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Review on Use of Phosphate solubilizing fungi as biofertilizer for Chikpea production

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ABSTRACT

Phosphate solubilizing microorganism plays an important role in the plant nutrition through increase in P uptake by the plants and their use as plant growth supporter, is an important contribution to biofertilization of agricultural crops. The use of efficient PSM (phosphate-solubilizing microorganisms), opens up a new option for better crop productivity and for better yield performance without affecting the soil health. Phosphorous is one of the most abundant metallic element found in the earth's crust and present in soils in both organic and inorganic forms. Though it is present in high concentration, only 0.1% of the total P is available to plant because of poor solubility and its fixation in soil with other metallic elements in the soil such as Ca, Al, Fe to form calcium phosphate, aluminum phosphate and ferrous phosphate and thus becomes unavailable to plants. Execusaive use of chemical based P fertilizers has long term impact on the environment in terms of eutrophication, soil and fertility reduction.

Keywords: *Aspergillus, Penicillium , Phosphate solubilizing fungi & Solubilization*

Many researchers reported the positive effects of phosphate solubilizing fungi on the growth of various plants. [1] was expalin the growth of maize (*Zea mays*) plant were significantly enhanced by *Aspergillus tubingensis* and *A. niger* in nursery condition. [2] was arrangement of pot experiment of soyabean plant. *A.niger* and *P. italicium* significantly improved dry matter, yield of plant, percentage of protein and oil. [3] reported that the dual inoculation of *Aspergillus niger* and *P. notatum* was significantly improved dry matter, yield of groundnut plant, percentage of protein, nitrogen, phosphors and oil content in pot experiment. [4] investigated the enhancement of the growth and mineral nutrition of lettuce plants by *Penicillium albidium*. [5] reported the effect of phosphate solubilizing fungi (*Penicillium bilaji and Penicillium* sp.) and phosphorus levels on growth, yield and nutrient content in maize. They explained significantly influenced plant height, number of leaves per plant, dry matter production, cob length, grain weight per cob, grain yield and tissue nutrient content. Effect of phosphate solubilizing fungi on the soil nutrient status and yield of mungbean (*Vigna radiate* L) crop was reported by [6].

[7] seperated *Penicillium menonorum* from rhizosphere soil in Korea, and found that this organism support the growth of cucumber. Inoculation with the isolate were significant enhanced the dry biomass of cucumber roots and shoots. Chlorophyll, starch, protein, and P contents were also increased. [8] exposed increased in P uptake and growth of wheat and field bean plants due to inoculation with P solubilizing *Penicillium bilaji* strain. [9] explained the effect of *Aspergillus niger* strain BHUASO1, *Penicillium citrinum* strain BHUPCO1 and *Trichoderma harzianum* on the chickpea growth parameters and reported that coinoculation of *T. harzianum* and *A. niger* could be effective biofertilizer and biocontroling agent for chickpea production.

[10] Babana and Antoun (2006) demonstrated the effect of inoculation of Tilemsi phosphate rock (TPR) solubilizing microorganisms isolated from Malian soils and with a commercial isolate *Glomus intraradices* [arbuscular mycorrhizal (AM) fungus] on growth, yield, P concentration of the cultivar tetra of wheat and AM root length colonization under field conditions in Mali. Experiment was conducted in Koygour (Dire') during 2000-2001 cropping the seasonyea. In this study, two fungal strains *Aspergillus awamori* (C1) and *Penicillium chrysogenum* (C13) and an isolate of *Pseudomonas* sp. (BR2) were used alone or in fungus-bacterium combinations in the presence or absence of AM fungus. TPR or diammonium phosphate (DAP) was used as source of fertilizer. Wheat plant harvested after 45 days of inoculation showed highest root length AM colonization (62%) with TPR + AM fungus + BR2. Combination of TPR, AM fungus, BR2 and C1 produced the best grain yield with the highest P concentration. [11] recorded the maximum growth and yield of wheat in plants supplied with phosphorus source in combination with farmyard manure and phosphate solubilizing bacteria (*Pseudomonas striata*) in a field experiment conducted at Bilaspur, Chhattisgarh.

[12] demonstrated significant increase in dry matter, protein, oil, percentage of nitrogen and phosphorus and yield of groundnut plants in pot experiment. [13] studied the enhancement of the growth and mineral nutrition of lettuce plants by *Penicillium albidium*. [14] reported increase in fresh and dry weight of shoot and root, root and shoot length of chickpea inoculated with *Trichoderma* sp. under glasshouse conditions. [14] carried out an experiment to assess the effect of phosphate solubilizing fungi (*Aspergillus awamori* and *Trichoderma viridae*) in phosphocompost preparation along with low grade rock phosphate. A significant enhance in the nutrient value of the compost was observed with the co-inoculation of these fungi. Therefore, this P-solubilizing efficiency of *A. awamori* and *T. viridae* can be exploited for the solubilization of fixed phosphates thus enhancing soil fertility and plant growth. Phosphocompost preparation along with rock phosphate and phosphate solubilizing fungi improved acid and alkaline phosphatases activity compared to ordinary compost. Maximum P content was observed with the co-inoculation followed by single inoculation with *A. awamori*.

[16] isolated phosphate solubilizing bacteria (PSB) from the rhizosphere of rice (*Oryza sativa* L.). They also tested the performances of three most efficient isolates (B1, B2 and B3) in rice alone or in combination of triple super phosphate (TSP-P1) and rock phosphate (RP-P2). A significant increase in plant height and the number of tillers per plant was stated by all PSB isolates when used in combination with TSP whereas; PSB alone did not affect much on plant height and the number of tillers with the exception of B1. The nutrient content in plant were increased by the application of the PSB in combination with TSP, while, the performance of B1 was found to be superior in all aspects to B2 and B3 isolates.

[17] studied the effect of application of phosphate solubilizing fungi with biochar and the compost produced from oil palm tree empty fruit bunches on the growth and yield of maize in ultisol of central Kalimantan. They conducted two experiments; in the first experiment they inoculated four phosphate solubilizing fungi namely *Acremonium* (TB1), *Aspergillus* (TB7), *Hymenella* (TM1) and *Neosartorya* (TM8) isolated from oil palm empty fruit bunches, into biocam media (mixture of biochar and composed prepared from oil palm empty fruit bunches). In the second experiment, the best outcomes from the first experiment were chosen and applied to an ultisol soil planted with maize. The results showed that the isolates *Aspergillus* and *Neosartorya* were best adapted to biocam media. The application of *Neosartorya* on an ultisol soil considerably enhanced the growth and yield of maize, as well as its phosphorus uptake efficiency.

[18] isolated the six phosphate-solubilizing fungi (PSF, two strains of *Aspergillus awamori*, and four of *Penicillium citrinum*) from rhizosphere of various crops, was observed on the growth and seed production of chickpea plants (Cicer arietinum L. cv. GPF2) in pot experiments. Maximum stimulatory effect on chickpea plants growth was observed by inoculation of two *A. awamori* strains. This treatment resulted in 7–12% increase in shoot height, nearly three-fold increase in seed number and two-fold increase in seeds weight as compared to the control (un-inoculated) plants. Inoculation of four strains of *P. citrinum* exhibited lesser stimulatory effect. It showed 7% increase in shoot height, two-fold increase in seed number and 87% increase in seeds weight as compared to the control plants.

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