जैवउर्वरक सूचना पत्र

BIOFERTILISER NEWSLETTER

अंक-१४	क्र. २	दिसम्बर २००६
Vol.- 14	No.2	December 2006

From Editors Desk

Dear Readers,

Production of Biofertilizers in India has witnessed quantum jump from less than a tonne in 1960s' to 10,218.85 metric tonnes in 2005-06. This reveals tremendous growth of biofertilizer industry in India. The biofertilizers like Azotobacter, Azospirillum, Rhizobium and Phosphate Solubilizing Bacteria are currently manufactured commercially in both solid and liquid formulations. Among them Phosphate Solubilizing Biofertilizer (PSB) is most popular. Although, due to use of improved microbial technologies and biotechnological protocols, the microbial inoculants' quality has improved but often many of the biofertilizer products available in the market, are far from satisfactory. In order to streamline the flow of quality biofertilizers, for the first time, Govt. of India has amended the fertilizers Control Order, 1985 in March, 2006 under the provisions of essential Commodities Act, 1955 for maintenance of quality of biofertilizers. The biofertilizers like Rhizobium, Azotobacter, Azospirillum and Phosphate Solubilising bacteria are included with requisite specifications.

Under the law, the biofertilizer means the product containing carrier based solid or liquid living micro-organisms which are agriculturally useful in terms of nitrogen fixation, phosphoate solubilization or nutrient mobilization to increase productivity of the soil and/ or crop. The biofertilizer samples are to be collected by notified Inspectors of the State Government and the samples are to be analyzed at NCOF, Ghaziabad for the states of U.P., Uttaranchal and Delhi; RCOF, Bhubaneswar for the states of Orissa , Bihar, Jharkhand, West Bengal and Andaman Nicobar Islands; RCOF, Bangalore for the states of Karnataka, Tamil Nadu, Kerala, Pondicherry; RCOF, Nagpur for the states of Andhra Pradesh, Maharastra ,Goa, Daman & Deu; RCOF Jabalpur for the states of Madhya Pradesh , Chattishgarh, Gujurat, Rajastan; RCOF Hissar for the states of Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir and RCOF Imphal for 8 North Eastern States

This volume pertains to basic issues portrayed in the FCO, 2006 so as to facilitate quality assurance for the manufacturers, distributors and farmers. Bedsides, this issue has also deal with crop response of Phosphobacteria. This issue has also retained the research notes, new reports, news on seminars, conferences and workshops as well as book reviews. It is expected that, this issue would serve as quality guidance among biofertilizer consumers.

Dr. R.N. Bisoyi
Editor

Glimpses of Biofertilizers Covered in Fertilizer (Control) Order, 1985 (Amendment, March 2006)

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Introduction

Ministry of Agriculture, Department of Agriculture and Cooperation, Government of India, New Delhi, vide their order Dated 24th March, 2006 included biofertilizers under section 3 of the Essential Commodities Act, 1955 (10 of 1995), in Fertilizer (Control) Order, 1985.

Definition (Clause 2 a)

Biofertilizers means the product containing carrier based (solid or liquid) living microorganisms which are agriculturally useful in terms of nitrogen fixation, phosphorus solubilization or nutrient mobilization, to increase the productivity of the soil and/or crop.

Biofertilizers are also covered under the broad term of fertilizers

As per the clause 2(h) "Fertiliser means any substance used or intended to be used as a fertilizer of the soil and/ or crop specified in Part A of Schedule – I and includes a mixture of fertilizer, special mixture of fertilizer, biofertilizers specified in Schedule III and organic fertilizers specified in Schedule IV".

Prescribed standards (Clause 2(q) [iv])

Prescribed standards in relation to a Biofertilizer means the prescribed limit of components included in column 1 of part A of Schedule III, and the standard set out in the corresponding entry in column 2, subject to the limits of permissible variation as specified in part B of that schedule".

Restriction on preparation of biofertiliser (Clause 12)

No person shall carry on the business of preparing biofertilisers, except under and in accordance with the terms and conditions of a certificate of manufacture granted to him under Clause 15.

Conformity in manufacture (Clause 13 b)

No person shall manufacture any Bio-fertilizer unless such Bio-fertilizer conforms to the standards set out in the part A of schedule-III.

Requirement for certificate of manufacture (Clause 14)

In compliance of Clause 14(3) "Every person desiring to obtain a certificate of Manufacture for preparation of Bio-fertilizer shall make an application in Form D, in duplicate, together With a fee prescribed therefore under clause 36, to registering authority".

Grant or refusal of certificate of manufacture (Clause 15)

Sub-Clause (1) - On receipt of an application under Clause 14 the registering authority shall, by order in writing, either grant or refuse to grant the certificate of manufacture in respect of biofertiliser and shall, within 45 days from the date of receipt of application, furnish to the applicant a copy of the order so passed.

Sub-Clause (2) - Where an application for a certificate of manufacture for biofertilisers is not refused under sub-clause (1), the registering authority, shall

within 45 days from the date of receipt of the application, grant a certificate of manufacture in Form F.

Period of validity of a certificate of manufacture for preparation of biofertilizers (Clause 17)

Every certificate of manufacture under Clause 15 for preparation of biofertilizers, shall, unless suspended or cancelled, be valid for a period of three years from the date of issue.

Renewal of certificate of manufacture (Clause 18)

1. Every holder of certificate of manufacture for preparation of biofertilizer desiring to renew the certificate, shall before the date of expiry of the said certificate of manufacture make an application to the registering authority in Form D in duplicate, together with the fee prescribed for this purpose under clause 36.
2. On receipt of application for renewal as provided in sub-clause (1) and keeping in view the performance of applicant and other relevant circumstances, the registering authority may, if he so decides, renew the certificate of manufacture by endorsement on Form F and in case the certificate of manufacture is not renewed, the registering authority shall record in writing his reasons for not renewing the certificate of manufacture.
3. Application made after the expiry but within one month can also be renewed on payment of additional fee.
4. Where application is made within the stipulated period, the applicant deemed to have valid certificate of manufacture till registering authority passes order on the application.
5. If application for renewal is not made within the stipulated period the certificate of manufacture shall be deemed to have expired immediately on the expiry of its validity period and any business carried after that date shall be deemed to have been carried on in contravention of clause 12.

Requirement of packing and marking (Clause 21 aa)

Every container in which biofertiliser is packed shall conspicuously be superscribed with the words BIOFERTILISER and shall bear only such particulars and unless otherwise required under any law nothing else, as may from time to time, be specified by the controller in this behalf.

Registering and Notified authorities (Clause 26)

The State Government may, by notification in the official Gazette, appoint such number of persons, as it think necessary, to be Registering or Notified Authority for the purpose of this order and define the local limit within which each such Registering or Notified authority shall exercise his jurisdiction

Appointment of inspectors (Clause 27)

The State Government or Central Government may by notification in the official Gazette appoint such number of persons as it think necessary to be inspectors of biofertilisers for the purpose of this order and define the limits of local area within which each inspector shall exercise his jurisdiction.

Qualifications for appointment of biofertiliser inspectors (Clause 27 B)

No person shall be eligible for appointment as inspector of biofertilisers under this order unless he may possess the following qualifications namely:

1. Graduate in Agriculture or science with Chemistry/ Microbiology as one of the subjects and
2. Training or experience in the field of quality control of biofertilisers.

Analysis of samples (Clause 29 1A)

A biofertiliser sample drawn by an inspector shall be analysed in accordance with the instructions laid down in schedule III in the National Centre of Organic Farming, Ghaziabad or Regional Centres of Organic Farming at Bangalore, Bhubaneshwar, Hissar, Imphal, Jabalpur and Nagpur or any other laboratory notified by Central or State Government.

Time limit for analysis and communication of results (Clause 30)

1. Where sample of a biofertiliser has been drawn, the same shall be dispatched along with a memorandum in form K-1 to the laboratory for analysis within a period of seven days from the date of its drawl.
2. The laboratory shall analyse the sample and forward the analysis report in Form L-1 within 30 days from the date of receipt of the sample in the laboratory to the authority specified in the same memorandum.
3. The authority to whom the analysis report is sent, shall communicate the result of the analysis to the dealer/manufacturer etc from whom the sample was drawn within 15 days from the date of receipt of the analysis report of the laboratory.

Maintenance of records and submission of returns, etc. (Clause 35)

1. The controller may by an order made in writing direct the dealers, manufacturers/importers, and pool handling agencies:-
   (a) to maintain such books of accounts, records, etc. relating to their business in Form 'N' and
   (b) to submit to such authority, returns and statements in such form and containing such information relating to their business and within such time as may be specified in that order.

Fees (Clause 36)

The fees payable for grant, amendment or renewal of an authorization letter or certificate of registration or certificate of manufacture, a duplicate of such certificates or, renewal thereof under this Order shall be such as the State Government may, from time to time fix, subject to the maximum fees fixed for different purposes by the Central Government and different fees may be fixed for different purposes or for different classes of dealers or for different types of fertilizer.

Specification of Biofertilizers

1. Rhizobium

(i)	Base	Carrier based*or liquid based
(ii)	Viable cell count	CFU minimum 10^7 cell/g of carrier material or 10^7 cell/ml of liquid material.
(iii)	Contamination level	No contamination at 10^5 dilution
(iv)	PH	6.5-7.5
(v)	Particles size in case of carrier based material.	All material shall pass through 0.15-0.212mm IS sieve
(vi)	Moisture percent by weight, maximum in case of carrier based.	30-40%
(vii)	Efficiency character	Should show effective nodulation on all the species listed on the packet.

***Type of carrier:** The carrier materials such as peat, lignite, peat soil, humus, wood charcoal or similar material favouring growth of organism.

2. Azotobacter

(i)	Base	Carrier based*or liquid based
(ii)	Viable cell count	CFU minimum 10^7 cell/g of carrier material or 10^7 cell/ml of liquid material.
(iii)	Contamination level	No contamination at 10^5 dilution
(iv)	PH	6.5-7.5
(v)	Particles size in case of carrier based material.	All material shall pass through 0.15-0.212mm IS sieve
(vi)	Moisture percent by weight, maximum in case of carrier based.	30-40%
(vii)	Efficiency character	The strain should be capable of fixing at least 10 mg of nitrogen per g of sucrose consumed.

***Type of carrier: -** The carrier material such as peat, lignite, peat soil, humus, wood charcoal or similar material favouring growth of the organism.

3. Azospirillum

(i)	Base	Carrier based*or liquid based
(ii)	Viable cell count	CFU minimum 10^7 cell/g of carrier material or 10^7 cell/ml of liquid material.
(iii)	Contamination level	No contamination at 10^5 dilution
(iv)	PH	6.5-7.5
(v)	Particles size in case of carrier based material.	All material shall pass through 0.15-0.212mm IS sieve
(vi)	Moisture percent by weight, maximum in case of carrier based.	30-40%
(vii)	Efficiency character	Formation of white pellicle in semisolid N-free bromothymol blue media.

***Type of carrier:-** The carrier material such as peat, lignite, peat soil, humus, wood Charcoal or similar material favouring growth of the organism.

4. **Phosphate solubilising Bacteria**

(i)	Base	Carrier based*or liquid based
(ii)	Viable cell count	CFU minimum 10^7 cell/g of carrier material or 10^7 cell/ml of liquid material.
(iii)	Contamination level	No contamination at 10^5 dilution
(iv)	PH	6.5-7.5
(v)	Particles size in case of carrier based material.	All material shall pass through 0.15-0.212mm IS sieve
(vi)	Moisture percent by weight, maximum in case of carrier based.	30-40%
(vii)	Efficiency character	The strain should have phosphate solubilizing capacity in the range of minimum 30% when tested spectrophotometrically. In terms of zone formation, minimum 5mm solubilization zone in prescribed media having at least 3mm thickness.

***Types of Carrier:-** The carrier material such as peat, lignite, peat soil, humus, wood Charcoal or **similar** material favouring growth of the organism.

Part-B

Tolerance limit of Biofertilizers

$5x10^5$ CFU /g of carrier or per ml of liquid material.

Part –C

Procedure for drawl of sample of biofertilizer

Procedure for Sampling of Bio-Fertilizers.

1. General Requirements

1.0 In drawing, preparing and handling the samples, the following precautions and direction shall be observed.

1.1 Sampling shall be carried out by a trained and experienced person, as it is essential that the sample should be representative of the lot to be examined.

1.2 Since the Samples are also required for microbiological analysis, utmost care is necessary to avoid extraneous contaminations while drawing and handling the samples and to preserve them in their original conditions till they are ready for examination in the laboratory.

1.3 Samples in their original unopened packets should be drawn and sent to the laboratory to prevent possible contamination of the samples during handling and help in revealing the true condition of the material.

1.4 Intact packets shall be drawn from a protected place not exposed to dampness, air, light, dust or soot.

3. Scale of sampling

3.1 Lot

All units (containers in a single consignment of type of material belonging to the same batch of manufacture) shall constitute a lot. If a consignment consists of different batches of the manufacture the container of the same batch shall be separated and shall constitute a separate lot

3.2. Batch

Inoculants prepared from a batch fermentor or a group of flask (container) constitutes a batch.

3.3. For ascertaining conformity of the material to the requirements of the specification, samples shall be tested from each lot separately.

3.4. The number of packets to be selected from a lot shall depend on the size of the lot and these packets shall be selected at random and in order to ensure the randomness of selection.

4. Drawl of samples:

4.1. Three samples should be drawn separately from each lot.

Packing, Marking, Storage and Use

Packing - Biofertiliser shall be packed in polyethylene packs thickness of which shall not be less than 75-100 micron.

Marking - Each polyethylene pack shall be marked legibly and indelibly with the following information:

(a) Name of the product,
(b) Name and address of the manufacturer,
(c) Crops for which intended;
(d) Type of the carrier used;
(e) Batch number;
(f) Date of manufacture;
(g) Expiry date which shall not be more than 6 months from the date of manufacture;
(h) Net mass in kg/gram and area meant for;
(i) Storage instruction worded as under; "STORE IN COOL PLACE AWAY FROM DIRECT SUN LIGHT AND HEAT"
(j) Any other information required under the standards of weights and Measure (Packaged Commodities) Rule.1977.

Effect of Biofertilizers and Phosphorus Fertilization on Nodulation Pattern, Productivity and Phosphorus Uptake by Summer Mung (*Vigna radiata* Wilczek)

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Summer mungbean is an important short duration crop grown in intensive cropping systems after the harvest of *rabi* and before the sowing of kharif crops. It acts as an important break crop between major crops in *rabi* and *kharif*. Due to continued occupation of field by different crops and the higher temperature, the soils tend to lose their inherent capacity to support biochemical processes and microbial activities resulting in dwindling nutrient availability to mungbean. This necessitates proper nutrient management through use of biofertilizers and phosphorus fertilizer for successful summer mungbean production.

A field experiment was therefore carried out to study the effect of biofertilizers and phosphorus fertilizers on nodulation pattern, phosphorus uptake and production of summer mungbean at the farm of the Amar Singh Post Graduate College, Lakhaoti, Bulandshahr during summer 2004. The treatments consisted of 4 levels of biofertilizers viz. control, *Rhizobium*, phosphorus solubilizing bacteria (PSB) and vesicular arbuscular mycorrhiza (VAM); and 4 levels of phosphorus viz. 0,30,60 and 90 kg P_2O_5 ha^{-1}. These treatments were tried in randomized block design in 3 replications. The soils of the experimental site was sandy loam in texture, slightly alkaline in reaction (pH 7.5) analyzing low in available nitrogen, medium in available phosphorus and potassium. The greengram variety 'Pusa Vishal' was sown on 22 March 2004 in 30 cm rows after seed inoculation with biofertilizers as per treatments. A basal dose of 20 kg N and 20 kg k_2O ha^{-1} as urea and muriate of potash, respectively along with phosphorus as per treatments was applied before sowing. Another 20 kg nitrogen was top dressed 30 days after sowing (DAS). All other agronomic practices were followed as per package of practices. The nodulation pattern was studied at vegetative and flowering stages while the phosphorus content was estimated after harvest (May 2004) in seed and vegetative parts. The uptake was computed by multiplying with corresponding yield of seed and stover. The data on various parameters was analyzed as per analysis of variance (ANOVA) technique for randomized block design. The significance was tested by calculating the critical difference (CD) at 5% level wherever F test was found significant.

The application of biofertilizers recorded increased number of nodules per plant than no biofertilizers at both the stages of observation. Between the stages, flowering stage recorded higher number of nodules per plant. Among biofertilizers no significant variation was noted. Sharma and Singh (1980) have also

reported increased nodulation and their dry weight due to *Rhizobium* inoculation. The phosphorus application significantly increased the nodule number at both vegetative and flowering stages. Application of 30 and 60 kg P_2O_5 ha^{-1} recorded linear and significant increase in nodule number per plant. The 60 and 90 kg P_2O_5 ha^{-1} were however at par. The fresh weight of nodules increased progressively with the advancement in growth stage from vegetative to flowering stage of the crop. At both the stages, VAM recorded the highest nodule weight closely followed by PSB and *Rhizobium* inoculation. The control plots recorded minimum weight at both the stages. Application of phosphorus up to 60 kg P_2O_5 ha^{-1} recorded significant increase in nodule weight. However phosphorus application beyond 60 kg P_2O_5 ha^{-1} did not increase the weight of nodule at any stage of crop growth. A significant increase in number of nodules and nodule weight per plant due to application of phosphorus was also observed by Shukla and Dixit (1996).

The content of phosphorus in seed and stover recorded significantly higher values over no biofertilizers as a result of biofertilizers application. Application of VAM showed higher phosphorus content in seed and stover. The lowest value of phosphorus content was recorded in control. Chatterjee and Bhattacharjee (2002) also recorded highest phosphorus content and uptake in seed due to biofertilizers inoculation.

Significant increase in phosphorus content was observed due to application of phosphorus over control. The phosphorus content was lowest in both seed and stover under control and increased significantly up to 60 kg P_2O_5 ha^{-1}. However both 60 and 90 kg P_2O_5 ha^{-1} were statistically at par with each other . Meena *et al* (1993) also reported significant increase in phosphorus uptake in summer mungbean with the application of 40 kg P_2O_5 ha^{-1} over control.

The uptake of phosphorus was also significantly increased by biofertilizers. Application of VAM resulted in highest uptake of phosphorus followed by PSB and *Rhizobium* inoculation. The lowest uptake was recorded in control. The magnitude of difference between 0 and 30 kg P_2O_5 ha^{-1} was much higher than 30 and 60 kg P_2O_5 ha^{-1}. The biofertilizers treatment recorded significantly higher seed yield of mungbean than no biofertilizers. Application of VAM resulted in the highest seed yield among biofertilizers. The percent increase in yield through biofertilizers was 8.3, 11.6 and 18.7 due to treatment with *Rhizobium,* PSB and VAM over control, respectively. Chatterjee and Bhattacharjee (2002) also recorded higher yield of mungbean due to inoculation of *Rhizobium* and PSB.

The seed yield also increased significantly due to phosphorus application up to 60 kg P_2O_5 ha^{-1}. However further increase to 90 kg P_2O_5 ha^{-1} had no beneficial effect on the seed yield of mungbean. The magnitude of superiority with 60kg P_2O_5 ha^{-1} over 0 and 30 kg P_2O_5 ha^{-1} was to the tune of 39.4 and 49.3 percent, respectively. Ardeshna *et al* (1993) too recorded highest yield with application of 40 kg P_2O_5 ha^{-1}.

The straw yield of mungbean was highest with VAM application followed by PSB and *Rhizobium.* And all the biofertilizers recorded significantly higher stover yield over control. There was significant increase in stover yield of mungbean due to phosphorus application up to 60 kg P_2O_5 ha^{-1} over 0 and 30 kg P_2O_5 ha^{-1}. However 60 and 90 kg P_2O_5 ha^{-1} were at par with each other.

Table 1. Effect of biofertilizers and phosphorus levels on nodulation pattern in mungbean

Treatment	No. of nodules/plant		Dry weight of nodules (g/plant)	
	Vegetative	Flowering	Vegetative	Flowering
Biofertilizers				
Control	14.87	23.43	18.59	29.66
Rhizobium	16.55	24.15	20.35	30.46
PSB	17.02	24.24	20.83	30.90
VAM	17.08	24.53	21.51	31.98
Sem+/-	0.26	0.33	0.26	0.43
CD at 5%	0.75	0.96	0.75	1.25
Phosphorus levels (kg P_2O_5/ha)				
0	14.23	21.39	16.83	27.71
30	16.14	24.07	20.10	31.01
60	17.15	25.42	22.03	32.03
90	17.62	25.47	22.32	32.25
Sem+	0.26	0.33	0.26	0.43
CD at 5%	0.75	0.96	0.75	1.25

Table 2. Effect of biofertilizers and phosphorus levels on phosphorus content and uptake and seed and stover yield of mungbean

Treatment	Phosphorus content (%)		Phosphorus content (kg/ha)		Yield (kg/ha)	
	Vegetative	Flowering	Vegetative	Flowering	Seed	stover
Biofertilizers						
Control	0.418	0.105	2.54	1.92	604	1810
Rhizobium	0.455	0.138	3.03	2.80	659	2019
PSB	0.467	0.153	3.17	3.15	674	2046
VAM	0.473	0.158	3.14	3.30	717	2083
Sem±-	0.003	0.0006	0.030	0.021	4	19
CD at 5%	0.009	0.0016	0.086	0.061	13	56
Phosphorus levels (kg P_2O_5/ha)						
0	0.415	0.120	2.05	2.02	493	1671
30	0.453	0.138	3.12	2.82	687	2037
60	0.467	0.147	3.45	3.13	736	2098
90	0.478	0.147	3.53	3.20	739	2153
Sem±	0.003	0.0006	0.030	0.021	4	19
CD at 5%	0.009	0.0016	0.086	0.061	13	56

On the basis of these finding of the experiment it may be concluded that seed inoculation with biofertilizers and application of phosphorus up to 60 kg P_2O_5 ha^{-1} is necessary for increasing the productivity of summer mungbean under irrigated conditions of western Uttar Pradesh.

Refrences

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Certification of Biofertilizers by NPOP accredited Certification Bodies is not a Quality Assurance

Recently it has been noticed that many certification bodies, accredited under National Programme on Organic Production (NPOP), of Ministry of Commerce, Government of India are also certifying the organic and biological inputs including biofertilizers. Here it is clarified that the Certification Bodies accredited under NPOP are authorized to undertake certification of organic production, which is a process-certification mechanism and includes plants, crops, handling of organically grown commodities and processing of organically grown food items for production of organic processed food items. Any raw material or input used for the production of such crops and components can not be certified.

Also the Organic certification is a process certification and only guarantees that the product has been grown or processed as per the protocols laid under NPOP. This certification do not guarantees the quality requirement of the product. As per the NPOP, inputs used in organic agriculture, if purchased, need to be approved/ authorized by the certification bodies. After thorough screening of their production process, the certification bodies can approve these products for restricted use in organic production. In any circumstance they can not certify any product/ input used in agriculture. India Organic Logo also can not be used on the inputs such as biofertilizers. At the best, if such products have been authorized by certification bodies under NPOP, they can mention "APPROVED INPUT FOR RESTRICTED USE IN ORGANIC AGRICULTURE" with logo of concerned certification agency and certainly not with India Organic logo.

Consumers should be fully aware of this and whenever they notice any violation of prescribed norms, they can lodge their complaint either to the National Centre of Organic Farming, Ghaziabad (nbdc@nic.in) or to Agricultural Processed Food Export Development Authority (APEDA), Siri Fort Institutional Area, New Delhi

Remember Organic Certification of Biofertilizer is not a Quality Assurance

Research Notes and New Reports

Effects of Glucosinolates and Flavonoids on Colonization of the Roots of *Brassica napus* by *Azorhizobium caulinodans* ORS571 - Plants of *Brassica napus* were assessed quantitatively for their susceptibility to lateral root crack colonization by *Azorhizobium caulinodans* ORS571(pXLGD4) (a rhizobial strain carrying the *lacZ* reporter gene) and for the concentration of glucosinolates in their roots by high-pressure liquid chromatography (HPLC). High- and low-glucosinolate-seed (HGS and LGS) varieties exhibited a relatively low and high percentage of colonized lateral roots, respectively. HPLC showed that roots of HGS plants contained a higher concentration of glucosinolates than roots of LGS plants. One LGS variety showing fewer colonized lateral roots than other LGS varieties contained a higher concentration of glucosinolates than other LGS plants. Inoculated HGS plants treated with the flavonoid naringenin showed significantly more colonization than untreated HGS plants. This increase was not mediated by a naringenin-induced lowering of the glucosinolate content of HGS plant roots, nor did naringenin induce bacterial resistance to glucosinolates or increase the growth of bacteria. The erucic acid content of seed did not appear to influence colonization by azorhizobia. Frequently, leaf assays are used to study glucosinolates and plant defense; this study provides data on glucosinolates and bacterial colonization in roots and describes a bacterial reporter gene assay tailored easily to the study of ecologically important phytochemicals that influence bacterial colonization. (Source – Callaghan et al 2000, Applied and Environmental Microbiology, May 2000, Vol. 66, No. 5 p. 2185-2191)

Endophytic colonization of plant roots by nitrogen-fixing bacteria - Nitrogen-fixing bacteria are able to enter into roots from the rhizosphere, particularly at the base of emerging lateral roots, between epidermal cells and through root hairs. In the rhizosphere growing root hairs play an important role in symbiotic recognition in legume crops. The inoculation of non-legumes, especially cereals, with various non-rhizobial diazotrophic bacteria has been undertaken with the expectation that they would establish themselves intercellularly within the root system, fixing nitrogen endophytically and providing combined nitrogen for enhanced crop production. However, in most instances bacteria colonize only the surface of the roots and remain vulnerable to competition from other rhizosphere micro-organisms, even when the nitrogen-fixing bacteria are endophytic, benefits to the plant may result from better uptake of soil nutrients rather than from endophytic nitrogen fixation. *Azorhizobium caulinodans* is known to enter the root system of cereals, other non-legume crops and *Arabidopsis*, by intercellular invasion between epidermal cells and to internally colonize the plant intercellularly, including the xylem. This raises the possibility that xylem colonization might provide a non-nodular niche for endosymbiotic nitrogen fixation in rice, wheat, maize, sorghum and other non-legume crops. A particularly interesting, naturally occurring, non-nodular xylem colonising endophytic diazotrophic interaction with evidence for endophytic nitrogen fixation is that of *Gluconacetobacter diazotrophicus* in sugarcane. Could this beneficial endophytic colonization of sugarcane by *G. diazotrophicus* be extended to other

members of the Gramineae, including the major cereals, and to other major non-legume crops of the World?
(Source – Cocking 2003, Plant and Soil Vol 252, 169-175)

Nodulation of Oilseed Rape (*Brassica napus*) by Rhizobia - Nodules were induced on the non-legume oilseed rape, following enzyme treatment of seedling roots and inoculation with *Rhizobium legnminosarum, Bradyrhizobtum* 32H1 or a mixture of R. *lott* with Bradyrhizobium 32H1 in the presence of PEG. A Nod– strain of R *leguminosarum* also induced nodules, but a Nod– strain failed to elicit this response Nodules induced on oilseed rape were morphologically similar, when examined by light microscopy and cryo-scanning electron microscopy, to those induced on roots of white clover by *R trifolu*. Transmission electron microscopy showed rhizobia within cells of the nodules (Source – Mozahim K Al Mallah et al, J. Experimental Botany 41(12) 1567-1572)

New Molecular Screening Tools for Analysis of Free-Living Diazotrophs in Soil - Molecular methods based on universal PCR detection of the *nifH* marker gene have been successfully applied to describe diazotroph populations in the environment. However, the use of highly degenerate primers and low-stringency amplification conditions render these methods prone to amplification bias, while less degenerate primer sets will not amplify all *nifH* genes. We have developed a fixed-primer-site approach with six PCR protocols using less degenerate to nondegenerate primer sets that all amplify the same *nifH* fragment as a previously published PCR protocol for universal amplification. These protocols target different groups of diazotrophs and allowed for direct comparison of the PCR products by use of restriction fragment length polymorphism fingerprinting. The new protocols were optimized on DNA from 14 reference strains and were subsequently tested with bulk DNA extracts from six soils. These analyses revealed that the new PCR primer sets amplified *nifH* sequences that were not detected by the universal primer set. Furthermore, they were better suited to distinguish between diazotroph populations in the different soils. (Source – Bürgmann et al Appl Environ Microbiol. 2004 January; 70(1): 240–247)

Nitrogen fixation in nodules of maize (*Zea mays*) roots by introduced free-living diazotroph - N fixation and yield were evaluated in maize (cv. Kiran) seedlings inoculated with *Azospirillum brasilense*. Seedlings were grown in Hoagland's solution with 1.0 ppm 2,4-D and 0.1 ml of *A. brasilense* culture containing 10×10^7 to 10×10^8 cells/ml. Nitrogenase activity in actively growing intact nodules was assayed after 2 weeks. Maize seedlings treated with 2,4-D developed nodule-like structures on roots. However, well-developed nodule-like tumour knots that can be described as modified lateral roots (para-nodules) emerged only when the seedlings were inoculated with *A. brasilense* along with 2,4-D. Acetylene reduction was higher in seedlings treated with *A. brasilense* and 2,4-D than in seedlings treated with *A. brasilense* alone. The control and 2,4-D-treated seedlings did not exhibit acetylene reduction. Leghaemoglobin was detected in seedlings inoculated with *A. brasilense*. The nodule-like structures induced by 2,4-D provided a niche for the establishment of the bacterium, thereby enhancing N fixation in the nodulated roots.
(Source – Srivastava et al Indian Journal of Agricultural Sciences, 2004, 74 (4) : 213-214)

Seminar/ Conference/ Workshops

7th International Workshop on Plant Growth Promoting Rhizobacteria - The **7th** PGPR meeting was scheduled for May 28th to June 2, **2006** in the Netherlands. The theme of this meeting was on the evaluation of research done during the past decades. It emerged that PGPR research has been focused on multiple topics, including: mechanisms of plant growth promotion and disease suppression, traits involved in root colonization by PGPR, the role of PGPR in microbial interactions, the molecular and biochemical basis of disease suppression and root colonization, the role of PGPR in disease suppressive soils, plant responses to PGPR, discovery of novel PGPR strains and traits, pathogen responses to PGPR, risk assessment of PGPR, production, formulation and delivery strategies of PGPR, performance of PGPR in greenhouse trials and agricultural fields and registration and commercialization of PGPR. In addition to the research topics mentioned above, the meeting also focused on recent developments in genomics, metagenomics, proteomics and metabolomics of PGPR. For further details contact Dr. Jos Raaijmakers, Secretary, Wageningen University, The Netherlands. Abstracts are available on line at www.bio.uu.nl

7th European Nitrogen Fixation Conference - The 7th Nitrogen Fixation Conference was organized in Aarhus, Denmark during 22-26 July 2006. This conference was the 7th in a series of conferences dealing with the highly topical area of *Biological Nitrogen Fixation* designed to enhance European collaboration in the field of Nitrogen Fixation research and to foster scientific and technological co-operation between Europe and the rest of the world, particularly with Developing Countries. This multidisciplinary conference, on a topic of importance and of excellence in Europe, represented an excellent training ground for junior researchers. The opening session of the Aarhus conference was intended to raise awareness of the social importance of this exciting research field by placing it in the context of global agriculture and environmental change. The remaining oral and poster sessions covered varied aspects of BNF research, from the laboratory to the field, using a range of multidisciplinary approaches. For further details visit http://www.7theuronfc.dk/intro.htm
8th European Nitrogen Fixation Conference will be held in Gent, Belgium, in 2008

The 20th North American Symbiotic Nitrogen Fixation Conference is scheduled for July 10 – 14 2007 at Alumni Memorial Union located at 1442 West Wisconsin Avenue in Milwaukee, Wisconsin. The conference is likely to have 7 plenary sessions and three poster sessions. The themes of Plenary sessions are: Nodule Development and Physiology**,** Evolution of Symbioses**,** Bacterial Endophytes**,** Agricultural Applications**,** Physiology and Genetics of the Bacteria**,** Physiology and Genetics of the Plant Host and Genomic Approaches to Understanding Symbiosis. For further information visit http://www.marquette.edu/NASNFC/

Book Reviews

Bioinoculants for Sustainable Agriculture and Forestry (Proceedings of National Symposium Held on Feb. 16-18, 2001) Edited by S.M. Reddy, S. Ram Reddy, M.A. Singarachary and S. Girisham. Jodhpur, Scientific, 2002, viii, 221 p., Price, $44. ISBN 81-7233-307-2 - "This book forms the proceedings of National Symposium and covers different aspects of biofertilizers and biocontrol agents. The contributions are from the leading microbiologists in their respective fields. The book presents a holistic picture of role of microorganisms in plant growth and development on one hand and plant protection on the other. An up-date information is provided in this book. Role of biofertilizers in integrated nutrient management has been highlighted and similarly the need of transgenic microbial inoculants for sustainable agriculture has been emphasized. A role of ectomycorrhizae, heavy metal tolerance and in reclaiming wastelands are also discussed. "Structure and importance of VAM fungi in growth and development of medicinal plants, tomato, sugarcane and millets have been elucidated by different workers. A critical review on actinorrhizae is also included. *Azospirillum* plant association in stress tolerance has been highlighted. Need of cyanobacterial biofertilizers for sustainable agriculture is also dealt. Phosphate solubilizing microbes and other microorganisms and plant productivity are dealt in two different chapters. Beneficial effect of *Rhizobium* on black gram is also illustrated. Management of pests through microbial pathogens including viruses, and VAM fungi is also discussed. Besides the has dealt in management of mites through fungi in the last two chapters. It is expected that the book would meet the needs of researchers, extension Officers working with biofertilizers. (AKY)

Biotechnology of Biofertilizers By S. Kannaiyan Publisher: Springer; ISBN-13: 978-1402002199 375 pages. Price $ 165 - Biofertilizers are important components of integrated nutrient management. They are cost effective, ecofriendly and a renewable source of plant nutrients to supplement chemical fertilizers in sustainable agricultural systems in India. This book is written with the objective of covering the basic issues in Biological Nitrogen Fixation (BNF), such as physiology, biochemistry and molecular genetics of nitrogen fixation, role of signal molecules and host gene expression in nodulation and nitrogen fixation for a thorough understanding of these processes in symbiotic nitrogen fixing systems and the possibilities of extending these agronomically potential and significant processes to non-legumes. The potential benefits from the N_2 fixing symbiotic systems such as *Sesbania rostrata, Azolla*, and free-living cyanobacteria to rice crop and associative symbiotic N_2 fixer *Azospirillum* to rainfed crops have been discussed in detail. Immobilization of cyanobacteria in a solid matrix such as polyurethane foam for maximising ammonia production in rice fields and endophytic nitrogen fixation in wheat have also been included which are considered as technologies for the future. The solubilization of nutrients by phosphobacteria, the mobilization of VA mycorrhiza, role of *Acetobacter diazotrophicus* as a novel biofertilizer for sugarcane and the cycad-cyanobacterial symbiosis have been clearly elucidated.

Biofertilizer Production News (2005-06)

With the incorporation of biofertilizers under FCO, various microbial inoculants/ formulations being prepared for use in agricultural crops are now being clubbed under two categories: (i) biofertilizers namely Rhizobium, Azotobacter, Azospirillum and PSB and (ii) Other microbial inoculants such as VAM biofertilizers, PGPRs, cellulose decomposers etc. Production of biofertilizers is continuously on the rise and every year new formulations are being added. Lot of liquid formulations of different biofertilizers have been introduced. Out of the four most popular biofertilizers (also covered under FCO, 1985), PSB alone accounts for nearly 50% of total production. Other microbial inoculants accounts for nearly 48% of total microbial inoculant production. State wise and production agency wise break up of different biofertilizers is presented here for the year 2005-06. The information provided here is based on the documented information provided by the production units. Installed production capacity, actual production could be much more than reported here, because large number of units have not provided requisite information. However, the comprehensive data are as follows:

State wise status of Biofertiliser Production (tonnes)

Name of State	Biofertiliser Production during the Year 2005-06							
	Azotobacter	*Azospirillum*	*Acetobacter*	*Rhizobium*	PSB	Total BF	Others*	Grand Total
Andhra Pradesh	3.35	19.61	N.A.	34.18	2189.29	2246.43	15.04	2261.47
Assam	N.A.	N.A.	N.A.	N.A.	106.20	106.20	7250.56	7356.76
Bihar	9.00	8.00	N.A.	5.50	18.50	41.00	N.A.	41.00
Gujarat	294.50	119.97	80.19	126.18	750.76	1371.60	N.A.	1371.60
Delhi	0.49	0.06	N.A.	0.18	0.50	1.23	1.09	2.32
Haryana	6.85	N.A.	0.19	6.46	9.98	23.48	N.A.	23.48
Himachal Pradesh	4.29	N.A.	N.A.	5.30	N.A.	9.59	9.59	9.59
Jharkhand	1.5	0.98	N.A.	1.00	5.52	9.00	200	209.0
Karnataka	3.978	4.61	N.A.	13.91	45.34	67.84	0.08	67.92
Kerala	N.A.	4.89	N.A.	0.64	2.81	8.34	8.34	8.34
Madhya Pradesh	136.95	0.51	N.A.	252.17	433.44	823.07	140.57	963.64
Maharastra	1064.82	37.36	0.85	152.45	843.49	2098.96	394.04	2493.00
Nagaland	3.39	2.17	N.A.	3.30	8.17	17.03	N.A.	17.03
Orissa	7.98	7.00	N.A.	24.99	26.00	65.97	200	265.97
Punjab	N.A.	N.A.	N.A.	2.27	N.A.	2.27	N.A.	2.27
Rajasthan	42.78	N.A.	83.40	99.57	204.84	430.59	6.18	436.77
Pondicherry	N.A.	1.98	N.A.	3.77	2.03	7.78	1.96	9.74
Tamilnadu	10.87	929.16	0.06	264.96	1002.52	2207.57	77.99	2285.56
Uttar Pradesh	168.21	0.08	15.82	50.55	251.64	486.30	N.A.	486.30
West Bengal	35.857	36.561	N.A.	38.1	84.09	194.60	1285.51	1480.12
Total	**1794.815**	**1172.941**	**180.51**	**1085.48**	**5985.12**	**10218.85**	**9573.02**	**19791.88**

* Others = Biofertilizers other than Rhizobium, Azotobacter, Azospirillum, Acetobacter and PSB. This includes other microbial inoculants including Trichoderma for decomposition

The information is based on data received from different production units/State Agri. Labs and SAUs and other agencies.

Detailed Production of biofertilizers / other microbial inoculants by different production units during 2005-06

States	Organization Name	GOI Funded	AZOTO.	AZOSP.	ACETO.	RHIZ.	PSB	Total BF	Others	Total
Andhra Pradesh	Mr. Krishan Rao, Krishna Agro Bioproducts Vrikshamitra 9/1/A-1 Road No. 16 IDA Nacharam, Hyderabad	No	0	0	0	0	2153.00	2153.00	0	2153.00
Andhra Pradesh	Biofertilizer Production Unit, Tiruchirapalli	GOI	0	9.55	0	0	10.31	19.86	10.47	30.33
Andhra Pradesh	Radar Biotech Vijay wara		0	3.10	0	0.15	5.00	8.25	2.67	10.92
Andhra Pradesh	Rovar Biotech Vijaywara		3.33	6.85	0	1.48	7.34	19.00	1.90	20.90
Andhra Pradesh	RSTL, Hyderabad		0.02	0.11	0	32.55	13.64	46.32	0	46.32
Andhra Pradesh Total			**3.35**	**19.61**	**0**	**34.18**	**2189.29**	**2246.43**	**15.04**	**2261.47**
Assam	N.E.Green Tech P.Ltd Guwahati	No	0	0	0	0	53.80	53.80	291.76	345.56
Assam	Director of Agriculture, Guwahati		0	0	0	0	52.40	52.40	6958.80	7011.20
Assam Total			**0.00**	**0.00**	**0.00**	**0.00**	**106.20**	**106.20**	**7250.56**	**7356.76**
Delhi	IARI, New Delhi		0.49	0.06	**0**	0.18	0.50	1.23	1.09	2.32
Delhi Total			**0.49**	**0.06**	**0**	**0.18**	**0.5**	**1.23**	**1.09**	**2.32**
Gujarat	Gujarat State Cooperative Marketing Fed. Ltd., Ahemdabad	GOI	0	76.31	0	16.55	99.78	192.64	0	192.64

State	Organization Name	GOI Funded	AZOTO.	AZOSP.	ACETO.	RHIZ.	PSB	Total BF	Others	Total
Gujarat	Gujarat State Fertilizers & Chemicals Ltd., Vadodara	GOI	139.36	23.88	31.42	32.90	206.49	434.05	0	434.05
Gujarat	KRIBHCO- Hazira, Surat	GOI	96.34	5.00	48.77	57.98	331.13	539.22	0	539.22
Gujarat	CORDET Kalol, Gandhi Nagar		58.80	14.78	0	18.75	113.36	205.69	0	205.69
Gujarat Total			**294.50**	**119.97**	**80.19**	**126.18**	**750.76**	**1371.60**	**0**	**1371.6**
Haryana	CCSHAU, HISAR	GOI	6.85	0	0.19	6.46	9.98	23.48	0	23.48
Haryana Total			**6.85**	**0**	**0.19**	**6.46**	**9.98**	**23.48**	**0**	**23.48**
Himchal Pradesh	Sr. Analytical Chemist Laboratory, Shimla	GOI	4.29	0	0	5.30	0	9.59	0	9.59
Himchal Pradesh Total			**4.29**	**0**	**0**	**5.30**	**0**	**9.59**	**0**	**9.59**
Karnataka	Rhizobium Culture Lab, GKVK, Bangalore	No	0.098	0.11	0.00	0.20	0.13	0.54	0.08	0.62
Karnataka	Rhizobium Lab, Dharwad	GOI	2.38	0	0	2.52	3.10	8.00	0	8.00
Karnataka	West Coast Herbo Chem Ltd., Bangalore	GOI	0	0	0	3.81	35.01	38.82	0	38.82
karnataka	Rhizobium Laboratory, Kotnur, Gulberga	GOI	1.50	4.50	0	7.38	7.10	20.48	0	20.48
Karnataka Total			**3.978**	**4.61**	**0.00**	**13.91**	**45.34**	**67.84**	**0.08**	**67.918**
Kerala	The Fertilizers and Chemicals Travancore Ltd., Cochin	GOI	0	4.89	0	0.64	2.81	8.34	0	8.34
Kerala Total			**0**	**4.89**	**0**	**0.64**	**2.81**	**8.34**	**0**	**8.34**
Madhya Pradesh	Nafed Biofertilizer , Indore	GOI	53.59	0	0	124.91	47.07	225.57	0	225.57
Madhya Pradesh	NFL-Vijaypur, Guna	No	45.85	0	0	17.55	111.70	175.10	0	175.10

State	Organization Name	GOI Funded	AZOTO.	AZOSP.	ACETO.	RHIZ.	PSB	Total BF	Others	Total
Madhya Pradesh	Agri Business & Dev. Coop. Bhopal		4.16	0.51	0	8.69	26.00	39.36	0	39.36
Madhya Pradesh	The M.P. State Agro Ind. Dev. Corpn., Bhopal	GOI	33.35	0	0	101.02	248.67	383.04	140.57	523.61
Madhya Pradesh Total			**136.95**	**0.51**	**0**	**252.17**	**433.44**	**823.07**	**140.57**	**963.64**
Maharashtra	M/s Niku Bio Research Station 613, Nanapeth, Pune	GOI	5.55	0	0	1.71	3.00	10.26	6.61	16.87
Maharashtra	Microplex India 36 Mohata Market, Main Road, Wardha	No	42.14	0	0	0.89	68.79	111.82	0	111.82
Maharashtra	Kumar Krishi Mitra Bio Products(I) P Ltd., Pune	No	719.03	0	0	0	180.20	899.23	0	899.23
Maharashtra	Agricultre Bact, Section, Coll Agril, Pune	No	4.178	2.362	0	0.725	2.18	9.44	2.451	11.892
Maharashtra	Choudhury Agro Tech, Nagpur	No	4.00	0	0	6.00	12.50	22.50	10.00	32.50
Maharashtra	Vaibhav Laxmi Biocontrol Lab	No	6.50	0	0	7.00	13.00	26.50	5.00	31.50
Maharashtra	Aviskar Biofarm Pvt. Ltd. At Post Pravanagar Tal. Rahat, Ahmednagar	No	20.00	9.15	0	1.99	62.02	93.16	49.43	142.59
Maharashtra	Arun BiofertilisersNear MSEB, Power House Kurundwad, Tal-Shirol, Kolhapur	GOI	25.00	10.00	0	5.00	85.00	125.00	25.00	150.00

State	Organization Name	GOI Funded	AZOTO.	AZOSP.	ACETO.	RHIZ.	PSB	Total BF	Others	Total
Maharashtra	Nirmal Seeds Pvt. Ltd. Bhadegaon Road, Pachora (Jalgoan)	GOI	61.00	0	0	19.00	80.00	160.00	0	160.00
Maharashtra	Nomain Agribioproducts,Pune	0	0	0	0	0	1.55	1.55	1.94	3.49
Maharashtra	Nilayam Bio-fertilizer Prod. Unit Plot No. 46/40, Mahad Colony Near ITI, Wardha	GOI	10.20	0	0	20.30	17.00	47.50	0	47.50
Maharashtra	Kisan Agrotech, Nanded	No	0	0	0	5.00	0	5.00	0	5.00
Maharashtra	Ellora Biotech, Nanded	0	17.00	0	0	3.00	6.00	26.00	0	26.00
Maharashtra	K-Fert Lab 25 First Floor Gurunank Market, Nanded	GOI	15.00	5.00	0	24.75	34.25	79.00	0	79.00
Maharashtra	INORA, Pune	GOI	19.50	1.00	0	2.25	35.50	58.25	50.00	108.25
Maharashtra	Vasant Dada Sugar Institute, Pune	GOI	43.30	0.49	0	0.36	58.61	102.76	79.81	182.57
Maharashtra	SMSMP Patil, Aaklunj	0	0	0	0	0	77.63	77.63	20.025	97.655
Maharashtra	Sai Nath, Pune	0								
Maharashtra	MRDC, Solapur	GOI	4.11	0	0	1.77	23.38	29.26	23.16	52.42
Maharashtra	BAIF Development Res. Foundation, Pune	GOI	0.50	0	0	0.50	5.00	6.00	0	6.00
Maharashtra	Envrionmental Prod.Res.Foun, Sangali		8.00	0	0	1.25	8.00	17.25	24.00	41.25
Maharashtra	Bioira Ramtech, Nagpur		8.00	0	0	13.00	20.00	41.00	17.50	58.50
Maharashtra	Govinda Agrotech, Nagpur	0	12.00	0	0	7.00	22.00	41.00	15.00	56.00
Maharashtra	Jain Biotech, Nagpur	0	1.00	0	0	3.50	1.50	6.00	0	6.00

State	Organization Name	GOI Funded	AZOTO.	AZOSP.	ACETO.	RHIZ.	PSB	Total BF	Others	Total
Maharashtra	Krishi Jevarnu Anubagh Krishividyalya, Pune	0	4.18	2.36	0	0.73	2.18	9.45	2.45	11.90
Maharashtra	K.N.S, Biotech, Nanded	0	1.50	1.00	0	1.00	1.50	5.00	0	5.00
Maharashtra	OM.Agro Org, Yavatamal	0	18.00	0	0	8.00	22.00	48.00	0	48.00
Maharashtra	Krishak Bharati Cooperative Ltd, Lanja	0	15.03	6.00	0.85	16.53	0	38.41	61.66	100.07
Maharashtra	Krishi Vigayan Kendra, Jintur Road, Parbhani		0.10	0	0	1.19	0.70	1.99	0	1.99
Maharashtra Total			**1064.8**	**37.36**	**0.85**	**152.45**	**843.49**	**2098.96**	**394.04**	**2493.00**
Nagaland	Biofert Lab, Medziphema	GOI	3.39	2.17	0	3.30	8.17	17.03	0	17.03
Nagaland Total			**3.39**	**2.17**	**0**	**3.3**	**8.17**	**17.03**	**0**	**17.03**
Orissa	Orissa A.I.C.Ltd., BBSR.	Funded	4.98	4.00	0	9.99	17.00	35.97	0	35.97
Orissa	Deputy Director of Agril., BBSR	Funded	3.00	3.00	0	15.00	9.00	30.00	0	30.00
Orissa	Maa Kanak Biofertilizer, BBSR	Pvt.	0	0.00	0	0	0.00	0.00	200	200.00
Orissa Total			**7.98**	**7.00**	**0**	**24.99**	**26.00**	**65.97**	**200**	**265.97**
West Bengal	B.C.K.V., Kalayani	Funded	5.75	6.25	0	9.00	11.00	32.00	60.00	92.00
West Bengal	Nitrofix Laboratories, Kolkatta	Funded	10.00	9.746	0	20.524	40.00	80.27	0	80.27
West Bengal	Vivekand Instt. of Biotechnology, 24-Pargansa, Kolkatta	Funded	0.107	0.07	0	0.076	0.086	0.33	2.511	2.85

State	Organization Name	GOI Funded	AZOTO.	AZOSP.	ACETO.	RHIZ.	PSB	Total BF	Others	Total
West Bengal	Excel Biotech Pvt. Ltd., 24-Paragansa, Kolkotta	Pvt.	17.00	18.00	0	0	17.00	52.00	743.00	795.00
West Bengal	Lila Agrotech	Pvt.	3.00	2.50	0	8.5	16.00	30.00	480.00	510.00
West Bengal Total			**35.857**	**36.561**	**0**	**38.1**	**84.086**	**194.60**	**1285.51**	**1480.115**
Jharkhand	Birsa Agril, University, Ranchi	Pvt.	1.5	0.98	0	1.00	5.52	9.00	0	9.00
Jharkhand	Swarnarekha Enterprises, Ranchi	Pvt.	0	0.00	0	0	0.00	0.00	200.00	200.00
Jharkhand Total			**1.5**	**0.98**	**0**	**1**	**5.52**	**9.00**	**200**	**209**
Bihar	Association for social Economic Transforamtion, Patna	Pvt.	9.00	8.00	0	5.5	18.5	41.00	0	41.00
Bihar Total			**9.00**	**8.00**	**0**	**5.5**	**18.5**	**41.00**	**0**	**41.00**
Punjab	Biofertiliser Prd. Unit Ludhiana	GOI	0	0	0	1.08	0	1.08	0	1.08
Punjab	PAU, Ludhiana	No	0	0	0	1.19	0	1.19	0	1.19
Punjab Total			**0**	**0**	**0**	**2.27**	**0**	**2.27**	**0**	**2.27**
Rajasthan	Vasta Mahavir Bio Lab, Udaipur		0.80	0	0	1.1	1.10	3.00	0	3.00
Rajasthan	Rhizobia Scheme Agril Deptt., Jaipur	No	10.00	0	10.11	15.00	15.00	50.11	0	50.11
Rajasthan	Nafed Biofertilizer, Bharatpur	GOI	31.98	0	73.29	83.47	188.74	377.48	6.18	383.66
Rajasthan Total			**42.78**	**0**	**83.4**	**99.57**	**204.84**	**430.59**	**6.18**	**436.77**
Tamil Nadu	Biofertilizer Prd. Unit,Trichy	No	0	104.22	0	43.85	67.13	215.20	0	215.20
Tamil Nadu	Biofertilizer Prd. Unit,Cuddalore	No	0	117.86	0	56.46	65.69	240.01	0	240.01

State	Organization Name	GOI Funded	AZOTO.	AZOSP.	ACETO.	RHIZ.	PSB	Total BF	Others	Total
Tamil Nadu	Biofertilizer Prd Unit, Kudumiamalai	No	0	116.93	0	33.29	74.40	224.62	0	224.62
Tamil Nadu	Biofertiliser Prd Unit,Salem	GOI	0	118.22	0	68.06	113.41	299.69	0	299.69
Tamil Nadu	SPIC, Chennai	GOI	0.25	0.50	0	0.02	0.31	1.08	0	1.08
Tamil Nadu	Esvin Advanced Technologies Ltd., Chennai	GOI	6.62	0	0.06	0.10	7.75	14.53	77.99	92.52
Tamil Nadu	Madras fertilizer Limited, Chennai	No	0	114.74	0	3.80	116.74	235.28	0	235.28
Tamil Nadu	T. Stanes and Company Ltd.- Coimbatore	No	2.00	36.50	0	4.10	191.00	233.60	0	233.60
Tamil Nadu	Modern Nursery Divn, Chennai	No	2.00	36.50	0	4.10	191.00	233.60	0	233.60
Tamil Nadu	BF Prd Unit,Ramnad		0	148.89	0	22.55	92.71	264.15	0	264.15
Tamil Nadu	BF Prd Unit, Sakkottai		0	133.45	0	28.63	81.03	243.11	0	243.11
Tamil Nadu	SIMA Cotton Dev Soc., Coimbutore	GOI	0	1.35	0	0	1.35	2.70	0	2.70
Tamil Nadu Total			**10.87**	**929.16**	**0.06**	**264.96**	**1002.52**	**2207.57**	**77.99**	**2285.56**
Uttar Pradesh	Deptt of Agri. Govt of UP., Lucknow	GOI	10.00	0	0	50.00	65.00	125.00	0	125.00
Uttar Pradesh	Krishak Bharati Cooperative Ltd, Varanasi	GOI	57.74	0	6.02	0.54	71.58	135.88	0	135.88
Uttar Pradesh	IFFCO, Phulpur, Allahabad	GOI	100.47	0.08	9.80	0.01	115.06	225.42	0	225.42
Uttar PradeshTotal			**168.21**	**0.08**	**15.82**	**50.55**	**251.64**	**486.30**	**0**	**486.30**

State	Organization Name	GOI Funded	AZOTO.	AZOSP.	ACETO.	RHIZ.	PSB	Total BF	Others	Total
Pondicherry	Pondicherry Agro Service And Industries Corporation (Pasic), Thattanchavady		0	1.98	**0**	3.77	2.03	7.78	1.96	9.74
Pondicherry Total			**0**	**1.98**	**0**	**3.77**	**2.03**	**7.78**	**1.96**	**9.74**
Grand Total			**1794.8**	**1172.94**	**180.51**	**1085.4**	**5985.11**	**10218.8**	**9573.0**	**19791.87**