

Importance of bio-fertilizers in agriculture

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Liebig in Germany and Lawes in England developed independently the idea of treating phosphate with H_2SO_4 and producing a water soluble phosphate by about 1840. It is known as superphosphate or simply super. Lawes set up a factory at Deptford in 1843 for the production of superphosphate. Possibly this was the first factory to be set for the production of artificial fertilisers on a commercial scale.

Fertilizers are the organic or inorganic materials of natural or synthetic origin which are added to the soil to



supply certain elements essential to growth of plants. The term fertilizer is now commonly restricted to commercial products (Katyayan, 2008).

What is bio-fertilizer?:

A bio-fertilizer is a substance which contains living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant (Vessey, 2003). Bio-fertilizers add nutrients through the natural processes of nitrogen fixation, solubilising phosphorus, and stimulating plant growth through the synthesis of growth-promoting substances. Bio-fertilizers can be expected to reduce the use of chemical fertilizers and pesticides. The microorganisms in bio-fertilizers restore the soil's natural nutrient cycle and build soil organic matter.

Why use bio-fertilizers? : Bio-fertilizers are supposed to



be a safe alternative to chemical fertilizers to minimize the ecological disturbance. Bio-fertilizers are cost effective, eco-friendly and when they are required in bulk can be generated at the farm itself. They increase crop yield upto 10-40% and fix nitrogen upto 40-50 kg. The other plus point is that after using 3-4 years continuously there is no need of application of bio-fertilizers because parental inoculums are sufficient for growth and multiplication. They improve soil texture, pH, and other properties of soil. They produce plant growth promoting substances IAA amino acids, vitamins etc. They have 75% moisture and it could be applied to the field directly. Bio-fertilizers contained 3.5% - 4% nitrogen, 2% - 2.5% phosphorus and 1.5% potassium. In terms of N: P: K, it was found to be superior to farmyard manure and other type of manure (Mukhopadhyay, 2006).

Classification of bio-fertilizers: The bio-fertilizers are classified into four groups on the type of microorganisms as follows:

- *Algal bio-fertilizers:* Example: Azolla, Blue green algae (BGA) etc.
- *Fungal bio-fertilizers:* Example: Mycorrhiza etc.
- *Bacterial bio-fertilizers:* Example: Azospirillum, Azotobacter, Phosphobacteria, Rhizobium, etc.
- *Actinomycetes bio-fertilizers:* Example: Frankia etc.

Types of bio-fertilizers: There are three types of bio-fertilizers which help the plant to grow at different levels of its growth.

Nitrogen bio-fertilizers: This type of bio-fertilizer helps the soil to correct its nitrogen level. Nitrogen is an essential component for plant growth but plants need it in a limited amount. Different soils have different requirements for nitrogen that is why it depends on the cultivated crops that which type of nitrogen bio-fertilizer should be used. Azotobacter is a bio-fertilizer which provides the required amount of nitrogen to the plant from the soil.

Phosphorus bio-fertilizers: Phosphorus is also a limiting factor and plants need it in particular amount. Phosphorus bio-fertilizers help the soil to correct the phosphorus level. As nitrogen bio-fertilizers depend on the cultivating crops, phosphorus bio-fertilizers do not depend on the cultivating crops. Rhizobium is the phosphorus bio-fertilizer.

Compost bio-fertilizers: Compost bio-fertilizers are animals' wastes which are degraded by the bacteria and

used as the best naturally occurring bio-fertilizers. They not only protect the plants from diseases but also help them to grow in a healthy environment.

Application of bio-fertilizers: There are four types of methods for application of bio-fertilizers:

- Seed treatment
- Set treatment
- Seedling treatment
- Soil treatment

Seed treatment: For inoculation of cereals like rice, wheat, sorghum, maize etc. and oilseeds like groundnut, sunflower, mustard, safflower, pulses like cowpea, green gram, black gram, and soybean etc., seed treatment of bio-fertilizer is recommended. One packet (200g) is sufficient to treat 10-12 kg seed. On this basis the dose of bio-fertilizer per acre can be worked out, based on the seed rate.

Method:

- Keep the seeds required for sowing one acre in a heap on a clean cemented floor or gunny bag.
- Prepare culture suspension by mixing 1 packet (200g) bio-fertilizer in approx. 400 ml water (1:2).
- Sprinkle the culture suspension on the heap of the seeds and mix by hand so that thin coating is uniformly applied to the seeds.
- Spread the seeds under shade for some time for drying and then sown.
- In place of water, rice glue can also be used for better results.

Set treatment : This method is recommended generally for treating the sets of sugarcane, cut pieces of potato and the base of banana suckers.

Method:

- Prepare culture suspension by mixing 1 kg (5 packets) of bio-fertilizer in 40-50 litres of water.
- The cut pieces of planting material required for sowing one acre are kept immersed in the suspension for 30 minutes.
- Bring out the cut pieces and dry them in shade for some time before planting.
- After planting, the field is irrigated within 24 hours.
- For set treatment, the ratio of bio-fertilizer to water is approximately 1:50.

Seedling treatment: This method is recommended for crops like paddy, tobacco, tomato, chilly, onion, cabbage, cauliflower etc.

Method:

- Prepare the suspension by mixing 1 kg (5 packets) bio-fertilizer culture in 10-15 litres of water.
- Get the seedlings required for one acre and make small bundles of seedlings.
- Dip the root portion of these seedlings in this

suspension for 15-30 minutes and transplant immediately.

- Generally, the ratio of inoculants and water is 1:10 (Approx) i.e. 1 kg bio-fertilizer in 10 litres of water.
- For vegetables like chilly, tomato, cabbage, cauliflower, 1 packet of bio-fertilizer is sufficient for 0.1 ha (10000m²) land.

For flower and ornamental plants: These bio-fertilizers can also be used for flowers and ornamental plants like roses, jasmine, chrysanthemum, marigold, dahlias etc. Regarding the method of application, it is generally done by root dip method or by the cutting method.

For root dip method:

Dissolve one packet of bio-fertilizer (200 g) in 2 litres of water which is sufficient to treat 200-300 plants. Similarly, one packet in 2 litres is sufficient to treat 200-300 sets under cutting method.

Soil application : This method varies crop to crop depending on its duration. Generally, for a short duration (less than 6 months) crop, 10-15 packets (each of 200g) are mixed with 40-60 kg of well decomposed cattle manure or with 40-60 kg soil for one acre of land. The mixture of bio-fertilizer and cattle manure/soil sprinkled with water is then broadcasted into soil at the time of sowing or at the time of irrigation in standing crop. For long duration crop (perennial crop) 20-30 packets of bio-fertilizer (each containing 200g) are mixed with 80-120 kg cattle manure or soil per acre.

Application in standing crop : Perennial plants are pruned once in a year. After pruning, the soil in the bed is dug up with a fork with due care to avoid any damage to the roots.

Apply a mixture of bio-fertilizer and FYM/soil by incorporating it into the soil followed by irrigation.

Precautions adopted in using bio-fertilizers:

- No other fertilizers or insecticides/ fungicides should be mixed with seeds that are treated with bio-fertilizer.
- The seed treatment, if required, should be done at least 24 hours before mixing the seeds with bio-fertilizer.
- The bio-fertilizer should not be used with any other fertilizers of insecticides.
- Use of organic manures is essential to get the good results of bio-fertilizer.
- The packet of bio-fertilizers should not be kept in damp place and in bright sun.
- The bio-fertilizer should be used before expiry date (Das, 2009).

Role of bio-fertilizers in agriculture: Some of the important roles of Bio-fertilizers in agriculture are:

- They supplement chemical fertilizers for meeting the integrated nutrient demand of the crops.

- They can add 20-200 kg N/ha year (eg. *Rhizobium* sp 50-100 kg N/ha /year; *Azospirillum*, *Azotobacter* : 20-40 kg N/ha /yr; *Azolla* : 40-80 kg N/ha; BGA :20-30 kg N/ha) under optimum soil conditions and thereby increases 15-25 per cent of total crop yield.
- They can at best minimize the use of chemical fertilizers not exceeding 40-50 kg N/ha under ideal agronomic and pest-free conditions.
- Application of bio-fertilizers results in increased mineral and water uptake, root development, vegetative growth and nitrogen fixation.
- Some bio-fertilizers (eg, *Rhizobium* BGA, *Azotobacter* sp) stimulate production of growth promoting substance like vitamin-B complex, Indole acetic acid (IAA) and Gibberellic acids etc.
- Phosphate mobilizing or phosphorus solubilising bio-fertilizers / microorganisms (bacteria, fungi, mycorrhiza etc.) converts insoluble soil phosphate into soluble forms by secreting several organic acids and under optimum conditions they can solubilise / mobilize about 30-50 kg P₂O₅/ha due to which crop yield may increase by 10 to 20%.
- Mycorrhiza or VA-mycorrhiza (VAM fungi) when used as bio-fertilizers enhance uptake of P, Zn, S and water, leading to uniform crop growth and increased yield and also enhance resistance to root diseases and improve hardiness of transplant stock.
- They liberate growth promoting substances and vitamins and help to maintain soil fertility.
- They act as antagonists and suppress the incidence of soil borne plant pathogens and thus, help in the bio-control of diseases.
- Nitrogen fixing, phosphate mobilizing and cellulolytic microorganisms in bio-fertilizer enhance the availability of plant nutrients in the soil and thus, sustain

the agricultural production and farming system.

- They are cheaper, pollution free and renewable energy sources
- They improve physical properties of soil, soil tilth and soil health in general.
- They improve soil fertility and soil productivity.
- Blue green algae like *Nostoc*, *Anabaena* and *Scytonema* are often employed in the reclamation of alkaline soils.
- Bio-inoculants containing cellulolytic and lignolytic microorganisms enhance the degradation/ decomposition of organic matter in soil, as well as enhance the rate of decomposition in compost pit.
- BGA plays a vital role in the nitrogen economy of rice fields in tropical regions.
- *Azotobacter* inoculants when applied to many non-leguminous crop plants, promote seed germination and initial vigour of plants by producing growth promoting substances.
- *Azolla-Anabaena* grows profusely as a floating plant in the flooded rice fields and can fix 100-150 kg N/ha/year in approximately 40-60 tones of biomass produced,
- Plays important role in the recycling of plant nutrients.

References:

Das, P. C. (2009). Manures and fertilisers. *Kalyani publishers*, p. 85.

Katyayan, A. (2008). Fundamental of agriculture. *Kushal publications and distributors Varanasi*, vol. 1. p. 238.

Mukhopadhyay, S.N. (2006). Eco-friendly products through process biotechnology in the provision of biotechnology economy-Recent advances. Technorama, A. Supplement to IEI News, March.

Vessey, J.K. (2003). Plant growth promoting rhizobacteria as bio-fertilizers. *Plant Soil*, pp. 255, 571-586.

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