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BIO-FERTILIZERS- INCREASING SOIL FERTILITY AND CROP PRODUCTIVITY

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ABSTRACT

Pl. write the abstract & Keywords

Biological soil fertility management is an ecological approach for sustainable crop production. Different soil micro-organisms play an important role in transformation of nutrients for plant use. Some micro-organisms are capable of fixing nitrogen, while some can increase the availability of nitrogen and phosphorus. Bio-fertilizers are the products containing living cells of micro-organisms that have the ability to mobilise the nutrients from non-usable form through biological processes.

Why to explore bio-fertilizers

- Demand is much higher than the availability. It is estimated that by 2020, to achieve the targeted production of 321 million tonnes of food grain, the requirement of nutrient will be 28.8 million tonnes, while their availability will be only 21.6 million tones being a deficit of about 7.2 million tones.
- Depleting feedstock/fossil fuels (energy crisis) and increasing cost of fertilizers. This is becoming unaffordable by small and marginal farmers.
- Depleting soil fertility due to widening gap between nutrient removal and supplies.
- Growing concern about environmental hazards.
- Increasing threat to sustainable agriculture. Besides above facts, the long term use of bio-fertilizers is economical, eco-friendly, more efficient, productive and accessible to marginal and small farmers over chemical fertilizers

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"Bio-fertilizers also known as microbial inoculants have great potential as supplementary, renewable and environmental friendly source of plant nutrients and are an important component of Integrated Plant Nutrient System (IPNS). During the last decade the phenomenal increase in production and use of bio-fertilizers in India is the result of special attention given by the government and interest by entrepreneurs to set up bio-fertilizer production facilities. Farmers have also realized the benefits of the use of bio-fertilizers. For ensuring rapid growth of bio-fertilizers, constant research support is critical to obtain latest information on improvement of production technology, standardization of handling and storage norms and their use in diversified agro climatic conditions.

Why to apply bio-fertilizers

- Plant nutrients are lost from soil in different ways, large quantities are removed from the soil due to the harvest of crops, and weeds also remove a considerable quantity of plant nutrient from soil. Nutrients can also be removed by leaching and erosion. Nitrogen is mostly loosed by volatilization and de-nitrification. To increase production and productivity, maintain soil health, reduce nutrient losses, improve soil environment and minimize energy consumption, it is necessary to use bio-fertilizers with chemical fertilizers. Bio-fertilizers also help in fixing atmospheric nitrogen, dissolve soil phosphorus and stimulate plant growth through synthesis of growth promoting substances.

There are mainly two types of bio-fertilizers:
1. Nitrogen fixing micro-organism (NFM)
2. Phosphorus solubilising micro-organism (PSM)

Rhizobium: Rhizobium bacteria are capable of fixing atmospheric nitrogen in association with leguminous crops. Rhizobium species enter the roots of host plants and form nodules on the root surface. Rhizobium supplies nitrogen to the host plant, nitrogen fixed by the rhizobium is translocated through xylem vessels of the host plant mainly in the form of aspergine and to some extent as glutamine. Rhizobium is a host species and different crops have different rhizobium species given as below:

Rhizobium species	crop
1. *R. leguminosarum*	Pea, lathyrus, lentil
2. *R. tripoli*	Berseem
3. *R. phaseoli*	Kidney bean
4. *R. lupini*	Lupinus
5. *R. japonicum*	Soybean
6. *R. meliloti*	Melilotus, lucerne, fenugreek

Different methods for *rhizobium* application

a. Seed treatment: It is the best method. *Rhizobium* inoculum @ 1.5 kg/ha is mixed with 50-100 g of jaggery solution. This mixture is then sprinkled over the seeds.

b. Soil treatment: *Rhizobium* inoculum is mixed with soil is spread over the field.

c. Soil application

2. *Azolla:* *Azolla* is a free floating fresh water fern. A thick mat of azolla supplies 30-40 kg N/ha. Unlike, BGA it thrives well at low temperature, normal growth of azolla occurs in temperature of 20°-30°C and pH = 5.5-7.0. It may be applied as a green manure crop or as a dual crop.

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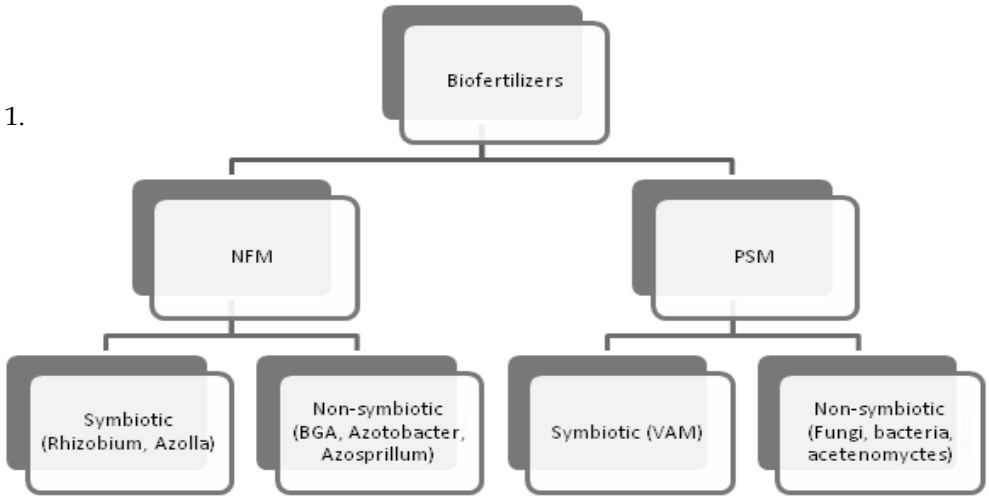

Biofertilizers	Mode of action	Method of treatment	Quantity of inoculums (g/ha)
Rhizobium	Symbiotic N fixation	Seed treatment	600
Azotobacter	Asymbiotic N fixation	Seed treatment	3400
Azospirillum	Asymbiotic N fixation	Seed treatment, soil application	1000,2000
Blue Green Algae	Asymbiotic N fixation	Soil application	1000
Azolla	Asymbiotic N fixation	Soil application	1000
Phosphate Solubilisers	Phosphorus solubilization	Seed treatment	600

3. Blue green algae (BGA) : BGA can fix atmospheric nitrogen. They are also called as cynobacteria and are free living organisms. They are photosynthetic nitrogen fixers which derives their energy from photosynthesis to fix atmospheric nitrogen. The most species of BGA are *Anabena* and *Nostoc*. The amount of nitrogen fixed by BGA ranges from 15-45 kg/ha. It can grow at a temperature range of 25-45°C and pH = 7-8. The BGA can be cultured in small pits and used as inoculum in rice fields @ 12-15 kg/ha.

4. *Azotobacter* and *Azosprillum* : *Azotobacter* is capable of fixing 20-30 kg N/ha. It can be applied by seed inoculation, seedling dip or by soil application. The inoculum required is 3-5 kg/ha. *Azotobacter* can be used for rice, cotton and sugarcane. *Azosprillum* is mainly used for cereal crops and mainly for sorghum.

B. 5. PSB belonging to genera *Pseudomonas* and *Bacillus* and fungi to the genera *Penicillium* and *Aspergillus* have the ability to solubilise the bound phosphate in soil and increase its availability to plant. Inoculation of seed or seedling with microphos bio-fertilizers can provide 30 kg P_2O_5 /ha.

Vasicular Arbicular Mycorrihiza (VAM) helps in phosphorus nutrition by not only increasing its availability but also increasing its mobility. VAM are obligate symbionts and improve the uptake of Zn, Co, P and H_2O. Its large scale application is limited to perennial crops and transplanted crops.

Advantages of Bio-fertilizers

- Increase crop yield by 20-30%.
- Replace chemical nitrogen and phosphorus by 25%.
- Stimulate plant growth.
- Activate the soil biologically.
- Restore natural soil fertility.
- Build up soil fertility in the long term
- Cost effective, i.e. reduces the costs toward fertilizers use especially regarding nitrogen and phosphorus
- Supplement to fertilizers.
- They are eco-friendly and pose no damage to the environment.

Disadvantages of Bio-fertilizers

- Specific to the plants
- *Rhizobium* spp. Culture does not work well in high nitrate tolerant strains of soyabean
- The acceptibility of bio-fertilizers has been rather low chiefly because they do not produce quick and spectacular responses
- Require skill in production and application
- Difficult to store
- Inadequate awareness about its use and benefits.