Journal of Biofertilizers & Biopesticides

Machiavelli and Khurana, J Biofertil Biopestici 2013, 4:1
DOI: 10.4172/2155-6202.1000e110

Editorial Open Access

# An Inoculating Potential of Phosphate-Solubilising Microbes as Biofertlizers

**Machiavelli* and SM Paul Khurana**

*Amity Institute of Biotechnology (AIB), Amity University Haryana (AUH), Manesar – Gurgaon, India.*

**Abstract**

The microbial inoculants are playing important role in managing phosphorus as the major nutrients sustainability of agro-ecosystems. A broad canvas of biofertilizers that enhance nitrogen and specific to legumes and non legumes along with inoculants that enhance phosphorus nutrition are discussed from several perspectives. The mode of action of these microorganisms within and the transformation of nutrients is elucidated. In the Indian scenario, use of biofertilizers faces various constraints, such as longevity, etc., need to be overcome to achieve substantial fertilizer savings. One of the key issues that still remains is the method of formulation of these biofertilizers.

**Keywords:** Phosphate-solubilising microbes (PSM); Phosphorus; Phosphate; Maturity

As the world's human population continues to increase, the demands placed upon agriculture to supply future food will be one of the biggest challenges facing the agrarian community. In order to meet this challenge, a great deal of effort focusing on the soil biological systems and the agro-ecosystem as a whole is needed. In addition, intensification of agricultural production necessitates the addition of fertilizers not only to increase crop production and improve soil nutrient status, but the use of chemical fertilizers is touching the theoretical maximum use beyond which there will be no further returns for crop yields.

Phosphorous (P) is one of the major nutrients for plant growth. It is second after the nitrogen in mineral nutrients most commonly limiting the growth of crops. Phosphorus is an essential element for plant development and growth making up about 0.2% of plant dry weight. Phosphorus is essential in seed formation and occurs in large quantities in plant seed and fruits. It is required for growth and development of a plant, in many physiological activities such as cell division photosynthesis and development of an effective root system and utilization of carbohydrate, signal transduction, energy transfer, respiration etc. It helps in early maturity of crops; poor availability of this nutrient markedly reduces plant growth, particularly for cereals.

As per recent reports the soils have a high reserve of total phosphorus accounting for about 0.05% of soil content on average; however, only 0.1% of the total phosphorus is available to plants. Plants acquire P from the soil solution as phosphate anions; however, these are extremely reactive and may be immobilized through precipitation with cations such as $Ca^{2+}$, $Mg^{2+}$, $Fe^{3+}$ and $Al^{3+}$ depending on the particular properties of a soil. In these forms, P is highly insoluble and a large portion of soluble inorganic phosphate applied to the soil as chemical fertilizer is immobilized rapidly and becomes unavailable to plants. This is known as chemical fixation of phosphate. Hence, the amount available to plants is usually a small proportion of this total application. So, the unmanaged use of phosphate fertilizers has increased agricultural costs and resulted in a variety of environmental problems. Secondly, the global energy crisis and dwindling resources have increased the cost of chemical fertilizers and this trend is expected to continue. Increasing the level of food production without affecting the cost-benefit ratio is thus a challenging task ahead of scientists worldwide. Every unit of chemical fertilizers getting substituted by biofertilizers adds to sustainability and in the long run reduces the hazardous load of chemicals in the ecosystem.

The soil and agro biologists are looking for an alternative source of phosphate fertilizer to supplement, or to replace in some cases, the chemical fertilizers to ensure competitive yields of crops. So, an alternative to chemical phosphate fertilizers is the exploration of various microbial processes contained in the soil-root interface (rhizosphere) as biofertilizers.

## Biofertilizer: Preparations Containing Beneficial Microorganisms which Enhance Plant Growth

The concept of adding or inoculating Phosphate-solubilizing Microbes (PSM) to agro-ecosystems as providers of soluble (available) phosphorus presents an economically and environmentally promising strategy. In ancient times the use of animal manures to provide phosphorus for plant growth was a common agricultural practice. Organically bound phosphorous enters in the soil during the decay of natural vegetation, dead animals and from animal excretions. At that time the role of micro flora on soil fertility was hardly understood. But now it is well understood that a large fraction of soil microbes can dissolve insoluble inorganic phosphates present in the soil and make them available to the plants. This insoluble P is converted in available/soluble P by the microbes called phosphate-solubilizing microbes. These microbes are present in the rhizosphere of the plant and are capable of solubilizing tri-calcium, aluminum and iron phosphates, as well as rock phosphate, making the phosphorus present in the soil available to plants. In the case of soils low in phosphates, PSM can be added with low-grade rock phosphates, slag & bone meal. PSM also mineralized organic phosphorus, making it available to plants.

The mechanisms of phosphorus solubilization are based on mineralization and solubilization potential microbes for organic and inorganic phosphorus, respectively. This activity is determined by the ability of microbes to release metabolites such as organic acids,

***Corresponding author:** Machiavelli, Amity Institute of Biotechnology (AIB), Amity University Haryana (AUH), India, Tel: +91-9996633376; E-mail: msingh2@ggn.amity.edu

**Received** March 25, 2013; **Accepted** March 26, 2013; **Published** March 27, 2013

**Citation:** Machiavelli, Khurana SMP (2013) An Inoculating Potential of Phosphate-Solubilising Microbes as Biofertlizers. J Biofertil Biopestici 4:e110. doi:10.4172/2155-6202.1000e110

enzymes etc. which through their hydroxyl and carboxyl groups chelate the cation bound to phosphate, the latter being converted to soluble forms. A wide range of microbial P solubilization mechanisms exists in nature and much of the global cycling of soil phosphates is attributed to bacteria and fungi. A high proportion of phosphorus solubilizing microorganisms are concentrated in the rhizospheric soils. Phosphorus solubilizing fungi belong predominantly to the *Aspergillus*, *Penicillium*, *Fusarium* genera and in bacterial genera *Bacillus, Azotobacter, Agrobacteria, Rhizobium, Achromobacteria*, *Enterobacter and Psedomonas* are commonly found in soil.

## Conclusion

Adding these microbes can shorten the period of maturity, improve the quality, increase the soluble phosphorus content, and enhance the populations of phosphate-solubilizing microbes in soil. Therefore, inoculating phosphate-solubilizing microbes in agricultural and animal wastes represents a practical with low cost inputs with high benefits. There is a dire need to popularize this practice with the farming community to reap higher dividends in saving the much needed foreign exchange. A dedicated effort between soil scientists, microbiologists, extension workers and farmers is needed to facilitate microbial inoculants towards sustainability in agriculture.