor pusillus* were added after 5 and 30 days of decomposition @ 500 g mycelial mat per 1000 kg of waste material. Rock phosphate was used @2.5% P_2O_5 and starter nitrogen @0.5 % on material dry weight basis. For vermi-compost, separate pit was used, in which the material was mixed with fresh cow dung in the ratio of 1:0.2 (W/W) and allowed to decompose for one month. After decomposition, *Eridillus eugenia* and *Perionyx excavatus* were added @ 1kg/tonne of material (about 1000-1200 numbers). After 3 months of decomposition, the bulk density varied from 0.91-1.17 g cm^{-3}. Temperature varied from 20-25 °C. The compost was dark black to deep brownish in color. In compost, the total organic carbon and total nitrogen contents varied from 11-15 % and 0.87 to 1.1 %, respectively. The C/N ratio varied from 12.6 to 13.6:1. The substantial amount of hot water soluble C and carbohydrates decreased with increase in decomposition. The compost respiration was relatively higher in uninoculated control as compared to inoculated enriched compost. Finally, the compost was ready after 3 months of decomposition.

Soil organic matter dynamics under varying conditions of soil moisture and temperature

Carbon mineralization and cultural biodiversity were assessed with three hydrological regimes *viz.* 50% moisture holding capacity (MHC), 100% MHC and submerged condition and three temperature conditions *i.e.*, 25, 35 and 45°C in a field experiment on INM. C-Mineralization in terms of CO_2 evolution was recoded at 210 days after incubation. CO_2-evolution initially increased with temperature up to 40 days of incubation but at later stage, it substantially decreased with increase in temperature. But, CO_2-evolution decreased with increase in moisture holding capacity of soil. Under water-logged soil, it substantially decreased at 210 days after incubation. The heterotrophs population decreased 10-fold with temperature at 90 days of incubation. Similarly, ammonifiers population abruptly reduced as incubation progressed up to 210 days. Under submerged condition, bacterial substrate induced respiration (SIR) was greater than fungal-SIR and it was reverse under 100% MHC at 35°C temperature.

The C-mineralization rate constant increased with increase in temperature. The Q_{10} values increased with increase in moisture content of the soil and it was relatively greater under 100 % moisture holding capacity of soil. The larger emission of gaseous-C was due to exhaustion of the labile pools of carbon under 100 % MHC than submerged condition.

Transition in agriculture of Madhya Pradesh state

An economy in the process of growth is theoretically visualised to become less dependent on agriculture and increasingly dependent on the secondary and tertiary sectors. However, this has not been true for Madhya Pradesh state, because agriculture alone continues to contribute about 30% in the net state domestic product in the state. At the same time, the value of output from crop production has grown by more than 5% annually during last 15 years (1990-2005). There has been continuous shrink in area of several crops like coarse cereals and other oilseed crops since late Seventies in the state, which provided enough space for other crops like soybean, cotton, rapeseed-mustard (R/M), etc to expand. On account of expansion in GCA, area under foodgrains also remained steady. There was also a vertical expansion in crop production in the state as barring a few exceptions; yield of most of the crop has improved in the recent years. On an average, yield of foodgrains in the state is almost 30% lower than the national average, which is badly affecting the farmers' profitability. Notably, the growth in yield of more crops in recent years have become negative as well as high (>5%) as compared to previous decade as shown in the table below.

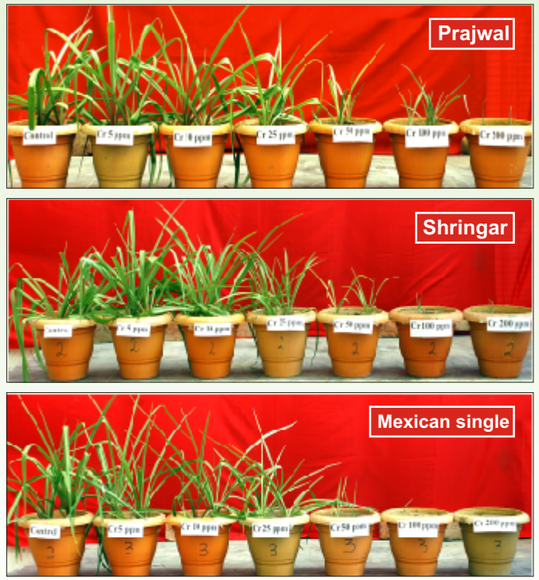
Growth in area and yield of different crops in Madhya Pradesh

Growth rate	Crop area		Crop Yield	
	Nineties	2000-07	Nineties	2000-07
Negative	Jowar, Bajra, Arhar, Cotton, Groundnut, Sesamum, Linseed	Rice, Jowar, Barley, Linseed, Groundnut	Jowar, R/M	Maize, Gram, Arhar, Potato
Low (<2%)	Rice, Maize, Barley, **Foodgrains**	Maize, Arhar, Sesamum,Soybean, **Foodgrains**	Rice, Maize, Barley, Arhar, Soybean, Sesamum	Barley, R/M Groundnut, **Foodgrains**
Medium (2-5%)	Wheat, Gram, R/M	Bajra, Wheat, Cotton, Potato, Gram	Bajra, Wheat, Gram, G.nut, Linseed, Nigerseed, Potato, **Foodgrains**	Bajra, Wheat, Rice
High (>5%)	Soybean, Potato	R/M	Cotton	Jowar, Soybean, Sesamum, Cotton, Linseed

IISS NEWSLETTER

Phyto-extraction of chromium by tuberose

In a screen house experiment conducted in kharif season, some of the varieties of tuberose (Prajwal, Shringar and Mexican Single) were screened for their tolerance to different levels of Cr (0,5,10,25,50,100 and 200 ppm). Among the varieties, Prajwal was found to be more tolerant than Shringar and Mexican Single. In all the three varieties, the sprouting of the bulbs was delayed by 10 days in 25 ppm and by 35 days beyond 50 ppm. In Shringar and Mexican Single, very little growth was observed at 100 and 200 ppm of Chromium application.



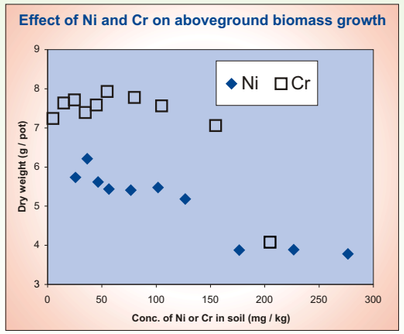
Cr tolerance of different varieties of Tuberose

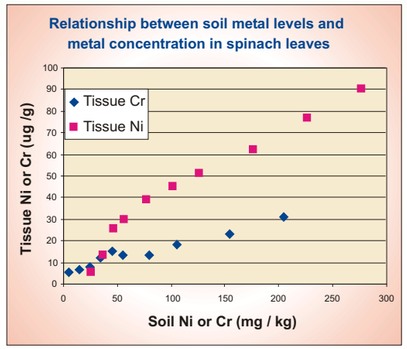
Effect of Ni and Cr pollution in soil on spinach biomass growth

Critical soil limits based on adverse effect on plant growth

Nickel and Chromium are the two important environmental pollutants posing threat to the environment and its living components. For determining ecotoxicological rates, screen house experiments were conducted on an acidic alluvial soil with spinach as test crop. Increasing doses of Ni application resulted progressive decrease in the above ground biomass from 20 mg Ni/kg dose onwards. Application of 150 mg Ni/kg resulted about 32% reduction in dry weight of aboveground biomass. Dry weight of leaves was significantly and negatively correlated (r = -0.918*) with Ni concentration in the leaf tissue, indicating toxic effect of Ni on plant growth due to high Ni absorption by plant. Application of Cr upto 150 mg/kg rate did not result any significant effect on vegetative growth of spinach. However, the highest application dose of 200 mg Cr/kg resulted significant reduction (43.7%) in dry weight of above ground biomass. Above ground biomass of spinach correlated significantly and negatively (r = -0.75*) with leaf tissue concentration of Cr.

Relative above ground biomass growth (in respect of control) was related to soil Ni or Cr levels and plant Ni or Cr concentrations by polynomial functions. Generally, 80% relative yield is considered for determining critical limit of deficiency of essential nutrient element in soil. Using this phyto-toxicity approach, critical toxic level (that reduces above ground biomass growth of spinach by 20%) of Ni and Cr was computed through best fit polynomial equations as 153 and 176 mg/kg in soil, respectively.



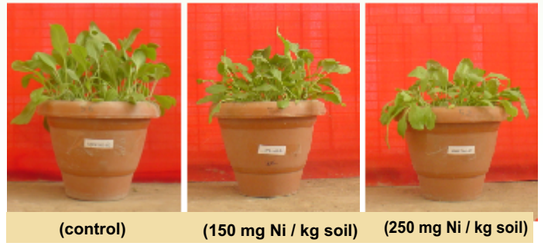


Critical soil limits based on food contamination pathway

Analysis of spinach leaf samples collected from farmers' fields indicated that Ni and Cr contents varied from 1.2 to 5.8 and from 5.5 to 20.8 g/g with mean (μ) values of 2.9 and 14.0 g/g and standard deviation (ó) values of 1.65 and 4.09 g/g, respectively. Upper limits of background concentration (C_{ul}) for Ni and Cr in spinach leaf for uncontaminated area were calculated using the equation 'C_{ul} = μ + 3*ó' as 10.55 and 17.52 g/g respectively.

Relationship between concentrations of heavy metals in spinach leaf tissue and in soil was established through screen house experiment. Maximum concentrations of metals in the experimental soil that might not contaminate spinach leaves were calculated from the best fit equations as 32.5 mg Ni/kg and 88 mg Cr/kg. These values are much lower as compared to the critical values obtained through phytotoxicity pathway. The results thus indicate that food chain contamination with Ni and Cr occurs to an alarming level before these elements show their adverse effect on plant growth.

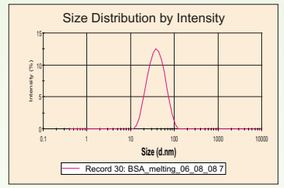
Effect of Cr contamination in soil on spinach biomass growth



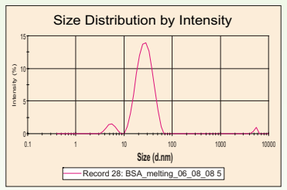
Effect of Ni contamination in soil on spinach biomass growth

Synthesis of rock phosphate nano particle and its effect on seed germination

Phosphatic fertilizers are mainly manufactured from rock phosphate ores. In India, out of 260 million tonnes (Mt) of recoverable reserves of rock phosphate (RP), approximately 20 Mt have been estimated to be of high grade which are being mined by different government agencies for commercial purposes. The depletion of high grade phosphate ores has brought about a search for suitable economically viable technique/process for beneficiating available low grade phosphate reserves. In view of this, rock phosphate (HGRP3 and Stone 3) nano particle was prepared by grinding it in a high energy ball mill. Milling increased the solubility of RP by increasing the proportion of X-ray amorphous material and reducing the size of remaining apatite crystals. Rock phosphates were ball milled at ambient temperature and high energy intensities, which induces phase changes through solid-solid reactions. During this milling process, repeated collisions between ball and powder continuously expose new reactant surfaces. After ball milling, these RP particles (HGRP3 and Stone 3) were analyzed by Photon Collision Spectroscopy (Dynamic light scattering techniques) to know the size distribution of the particles. The results pointed out that produced RP powder is a highly disperse, nano-scaled mixture of small particles, that is crystallites with sizes in the range of 10-100 nm. Maximum portion of HGRP3 is in the size of 28 nm and Stone-3 is in 42 nm.



Stone-3, Av. Size 42 nm; Intensity 100%



HGRP-3, Av. Size 28.20 nm; Intensity 93.1%

A series of laboratory experiments were carried out to know the effect of RP nano particle on germination and growth of seeds of soybean and mustard. In both the crops, germination was not checked up to 200 ppm P (applied through TCP nanoparticles and RP nanoparticles), and an increasing trend was observed in root growth of the crops. Solution culture study showed that 31 mg P/L (as nano rock phosphate particle- 28 nm and 42nm) maintained the good growth of maize plant. The all plant parameters like, plant height, root length, root volume, dry matter weight head all improved due to application of nano RP particle. Results indicated that plant root might have got the unique mechanism of assimilating nano RP particle for its growth and development.

Nano rock phosphate vs nano HA

Micro (10-40 m) vs Nano (28 nm) rock phosphate

IISS NEWSLETTER

Poor stomatal regulation triggers wilting in soybean (var. JS 9305) under drought stress

As projected by the Intergovernmental Panel on Climate change, Central India has been receiving deficit rainfall for the last few years. Rain-fed soybean crop growth, which is sown with the onset of monsoon and experiences intermittent drought, depends on variety as well as the stage at which it occurs. In 2007 and 2008, drought occurred because of prolonged dry spell when the crop was at early pod development stage and in 2009, drought occurred at pre-flowering stage. Drought at post-flowering induced wilting in one of the varieties JS 9305 while, another popular variety JS 335 did not wilt. However at pre-flowering, drought did not elicit wilt in both the varieties. Wilt in addition to reducing the plant population, drastically reduced quantity and quality of seed yield.

At post flowering, wilt sensitive variety JS 9305 had high metabolic processes as compared to tolerant variety JS 335. Under soil moisture depletion, JS 335 significantly reduced the stomatal conductance and conserved leaf water whereas; the stomatal conductance and the transpiration loss of water were high in JS 9305. The imbalance in soil water supply and the transpiratory loss of water led to wilt in JS 9305.

This study suggests that the stomatal regulation is one of the most important traits that need to be incorporated while evolving newer varieties for stress tolerance/resistance. Secondly, it was observed from the study that, to certain extent wilting can be managed by the application of organic manure to the soil.

Field view of soybean varieties JS 335 and JS 9305 during early September, 2009

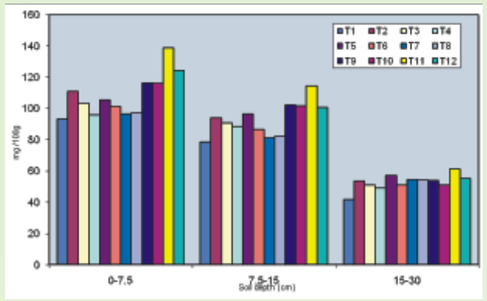
Scaling-up of Balanced and Integrated Nutrient Management (INM) Technology

One hundred demonstration trials were conducted on soybean with 3 nutrient management options (farmers' practice, integrated nutrient management and balanced fertilization through inorganic fertilizers) during *kharif* 2009 in different villages of Vidisha, Rajgarh and Raisen districts. About 98 trials were successfully harvested out of 100 trials originally planned. The pooled results of these 98 trials revealed that the INM module which comprises "50%NPKS+ 5t FYM/ha+*Rhizobium* inoculation" to soybean produced higher soybean seed yield by 52% over the farmers' practice. The balanced fertilizer intervention (100% recommended rate of NPKSZn) increased the soybean seed yield by 32% over the farmers' practice. INM module produced about 15% higher soybean seed yield over the balanced fertilization through inorganic fertilizers.

Soybean growth under INM, Balanced Fertilization (BF) and Farmers' Practice (FP)

Long term INM intervention affects carbohydrate carbon in soil

In a soybean-wheat cropping system, involving different INM interventions, the carbohydrate carbon in terms of glucose equivalent carbohydrates for three depths *viz.* 0-7.5, 7.5-15 and 15-30 cm was recorded. The highest concentration of glucose equivalent carbon was found in 0-7.5 cm soil depth followed by 7.5-15 and 15-30 cm after five years. The content of glucose equivalent carbohydrates varied between 93.2-138.9; 78.7-114.6 and 41.7-61.2 mg/100g soil in 0-7.5, 7.5-15 and 15-30 cm soil depth, respectively. The magnitude of difference was less between 0-7.5 and 7.5-15 cm depth, however, a sharp decline in glucose equivalent carbohydrates was observed in 15-30 cm depth indicating the effect of added carbon as well as root activity in the surface plough layer. Higher carbohydrates were recorded in treatments receiving higher quantities of organic inputs. The highest carbohydrate content was recorded in treatment that received 8 t FYM to soybean and 16 t FYM to wheat followed by treatment that received 20 t FYM to wheat once in four year in addition to 50% NPK to soybean and wheat every year.



Effect of long term INM interventions on glucose equivalent carbohydrates

Reassessment and delineation of secondary- and micro-nutrient deficient areas in Gujarat

The latest status of S and micronutrients in the soils of different districts of Gujarat on the basis of analysis of 6932 surface soil samples for S and 4277 for micronutrients (after 1990) revealed that the percentage of deficiency of S, Fe, Mn, Zn and Cu was to the extent of 31.2, 16.3, 8.4, 33.4 and 0.2, respectively. Accordingly, an increase in deficiency in all these nutrients was observed in comparison to the observation made earlier *i.e.* before 1990. This could be attributed to the nutrient exhaustion of the soil due to intensive cropping with the increased irrigation facilities, use of high yielding varieties, etc. The deficiencies of Fe and Mn were found to be doubled during same period. The percent deficiency in different districts varied from 12.8-53.3 for S, 0.0- 74.3 for Fe, 0.0-41.5 for Mn, 10.4-80.3 for Zn and 0.0-2.4 for Cu. However, actual nutrient index (NI) value indicated medium status for all the nutrients except for Cu which showed a high status and it was 2.06, 2.24, 2.61, 1.97 and 2.98 for the studied nutrients, respectively.

Micronutrients application through soil and seed treatments for enhancing fertilizer use efficiency in soybean

An experiment was carried out at RRS, Rudrur, Andhra Pradesh with soybean (variety JS-338) on clay loam soil, with 13 treatments consisting of control, seed treatment with Zn(0.3% Zn O), Mo (0.2% Sodium molybdate), Boron (0.2% Borax), soil application of 25 kg $ZnSO_4$ ha^{-1}, 0.5 kg molybdenum ha^{-1}, 1.0 kg Boron ha^{-1}, combination of reduced rates of Soil application of Zn (12.5 kg $ZnSO_4$ ha^{-1}) , Mo (0.25 kg Mo ha^{-1}), B (0.5 kg B ha^{-1}) along with seed treatment of Zn (0.3% ZnO), Mo (0.2% Sodium molybdate), Boron (0.2% Borax). Significant effect of Zn, B and Mo was observed on the pod yield of soybean by all the methods of application except seed treatment with 0.2 % sodium molybdate. Soil application of Zn recorded the maximum yield (2225 kg ha^{-1}) with 43% response followed by Boron (2012 kg ha^{-1}) with 29% and Mo (1886 kg ha^{-1}) with 21% response. Among the methods of application, soil application of Zn, B and Mo significantly increased the yields (2032, 1896 and 1896 kg ha^{-1}) over the seed treatments with Zn, B and Mo (1801, 1655 and 1615 kg ha^{-1}), respectively. Total Zinc uptake ranged from 79.88 to 150.54 g ha^{-1}, with the highest uptake was recorded, where soil application of Zinc was applied. Highest Boron uptake was also recorded in the soil applied boron treatment.

Reutilization of accumulated phosphorus in long term fertilizer experiments

Continuous use of phosphatic fertilizer resulted in accumulation of P in soil. To reutilize the accumulated P, strategies have been developed by applying half of the dose of P to both the crops finger millet and maize at Banglore; and maize and wheat at Ludhiana after splitting the plot. There was no decline in productivity on reduction in P dose to half even after 6 years at Bangalore and after 12 years at Ludhiana within the treatment. Similarly in finger millet- maize at Bangalore, the reduction in P dose to half did not have any adverse effect on productivity of either finger millet or maize. However, little improvement in productivity in both the crops was recorded on application of lime and FYM.

Maize and wheat yield as influenced by superimposition of P and Zn at Ludhiana (Punjab)

Treatments	12 Years Average Yield (q ha^{-1})	
	Maize	Wheat
150% NPK*	35.4	47.9
150% NK+100% P	35.5	49.7
150% NK+100% P+Zn	36.9	49.0
100% NPK	36.4	47.2
100% NK+50% P	36.0	47.6
100% NK+50% P+Zn	36.6	47.6
100% NPK (DAP)	34.9	41.4
100% NK+50% P	36.9	42.7
100% NK+50% P+Zn	39.8	46.8

Finger millet and maize yield as influenced by superimposition of P and lime at farmers' field in Bangalore (Karnataka)

Treatment	Average of yield from 6 farmers' field (q ha^{-1})	
	Finger millet	Maize
100% NPK	34.0	47.0
100% N ½ PK	34.6	47.4
100% N ½ PK+ lime	39.8	48.6
100% N ½ PK+FYM	36.0	51.3

Biofertilzer production and demonstrations

Soybean rhizobial and PGPR strains of IISS were supplied for mass production to JNKVV Biofertilzer production centre. During 2009, 2.13 lakh inoculant packets were prepared with these strains and supplied all over Madhya Pradesh. These inoculants packets were also used in 1000 demonstrations on farmer fields in a TATA-ICRISAT livelihoods project in various districts of M.P; and 100 demonstrations conducted by IISS, Bhopal. Detailed observations in five farmer fields in Raisen District showed that soybean seed yield increased with INM option with biofertilizers by 18% over balanced fertilization and 54% over farmers practice.

Effect of biofertilizer on soybean production

Frontline demonstrations of STCR technology on farmers' fields

Large number of target yield equations have been generated for different crops including cereals, pulses, oilseeds, vegetables and medicinal and aromatic plants under the AICRP on STCR Scheme. Ready reckoners have been prepared using the equations for facilitating the users in applying recommended fertilizers based on the soil test values. The STCR centres have conducted an about 98 front line demonstrations in oilseed crops during 2009-10 on farmers' fields to demonstrate the beneficial value of the STCR technology.

Toria crop at nutrient levels targeted to get 15 q ha^{-1} yield in Una district of Himachal Pradesh (Inset close view)

Frontline demonstrations of STCR technology in different oilseed crops

Centre	Location/District	Crop	No.of Trials
Rahuri	Rahuri and Shrinampur tehsils	Chickpea	10
Bikaner	Bikaner and Sriganganagar	Mustard	10
Coimbatore	Sourthern zone and North Western Zone	Groundnut Sunflower	2 2
Bangalore	Babbur village	Safflower	5
Hyderabad	Jagtial in Karimnagar distt. Nandyal in Kurnool dist & Kadapah districts	Bengal gram, Sesame Sunflower	3
Palampur	Bilaspur and Hamirpur districts Una district Bilaspur district	Soybean Toria Maize	4 6 8
Vellanikkara	Thrissur and Malappuram districts Thrissur and Palakkad districts Palakkad district	Nendran Banana Salad Cucumber Rice	4 4 3
Jabalpur	Sajpani Village Jabalpur dist Bilgawan vil Jabalpur dist.	Urd Soybean	2 2
Raipur	Telga village Durg dist.	Soybean Safflower	5 5
Bhubaneswar	Bhubaneswar and Cuttack dist.	Groundnut Sesame	6 4
Kalyani	Hooghly and Murshidabad dist North 24 Parganas Murshidabad dist.	Rice Mustard	10 3
		TOTAL	98

Jabalpur

Blackgram (PU-19)

Two front line demonstrations of blackgram on deep black soil were organized in Jabalpur and Narsingpur districts during 2009-10. The available N and P were low and K was medium to high in farmers' fields. The nutrients were applied to get desired target yield 1.2 t ha^{-1} and 1.5 t ha^{-1} of Narsinghpur and Jabalpur districts.

Soybean (Var. JS9752)

Two frontline demonstrations of soybean on deep black soils were organized in Bilgawan village of Jabalpur district. The soil fertility status was low in both available N & P and high in available K in both farmers' fields. The fertilizer nutrients were applied as per developed STCR equations for desired targets of 25 q ha^{-1}.

Palampur

Maize

In order to popularize IPNS based fertilizer recommendations for maize eight front line demonstrations were organized in farmers' fields of Bilaspur district. The IPNS equations were used for making fertilizer recommendations. The results of trials revealed that the yield was low (1.6 t ha^{-1}) in farmers' practice while that of STCR dose resulted in 2 t ha^{-1} and that of integrated treatment with 2.7 t ha^{-1}.

New Externally Funded Project

The Ministry of Environment and Forest has approved the project entitled "Impact assessment of continuous fertilization on heavy metals and microbial diversity in soils under long-term fertilizer experiment" from October 2009 to September 2012.

Awards and Honours

Dr. M.C. Manna was selected as Fellow of the Indian Society of Soil Science, New Delhi.

Dr. Y. Muralidharudu, P.C. (STCR) acted as Co-chairman of the poster session during International Symposium on "Potassium - Role and benefits in improving nutrient management for food production, quality and reduced environmental damages" during 5th to 7th Nov., 2009 at OUAT, Bhubaneswar.

Dr. D.L.N. Rao, NC (BF) acted as convener of the symposium on "Soil Science- Next 25 years" at the 75th Platinum Jubilee Celebration of the Indian Society of Soil Science, New Delhi during 22nd to 23rd Dec., 2009 at IARI, New Delhi.

Major Events

Technical Discussion on Rhizobial Diversity and Soil Genomics

The technical programme for two sub-programmes of the All India Network Project on Soil Biodiversity-Biofertilizers, namely, `Genetic Diversity of Rhizobia in Indian Soils' and `Soil Genomics for Soil Health Assessment" was finalized in a meeting held at CRIDA, Hyderabad on July 25-26, 2009. Dr. D.L.N. Rao, Network Coordinator (BF), Dr. B. Venkateswarlu, Director, CRIDA, Hyderabad, Dr. T.K. Adhya, Director, CRRI, Cuttack and 10 PI's of the concerned centers participated to finalize the experimental details.

CAC meeting of NAIP sub-project on "Soil Quality and Resilience"

The Consortium Advisory Committee (CAC) meeting for the NAIP sub-project "Assessment of Quality and Resilience of Soils in Diverse Agro-ecosystems" was held at IISS, Bhopal on 5th September 2009. The meeting was chaired by Dr. N. Panda, Ex-vice-chancellor, Sambalpur University. Dr. M. Velayutham (Member CAC), Dr. A. Bandyopadhyay (National Coordinator, Component 4), Dr. A. Subba Rao, Dr. S. Kundu and other CCPI's and CoPI's attended the meeting.

Second CIC meeting of NAIP sub-project ***"Understanding the mechanism of variation in status of a few nutritionally important micronutrients in some important food crops and the mechanism of micronutrient enrichment in plant parts"*** was held at IISS, Bhopal on 29th October 2009.

Twenty seventh workshop of All India Coordinated Research Project on ***"Micro- and Secondary Nutrients and Pollutant Elements in Soils and Plants"*** were organized at CSKHPKVV, Palampur (H.P.) during October 6 to 9, 2009. Dr. P. D. Sharma, ADG(Soil), ICAR, New Delhi inaugurated the workshop and Dr. Tej Pratap, Vice chancellor, CSKHPKV, Palampur presided over the session.

Workshop of AICRP on Long Term Fertilizer Experiment was organized at IGKVV Raipur (C.G) during 6-8th December 2009. The workshop was inaugurated by Dr. A. K. Singh, DDG (NRM), ICAR and presided by Prof. M.P. Pandey, Vice Chancellor, IGKVV. In the Workshop, a Souvenir and 6 other LTFE publications were released

Release of LTFE publications during the Workshop at IGKVV, Raipur

Hindi Workshop on "प्रदुषण : समस्या एवम् समाधान" Organized

A one day hindi workshop on "प्रदुषण : समस्या एवम् समाधान" was organized on 19 September 2009 at Indian Institute of Soil Science, Bhopal. During this workshop, five important papers were presented on- (1) Environment and Cancer, (2) Management of Rural Environment, (3) Water Pollution (4) Swine Flu -Causes and Remedies and (5) Economic Aspects of Environmental Pollution.

Winter School Organized

Dr. A. B. Singh, Course Director, Organized 21 days winter school training on "Efficient Farm Wastes Utilization for Sustainable Agriculture and Enhancing Soil and Produce Quality" during December 1-21, 2009.

Training on integrated plant nutrient management

Training was organized for the district level agriculture officers of Department of Agriculture, Govt. of Nagaland on "***Integrated Nutrient Management***" at IETC Medziphema during 25-27 November, 2009. Thirty one agriculture officers from different districts of Nagaland attended the training programme. During this training programme, Drs. A.K. Biswas M.C. Manna, N.K. Lenka, Brij Lal Lakaria and R.H. Wanjari delivered lectures on different aspects of INM. The training was sponsored by State Department of Agriculture, Nagaland.

Participants of training on INM at IETC, Medziphema

Model Training Courses (MTCs)

✦ An eight days Model Training Course (MTC) on "Crop Production and Environmental Sustainability through Organic Farming" was organized during 8-15th September 2009, which was sponsored by Ministry of Agriculture, Department of Agriculture & Cooperation, Directorate of Extension, New Delhi. Thirty candidates from different State Agricultural/Horticulture Departments, State Agricultural Universities and ICAR Institutes participated in the training program. Dr. P. Ramesh, Principal Scientist was the Course Director of the training program..

Inaugural function of the Model Training Course

✦ A Model Training Course (MTC) on "Efficient recycling of mineral and by-product nutrient sources for sustainable crop production" was organized during 2-9 November 2009 for Agricultural and Horticultural Officers of different state Departments. MTC was sponsored by the Department of Agriculture and Co-operation, Ministry of Agriculture, Govt of India, New Delhi.Seventeen trainees from different states attended the training programme. Dr. K.S. Reddy and Dr. A.B. Singh were the Course Director and Course Co-Director, respectively.

Dr. M.Velayuthum, Former Director, NBSS&LUP, Nagpur inaugurating the MTC

Extension activities

- Dr. D.L.N. Rao, NC (BF) visited an organic biodynamic farm at village Dhaban, Taluka Sangaria, Dt. Hanumangarh, Rajasthan on July 15-16, 2009 to study the farming practices of an entrepreneur farmer Mr. Kishan Kumar based on Zero external inputs farming and collected soil samples for biodiversity and genomic studies.
- Dr A. B. Singh had given training on vermicompost production and organic farming to 50 farmers during August 1-2, 2009 sponsored by State department of Agriculture, Bhopal.
- Dr A. B. Singh organized ATMA Sponsored one week Inter-state Farmers Exposure Visits Training to 3 batches of 25 Farmers each from Gaya, Banka and Madhepura districts of Bihar in the institute during August- November, 2009.

Scientists' participation in conferences/seminar/training/ workshop/group discussion

Name	Programme	Venue	Period (July- Dec, 2009)
Dr. K. Sammi Reddy	Short Training Course on " GIS for Landscape Analysis"	ICRISAT, Hyderabad	July 27-31
Dr. M. V. Singh	International Plant Nutrition Colloquium (IPNC)	California, USA	Aug. 26-30
Dr. D.L.N. Rao	SAARC workshop on "Improving Nutrient Use Efficiency in Agriculture"	CSSRI, Karnal	Sept. 9-10
Drs. Brij Lal Lakaria, J. Somasundaram and Pramod Jha	Conference on "*Food and Environmental Security through Resource Conservation in Central India: Challenges and Opportunities*"	CSWCRTI, Research Centre, Agra	Sept. 16-18
Dr.M.C.Manna	CAC and CIC meeting of NAIP(Code 2031)	CRRI, Cuttack	Sept. 20-23
Dr. M. V. Singh	27th Workshop of AICRP Micronutrients	CSKHPKV, Palampur	Oct. 6-9
Dr. K.B. Hebbar	Interim Review Workshop of NATCOM-II	Amaltas, India Habitat Centre, Lodhi Road, New Delhi.	Oct. 13
Dr. K.B. Hebbar	National Workshop on "Towards Preparation of Comprehensive Climate Change Assessment"	Ashoka Hotel, Chanakya Puri, New Delhi	Oct. 14
Dr. K.B. Hebbar	High level conference on "Climatic change: 'Technology Development and Transfer"	Vigyan Bhawan, New Delhi	Oct. 22-23
Dr. D.L.N. Rao	"Vigilance Administration"	NAARM, Hyderabad	Oct. 29-31
Dr. K. Ramesh	DST sponsored training programme on "*Plant Atmospheric Interactions*"	CRIDA, Hyderabad	Oct. 22- Nov. 11
Drs.A. Subba Rao, Y.Muralidharudu, Muneshwar Singh and R.H. Wanjari	International Symposium on "Potassium Role and Benefits in Improving Nutrient Management for Food Production, Quality and Reduced Environmental Damages"	OUAT, Bhubaneswar	Nov. 5-7
Dr. M.C.Manna	International conference on "Climate Change & Sustainable Management of Natural Resources"	TIMS, Gwalior	Nov. 10-12
Drs A. B. Singh, Ranjit Kumar and S.K. Behera	International Conference on"Nurturing Arid Zones for People and Environment: Issues and Agenda for 21 Century	CAZRI, Jodhpur	Nov. 23-27
Ms. I. Rashmi and S. Neenu	Winter School on "*Efficient Farm Waste Utilization for Sustainable Agriculture and Enhancing Soil and Produce Quality*"	IISS, Bhopal	Dec. 1-21
Dr. Ranjit Kumar	Training Programme on "Agricultural Policy Analysis"	NCAP & CSD, New Delhi	Dec. 7-11
Drs. A. Subba Rao, Y. Muralidharudu, M.V. Singh, D.L.N. Rao, Muneshwar Singh, M.C. Manna,A. B. Singh, K. Sammi Reddy,Brij Lal Lakaria, A. K. Tripathi, J. Somasundaram, Pramod Jha, S.K. Behera, Tapan Adhikari	74th Annual Convention of Indian Society of Soil Science	IARI, New Delhi	Dec. 22-25
Dr. A. B. Singh	National Seminar on "Organic farming for Sustainable Agriculture and Livelihood Security	Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior	Dec. 23-24