

## BIO-FERTILIZERS AND THEIR USE IN AGRICULTURE

For a sustainable agriculture system, it is essential to use renewable inputs (fertilizer, pesticides, water etc.) which can benefit the plant and cause no or minimal damage to the environment. One possible way is to reduce the use of chemical fertilizers and pesticides.

One of the energy efficient and pollution free method is to exploit the ability of certain microorganisms like bacteria, algae and fungi to fix atmospheric nitrogen, solubilize phosphorus, decompose organic material or oxidize sulphur in the soil. When they are applied in the soil, they enhance growth and yield of crops, improve soil fertility and reduces pollution. They are known as “bio fertilizers”.

Thus bio-fertilizers are living or biologically active products or microbial inoculants of bacteria, algae and fungi (separately or in combination) which are able to enrich the soil with nitrogen, phosphorus, organic matter etc.

### 21.5.1 Important bio fertilizers

Following are some of the important types of bio fertilizers which can be considered for agro based industries.

- Rhizobium biofertilizer: Rhizobium is a symbiotic bacteria forming root nodules in legume plants. These nodules act as miniature nitrogen production factories in the fields. The nodule bacteria fix more nitrogen ( $N_2$ ) than needed by legume plant and the bacteria. The surplus fixed nitrogen is then secreted and fertilizes the soil. Rhizobium is more efficient than free living nitrogen-fixing bacteria and can fix upto 200 kg N/ha/yr .

- Azotobacter biofertilizer:

Azotobacter are aerobic free living nitrogen fixers. They grow in the rhizosphere (around the roots) and fix atmospheric nitrogen non-symbiotically and make it available to the particular cereals. These bacteria produce growth promoting hormones which helps in enhancing growth and yield of the plant.

- Azospirillum biofertilizer:

These are aerobic free living nitrogen fixers which live in associative symbiosis. In this type of association bacteria live on the root surface of the host plant and do not form any nodule with roots of grasses. It increases crop yield and its inoculation benefits crop. They also benefit the host plants by supplying growth hormones and vitamins. These bacteria are commonly used for the preparation of commercial inoculants.

- Blue green algae:

Blue green algae (BGA or cyanobacteria) like Nostoc and Anabaena are free living photosynthetic organisms also capable of fixing atmospheric nitrogen. In the flooded rice fields blue green algae serves as a nitrogen biofertilizer .

- Azolla biofertilizers: Azolla is a water fern inside which grows the nitrogen fixing blue green algae Anabaena. It contains 2-3% nitrogen when wet and also produces organic matter in the soil. The Azolla-Anabaena combination type biofertilizer is used all over the world. This can be grown in a cooler regions. But there is a need to develop a strain that can tolerate high temperature, salinity and resistant to pests and diseases.

Production technology is very easy and can be adopted by rice farmers. The only constraint in Azolla is that it is an aquatic plant and water becomes limiting factor in growing it particularly in summer .

- Phosphorus solubilising bio fertilizer:

Phosphorus is an important element required for plant growth. This element is also needed for nodulation by rhizobium.

Some microorganisms are capable of solubilizing immobilized phosphorus making it available to plants for absorption.

- Mycorrhizal fungi acts as biofertilizer are known to occur naturally on roots of forest trees and crop plants. In soils low in available nutrients there is an increased absorption of nutrients by plants infected with Mycorrhiza. The fungus has the ability to dissolve and absorb phosphorus that plant roots can not readily absorb.

A wise way will be to develop an integrated nutrient supply system involving the combination of chemical fertilizers and biofertilizers.