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Role Of Biofertilizer In Sustainable Agriculture

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Absract

It has become important for us to increase the productivity of plants because of the ever increase in demand of agricultural produce by using various fertilizers, insecticides and pesticides. All the same the tremendous use of these products results in the soil becoming depleted of the essential minerals. So, it has become important to explore ways to overcome this problem. Use of biofertilizers is one such method that can help improve the health of the soil. The green revolution brought impressive gains in food production but with insufficient concern for sustainability. The Government of India has been trying to promote an improved practice involving use of bio- fertilizers along with other fertilizers. These inputs have multiple beneficial impacts on the soil and can be relatively cheap and convenient for use. Biofertilizers make nutrients that are naturally abundant in soil or atmosphere usable for plants.

Keywords: Bio-fertilizer, microorganisms, *Rhizobium, Azotobacter, Phosphate solubilizing biofertilizes.*

Introduction

About 100 years ago, Hellriegal and Wilfarth demonstrated clearly that fixation of atmospheric nitrogen takes place in legumes, although earlier in 1980s, Boussingault, a French agriculturist, provided the data to show that legumes are superior to cereals in furnishing the nitrogen to plant. Bio-fertilizers, in strict sense, are not fertilizers, which directly give nutrition to crop plants. These are cultures of microorganisms like bacteria, fungi, packed in a carrier material. Thus, the critical input in biofertilizer is the microorganisms. They help the plants indirectly through better Nitrogen (N) fixation or improving the nutrient availability in the soil. The term "Biofertilizer" or more appropriately

"Microbial inoculants" can generally be defined as preparation containing live or latent cells of efficient strains of Nitrogen fixing, Phosphate solublising or cellulolytic microorganisms used for application to seeds, soil or composting areas with the objective of increasing the number of such microorganisms and accelerate those microbial process which augment the availability of nutrients that can be easily assimilated by plants. In other words, "Biofertilizer 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). This definition separates biofertilizer from organic fertilizer.

Literature Review

For optimum plant growth, nutrients must be available in sufficient and balanced quantities (Chen, 2006). Excessive and inappropriate use of agrochemicals has undeniably resultedin negative and sometimes irreparable effects on the environment and on human health. Degraded soils and groundwater pollution caused by chemical leaching have resulted in nutritionally imbalanced and unproductive lands. The growth in agricultural production during the last three decades has been accompanied by a sharp increase in the use of chemical fertilisers, causing serious concern (Marothia, 1997). Foremost among these concerns is the effect of excessive fertiliser (especially nitrogenous fertilisers) on the quality of soil and ground water. Soil fertility can be restored effectively through adopting the concept of integrated soil fertility management (ISFM) encompassing a strategy for nutrient management-based on natural resource conservation, biological nitrogen fixation (BNF) and increased efficiency of the inputs (Vlek and Vielhauer, 1994).

Biofertilizers are products containing living cells of different types of microorganisms which when, applied to seed, plant surface or soil, colonize the rhizosphere or the interior of the plant and promotes growth by converting nutritionally important elements (nitrogen, phosphorus) from unavailable to available form through biological process such as nitrogen fixation and solubilization of rock phosphate (Rokhzadi*et al*., 2008). Beneficial microorganisms in biofertilizers accelerate and improve plant growth and protect plants from pests and diseases (El-yazeid*et al*., 2007). The role of soil microorganisms in sustainable development of agriculture has been reviewed (Lee and Pankhurst, 1992; Wani*et al*., 1995).

Biofertilizers are usually prepared as carrier-based inoculants containing effective microorganisms. Incorporation of microorganisms in carrier material enables easy-handling, long-term storage and high effectiveness of biofertilizers. Among various types of biofertilizers, bacterial inoculant is one major group which includes rhizobia, nitrogen-fixing rhizobacteria, plant growth-promoting rhizobacteria, phosphate-solubilizing bacteria, and so on.

Basically, the carrier-based inoculant of these bacteria can be prepared by a common procedure. Most of the bacteria included in biofertilizer have close relationship with plant roots. *Rhizobium* has symbiotic interaction with legume roots, and rhizobacteria inhabit on root surface or in rhizosphere soil. To achieve the successful inoculation of *Rhizobium* or rhizobacteria, large population of the bacterial strain must be placed close to the emerging root, so that the majority of nodules are formed by the inoculated rhizobial strain, and that the inoculated rhizobacterial strain occupies the rhizosphere as major member of rhizobacteria. If the population is not large enough, the native rhizobia / rhizobacteria will occupy most of the root nodules / rhizosphere, leading to unsatisfactory effect of inoculation.

The most common way of inoculation is "seed inoculation", in which the inoculant (bacteria-carrier mixture) is mixed with water to make slurry-form, and then mixed with seeds. In this case, the carrier must be a form of fine powder. To achieve the tight coating of inoculant on seed surface, use of adhesive, such as gum arabic, methylethylcellulose, sucrose solutions, and vegetable oils, is recommended. Any locally available sticky material, which is non-toxic to bacteria and seeds, can be used as adhesive. Seed inoculation may not always be successful, i.e. the inoculation resulted in low nodule In India the first study on legume.

Rhizobium symbiosis was conducted by N.V.Joshi and the first commercial production started as early as 1956. However, the Ministry of Agriculture under the Ninth Plan initiated the real effort to popularize and promote the input with the setting up of the National Project on Development and Use of Biofertilizers (NPDB). Commonly explored biofertilizers in India are mentioned below along with some salient features.

Rhyzobium (RHZ): These inoculants are known for their ability to fix atmospheric nitrogen in symbiotic association with plants forming nodules in roots. RHZ are however limited by their specificity and only certain legumes are benefited from this symbiosis. *Rhizobium* multiplication in carrier in ambient temperature up to 90 days. Carrier sterilization contributed significant increase in grain yield, nodule number and nitrogen content. It can be stored in a dry state without losing much viability.

Azotobacter (AZT): This has been found beneficial to a wide array of crops covering cereals, millets, vegetables, cotton and sugarcane. It is free living and non-symbiotic nitrogen fixing organism that also produces certain substances good for the growth of plants and antibodies that suppress many root pathogens. *Azospirillum (AZS):* This is also a nitrogen-fixing micro organism beneficial for non-leguminous plants. Like AZT, the benefits transcend nitrogen enrichment through production of growth promoting substances.

Blue green Algae (BGA) and Azolla: BGA are photosynthetic nitrogen fixers and are free living. They are found in abundance in India i. They too add growth-promoting substances including vitamin B12, improve the soil’s aeration and water holding capacity and add to bio mass when decomposed after life cycle. Azolla is an aquatic fern found in small and shallow water bodies and in rice fields. It has symbiotic relation with BGA and can help rice or other crops through dual cropping or green manuring of soil.

Phosphate solubilizing (PSB)/Mobilizingbiofertilizer: Phosphorus, both native in soil and applied in inorganic fertilizers becomes mostly unavailable to crops because of its low levels of mobility and solubility and its tendency to become fixed in soil. The PSB are life forms that can help in improving phosphate uptake of plants in different ways. The PSB also has the potential to make utilization of India's abundant deposits of rock phosphates possible, much of which is not enriched. the use of PSB in agricultural practice would not only offset the high cost of manufacturing phosphate fertilizers but would also mobilize insoluble in the fertilizers and soils to which they are applied (Chang and Yang, 2009; Banerjee *et al*., 2010).

Mycorrhiza inoculums are the biofertilizer that is increasingly being utilized and accepted in agriculture industry of Malaysia. Large scale productions of biofertilizer are produced mainly for supplying nutrient, amelioration of toxic effect in soils, root pest and disease control, improved water usage and soil fertility (Abdul Halim, 2009). While *Rhizobium*, Blue Green Algae (BGA) and *Azolla*are crop specific, bio-inoculants like *Azotobacter,Azospirillum,* Phosphorus Solubilizing Bacteria (PSB), VesicularArbuscularMycorrhiza (VAM) could be regarded as broad spectrum biofertilizers (Gupta, 2004).

The phospho-microorganism mainly bacteria and fungi make insoluble phosphorus available to the plants (Gupta, 2004). Several soil bacteria and a few species of fungi possess the ability to bring insoluble phosphate in soil into soluble forms by secreting organic acids (Gupta,2004). These acids lower the soil pH and bring about the dissolution of bound forms of phosphate.

As biofertilizers contain living organisms, their performance, therefore, depends on surrounding environment. Hence, outcomes are bound to be inconsistent (Rahim, 2002). Government research institute, the Malaysian Rubber Board (MRB) had been conducting research on *Rhizobium* inoculums for leguminous cover crops in the inter rows of young rubber trees in the large plantations. Besides, University Putra Malaysia (UPM) also has conducted many researches since 1980's on *Mycorrhiza*and initiated the research to evaluatethe contribution of nitrogen from *Azospirillum* to oil palm seedlings (Abdul Halim, 2009).

Table-1: Major Biofertilizers and target crops

Biofertilizers	**Target crop**
Rhizobium	Leguminous crops (Pulses, oilseeds, fodder)
Azatobacter	Wheat, rice, vegetables
Azospirillum	rice, sugarcane
Blue green algae (BGA)	Rice
Azolla	Rice
Phosphate solubilising microorganisms (PSMs)	All

The potential of biofertilizers is evidenced by the fact that about 90% of Haryana's soil is deficient in nitrogen, indicating severe nutrient deficiency (Dahiya *et al.*, 1993). Biofertilizers can also reduce the intensity of chemical fertiliser consumption, especially in irrigated areas.

Conclusion

Biofertilizers can provide an economically viable support to small and marginal farmers for realizing the ultimate goal of increasing productivity. Biofertilizers are low cost, effective and renewable source of plant nutrients to supplement chemical fertilizers. In nature, there are a number of useful soil microorganisms that can help plants to absorb nutrients. Their utility can be enhanced with human intervention by selecting efficient organisms, culturing them and adding them to soils directly or through seeds. The cultured microorganisms packed in some

carrier material for easy application in the field are called biofertilizers. Bio-fertilizers are living microorganisms of bacterial, fungal and algae origin. Their mode of action differs and can be applied alone or in combination. Biofertilizers enhance the nutrient availability to crop plants (by processes like fixing atmosphere N or dissolving P present in the soil); and impart better health to plants and soil thereby enhancing crop yields in a moderate way. It is a natural method without any problems like salinity and alkalinity, soil erosion etc.. In the vast areas of low input agriculture and oil seeds production, as also in crops like sugarcane, etc, these products will be of much use to give sustainability to production.

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