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Newsletter

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Farmers' Day

A farmers' day was organized on 28 February in Mugaliahat village to educate the farmers on eco-regional integrated nutrient management and show the field trials on IPNS conducted under FAO-ICAR-IFFCO collaborative project.

New Publications

1. Indigenous Nutrient Management Practices – Wisdom Alive in India (Eds. C.L. Acharya., P.K. Ghosh and A. Subba Rao).
2. Soil Test Based Fertilizer Recommendations for Targeted Yields of Crops (Eds. A. Subba Rao and S. Srivastava).

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From the Director's Desk...

Promote Biofertilizer Usage

There is a world-wide consensus now that sole dependence on chemical input based agriculture is not sustainable in the long run and only integrated plant nutrient systems (IPNS) involving a combination of fertilizers, organic/green manures and biofertilizers are essential to sustain crop production, preserve soil health and soil biodiversity. There is a gap of about 10 million tonnes between crop removal and addition of NPK. Recycling organic wastes and use of bio-inoculants have a promising role to play in bridging this gap. In addition there are economic compulsions and environmental concerns which explain the need for promoting biofertilizer usage. Research on biological nitrogen fixation (BNF) and biofertilizers in India is more than 60 years old and was particularly intensified by the ICAR during the last 25 years through the AICRP on Biological Nitrogen Fixation. Various bio-inoculants for all crops in various agro-ecological regions of India have become available for augmenting the supply of mainly N and P in cropping systems and for promoting plant growth. The biofertilizer technology has also been successfully demonstrated on farmers' fields in front-line demonstrations. As a result of concerted efforts the biofertilizer consumption in the country has increased five fold in the last seven years.

However, there are concerns. The research agenda has remained essentially unchanged in the last three decades. Screening of strains is not done stringently, assessment of actual benefits of BNF by isotope dilution or simple methods like inclusion of non-nodulating hosts is more of an exception. Survival of introduced inoculum has been rarely assessed. No wonder despite our professed huge biodiversity, we have hardly been able to discover any new diazotrophs in India. Improving biofertilizer performance requires research in diverse disciplines as these biological systems involve a maze of interactions among the host, other rhizosphere microflora and fauna, and the environment. The future research must therefore be firmly by the "ecological route" with a focus on multi-disciplinary approach involving researchers representing microbiology, soil science, agronomy, plant breeding and plant physiology.

Lack of consistent response to biofertilizers is an issue to be addressed. Microbial preparations are essentially 'ecological' inputs and not 'chemical' inputs and it is unrealistic to expect dramatic effects. Lack of response in some cases should not discourage us. Even when yield benefits are not apparent, a hidden benefit of increased proportion of nitrogen fixed from air accrues. In the long-run this "sparing of soil nitrogen" by the inoculated legume adds up significantly to improve the nitrogen balance. Inoculation with a good quality inoculant is a must and should be treated as an insurance against failure of nodulation. The shelf life of biofertilizers can be improved by addition of organic polymers or related substances. We need to switch over to a completely sterile method of manufacturing to improve quality and be prepared to pay a higher price for quality inoculants.

The future of biofertilizers is very promising in the emerging environmentally conscious era and therefore there is a definite need to re-draft the present policy and vigorously promote R&D efforts on biofertilizers and their wider usage.

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Biofertilizers- A new vision for the new millennium

Nitrogen is the single most important nutrient determining primary productivity. Realising the huge potential of BNF, the ICAR established an AICRP on BNF in 1978 which has 13 cooperating research centres located in SAU's during the IX plan. The objective of the scheme is to supplement a part of the chemical fertilizer needs of crops by enhancing biological nitrogen fixation processes in legumes and cereals by symbiotic and non-symbiotic microorganisms. As a result of the researches in last 20 years we now have reliable and cost-effective biofertilizer technologies for most of the agro-ecological zones. The technology has also been successfully demonstrated on farmers' fields in front-line demonstrations. *Rhizobium* inoculation of legumes was shown to increase grain yields by 15-30% with residual benefits of about 30-40 kg N/ha. Inoculation with *Azotobacter* and *Azospirillum* in cereals gave 10-15% yield increase with benefits equivalent to about 10-15 kg N/ha primarily through promoting plant growth. Co-inoculation of *Rhizobium*, *Azospirillum*, VAM and PSB has been found to be significantly better than their single inoculation. A range of stress (temp, salinity) tolerant microorganisms and strains efficient in fixing N in the presence of recommended dose of N fertilizers have been developed. Soil amendment with organic materials like FYM/compost along with inoculation of *Rhizobium* in pulses or *Azotobacter*/*Azospirillum* in cereals significantly boosted BNF and grain yields. The recently concluded QRT of the AICRP on BNF has stated that the project has delivered the goods not only in terms of superior strain of N fixers and development of microbial technology but also helped in creating trained manpower.

Current production of biofertilizers in the country is about 10,000 tonnes per annum. In the past, the emphasis was only on nitrogen and phosphorus. In order to mobilize elements like potassium, sulphur, silicon, micronutrients etc. need for newer strains of biofertilizer organisms has arisen. As regards the future researches on BNF, a continuation of the conventional ecological approaches for exploiting the vast reservoir of microbial diversity is needed rather than on developing transgenic microbial inoculants whose survival and competitiveness in soil is a major uncertainty.

The research agenda of microbiologists has fallen into a predictable pattern, concentrating on isolating organisms in 4-5 known media, testing on limited scale, field inoculation and measuring agronomic parameters like yield and fertility equivalents or at the most integration with organics in an IPNS mode. The crucial first step of screening of strains is not done stringently enough and is bound to make us miss promising organisms. Assessment of actual benefits of BNF is not done properly. Survival of introduced inoculum is rarely assessed. Our taxonomy not only of plants but also microbes is very poor. This is a dangerous neglect. Hardly 10 new genera of diazotrophs have been reported in last 20 years. Biodiversity of nitrogen fixers and other agriculturally useful microorganisms should be a top most research priority. All this requires a multi-disciplinary approach.

Increasing success is now being achieved with inoculation of a group of microorganisms termed as 'Plant growth promoting rhizobacteria' (PGPR) including competitive antagonists, which stimulate plant growth and repress diseases, particularly the soil borne ones. In recent years many more bacteria viz., *Azoarcus*, *Klebsiella*, *Bacillus*, *Arthrobacter*, *Enterobacter*, *Burkholderia* and *Serratia* with growth promoting effects, including the N₂ fixers-*Azospirillum* and *Azotobacter* have been added to the list of PGPR's. The research strategy in this field in future ought to be, to find out such strains that can occupy the interior of plant cells, so that competition from other rhizosphere microorganisms could be avoided. In this way the *in situ* benefits of root elaboration by PGPRs can be expected. Additionally the twin benefits of N₂ fixation and growth factor production can be achieved inside the roots, without outside interferences.

Even though benefits from inoculation may not be readily apparent, hidden benefits due to "sparing of soil nitrogen" accrue. Therefore, inoculation with a good quality inoculant should be practiced wherever feasible. Improvements in quality and shelf life are needed to promote wider acceptance by farmers. Should we not be prepared to pay a higher price for quality cultures which can meet BIS standards? Production must be entirely privatized and market forces should determine what is the actual need. All subsidies must be removed to do away with bureaucratic controls and any other unhealthy practices. Governmental enforcement of standards is difficult but with an attractive price tag the manufacturers will be able to meet the required standards.



Beneficial effect of NPK + *Azospirillum* + PSB application (left) over NPK alone (right) on rice at Coimbatore

For promoting their wider use by farmers, more efforts for popularization of biofertilizers through IVLP (Institute-village link) and other programmes are needed on a massive scale. Distribution network of biofertilizers needs to be strengthened. As opined by the QRT of AICRP on BNF "Currently the production of inorganic nitrogenous fertilizers is still dependent on the availability of cheap fossil fuels. With the current price of crude oil back in the 30 US dollar bracket, bypassing biofertilization in the Indian context would be dangerous. It is therefore desirable that support for this important area be greatly strengthened".

D.L.N. RAO
Project Coordinator (BNF)

Research Highlights

Phosphorus- zinc interaction in wheat

Through a potted plant study with wheat, it was found that Zn uptake in roots and shoots increased with increasing levels of P up to 40 mg kg⁻¹ soil. However, P added at higher rates suppressed the Zn uptake by plant, the decrease being relatively of higher order in shoots than in the roots. A high P level in the soil was also associated with reduced Zn availability.

Crop residues promote P mobilization in Vertisols

Addition of soybean residue (SR) or wheat residue (WR) resulted in a net increase of labile inorganic (P_i), organic (P_o) and microbial P in a Vertisol throughout the incubation period, except that the WR decreased labile P_i during first two weeks. Integration of fertilizer- P (FP) with SR had no added benefit compared to SR alone, while use of FP+WR proved better in ensuring short term P availability by offsetting initial P immobilization associated with WR alone.

Effect of FYM and fertilizer N on soil P dynamics

Continuous application for 7 years of fertilizer N with or without FYM at a fixed level of added P affected the distribution of P pools in Vertisol under soybean-wheat system. The Olsen-P increased with manure, while showing a tendency to decrease with fertilizer N. Fertilizer P added in excess of crop removal accumulated as inorganic and organic forms in labile and moderately labile P fractions. FYM application enhanced accumulation of organic P.

Tillage x nitrogen effect on wheat

Studies on tillage management with differential N on soybean-wheat in Vertisol revealed that reduced tillage and no tillage were at par in affecting wheat yield. Tillage and N interaction effect was also not significant on grain yield of wheat.

Land treatment and tillage effects on rainfed cotton

The seed cotton yields from Broad Bed & Furrow (BBF) with 75% RDF and green manure in both conventional and reduced tillage practices were found better than those from flat bed system. The yields from reduced tillage were at par with the conventional tillage. The BBF system with green manures was found to have beneficial effect on soil health.

Spent wash improves soil fertility

Application of spent wash brought about a significant improvement in organic C, available N, P and K status of soil. Although there was a significant build-up of salinity due to spent wash application, it did not adversely affect crop productivity.

Heavy metal accumulation in sewage water irrigated soil

Use of sewage water for irrigation has been found to result in a significant buildup of heavy metals, particularly Zn, Cu, and Pb in soils.

Dynamics of organic pools in a long-term fertilized plot

In a long-term plot after 29 years of rice based cropping system on an Inceptisol showed that continuous use of N or NP alone could not improve active pools of carbon in soils. Particulate organic C (slow pool of C) increased with decreasing the particle size aggregates and was relatively higher under NPK and NPK+FYM treated plots. Passive pools of carbon did not differ with fertilizer treatments, but decreased with increasing soil depth.

Events

IMC: A meeting of the Institute Management Committee was held on 20 January .

Republic Day: Republic Day was celebrated on 26 January.

Task force meeting on organic farming(GOI): 9 February.

FAO-ICAR-IFFCO: Project review meeting, 10 February.

Women's Day: celebrated on 8 March.

RAC: The Research Advisory Committee meeting was held on 20-21 March under the chairmanship of Dr. J.S. Kanwar.

SRC: The Staff Research Council met on 8-11 May.



The RAC meeting in progress



Meeting of the Task Force on Organic Farming, GOI



FAO-ICAR-IFFCO project review meeting

Awards & Honours

Dr. A. Subba Rao, Project Coordinator (STCR) was honoured with the NAAS Fellowship on June 5. Dr. Rao also delivered an expert talk on "New Opportunities in Nutrient Management for Efficient Agriculture" on the Foundation Day of the NAAS.

Dr. C.L. Acharya, Director was the chief guest at the North Zone Regional Training Workshop on "Soil testing for balanced and integrated use of fertilizers and manures", HPKV, Palampur, 26-27 April.

D.L.N. Rao, Project Coordinator (BNF) rejoined the editorial board of the Journal of the ISSS from January.

Dr. D.L.N. Rao, Project Coordinator (BNF), chief guest on June 11 at GAU, Anand and delivered the keynote address on "Biofertilizers in the new millennium- Need for a new vision".

Dr. K.P. Raverkar, Sr. Scientist, delivered a keynote address at the II North Eastern Regional Conference on Biofertilizers, 22-24 January, AAU, Jorhat.

Lectures Delivered

Dr. C.L. Acharya, Director, 5 - 6 February, IIM, Kolkata; 5 March, PAU, Ludhiana; 17-19 April, IARI, New Delhi.

Dr. D.L.N. Rao, Project Coordinator (BNF), 12 March, JNKVV, Jabalpur.

Dr. M.C. Manna, Sr. Scientist, 16 February, TNAU, Coimbatore.

Dr. C.L. Acharya, Dr. T.K. Ganguly, Dr. R.S. Choudhary, Dr. T.R. Rupa, delivered radio talks on AIR, Bhopal during the first half of 2001.

Workshops/Training

1. The AICRP (STCR) conducted training workshops on "Soil testing for balanced and integrated use of fertilizers and manures" at BCKV, Kalyani, 05-06 February; UAS, Bangalore, 20-23 February; JNKVV, Jabalpur, 20-21 April and CSKHPAU, Palampur, 26-27 April.

2. The XXII AICRP (Micro and secondary nutrients and pollutant elements in soils and plants) workshop was held at OUAT, Bhubaneswar, 9-11 June.



The ICAR-ACIAR project collaborators reviewing the progress

3. Dr. A.K. Sharma, Sr. Scientist, attended training on "Agricultural Research prioritization techniques at NAARM, Hyderabad on 18-24 January.

Distinguished Visitors

Mr. M.A.K. Swain, MP, Dr. C.R. Hazra, Union Production Commissioner and Dr. Kunvarji Bhai Jadav, Chairman, Task Force on Organic Farming, GOI, 9 February.

Dr. J.S. Samra, DDG (NRM), ICAR, New Delhi, 10 February,

Dr. R.L. Yadav, PD, PDCSR, Modipuram, 15 February.

Dr. K. Pradhan, Secretary, NAAS, New Delhi, 27 February.

Dr. R.C. Dalal, Mr. Ken Casey and Mr. John Ritchie, Australia, 30 April - 4 May.

Dr. Panjab Singh, Director, IARI, New Delhi, 9 - 10 May.

Dr. Kirti Singh, Ex-Chairman, ASRB and Secretary, NAAS, New Delhi, 7 June.

Dr. Bert H. Janssen, Netherlands, 15 June - 7 July.

Staff News

Dr. A.K. Misra, Sr. Scientist joined as Head, Division of Soil Physics, 11 May.

Shri. M.S. Hedau promoted Upper Division Clerk, 18 May.



Scientists - Farmer interface during the Farmers' Day at Mugaliahat village