Review Article: Phosphate solubilizing bacteria (PSB) apply as Biofertilizer

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ABSTRACT

Bio-fertilizer is one of the best and eco-friendly tools in Agriculture. Biofertilizer may play an important role in Agriculture and apply its in replacement of our conventional fertilizers (chemical fertilizer). Farmers use chemical fertilizers and pesticides for agriculture purpose but they are not environment friendly and also disturb the soil ecosystem. It may cause soil and water pollution due to that fertility of soil decrease with long run. So, that Biofertilizer which contain useful microbial diversity which support the plants growths and also impact found on crop production.

Phosphorus is the second most limiting plant nutrient required for better crop yield. Indian soil contains on an average 0.05% Phosphorus which constitutes 0.2%dryweight.Most of the soil Phosphorus pool is not in forms available for plant uptake or the soil might contain insufficient amount of available phosphate to support plant growth. As a result of application of phosphatic fertilizer is therefore essential for optimum crop yield, the main problem concerning phosphatic fertilizer is that its fixation with soil.

Keywords: PSB (Phosphate solubilizing bacteria), growth hormones, Pesticides tolerance isolates, plants growth promoter bacteria

Phosphorus (P) is a major growth-limiting nutrient, and unlike the case for nitrogen, it is not large atmospheric source that can be made biologically available for root development, stalk and stem strength, flower and seed formation, crop maturity and production, N2-fixation in legumes, crop quality and resistance to plant diseases are the attributes associated with phosphorus nutrition. However, a greater part of soil phosphorous, approximately 95-99% is present in the form of insoluble phosphates and cannot be utilized by the plants, Phosphorus plays an indispensable biochemical role in photosynthesis, respiration, energy storage and transfer, cell division, cell enlargement and several other processes in the living plant. It helps plants to survive winter rigors and also contributes to disease resistance in some plants. P availability is low in soils because of its fixation as insoluble phosphates of iron, aluminum and calcium. Since deficiency of P is the most important chemical factor restricting plant growth, chemical phosphatic fertilizers are widely used to achieve optimum yields. Soluble forms of P fertilizer used are easily precipitated as insoluble forms, this leads to excessive and repeated application of P fertilizer to crop land.

Phosphorus is a plant macronutrient that plays a significant role in plant metabolism, ultimately reflected on crop yields. It is important for the functioning of key enzymes that regulate the metabolic pathways. It is estimated that about 98% of Indian soils contain insufficient amounts of available phosphorus, which is necessary to support maximum plant growth. The uptake of phosphorus by the plant is only a small fraction of what is actually added as phosphate fertilizer.

Hafiza MadehaSadiq (2013) reported that different strains of phosphate-solubilizing bacteria (PSB) were isolated from the rhizosphere of different plants of Lahore District, Pakistan. The objective was to explore the capabilities of PSB and evaluate their efficiency to enhance growth of sugarcane plants under greenhouse condition. The purified isolates were identified as Proteous vulgaris, Klebsiellapneumoniae, Enterobacteraerogenes, Burkholederiacepacia, Citrobacterfreundii, Acinetobacterlwoffii, and Pseudomonas fluorescens, and the identification was based on the characteristic morphological and biochemical behavior. The efficiency of different PSB isolates for phosphate solubilization was evaluated from the zones they formed on agar plates of Pickovaskaya growth medium (PVK) by solubilizing the tricalcium phosphate of the medium. The efficiency of purified PSB was evaluated from pot experiments of two different genetically modified sugarcane varieties (SCMV resistant CAMB-I and CAMB-II) under greenhouse condition for their positive role in plant growth promotion. All the six PSB enhanced the growth rate significantly over that in the non-inoculated control. A significant increase in plant height, number of leaves, root length and dry matter contents was recorded and E. aerogenes and C. freundii were found significantly superior over the rest of the isolates for all the tested parameters. The efficiency gradient of different isolates for CAMB-I and CAMB-II varieties was recorded as C. freundii> K. pneumoniae> E. aerogenes> B. cepacia> A. lwoffii> P. vulgaris and E. aerogenes> C. freundii> A. lwoffii> B. cepacia> P. vulgaris, respectively. The results of this greenhouse evaluation are encouraging and need to be confirmed under field condition in combination with organic and chemical fertilizers.

Supriya Tomer et al (2017) studies that the existence of diversified microbial flora in the rhizosphere of Himalayan Red Kidney Bean (RKB) (Phaseolus vulgaris L.) ,fifteen different temperate and subtropical regions of Western Indian Himalaya (WIH) were explored for the isolation of RKB rhizosphere-associated Phosphorus(P) solubilizing bacteria, Munsyari, Kandakhal and Nainital soils were selected for the isolation of P solubilizers. Among133 isolates, three bacteria viz. LysinibaccilusmacroidesST-30, Pseudomonas palleroniana N-26 and Pseudomonasjessenii MP-1 were selected based on their P solubilization potential. Moreover, in vitro seed germination assay was performed to investigate their effectiveness against four native crops viz. (Cicerarietrinum L.), (Vignaradiata L.),(Pisumsativum L.) and (Zea mays L.). Treated seeds showed significant increase in germination efficiency over their respective controls. The results suggest that Lysinibaccilusmacroides ST-30, strain is a potential plant growth-promoting bacterium for chickpea (Cicerarietrinum L.) and, therefore, could be implemented as a low cost bio-inoculant in hill agriculture system.

ZhiguangLiua,b et al.,(2014) reported that twenty phosphate-solubilizing bacteria (PSB) were isolated from calcareous rhizosphere soils. These bacterial strains were identified by sequence analysis of 16S rRNA genes as bacterial species of Bacillus megaterium (B. aryabhattai), Bacillus subtilis, Pseudomonas aeruginosa, Rhizobium sp., Acinetobacter sp., and Pseudomonas oryzihabitans. Seven of these strains were evaluated with the National Botanical Research Institute's Phosphate (NBRIP) plate culture, NBRIP liquid culture and soil incubation. Results showed that halo zone formation by PSB on NBRIP plates was a good indicator for screening PSB, but not good enough to quantify capability of P solubilization because of poor correlation between sizes of halo zone and water-soluble P (WS-P). The NBRIP liquid medium culture showed four PSB strains lowered medium pH (<4.3)and released WS-P up to 523.69 mg/l with three days incubation and Krome3 strain dissolved 95.3%tricalcium phosphate added after 35 days incubation. Incubation of PSB in a sandy soil showed that PSB increased WS-P, but not Mehlich-3 P. Therefore, each of the three culture practices has its strength and weakness for characterizing PSB. It is advisable to perform all three tests to provide acceptable indication of phosphate-solubilizing ability for PSB.

Sung-Man Woo (2014) reported that Phosphate solubilizing bacteria (PSB) were isolated from the rhizosphere of Chinese cabbage and screened on the basis of their solubilization of inorganic tricalcium phosphate in liquid cultures. Ten strains that had higher solubilization potential were selected, and they also produced indole-3-acetic acid, 1-aminocyclopropane-1-carboxylate (ACC) deaminase, and siderophores. The strains were identified to be members of Pseudomonas, Seed bacterization with PSB strains increased the root elongation and biomass of Chinese cabbage in seedling culture, although they had no effect on phosphorus uptake of plants. The plant growth promotion by PSB in this study could be due to the production of phytohormones or mechanisms other than phosphate solubilization, since they had no effect on P nutrition.

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Deepak Pandey (2018) reported that Phosphorus is important for early shoot and root development, providing energy for plant processes such as ion uptake and transport. Phosphorus is the most important nutrient element (after nitrogen) limiting agricultural production in most regions of the world. Phosphorous is the second major nutrient for the plants, however, it is the least soluble in soil. The total phosphorous in the soil ranges from 0.01 - 0.2 per cent but only a small amount of it is available to the plants. a total of ten different bacterial isolates were obtained from potato rhizosphere soil collected from different locations. Out of these, Enterobactercancerogenus D-m-2, having potential to solubilize insoluble inorganic phosphate was characterized. The strains showed diverse levels of phosphate solubilization activity in liquid broth culture in presence of various carbon and nitrogen sources. Enterobactercancerogenus D-m-2 showed maximum phosphate solubilizing with lactose as carbon source and ammonium oxalate as nitrogen source.

Sonam Sharma (2011) Plants acquire phosphorus from soil solution as phosphate anion. It is the least mobile element in plant and soil contrary to other macronutrients. It precipitates in soil as orthophosphate or is absorbed by Fe and Al oxides through legend exchange. Phosphorus solubilizing bacteria play role in phosphorus nutrition by enhancing its availability to plants through release from inorganic and organic soil P pools by solubilization and mineralization. Principal mechanism in soil for mineral phosphate solubilization is lowering of soil pH by microbial production of organic acids and mineralization of organic P by acid Phosphatase. Use of phosphorus solubilizing bacteria as inoculants increases P uptake. These bacteria also increase prospects of using phosphatic rocks in crop production. Greater efficiency of P solubilizing bacteria has been shown through co-inoculation with other beneficial bacteria and mycorrhiza. This article incorporates the recent developments on microbial P solubilization into classical the subject.

Zhen Wang et al (2017) noticed that Phosphate-solubilizing bacteria (PSB) can promote the dissolution of insoluble phosphorus (P) in soil, enhancing the availability of soluble P. Thus, their application can reduce the consumption of fertilizer and aid in sustainable agricultural development. From the rhizosphere of Chinese cabbage plants grown in Yangling, they isolated a strain of PSB (YL6) with a strong ability to dissolve P and showed that this strain promoted the growth of these plants under field conditions. However, systematic research on the colonization of bacteria in the plant rhizosphere remains deficient. Thus, to further study the effects of PSB on plant growth, in this study, green fluorescent protein (GFP) was used to study the colonization of YL6 on Chinese cabbage roots. GFP expression hadlittle effect on the ability of YL6 to grow and solubilize P. In addition, the GFP-expressing strain stably colonized the Chinese cabbage rhizosphere (the number of colonizing bacteria in the rhizosphere soil was 4.9 lg CFU/g). Using fluorescence microscopy, observed a high abundance of YL6-GFP bacteria at the Chinese cabbage root capand meristematic zone, as well as in the root hairs and hypocotyl epidermal cells. High quantities of GFP-expressing bacteria were recovered from Chinese cabbage plants during different planting periods for further observation, indicating that YL6-GFP had the ability to endogenously colonize the plants. This study has laid a solid and significant foundation for further research on how PSB affects the physiological processes in Chinese cabbage to promote plant growth.

CONCLUSION

Biofertilizer is part and concept of organic farming in Modern Agricultural culture science. Organic farming is important for globally requirement with the view of the growing demand for safe and healthy food with long term sustainability. Its Concerns on environmental pollution associated with excessive use of agrochemicals (chemical fertilizer and pesticides).Biofertilizer containing live or latent cells of nitrogen fixing, phosphate solubilizing or cellulolytic micro-organisms .its directly Apply on seed, soil or composting areas with the objective of increasing number of such micro-organisms which accelerate the availability of nutrients that can be easily assimilated by plants.

Phosphorus is vital to seed formation and its content is higher in seeds than in any other part of the plant. It helps plants to survive winter rigors and also contributes to disease resistance in some plants. Improve quality of many fruits, vegetables and grain crops. The inoculation of P-solubilizing microorganisms is a promising technique because it can increase P availability in soils fertilized with rock phosphates. Phosphate solubilizing bacteria can help plant growth directly or indirectly.

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