Nitrogen Fixing and Phosphate Solublizing Bio-Fertilizers

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INTRODUCTION

Appropriate biofertilizers need to be selected for specific crops or, purpose. The general recommendations are:

1. Rizobium for legume crops
2. Azotobacter and Azospirillum for non-legume crops
3. Acetobacter for sugarcane only
4. BGA and Azolla for low land paddy

Nitrogen Fixing Biofertilizer

Nitrogen is one of the major importance nutrients very essential for crop growth. Atmosphere contains about 80 percent of Nitrogen by volume in free state. The major part of the elemental Nitrogen that finds it way in to the soil is entirely due to its fixation by certain specialized group of microorganism, The natural supply of Nitrogen comes from irrigation water, rainfall and atmosphere, which is also utilized by soil micro flora and recycled, to crops during decomposition. Biological Nitrogen Fixation is considered to be an important process, which determines Nitrogen balance in soil ecosystem.

Rhizobium

The Genus has gone under tremendous changes recently and has been divided in to three well- known genera.

1. Rhizobium
2. Brady Rhizobium and
3. Azo Rhizobium.

There are some specific problems of Rhizobium of inoculants. Strains competition and variety strain compatibility are important. Strain competition is well known fact that inoculated strain and soil native strains of Rhizobium compete for nodulation site on host plant roots. For variety strain compatibility, both the parents of the symbiosis should be compatible to each other to form the effective symbiosis. Inoculation may generally increase Nitrogen fixation by 40-60 kg/ha (kumar Rao and Patil, 1976).

Table 1: Fast Growing Rhizobium

Rhizobium species	Rhizobium species
Rhizobium meliloti	Medicago, Melilotus,Trigonella
R.leguminosarum biovar trifoli	Trifolium spp
R.lrusegummnosarum biovar phaseoli	phaseolus sp.
R.legumincsarum biovar viceae	pisum, Lathyrus, Lens.

Table 2. Slow Growing Rhizobium

Rhizobium species	Rhizobium species
Rhizobium species	Genera of Los Legume
Brady Rhizobium japonica	Glycine
Brady Rhizobium sp. (vigna)	Vigna and numerous other genera and species
Brady Rhizobium sp. (lupimus)	Lypinus sp. Lotus pedunculatus

(source: Bergy's manual of determinative Bacteriology)

Azolla

Major limitation in the use of Azolla as biofertilizer is lack of water particularly in the north Indian and temperature sensitiveness of Azolla species. Maintenance of Azolla cultures in ponds during winter is a big problem. High temperature than 40^{O}C is also harmful for the fern. The multiplication of Azolla along with rice crop also suppresses the aquatic weed populations.Besids nitrogen contribution; weed suppression in wetland rice by Azolla is an added economic advantage to the rice growers.

Azospirilum:

Azospirilum is an aerobic, motile helical or, vibroid, gram-negative bacteria. It is found in Rhizosphere of different plants and has been reported to have association with C-4 plants like maize, sugarcane pearl millet etc. this bacterium is microaerophilic in nature and does not have much high potential of nitrogen fixation; however, it produces growth-promoting substances in Rhizosphere. Crops like bajra, jowar, ragi, maize, cotton, forage crops and sugarcane responded favorably to the inoculation of Azospirilum by increasing yield in the range of 5-10%. In the form of nitrogen it contributes about 20-30kg N per ha on inoculation. (Subbarao, N.S., 1973).

Azotobacter:

It is a free-living nitrogen fixer also found in the Rhizosphere of different crops. It is a pleomorphoc, gram-negative bacterium, motile by peritrichous flagella, depend upon the energy derived from the degradation of plant residues. Like Azospirillum, it can also used for all kinds of crops and trees. This organism is poor nitrogen fixer and yield increases are seldom statistically significant. However, Azotobacter is also known for its plant growth promoting and fungicidal activity. Its contribution in terms of nitrogen fixation is about 10-20 kg N ha^{-1}.

Cynobacteria: (BGA):

BGA is suitable nitrogen fixer for paddy fields. Cynobacteria are known to fix about 20-25 kg ha^{-1} year^{-1} and increase rice yield by about 10% (Kannaiyan, 1978). Besides BGA also adds considerable biomass I soil, which in turn liberate organic acids and organic compounds having chelating property so help in converting insoluble form of phosphorus to soluble form. Besides N fixation BGA also produce growth-promoting substances including B-12. They also improve soil structure by binding soil particles and adding organic matter in soil.

Phosphate Mobilizer:

These are some microorganisms that increase the availability of phosphorus to plants. Phosphorus differs fundamentally from nitrogen cycle in the sense that is no natural channel exists for return of large amount of phosphorus losses occurring annually. Hence the supply inevitably shrinking and deposits are limited. In this context the release of insoluble phosphorus in soil and fixed phosphorus in the clay mineral by microbes assumes significance.

Phosphate Solubilizing Bacteria (PSB):

Rock phosphate is a material having variable amount of phosphorus but unavailable to plant as such. There are basic raw material for phosphate fertilizer production. India though has about 100 million tones of rock phosphate deposits yet banning about 16 – 17 %, rest is iow grade and cannot be used for fertilizer production (Subbarao, 1982). Similarly into unavailable by reaction with soil iron or aluminum in acidic and with calcium in alkali soils.

Vesicular – Arbuscular Mycorrhizae Biofertilizer:

Evidence is accumulating to show that indigenous and introduced VAM fungi are involved in the development of different crop production system including plantation crop and transplantable horticultural crops. Phosphate transport by VAM is a key factor in plant nutrition. VAM can absorb several times more phosphate and have greater phosphate inflow rates than roots. The phosphate absorbed by VAM fungi as polyphosphate granules and this represents 16 – 40 % of the total phosphate in VAM fungi.

The VAM fungal population levels and specific composition are highly variable and is influenced by plants characteristics and environment factor viz temperature, soil, pH, moisture and nutrients. Various mechanisms are suggested for increase in 'p' uptake by mycorrhizal plants.These includes:

- Physical exploration of soil
- Faster movement of 'p' into mycorrhizal hyphae, and
- Modification of root environment.

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