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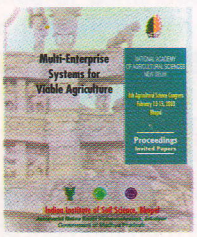
In this Issue

NEW PUBLICATIONS

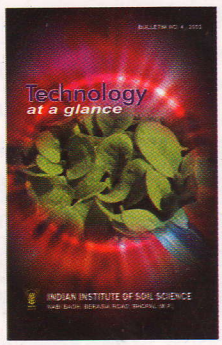


Multi-enterprise systems for viable agriculture: Proceedings

The "Proceedings- Invited Papers" of the 6th Agricultural Science Congress of the National Academy of Agricultural Sciences held at Bhopal from February 13-15, 2003 on the theme "Multi-Enterprise Systems for Viable Agriculture", edited by C.L. Acharya, R.K. Gupta, D.L.N. Rao and A. Subba Rao was released by Dr. Panjab Singh, vice President, NAAS at the AGB meeting of the Fellows held at NAAS, New Delhi on June 5, 2004

Technology at a glance

A bulletin, "Technology at a Glance" (in Hindi and English) edited by A.K. Misra, P.K. Ghosh, A.K. Biswas, A.K. Tripathi and A.K. Sharma has been released by Honourable Minister of State for Agriculture Sri. Kantilal Bhuria on June 22, 2004.



Union Minister of State for Agriculture visited the Institute

Honourable Minister releasing the bulletin- Technology at a Glance

The Honourable Minister of State for Agriculture, Sri Kantilal Bhuria visited the Indian Institute of Soil Science (IISS), Nabibagh, Berasia Road, Bhopal on 22nd June to review the work of Departments under DARE (Department of Agricultural Research and Education) and Ministry of Agriculture and Co-operation (DAC). The Directors/ Heads of the concerned departments highlighted their research activities and accomplishments. The Director, IISS, Bhopal, Dr. A. Subba Rao highlighted the research activities and said that this Institute has the mandate to carry out basic and strategic research on soils. Dr. Nawab Ali, Director, CIAE has highlighted the major achievements in agricultural mechanization, irrigation and drainage, post harvest and agro-processing technology including Soybean Processing and

Honourable Minister Shri Kantilal Bhuria, Union Minister of State for Agriculture reviewing the work of Departments under DARE and Ministry of Agriculture and Cooperation and offering suggestion

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Utilization, and agricultural energy and power. On behalf of High Security Animal Disease Laboratory (HSADL) Dr. P.R. Vanamayya briefed about the activities of HSADL- a very high-tech laboratory of its kind in Asia. Director, National Horticulture Board and Director, Directorate of Pulses Development have presented the mandate and programmes of the Departments. Similarly Sri. S.C.Jain, Director, Central Farm Machinery Training and Testing Institute, Budni, Sri. S.S. Bhatnagar, Regional Manager, National Seeds Corporation, Bhopal and Sri. P.K. Singh, Deputy Director, National Horticulture Board, Gurgaon have also highlighted activities and accomplishments of their respective departments.

Honourable Minister suggested for creating awareness among the farmers about the technologies developed at the Institutes, taking steps to disseminate recommendations to farmers, and promoting awareness on soil testing/analysis among the farmers to improve soil quality at village level.

Soil's knowledge – A moral imperative

Maintaining soil quality has become an essential need for sustaining higher agricultural productivity, employing holistic (as opposed to the traditional reductionistic) approach and evolving appropriate management practices compatible with total ecology by addressing soil, comprising physical, chemical and biological components, as a whole rather than the sum of their separate parts. The concept of soil quality is gaining momentum because of soils multiple functions namely, i) the ability of soil to enhance plant and biological productivity, ii) the ability of soil to attenuate environmental contaminants, pathogens and offsite damages and iii) the interrelationship between soil quality and plant, animal, and human health. Sustaining higher agriculture productivity mandates maintenance of soil quality.

The basic and strategic research conducted under Institute's one of the four priority programmes, i.e., "Management of soil physical and biological components" covers conservation tillage, residue management and carbon sequestration, improving water use efficiency, soil and water conservation, efficient management of limited irrigation water and integrated management of water, nutrient and energy for improving input use efficiency following holistic and multidisciplinary approach. The results showed that no tillage in soybean-wheat cropping system was as effective as other tillage systems in terms of soybean yield with additional advantages of saving energy and time and enhancing C content in soil. Combined effect of reduced tillage in broad bed furrow (BBF) with application of 100% recommended dose of fertilizers (NPK), green manuring and S or Zn increased soil organic carbon, soil moisture storage, improved mean weight diameter, decreased bulk density and crack dimensions and recorded higher yield of seed cotton and also higher benefit-cost ratio at Raichur, Junagadh, Indore, Guntur, Kovilpatti and Nagpur. The runoff and soil loss is reduced under BBF system as compared to flat on grade (FOG) system. Application of 100% NPK + FYM 5 t ha^{-1} in the alluvial sandy loam soil (Typic Ustochrept) of Delhi under maize-wheat-fodder cowpea rotation registered higher mean weight diameter (MWD) and soil moisture retention at lower suctions than 100% NPK, 100% NP, 100% N. These results clearly show that the adoption of conservation tillage, application of FYM/green manure/residues and balanced fertilizer bears potential of enhancing/sustaining productivity through sustenance and/or improvement in physical, chemical and biological attributes of soil (i.e., soil quality/health). Such management also improves the other soil functions like filtering, buffering and detoxifying capacity of soil as well as make soil more resilient.

The future research activities in the priority programme, "Soil physical and biological components" includes work on (i) moisture conservation, water harvesting and land treatments along with use of conservation tillage, residue recycling and nutrient management in different cropping systems/crop rotations etc. (ii) climate change and C sequestration, (iii) simulation modelling, and (iv) changes in soil attributes as influenced by varying management practices. For such studies the Division of Soil Physics is developing on use of the modern tools such as GIS/RS/GPS, fuzzy sets/fuzzy logic and neural networks etc.

Dr. A.K.Misra, Programme Leader,
Management of Soil Physical and
Biological Components

Research Highlights

Impact of the use of industrial wastewater on soils near Nagda industrial area

Water of Chambal river flowing through Nagda town is used for irrigation. Water of the river has been severely contaminated by the effluents generated from Nagda industrial area. Cultivated lands as well as crop yields of about 14 nearby villages at the downstream of Chambal river have been reported to be affected severely because of continuous use of this polluted river water for irrigation. Analysis of a large number of water samples showed that polluted river water contained high soluble salts (EC of water about 3.56 dSm^{-1}) and high sodicity hazard (SAR of about 16.7) containing about 6.92 times and 8.97 times more Cl^- and SO_4^{-2} than control (normal unpolluted ground water). Soil analysis revealed that soils of several villages near industrial area showed increase in EC from 0.71 to 3.34 dSm^{-1}, SAR from 2.39 to 24.03 and ESP from 1.5 to 31.2. Considerable increases in Na (25.6 times), Ca (7.8 times), Cl^- (10.6 times) and SO_4^{-2} concentrations (41.2 times) have also been noticed in solution composition of the polluted area.

Salt accumulation in Wheat field due to use of polluted irrigation water

Cd and Pb sorption characteristics in some benchmark soils

Benchmark soils of Linga, Kagwad, Sarol, Bajatta, Lohara, Shazadpur and Guttapalli were characterized for physico-chemical properties and used for Cd and Pb sorption study. Sorption of Cd and Pb was positively correlated with soil reaction, organic carbon, clay and $CaCO_3$ content of soils. Linga (Udic Haplustert) soil having higher pH and exchangeable bases showed greater sorption of Cd and Pb as compared to soils of Guttapalli (Typic Ustropept) having low pH and exchangeable bases.

Assessing soil potassium stock in Indian SAT regions based on biotite content

Mica is the key mineral that supplies K to crops. Among the micas, the biotite mica that mostly supplies K to growing plants, whereas the muscovite mica is relatively resistant to weathering and releases very little K in soils that is insufficient to growing plant. Therefore the relative abundance of biotite-mica in different soils was assessed. This indicates the probable response to added K and also serves as guidance for total releasable K stocks. Twenty-two benchmark series occurring in Indian SAT region were studied for measuring K stock in terms of biotite content. The biotite-mica content was measured in clay and silt fraction considering the 001/002 peak ratio of mica. In general, soil series representing Vertisols had relatively lower proportion of biotite mica while the soil series occurring in Indo-Gangetic alluvium are rich in biotite-mica and are expected to release K to crops rather more easily. At the same time, the silt size fractions should not lose the importance in measuring K stock as considerable amount of biotite mica was found in some soil series in silt fraction. Exhaustive K release through Ba-K batch type exchange of 22 soil series revealed that the cumulative K release ranged from 40 to 200 mg/kg. This showed that the soils of Indian SAT differ substantially in their K supplying capacities.

Improving the water use efficiency of wheat through sprinkler irrigation under limited water supply situation

Application of 20 cm irrigation water to wheat through sprinkler in 4 installments (4 cm presowing + 5 cm at CRI + 5 cm at maximum tillering + 6 cm at flowering) significantly improved the grain yield and water use efficiency of wheat crop in comparison to the application method where the same amount of water was applied through flooding in 3 installments (8 cm presowing + 6 cm at CRI + 6 cm at flowering).

Effect of tillage systems in Vertisols

The results of the fifth year of a long-term tillage experiment showed that the yield of soybean in no tillage (crop residues retained on the surface and direct drilling of seeds) in the soybean-wheat cropping system in Vertisols was same as in conventional tillage (residue removed + 1 summer tillage by cultivator + 2 tillage by cultivator). Soil moisture storage in no-tillage was more than the conventional tillage during the latter stage of soybean growth when rain was withdrawn.

Improved land treatment reduce run off and soil loss

Broad Bed & Furrow (BBF) land treatment registered 15.8, 11.8 and 15.9% higher grain yield of soybean, maize and pigeon pea, respectively than flat on grade (FOG) land treatment. Total seasonal runoff and soil loss from BBF were less than those from FOG during rainy season.

Suitable soil moisture conservation technique to carry over monsoonal moisture for growing chickpea in rabi season

Monsoonal soil moisture was carried over through different soil moisture conservation practices for growing chickpea. The practice of "Late interculture plus *gliricidia* cover @ 5 t/ha in the standing maize followed by maize stover application immediately after harvest of maize", was as effective as "Pre sowing irrigation" in terms of root and shoot growth, grain yield of chickpea and water use efficiency

Testing of Mixed Biofertilizers

In the AICRP-BNF integrated use of mixed biofertilizers (*Azotobacter, Azospirillum* and PSB) along with 75% of inorganic N and P fertilizers in acid soils of Orissa at OUAT, Bhubaneswar gave yields of tomato at par with 100% inorganic NP fertilizers, thus saving 25% NP fertilizers. The quality of tomato was improved in terms of higher content TSS, Lycopene, Ascorbic and Citric acid content. In Vertisols of Andhra Pradesh at ANGRAU, Amaravathi, inoculation of *Azospirillum* + PSB at 100% NP give significantly higher yield of Chillies- 3.8 t/ha (dry) as compared to control yield of 3.3 t/ha. Inoculation of *Azospirillum* + PSB at 100% NP gave yield of 2 tonnes cotton (kapas) per hectare which was 5.3% higher over 100% fertilizers. In sandy loam soils of Hisar at CCSHAU, Haryana, inoculation of biofertilizers (*Azotobacter, Azospirillum* and *Bacillus*) for pearl millet under irrigated conditions significantly increased the grain yield at 75% and 100% N amounting to approx. 800 kg/ha.

Nutritional quality of enriched compost vs. conventional compost

The use of phosphocompost and vermicompost has become important input in the integrated use of plant nutrient supply. Nutritional quality of N-enriched phosphocompost and vermicompost was compared with quality of farmyard manure (FYM) and conventional compost. Nitrogen, phosphorus, potassium, copper, zinc and manganese contents were higher in phosphocompost, N-enriched phosphocompost and vermicompost than those of FYM and conventional compost. Enriched compost and vermicompost also exhibited higher activity of alkaline and acid phosphatase as compared to conventional compost and FYM.

The performance of diversified crops in organic farming

Application of cattle dung manure and poultry manure recorded yields of chickpea, mustard and isabgol at par with chemical fertilizers. However, the highest grain yield of wheat was recorded with chemical fertilizers. Under three irrigation options *duram* varieties of wheat recorded higher grain yield than *aestivum* varieties.

Different varieties of wheat grown in IISS Organic Farming Block

Awards and Honours

Dr. D.L.N. Rao, Project Coordinator (BNF) was admitted to the fellowship of the National Academy of Agricultural Science (NAAS), New Delhi on June 5, 2004 at Delhi. Dr. Rao was cited for his original and outstanding contributions in the Biology, Organic matter and Nitrogen fertility of salt affected soils, Symbiotic nitrogen fixation, and Carbon sequestration potential of wastelands.

Drs K.M. Hati, K.K. Bandyopadhyay, A.K. Misra, K.G. Mandal, P.K. Ghosh and M. Mohanty received the Best Poster Prize for the research article entitled " Evaluation of Guelph Permeameter for studying spatial distribution of water transmission characteristics under *in-situ* condition in a Vertisol" presented during the symposium on "Geo-informatics Application for Sustainable Development" held at WTC, IARI, New Delhi from February 17-19, 2004

Visits abroad

Dr.. D.L.N. Rao, PC (BNF), IISS, Bhopal visited the All Russia Research Institute of Agricultural Microbiology, St. Petersburg, Russia under ICAR-RAAS Workplan. from March 6-15, 2004 for study visit on Soil Microbiology with emphasis on Biofertilizers. He also visited the Department of Geology and the Dokuchaev Central Soil Museum at St. Petersburg University.

Staff News

Dr. Mohan Singh, Pr. Scientist left the Institute on 15th May and joined IIPR, Kanpur

Sri. Ramesh Khawale, left the Institute on 23rd March and joined NBSS&LUP, Nagpur

Smt. Nirmala Mahajan, promoted to T-5

Smt. Geeta Yadav, promoted to PA

Events

Films: A documentary film in Hindi, English and local language (Telugu) was made on "Vermicomposting for Bio-Fertilization" in the institute for a duration of 15 minutes in each languages.

Republic Day: All the staff members and their families celebrated Republic Day (26.1.2004) with great enthusiasm.

Important Decision: The ICAR approved the replacement of AICRP on BNF with the AINP on Biofertilizers w.e.f 1.4.2004 at an overall outlay of Rs. 450 lakhs in the X plan. The project has 11 cooperating centers in SAU's (9) and ICAR institutes (2) with network coordinating center at IISS, Bhopal,

Distinguished Visitors

Dr. S.S. Khanna, former Advisor, Planning Commission, G.O.I., New Delhi and Ex. Vice Chancellor, NDUAT, Faizabad, U.P. visited the Institute to attend the National Seminar on "Technology for Compost Production in Urban and Rural Sector" on January17, 2004.

Twelve students from Institute for Excellence in Higher Education, Bhopal visited on February 7, 2004

Three scientists Dr. R.W. Bharud, Assoc. Director of Research, Dr. D.B. Yadav, Deputy Director of Research and Sri. R.P. Andhale, Technical Offcier from Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, visited from March 22-25, 2004.

A group of 24 PGT (Biology) teachers visited the Institute on 4.6.04. For them a lecture on "Soil Analysis and its role in agriculture" was delivered.

Hon'ble Minister of State for Agriculture, Government of India, Sri. Kanti Lal Bhuria visited the Institute on June 22, 2004.

Mrs. Neerja Raj Kumar, Jt. Secretary (AH), Sri. J.P. Meena, Jt. Secretary (Crops), GOI, Dr. B.B. Singh, Director (Cooperation), Sri. Dinesh Nigam, Asst. Commissioner, Sri. Shanmugam, Deputy Commissioner (Seeds) and Sri. R.K. Tripathi, Jt. Director (Extension) also accompanied during the visit of Hon'ble Minister of State for Agriculture, Government of India Sri. Kanti Lal Bhuria.

Scientists Participation in Conference/Seminar/Training/Group discussion

Dr. Ajay: 91st Session of Indian Science Congress, at P.U., Chandigarh, January 03-07, 2004.

Dr. P. Ramesh: National Seminar on Opportunities and Potentials of Spices for Crop Diversification, at JNKVV, Jabalpur, January 19-21, 2004.

Dr. B. Maji: VIIth National Seminar of Indian Society of Coastal Agricultural Research, at C.P.C.R.I., Kasaragod, January 21-24, 2004.

Dr. P. Ramesh: National Seminar on Resource Management for Sustainable Agriculture, at Agricultural College, Bapatla (A.P.), January 28-30, 2004.

Dr A.B. Singh: International Conference on Sustainable Management of Sodic Lands, IISR, Lucknow, Feb. 9-14, 2004.

Drs A.K. Misra, Dr K.M. Hati K.K. Bandyopadhyay and M. Mohanty: National symposium on "Geo-informatics Application for Sustainable Development" held at WTC, IARI, New Delhi, February 17-19, 2004.

Dr. A.K. Tripathi: IIIrd All India Science Conference, New Delhi, February 19-21, 2004.

Drs. M.C. Manna and K.K. Bandyopadhyay: Workshop on NATP, RNPS-25, ICRISAT, Hyderabad, February 21-23, 2004.

Dr. Ajay: National Seminar on Horticulture for Sustainable Income and Environmental Protection, at Nagaland University, Nagaland, February 24-26, 2004.

Dr. Ashwani K. Sharma; MDP on Performance Assessment of National Agricultural Research Organizations, National Academy of Agricultural Research Management, May 18-22, 2004.

Drs. A. Subba Rao, P. Ramesh and Mr. N. R. Panwar: First National Workshop on Organic Farming at PDCSR, Modipuram, May 22-23, 2004.

Sh. R.K.Singh: National Seminar on "Perspectives on Agrarian Relations in Water Management" at WALMI, Bhopal, June 9-10, 2004.

From the Director's Desk.....

Innovative Nutrient and Water Management Options on Small and Marginal Farms

In India, the number of land holdings is increasing and holding size steadily declining year after year. Small (1-2 ha) and marginal (below 1 ha) farms constituting 80.5 per cent of the total holdings account for only 36% of the area cultivated where as 18.4% medium farms (2-10 ha) account for 49.1% of the cultivated area and 1.2% large farms (above 10 ha) account for 14.8 per cent of the cultivated area. In spite of the gains of the green revolution, the productivity of different crops is very low on small and marginal farms due to inadequate use of plant nutrients/fertilizers and poor water management. The integrated plant nutrient supply (IPNS) system is one of the viable options for enhancing the productivity of these farms by utilizing all available on-farm and off-farm nutrient sources. Use of organic manures in integration with inorganic fertilizers not only substitute a part of fertilizer nutrients but also enhances the nutrient and water use efficiency by improving soil physical, chemical and biological quality. Production, marketing and incorporation of good quality biofertilizers such as *Rhizobium*, phosphate solubilizing bacteria and fungi, *Azospirillum, Azotobacter* etc. and the *in-situ* azolla production and incorporation in rice fields are essential for successful implementation of IPNS. The major constraint in success of the IPNS is limited availability of organic manures with the farmers as about 50% of the cattle dung produced is being used for making dung cakes. Small and marginal farmers must be encouraged to utilize valuable cattle dung for farmyard manure (FYM) or compost production by providing them alternate cooking fuels such as fuel wood, solar cooker etc. in adequate quantities. Promoting social forestry on wastelands can increase fuel wood availability. Indian forestry experts have identified 86 species of trees and shrubs, which are better fuel wood and could grow on the wastelands includes *Leucaena*, *Casuarina*, *Acacia*, *Karanj*, *Dalbergia*, *Eucalyptus*, *Poplar* and *Neem*. Composting technologies for enriched manures and vermicomposting need to be popularized for efficient utilization of available organic resources.

To make IPNS a reality, micro-watershed based farming systems approach, consisting of crop and animal husbandry, horticulture, dairy, beekeeping, pisciculture, etc. need to be adopted. Farming system approach reduces the risk involved in agriculture, generates organic matter for composting and supplies plant nutrients and provides feed and fodder for livestock's balanced ration. Integrated agri-horticulture system provides small and marginal farmers an opportunity to grow high value-low volume crops such as medicinal/aromatic plants, vegetables along with the staple food crops.

Use of non-monetary inputs and low-cost agro-techniques, namely, suitable crop rotation especially introduction of suitable legumes in rotations, optimum plant population, timely application of right fertilizer at right rate various techniques of application of fertilisers alone or with manures, etc. on small and marginal farms may help in efficient use of fertilizers and water. Selection of suitable crop rotations or intercropping systems may improve nutrient use efficiency on small and marginal farms. Growing of nitrate utilizing catch crops prevents residual N from being lost. Identification of the crops to be included in cropping systems for the efficient utilization of nutrients by way of exploiting principles of complementarity is an important strategy. Growing of deep-rooted crops following harvest of shallow rooting crops like vegetables is another option for N recycling. Winter wheat with deep rooting nature, high N demand and high N harvest index could serve this purpose well. Adoption of such cropping system strategy could substantially reduce leaching loss of N in humid and sub-humid regions.

On small and marginal farms, the residual fertility build up due to legumes in a cropping system is obviously a major contribution, which must fully be exploited. Selection of a particular legume crop in a cropping system assumes significance because each one possesses a differential effect on succeeding crops. Here also a word of caution needs to be kept in mind that leguminous crop is not to be followed by fallow as the nitrates released by way of legume action after the crop harvest may be lost to ground water. Further, fodder legumes contribute more N than grain legumes for use by the succeeding crop.

Green manuring *in-situ* by raising quick growing leguminous plants like *Sesbania, Crotalaria* etc for 45-60 days to tap atmospheric N and subsequently burying them into soil as green manures to recycle it is an attractive way of supplying about 30-40 kg N/ha to the succeeding crop. Where farmers are not willing to spare their meager land resources and inputs for two months exclusively for growing a green manure crop, fresh loppings of some perennial leguminous trees like *Glyricidia* grown in hedgerows or on bunds between two crop fields may be used for incorporation into soil as a sources of N.

Rainwater harvesting is an important but neglected activity of water management on small and marginal farms. They may not be able to spare the land for the construction of farm pond on individual farms for rainwater harvesting. In such cases, co-operative watershed development programme on community basis should be promoted. The rainwater from the farms should be collected into community water ponds through common trenches existing in villages. These water ponds definitely help in recharging the ground water level in that area. On-farm water harvesting techniques such as inter-row, inter-plot, trenching and micro-catchment techniques should be perfected for different soil, topography, rainfall and farming situations existing on small and marginal farms. A circular catchment technique which involves construction of circular catchment of 1.5 m radius with 5-10% slope around the transplanted plants would be helpful in increasing soil profile moisture storage. In canal irrigated areas, delivery of water distribution cycle does not many times match with cropping calendar and crop water requirement which causes insufficient and unreliable water distribution. To over come these, water supply be made by measurement, proper water scheduling be fixed up as per the area of the crops and water requirement at the critical period of the time. Since canal irrigation is a social system, farmers' involvement should be collective i.e. in the form of some organization – may be Water Users' Association, *Pani Panchayats* etc. These organizations should play an important role to ensure equitable water distribution among all categories of farmers at outlet level. Some times farmers are not very much convinced about the ill-effects of excess water application particularly in canal irrigated areas. It is essential that all efforts to be made to educate and convince the farmer about the irrigation water management techniques through various methods of transfer of technology, demonstration trials, regular training programmes etc.

A. Subba Rao