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Bio Fertilizer: Sustainable Approaches to Improve Soil Health

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Introduction

Any substance that contains living micro-organisms to enhance the plant nutrition by increasing availability of nutrients in soils or by mobilizing them is known as a bio fertilizer. It colonizes the rhizosphere or plant interior when applied to surface of plant, seed or soil and enhances plant growth by increasing the nutrient supply to the host plant. Bio fertilizers add nutrients through various processes like nitrogen fixation, solubilising phosphorus and enhancing plant growth by synthesizing the growth promoting substances. Bio fertilizers are naturally occurring fertilizers which are inoculants of algae, fungi and bacteria (individually or combined). They help in biological nitrogen fixation of plant. Bio fertilizers also help in building up the micro flora of soil and hence the soil health. They include organic fertilizers such as manure. In organic farming, use of bio fertilizers is suggested to enhance the fertility of soil.

In agriculture, use of synthetic fertilizers lead to deterioration and pollution of soil health. It leads to contamination of water channels. Modern agriculture focuses on use of hybrid seeds and high yielding varieties which respond to chemical fertilizers. This, eventually leads to deprivation of natural soil micro organisms and essential nutrients. Hence, making soil more prone to diseases. Soil ecology has been turned non inhabitable by the use of these synthetic fertilizers for both soil micro flora and micro fauna.

Bio fertilizers include a group of one or more micro-organism species that help in turning nutrients from non-usable to usable forms by various processes, excretion of plant growth promoting substances, cellulose and biodegradation in soil, compost and other factors. These are defined as preparations that contain living or latent cells of micro-organism strains which help plant uptake nutrients by interacting with the rhizosphere through seed or soil application. Bio fertilizers help in accelerating the microbial processes in soil which enhance the availability of nutrients to plants in the form that can be easily taken-up. Using bio

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fertilizers is a major component of integrated nutrient management since they are cost-effective and renewable source of nutrition to plants. Various micro-organisms and their plant interactions are being exploited to produce bio fertilizers.

Types of Bio fertilizers-

1. Bacterial bio fertilizers: live cells of bacteria are used as bio fertilizers. These contain Nif-gene which makes it capable for nitrogen fixation. The bacterial bio fertilizers function under two conditions:
   a) Symbiotic nitrogen fixers- These make an association with plants by forming root nodules. For eg. *Azospirillum spp., Rhozium*.
   b) Free living nitrogen fixers- These do not form association with the crop but fix atmospheric nitrogen by living freely.
   c) foreg. *Azotobacter*, *Klebsiella*.
2. Algal biofertilizers: more than 100 species of blue green algae can fix nitrogen, which is common in paddy fields. BGA can be easily produced.
   a) Blue green algae in association with Azolla.
   b) Anaebena, Nostoc, Ocillatoria.
3. Phosphate solubilizing bacteria : *Psuedomonas, Bacilllusmegaterium.*
4. Fungal biofertilizerm: Vascular arbuscularmycorrhiza.
5. Earthworms

Application Methods of Bio fertilizers

1. **Seed treatment:** It is by far the most common method used for any type of inoculant. Treating the seed with Rhizobium, Azospirillum, Azotobacter along with phosphorus solubilizing bacteria. Seed can be treated with two or more than two bacteria. This treatment has no side-effects. Initially, treat the seed with Azotobacter, Azospirillum or Rhizobium and then coat it with phosphorus solubilizing bacteria.
2. **Root dipping:** This method is used when *Azospirillum* has to be applied with paddy or vegetable crop plants. *Azospirillum* has to be mixed with 5-10 litres of water at one corner in the field and the plants have to kept dipped for a minimum of half an hour prior to sowing.
3. **Soil application:** Phosphate solubilising micro organisms is used for soil application. 2 kilograms of PSM is used per acre. Mix PSM with cow dung and rock phosphate. This

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mixture needs to be kept under shade or ceiling for a night with 50% moisture. This mixture can be used by applying to the soil or while land levelling.

Status of Bio fertilizers:

India is one of the mega-bio diverse countries in the world. It holds 2.5% land area and accounts for 7-8% of the recorded species in the world. Indian soils have less amounts of Carbon and therefore, biodiversity is being affected. Keeping in view the increasing population, the food demand is also increasing. Hence, additional amounts of fertilizers need to be added. Seeing the burden economically and environmental cost of application of these fertilizer, this demand can be met by using biological sources such as bio fertilizers. Bio fertilizer application will not only improve quality but also enhance the nutrient use efficiency. In India, bio fertilizers are of a major use since they are a cheap source of nutrient application, also the farming practices lie in the hands of small farmers.

Recently Introduced Biodertilizers in India:

- *Acetobacterdiazotrophicus*: This is an endophytic Nitrogen fixer in sugarcane.
- K-mobilizer: *Bacillus* and *Fraturia*spp.
- Zn- solubilizer: *Bacillus, Pseudomonas* and *Thiobacillus.*
- EM- effective micro-organisms: It includes a mixture of yeasts, *Lactobacillus* and *Rhodopseudomonas*. Best for faster residue degradation and fixed nutrient solubilization.

Promotion Schemes for Bio fertilizers:

Indian government has been applying the bio fertilizer promotion scheme since 7th five year plan. This includes one national centre (NCOF) and six regional centres (RCOFs). These centres promote the use of bio fertilizer through training, demonstrating and supplying of efficient cultures for bio fertilizer production.

Humans depend on chemical fertilizers so much so that it has increased the number of chemical industries and also hampered with human and environmental health. A shift from chemical to biological fertilizer use will enhance the growth of bio fertilizer industry and this will be ecologically beneficial. Bio fertilizers would play a key role in sustaining the soil health and environment protection for their eco-friendly and cost-effective properties.

Advantages of Bio fertilizers

- These are a renewable source of nutrients.

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- They sustain the soil health.
- Replace use of chemical or synthetic fertilizers.
- Enhance the yield of grain by 10-40%.
- Stabilize C:N ratio and help in decomposing plant residues.
- Improve structure, texture of soil and its water holding capacity.
- No deterioration in plant health, its fertility and growth.
- Enhance growth of crop plants by secretion of growth hormones.
- Help in solubilising and mobilizing nutrients.
- Have no adverse effect on environment, are non-pollutant and cost-effective.

Disadvantages of Bio fertilizers

- A little extra care needs to be given for long-term storage since bio fertilizers are alive.
- Bio fertilizers have an expiry date before which they need to be used.
- Bio fertilizers become less effective if the carrier medium is contaminated or if wrong strain is used.
- If the soil is very hot or very dry, bio fertilizers become less effective.

Precautions

- Bio fertilizers need to stored in a cool and dry place, not in direct contact of sunlight and heat.
- The right combination of bio fertilizers need to used.
- Some bio fertilizers are crop specific so use them in their specified crop. For e.g. *Rhizobium.*
- Bio fertilizers should not be mixed with chemicals.
- Since bio fertilizers come with an expiration date, use them before the date of expiry.
- Apply bio fertilizers only by the method that has been recommended.