Indian Farmer
Volume 8, Issue 01, 2021, Pp. 116-119.
Available online at: www.indianfarmer.net
ISSN: 2394-1227 (Online)

POPULAR ARTICLE OPEN ACCESS

Bio-fertilizers and their role in Agriculture

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Article Received on: *5 December 2020* ***Published on:*** *1 January 2021*

Bio-fertilizers emerged as a prospective environment friendly inputs essential forproper plant growth. They hold massive potential in meeting plant nutrient requirements while minimizing the use of chemical fertilizers. Bio-fertilizers are defined as material containing livingcells or latent cells of microorganisms with virulent strain which helps the crop plants in uptake of nutrients by their interactions with rhizosphere. They hasten certain microbial processes in the soil which enhance the extent of nutrient availability in easily assimilated form by plants. They help in returning soil health and thus provide a cost effective means to manage crop yield along with balancing the environment.

Bio-fertilizers are low charge, renewable sourcesof plant nutrients which complement chemicalfertilizers in natural means.The beneficial effect of legume crop in refining soil fertility was known since ancient times. The chronology of Bio-fertilizers starts with the launch of 'Nitragin' by Nobbe and Hiltner, a laboratory culture of *Rhizobia* in 1895, shadowed by the discovery of *Azotobacter*and then blue green algae (BGA) and a host of other microorganisms. *Azospirillum*and VesicularArbuscularMicorrhizae (VAM) are fairly recent innovations. In India the primary study on legume *Rhizobium* symbiosis was conducted by N. V. Joshi and the first commercial production started as early as 1956.Bio-fertilizers explored in India arementioned below along with salient features.

Different Types of Bio-fertilizers *Rhizobium:*

Symbiotic nitrogen fixer,belongs to bacterialgroup. It was considered as most effective bio-fertilizer in view of fixing nitrogen to the soil.*Rhizobium*invades in the legume root

and form root nodules where they reduce molecular nitrogen to ammonia which is utilized by the plant to produce valuable proteins, vitamins and other nitrogen containing compounds. It has been estimated that 40-250 kg N/ha/year is fixed by different legume crops by the microbial activities of *Rhizobium.*

***Azotobacter*:**

A significantfree living nitrogen fixing aerobic bacterium used as a Bio-Fertilizer for all non-leguminous plants particularly rice, cotton, vegetables etc. of the several species of *Azotobacter*, *A. chroococcum*happens to be the dominant inhabitant in arable soils. It has its capacity to fix Nitrogen(2-15 mg N_2fixed/g of carbon) in culture media. Low organic matter content in soil is a limiting factor for the proliferation of *Azotobacter*in the soil.

Azospirillum:

Bacterial strain fixes nitrogen in the choiceof 20- 40 kg N/ha in the rhizosphere in non-leguminous plants such as cereals, millets, oilseeds, cotton etc. The organism booms both anaerobic and aerobic conditions. It fails in the formation of root nodules and live inside plant roots. Stimulation ofgrowth promoting substance (IAA), disease resistance and drought tolerance were carried by *Azospirillum.*

Cyanobacteria:

A free-living as well as symbiotic blue green algaeand described by a group of one-celled to many-celled aquatic organisms. These can be brown, purple or red in colour, found in wet and marshy conditions, exclusively used for rice cultivation and do not survive in acidic condition.

Azolla:

Azolla, a free-floating water fern fixes atmospheric nitrogen in association with nitrogen fixing blue green algae*Anabaena azollae*. It is used as biofertilizer for wetland rice and it subsidize 40-60 kg N/ha per rice crop.*Azolla*has been used as a sustainable feed substitute for livestock especially dairy cattle, poultry, piggery and fish.

Phosphate solubilizing microorganisms (PSM):

Pseudomonas,Bacillus, Aspergillus sp. secretes organic acidand reduces the soil pH in their vicinity to bring about dissolution of bound phosphates in soil.

AM fungi:

An ArbuscularMycorrhiza (AM fungi) is a type of mycorrhiza in which the fungus penetrates the cortical cells of the roots of vascular plant.

Silicate solubilizing bacteria (SSB):

Throughthe metabolism of microbes several organic acids are produced and they act dual role in silicate weathering. They supply H^+ions to the medium and promote hydrolysis,organic acids like citric, oxalic acid, Ketoacids andhydroxy carboxylic acids which from complexes with cations, promote their removal and retention in the medium in a dissolved state.

Plant Growth Promoting Rhizobacteria (PGPR):

PGPR,group of bacteria colonize roots or rhizosphere soil are referred as biostimulants. They producephytohormonessuch as indole-acetic acid, cytokinins gibberellins and act asethylene inhibitors.

Liquid Biofertilizers:

Biofertilizers such as *Rhizobium, Azospirillum*and Phosphobacteriaare effectivelyemployed for rice, pulses, millets, cotton, sugarcane, vegetable and otherhorticulture crops as liquid formulations. The advantages of Liquid bio-fertilizerover conventional carrierare longer shelf life of 12-24 months, no contamination, no loss of properties due to storage upto 45º c, greater potentials to fight with innate population, high populations can be maintained, easy identification by fermented smell, quality control protocols are standard. Dosages is 10 time less than carrier based powder biofertilizers, high export potential and very high enzymatic activity since contamination is nil.

APPLICATION OF BIOFERTILIZERS

Seed treatment:
The seeds are homogeneouslymixed with slurry of inoculant and then shade dried for 30 minutes. The shade dried seeds are sown within 24 hours. One packet of the inoculant (200 g) is sufficient to treat 10 kg of seeds.

Seedling root dip:
Highly used for transplanted crops. Two packets of the inoculant are mixed in 40 litres of water. The root portion of the seedlings is dipped in the mixture for 5 to 10 minutes and then transplanted.

Main field application:
Four packets of the inoculant are mixed with 20 kg of dried and powdered farm yard manure (FYM) and then broadcasted in the main field just before transplanting.

Set treatment:
This method is recommended generally for treating sugarcaneset. Culture suspension is prepared bymixing 1 kg (5 packets) of bio-fertilizer in 40-50 litres of water and kept immersed in the suspension for 30 minutes. The cut pieces are dried in shade for some time before planting after imbibing of suspension. For set treatment, the ratio of bio-fertilizer to water is approximately1:50.

Mycorrhizae:

The fungi that are probably most abundant in agricultural soils are ArbuscularMycorrhizal (AM) fungi. They account for 5–50% of the biomass of soil microbes. Potential Role of AM fungi in Agriculture are as follows:

Improved nutrient uptake (macro and micronutrients):

It is reported that the AM- fungi increases the uptake of P, K and efficiency of micronutrients like Zn, Cu, Fe etc. By secreting the enzymes, organic acids which

chelates fixed macro and micronutrients into mobile nutrient. Better water relation and drought tolerance: AM fungi play an important role in the water economy of plants. Their association improves the hydraulic conductivity of water into root at lower soil water potentials and this improvement is one of the factors contributing towards better uptake of water and nutrients by plants.

Soil structure (A soil physical property):

Mycorrhizal fungi contribute to soil structure by growth of external hyphae into the soil to create a skeletal structure that holds soil particles together, creation of conditions by external hyphae that are conducive for the formation of micro-aggregates, enmeshment of micro aggregates to form macro aggregates and directly tapping carbon resources of the plant to the soils.

Enhanced phytohormone activity:

Theactivity of phytohormones like cytokinin and indole acetic acid is significantly higher in plants inoculated with AM. Higher hormone production results in better growth and development of the plant.

CONCLUSION

Application of organic manures particularly biofertilizers is the only option to improve the soil organic carbon for sustainance of soil quality and future agricultural productivity (Ramesh 2008). Biofertilizer have an important role to play in improving nutrient supplies and their crop availability in the years to come. They are of environment friendly non-bulky and low cost agricultural inputs. A biofertilizer is an organic product containing a specific micro-organism in concentrated form which is derived either from the plant roots or from the soil of root zone *(Rhizozsphere).*Among the biofertilizers*Azotobacter, Azospirillum, Acetobacter*are the important for nitrogen fixation, *Bacillus* sp. And *Aspergillus* sp. are important for phosphate solubilisation and other soil mineral nutrients.

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