NEWSLETTER

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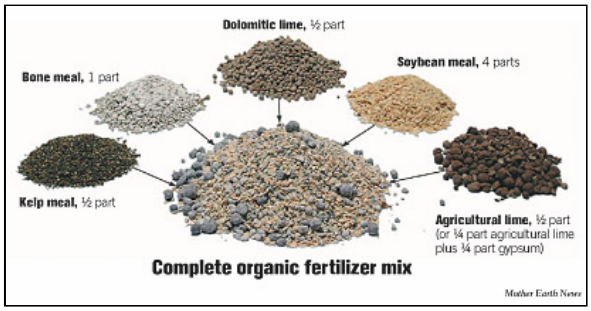
Special issue on Biofertilizer

Editorial

With the introduction of green revolution technologies the modern agriculture is getting more and more dependent upon the steady supply of synthetic inputs (mainly fertilizers), which are products of fossil fuel. Adverse effects are being noticed due to the excessive and imbalanced use of these synthetic inputs. This situation has lead to identifying harmless inputs like biofertilizers. Use of such natural products like biofertilizers in crop cultivation will help in safeguarding the soil health and also the quality of crop products. Biofertilizers are most advanced bio technology necessary to support developing organic agriculture, sustainable agriculture, green agriculture, and non-polluting agriculture. This bioorganic fertilizer can increase the output, improve the quality and it is responsible for agriculture environment. Today it has been widely used with excellent results in all kinds of plants and several countries. It is well known that continue use and overuse of petrochemical based fertilizers and pesticides have caused a detrimental effect to our soils, water supplies, foods, animals and also peoples. In view of the disadvantages associated with the use of chemical fertilizers, it is important to use alternative sources, which are environment friendly plant nutrients. Biofertilzers, most of which are nitrogen fixing microorganisms, are considered to be suitable alternative source of plant nutrition. Biofertilizers contain a wide range of naturally chelated plant nutrients and trace elements and carbohydrates, amino acids and other growth promoting substances. A number of intellectuals throughout the world started working on the alternatives and found that biofertilizers can help in increasing the yield without causing the damage associated with chemical fertilizers.

Prof. S. C. Santra
ENVIS In-Charge



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In This Issue:

Biofertilizers

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In tropical and sub-tropical agricultural land, normally more than 10 crore of microorganisms are present in 1gram of soil. Among these 10 crore of microorganisms, only 5-7% are infectious or otherwise harmful while the rest are either non-infectious or beneficial in nature and extremely useful in agriculture. This fact clearly indicates that, although some species of microorganisms cause economic damage to our environment (or agriculture), most of them plays important role in protecting environment and balancing the ecosystem. Therefore, the notion that all microorganisms are harmful is not correct at all. Microorganisms are extremely diverse in the nature and they are present in air, water and soil. Agriculture primarily depends on soil, which is a living body because it consists of *microflora* such as bacteria, *actinomycetes*, fungi and algae. Besides, soil also has *microfauna* such as protozoa and nematodes. The life in the soil is responsible for making numerous transformations that change plant nutrients to move in readily available forms. With the development of technology driven intensive modern agriculture and extensive use of chemical fertilizer and pesticides instead of organic agricultural inputs result in deterioration of soil quality and plant-soil relationship in different ways. One of the major effects of such activities is gradual decrease in the number of useful microorganisms in agricultural soil. The problem is so intense that, in many agricultural land of our country there are less than one crore of microorganisms has been found in one gram of soil. Because of these reasons, not only soil is being polluted through environment destabilization but the yield of agricultural produce also fluctuating alarmingly. To combat these problems the emphasis has been shifted towards the application of soil microorganisms as critical agricultural input.

Different kind of naturally living microorganisms directly or indirectly increases the fertility of soil. Some of them provide nitrogen to plants either symbiotically or non symbiotically by fixing nitrogen from atmosphere. Many microorganism increases availability of different nutrients like phosphorous, potash or sulphur to plants. Some other microorganism renders several vitamins and micronutrients available to plants.

A biofertilizer is an organic product (or formulation) containing a specific microorganism in concentrated form which is derived either from nodules of plant roots or root zone (rhizosphere). After collecting the microorganisms from soil, their population is usually increased in the laboratory culture medium until the population increase up to 10 to 100 crores depending upon the type of microorganism cultured. Biofertilizer is formulated by mixing the concentrated microflora with charcoal dust or kaolin in 1:3 ratios. The resulting mixture then dried under shed and kept in a labeled polythene packet and sealed carefully. The name of the organism, concentration of microorganism per gram, the crops in which it is applicable, application procedure and expiry date are usually mentioned in the label.

Generally, agriculturally used biofertilizers are classified into six categories depending upon microorganism involved:

A). Nitrogen fixing microorganism.
   i) Symbiotic nitrogen fixing microorganism for leguminous plants.
   ii) Free living or nonsymbiotic nitrogen fixing microorganism for non-leguminous plants.
   iii) Blue Green Algae (BGA) and *Azolla*.

B). Phosphate solubilizing organism.

C). Potassium accumulating organism.

D). Sulphur solubilizing organism.

E). Micorrhiza.

F). Cellulose decomposing microorganism.

A) Nitrogen fixing microorganism:

Nitrogen fixation in soil by different microorganism is a complex biochemical process by which atmospheric elemental nitrogen (unavailable to plants) is transformed into organic nitrogenous compound, which is available to plants. Different species of bacteria, some *actinomycities* and blue green algae are agriculturally important Nitrogen fixers.

i) Symbiotic nitrogen fixing microorganism for leguminous plants

Some species of *Rhizobium* bacteria forms nodule by colonizing in the roots of different leguminous plants. They derive carbohydrates (energy) and water from the root tissues of the host plants, which enables them to directly fix atmospheric nitrogen for the production of amino acids and protein to make cell materials. In return, the host plant received the mentioned nitrogenous compounds synthesized by the bacteria for their own growth and development. In this process, some amino acids and small proteins are extracted into the soil and the nitrogen content of the soil is enriched. After harvesting of the leguminous crops, the decaying nodules further add nitrogenous compounds in the soil and thereby increase soil fertility. The *Rhizobium* legume association could fix about 100-300kg nitrogen per hectare in one year or even in one crop season. There is a considerable specificity between *Rhizobium* species and leguminous host plants. That means a given *Rhizobium* species will form symbiotic association with specific group of leguminous host but not with others.
Some *Rhizobium* bacteria and name of their specific leguminous hosts are given below-

Leguminous plants	Rhizobium species
Peas, lathyrus, lentil.	*Rhizobium. Leguminous*
Soyabean	*R. japonicum*
Beans	*R. phaseoli*
Clovers	*R. trifoli*
Alfa-alfa (medicago), Lucern	*R. melitoli*
Lupines	*R. lupini*

It has been observed that productivity of leguminous crops is increased to an extent of 15-20% when *rhizobium* culture was used for seed treatment and/or direct soil application. Farmers, willing to use *Rhizobium* inoculants, as biofertilizar should know that bacterial activity increases many fold in the presence of calcium, phosphate and trace amount of cobalt & molybdenum in soil.

In spite of leguminous plants, there are some other non legumes (especially angiosparms) are known to develop nodule and fixed atmospheric nitrogen in more or less same manner. Examples of such symbiotic interactions are Azobacter (bacteria) with Paspulum, Frankier (*Actinomycities*) with Alders.

ii) Free living or nonsymbiotic nitrogen fixing microorganism for non-leguminous plants

Certain free-living microorganisms exist in soil and water are able to fix atmospheric nitrogen with out symbiosis. These organisms are mainly bacteria (*i.e. Azotobacter, Clostridium, Verxia, Azospirillum* etc.)

Among the free-living nitrogen-fixing bacteria, Azotobacter is most important. They colonize in rhizosphere and derived their energy by oxidation of soil organic matter and fix atmospheric nitrogen into the soil and subsequently increase the soil fertility. *Azotobacter* culture is useful cereals and other non-legumenous crops including Sunflower, Potato, Maize, different flowers, mustard, rice, wheat, cotton etc. *Azotobacter*, being aerobic, can't tolerate waterlogged conditions. However, in the rice field, they act as facultative anaerobes by utilizing oxygen liberated by algal mass and oxidized rice rhizosphere.

The biofertilizer application conditionally reduces the use of chemical fertilizers as well as increasing the crop yield. It should be kept in mind that during application of *Azotobacter* culture, the soil pH should not be acidic (i.e. not less than pH-6) and the soil should be sufficiently aerated.

Azotobacter does not only fix atmospheric nitrogen into the soil but also promote plant growth by supplying necessary hormone (Auxin, Gibberelin, Cytokinin), vitamin B complexes (essential for seed germination) and producing antibiotics under optimum conditions. The antibiotics produced by *Azotobacter* act on soil inhabiting disease producing fungi viz. *Fusarium, Rhizoctonia, Alternaria, Aspergillus,* etc.

In natural environment, *Azotobacter* could fix about 50-150 kg of nitrogen per hector. The Nitrogen fixing capability of *Clostridium* is significantly lower than *Azotobacter*; but their nitrogen fixing capability does not get affected in response to soil acidity, alkalinity, salinity or extent of air movement into the soil.

Azospirillum colonizes in root and stem of crops like rice, wheat, jowar, oat etc. They thrive at their best in an environment of low oxygen tension to fix atmospheric nitrogen. *Azospirillum* are most effective biofertilizer in rice field. This is also mentionable that efficiency of these bacteria does not affected by high summer temperature (35-40^{0}C), acidity or salinity etc.

From the study with Jowar and Millet, it was observed that the application of this bacterial culture gave equivalent result to application of 40 kg nitrogen per hectare.

iii) Blue Green Algae and Azolla

The symbiotic association of Anabaena (BGA) and Azolla (free floating water borne fern) produces 40-60 ton organic matter and at the same time they are capable of fixing 100 to 150 kg of atmospheric nitrogen per hectare per year. In our country their use as biofertilizer is yet to be popularized and their location specific and thermo-sensitive cultures are not easily available in the market. Another difficulty in mass production (large scale production or use) of these biofertilizer is that it is very costly.

B) Phosphate solubilizing Microorganisms:

Phosphorus is one of the least mobile elements in soil. In most soils (especially in acid soil), soluble phosphatic fertilizers locked in the soil by reacting with calcium, ferrous and aluminium and converted into insoluble phosphate. Insoluble phosphatic fertilizers (rock phosphate) are naturally unavailable or very slowly available to crops. A group of microorganisms in soil possesses the ability to transform insoluble phosphates and fixed phosphates into soluble and readily available form to plants. These organisms include bacteria species like Pseudomonas and Bacillus (marketable species- *Bacillus farmas* and *Bacillus magentherium*) and fungal species like *Penicilium* & *Aspergillus*. They usually produce organic acids (Malic, citric, acetic, succinic etc.) which lower the soil pH and bring about dissolution of immobile form of soil phosphate. Some of the organic acids may chelate calcium, aluminum, ferrous and magnesium further increasing phosphorus availability. The activity of these organisms increases with presence of soil organic matter. Work with phosphate solubilizing bacteria began in India with the supply of *Phosphobacterin* culture obtained from the former USSR.

In rice, maize, wheat, potato, millet, and other vegetable crops yield increases to 7-50 % with treatment of soil application and seed treatment with phosphate solubilizing bacteria.

C) Potassium accumulating organism:

Potassium is one o the important nutrients for plants. There are a number of microorganisms which can also accumulate potassium and thus help in enhancing soil fertility.

D) Sulphur solubilizing organism:

Sulphur is generally regarded as trace element in majority of crop plants. But this is one of the major elements in oilseed crops, some important vegetables (onion. oat, cauliflower etc.) and in some spices (ginger, garlic etc.) it is important element. Sulphur essential for biochemical synthesis of some important glycosides, pungent compound and disease resistant properties. Deficiency of sulphur in agricultural soil could be corrected using *Azotobacter pasturianam* as boifertilizer.

E) Micorrhiza:

Fungal species like *Aphalospora, Glomous, Jaigospora, Enterophosphora* etc penetrates roots of different crops (most commonly found in Litchi) and form specialized structures like *Vesicles* and *Arbuscles* within the cortex. For this reason they are popularly known as Vesicular Arbuscular Mycorrhiza or VAM. Almost 90% of plants, including the most important agricultural crops, are associated with VAM fungi. VAM –fungi reported to be increase the uptake of water, phosphorous and some other micronutrients like Cu, Zn, Mn or Fe. Besides these, they possess synergistic interaction with beneficial soil microorganisms such as nitrogen fixing and phosphate solubilizing microorganisms. In addition, VAM-fungi reported to supply some growth regulators to plants and protects crop plants from high temperature shock, drought, salinity and prevents different disease and nematode attack.

F) Cellulose decomposing inoculants:

Many soil borne fungal species like *Aspergillus, Penicillium, Tricoderma, Chaetomium* etc. acts as activator in the decomposition process of plant bodies containing cellulose or lignin. Plant bodies rich in cellulose and/or lignin are resistant to microbial decomposition and therefore, takes long time before they could be used as organic source of nutrition. High quality compost could be prepared within a short time by applying the mentioned fungal species into organic waste material collected from farm or community.

Application procedure of biofertilizer:

Generally agriculturally important biofertilizers could be used in three different ways or in combination:

i) **Seed Treatment-** About 200 gm of nitrogen fixing and phosphate solubilizing Biofertilizer formulation specific for the crop in question are mixed with diluted molaces to make a slurry. The seed required for

one bigha mixed with the slurry and dried for one hour in sheddy condition after that the seeds could be applied in the field directly.

ii) **Root application-** Biofertilizers could be applied in root of seedling plants before transplanting to get good result. 200gm of nitrogen fixing and 200gm phosphate solubilizing microorganism inoculants are mixed with 6 liter of water. The plant (seedling) roots are then immersed for 30 minutes.

iii) **Direct soil application-** Biofertilizers specific for the crop in question could be directly applied in agricultural field after mixing with organic manure. Specific strains of 400-500gm of nitrogen fixing and 300 – 400 gm phosphate solubilizing Biofertilizer are mixed with 25-30 kg of organic fertilizer and applied in one bigha of field.

From several research studies, it has been observed that with the application of nitrogen fixing and phosphate solubilizing biofertilizers, 2 – 4 kg of nitrogen and 1.5 – 2 kg phosphate become available to plants. Clearly nutritional elements supplied by the application of biofertilizers are not sufficient for better plant growth and development. Therefore, sufficient quantities of organic and chemical fertilizer should be applied along side biofertilizers; because by principle biofertilizers alone are not any substitute or alternative of chemical fertilizer and it could only be used as the supplementary fertilizer. This is also mentionable that biofertilizer should be applied after mixing with bulky organic manures, as organic compounds are essential for multiplication of microorganism.

Precaution for use of biofertilizer:

i) Biofertilizer containing specific species of microorganisms should be applied for specific crop.

ii) Biofertilizer packet should not be exposed to direct sunlight for long time; the seeds treated with biofertilizers should be kept for 30 minutes in shady place.

iii) For maximum result biofertilizers should always be mixed with bulky organic manures.

iv) Biofertilizer should be used before its expiry date.

v) After treating the seeds with biofertilizers, seeds should not be treated with any kind of chemical fertilizers or pesticides.

vi) Chemical fertilizers or pesticides should not be applied one week before or after application of biofertilizers.

Merits of Biofertilizer use:

i) Biofertilizer provide essential elements like nitrogen, Potash, Phosphorous, Sulphur etc by directly supplying them or transforming them into soluble form; in addition, they also helps plants to uptake several micronutrients.

ii) They supplies some important enzymes, hormones and antibiotics that enhances crop growth and crop yield.

iii) Some biofertilizers protects plants against diseases, nematodes, drought, high temperature shock, high salinity etc.

iv) Biofertilizers are natural product carrying living microorganism derived from rhizosphere. As such no harmful effect on soil fertility is generally discernible.

v) Soil bourn cellulose or lignin decomposing inoculant could produce high quality Compost.

vi) Biofertilizers under optimum condition could enhance the crop yield by 10-20%.

vii) Use of biofertilizers is economical with a high cost: benefit ratio, without risk Generally Biofertilizer required in smaller doses.

viii) Some biofertilizers may acts as biopesticide. For example *Azotobacterin* strain has shown potential to inhibit seed borne pathogen of cereals.

ix) Besides their effect on current crop, use of Biofertilizer also leaves considerable beneficial residual effect on soil fertility.

Address of Organisations that provides Biofertilizers Inoculants:

i) Nodule Research Laboratory, Bidhan Chandra Krishi Viswabidyalaya. Mohonpur, Nadia,

ii) National Laboratory, Agricultural Department, Govt. of West Bengal. 230, AJC Bose Road, Kol-40.

iii) Vivekananda Institute of Biotechnology. Nimpith Ashram, 24 - Pargana (South)

iv) Dept. of Forestry, Govt. of West Bengal. 6A, Raja Subhodh Chandra Mullik Square, Kol-13.

v) Development Research Communication and Service Centre. 58A, Esplanade Road, Kosba, Kol-42.

LIST OF COMMONLY PRODUCED BIO-FERTILIZERS IN INDIA

NAME	CROPS SUITED	BENEFITS USUALLY SEEN	REMARKS
Rhyzobium strains	Legumes like pulses, groundnut, soybean	10-35% yield increase, 50-200 kg N/ha.	Fodders give better results. Leaves residual N in the soil.
Azotobacter	Soil treatment for non-legume crops including dry land crops	10-15% yield increase-adds 20-25 kg N/ha	Also controls certain diseases.
Azospirillum	Non-legumes like maize, barley, oats, sorghum, millet, Sugarcane, rice etc.	10-20% yield increase	Fodders give higher/enriches fodder response. Produces growth promoting substances. It can be applied to legumes as co-inoculant
Phosphate Solubilizers*	Soil application for all crops	5-30% yield increase	Can be mixed with rock phosphate.
Blue-green algae and *Azolla*	Rice/wet lands	20 -30 kg N/ha, *Azolla* can give biomass up to 40-50 tonnes and fix 30-100 kg N/ha	Reduces soil alkalinity, can be used for fishes as feed. They have growth promoting hormonal effects. TNAU has developed high yielding *Azolla* hybrids.
Microhizae (VAM)	Many trees, some crops, and some ornamental plants	30-50% yield increase , enhances uptake of P, Zn, S and Water.	Usually inoculated to seedlings.

LIST OF COMPANIES PRODUCING BIOFERTILIZER WITH THEIR PRODUCTS:

COMPANIES	PRODUCTS
Agro-Biotech Research Centre Ltd.	Rhizobium, *Azospirillum*, *Azotobacter*, Phospho bacteria, Bio-Potash (*Frateuria aurentia*), VAM (V.A Mycorrhizae)
Biotech International Limited	Bioazoto, Biophos, Biopotash, Biospirillum
Biotech Consortium India Limited	BGA Biofertilizer
Jain Irrigation System Ltd	Vermicompost
Bhubani Products	Indian Vermicompost
Barod Feed Concern, Ujjain, Madhya Pradesh	Organic Fertilizers, Natural Fertilizers, Bio Fertilizers, Agricultural Fertilizers, Organic Manure
Sai International Trading Company, Kerala	Organic Fertilizers, Bio Fertilizers
Neem Products, Noida, Uttar Pradesh	Neem Fertilizer
Akshat Farms, Udaipur, Rajasthan	Bio Organic Fertilizer, Compost Fertilizer, Organic Vermicompost, Earthworm Compost, Vermiculture
Total Agri Care Concern Private Limited, Kolkata, West Bengal	Micro-nutrient Fertilizers, Organic Manures, Natural Fertilizers, Organic Fertilizers,
Suriya Farms, Madurai, Tamil Nadu	Vermi Composts, Vermi Culture, Farmyard Manure, Press Mud, Coco Pith
Srinivasa Marine Chemicals, Madurai, T.N.	Seaweed Fertilizer
Associated Alcohols and Beverage Ltd., Bharwaha, M.P.	Organic Fertilizers, Bio Organic Fertilizers, Agriculture Fertilizers, Micronutrient Fertilizers, Organic Manures
Scientific Agriculture Laboratory, Tamil Nadu	Biofertilizer
Ruchi Biochemicals, Mumbai, Maharastra	Biomedical Fertilizers, Organic and Natural Fertilizers
RBM Trade Care Pvt Ltd., Bhavnagar, Gujarat	Natural Fertilizer, Organic Fertilizer, Agricultural Fertilizer
Rays Bio Energy Pvt. Ltd., Raipur, Chattisgarh	Bio Organic Products, Bio Organic Fertilizers, etc.

Paks Agro Division, Mumbai, Maharashtra	Biofertilizers, Organic Manure, Bio-Potash
Padmavati Enterprises, Vadodara, Gujarat	Organic Fertilizers, Liquid Fertilizers, Natural Fertilizers, Agricultural Fertilizers, Organic Farming Fertilizers
Moonak Fertilizers, Moonak, Punjab	Micronutrient Fertilizers, Agricultural Fertilizers
Marygreen Agrotech Private Limited, Chennai	Biofertilizers, Organic Biofertilizers, Biocontrol Agents
Nafed Biofertilizer, Indore	Nafed Rhizobiumz, Nafed Azotobacter, Nafed Acetobacter, Nafed Superphos, Nafed Trichoderma, Nafed Composting Culture

News and Views

- **Eco-friendly biofertilizer technology to usher in another green**

An innovative, eco-friendly technology to convert marine algae into biofertilizers on commercial scale has been developed by the scientists of the Bhavnagar-based Central Salt and Marine Chemicals Research Institute (CSMCRI), with an aim to boost food production. Negotiations are now underway to transfer the technology to the industry, which is interested in the manufacture of biofertilizers in liquid form from a plethora of seaweeds available abundantly from the ocean. With demand for agro-products, produced from organic manure instead of chemical fertilizers, going up in the developed countries of late, and efforts across the globe to boost productivity to meet the demand of the growing population worldwide, search for locating alternative sources of biofertilizer with many advantages was on anvil. With the ocean, containing a variety of marine algae proving as a perennial source, the technology was expected to go a long way as application of the algae-based marine biofertilizer had many advantages over conventional and synthetic fertilizer. There were, however, at present only a handful of firms engaged in manufacturing biofertilizer using sea weed at present. Research proved that the sea-weed provided a very good source of macro and micro-nutrients, vitamins and plant growth regulators such as Cytokinins. Thus biofertilizer in different concentrations could be prepared to benefit agriculture.

(*November, 2006, Bureau Report, ZEE News*)

- **Tribal Farmers: Leaders in Organic Farming**

Gritty land, dry wells and indebted farmers: this is how the tribal area of Udaipur in Dewas district of Madhya Pradesh has been known to the world around. Growing a crop in the fields of this area has been like milking a dead cow. Some who dared to make their lands yield harvest using high-priced fertilisers and seeds and pesticides could not even repay the loans with the resultant harvest and had to sell their lands. The earthworms present in the soil of the area have accomplished the miracle. The tribal farmers used them for preparing vermicompost and thus found the mantra for turning their gritty land into a gold-yielding one. They no longer depend on chemical fertilisers. The earthworm is the only thing they need for lending enough vigour and fertility to their soil. Government officials who toured the area and other people told them about vermicompost. In December 2001, four women were sent to Guna district in Madhya Pradesh for training in preparing the organic fertiliser, on the initiative of Sakharam, Shobharam, Shersingh, Tanubai and Sitabai. A government programme for preparing vermicompost was being run there. On returning home after the training, they were full of enthusiasm and had also brought about ten thousand earthworms with them for taking up their first experiment. For preparing vermicompost, a pit, several feet deep, is dug and earthworms are sprinkled on layers of garbage, soil and dung. In a period of three months, vermin compost is ready for use. Though the process of preparing vermicompost had begun, the concept of organic farming needed to be disseminated among the farmers and the task required that they be organised. For this purpose, a Parivartan Kendra of the organisation has been set up at Bisali village. It has a plant nursery and pit for preparing vermicompost. Its activists have been going to the neighbouring villages for popularising the use of vermicompost and have demonstrated the process of preparing it to the farmers. These efforts have proven to be successful and hundreds of farmers in this area are using the organic fertilisers in their fields. There are some farmers who have not used even a grain of chemical fertilisers for the last two years. One can see numerous vermin compost pits in 30 villages in the area. In villages like Bisali, Jamsindh, Narsinghpura, Sitapuri and Anand Nagar, at least one vermicompost pit can be seen in the fields of each farmer. Bisali alone has 100 such pits.

(September 22, 2006, IBEF News)

FORTHCOMING EVENTS

Events	Date	Place
International Conference on Ecotoxicology and Environmental Safety	12-14 January, 2007	Kolkata, India
International Conference on Coastal Zone Environment and Sustainable Development-Vulnerability, Adaptation and Beyond	12-15 February, 2007	New Delhi, India
Hyderabad Sustainable Development Conference	13-14th January, 2007	Hyderabad, India
Delhi sustainable development summit 2007 (DSDS 2007)	22 to 24th January, 2007	Delhi, India
International Conference on Sustainable Agriculture for Food, Bio-energy and Livelihood Security	14 to 16th February, 2007	Jabalpur, Madhya Pradesh, India
Sixth International Conference on Ecology and Sustainable Development (ECOSUD 2007)	5-7th September, 2007	Coimbra, Portugal

Important Links

http://biofertilizer.com/english.html
http://www.ikisan.com/links/up_riceBiofertilizers.shtml#top
http://www.entireindia.com/YellowPg/YpCatList.asp?s=1159&cnm=Biofertilizers
http://www.glsbiotech.com/products.htm#biofertilizers
http://www.us.erc.org/greenchannel/gc7/innovativebiotechnologicalproductsforagriculture.php www.suvash.com
http://www.kumarbuilders.com/bio.htm,
http://www.calfertilizer.org/
http://www.planthealthcare.com/
http://www.yililai.com/yililai/english/principle.htm

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