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Inorganic Phosphate Solubilization by Fungi Isolated from Agriculture Soil

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Summary

Phosphorus is one of the major nutrients, second only to nitrogen in requirement for plants. Microorganisms are involved in a range of process that effect the transformation of soil phosphorus (P) and thus are integral component of the soil 'P' cycle. In the present study fungal strains isolated from agriculture soil, having potential to solubilize insoluble inorganic phosphates were characterized. Two fungal isolates were tested for their phosphate solubilization efficiency in both solid and liquid medium. Isolates were identified as *Aspergillus* sp. and *Penicillium* sp. depending upon their colony morphology and microscopic studies. Phosphate solubilization was related to pH decrease caused by growth of fungus in medium containing glucose as carbon source. The rock phosphate was solubilized upto 61.6% gm biomass in 10 days at 30◦c. Decrease in pH indicates that absence of soluble P in media induces the acid production. Phosphate solubilizing microorganisms convert insoluble phosphates into soluble forms generally through the process of acidification, chelation and exchange reactions. Thus such microorganisms may not only compensate for higher cost of manufacturing fertilizers in industry but also mobilizes the fertilizers added to soil.

Key Words: Rock phosphate, phosphate solubilization, *Aspergillus*, *Penicillium*

Introduction

The phosphorus is essential for the general health and vigour off all plants. Low soil phosphorus availability is a primary constraint to plant growth over much of the earth's surface, principally because phosphorus is commonly bound to soil constituents that make it unavailable to plants. In agricultural systems, low-phosphorus availability has been addressed through the application of concentrated phosphorus fertilizers, but the efficiency of this process is affected by chemical immobilization of phosphorus in soil, depletion of nonrenewable sources of phosphorus ore, and cost of fertilizer processing. Most agricultural soils contain large reserves of phosphorus (P), a considerable part of which accumulates as a consequence of regular applications of P fertilizers. However, a greater part of soil phosphorus, approximately 95–99% is present in the form of insoluble phosphates and hence cannot be utilized by the plants. A greater part of soil phosphorus, approximately 95–99% is present in the form of insoluble phosphates and cannot be utilized by the plants (Vassileva et al., 1998). To increase the availability of phosphorus for plants, large amounts of fertilizer are being applied to soil. But a large proportion of fertilizer phosphorus after application is quickly transformed to the insoluble form (Omar, 1998). Therefore, very little percentage of the applied phosphorus is available to plants, making continuous application necessary (Abd Alla, 1994).

Phosphate solubilizing microorganisms (PSMs) play an important role in supplementing phosphorus to the plants, allowing a sustainable use of phosphate fertilizers. Application of PSMs in the field has been reported to increase crop yield. Several mechanisms like lowering of pH by acid production, ion chelation and exchange reactions in the growth environment have been reported to play a role in phosphate solubilization by PSMs (Abd-Alla, 1994; Whitelaw, 2000). Species of *Aspergillus, Penicillium* and yeast have been widely reported solubilizing various forms of inorganic phosphates (Whitelaw, 2000). Fungi have been reported to possess greater ability to solubilize insoluble phosphate than bacteria (Nahas, 1996). In the present study fungal strains having potential to solubilize insoluble phosphates were isolated. The fungal isolates were checked for the ability to solubilize different insoluble phosphates.

Materials and Methods

Microorganisms

Fungal strains were isolated from the different agriculture field of Sikkim, India after serial dilution of soil solution on Potato Dextrose Agar plates. Isolated, predominant, morphologically distinct colonies were selected, purified by repeated culturing and maintained on PDA slants at 4°C. Isolates were identified by their colony characteristics, spores morphology and microscopic observations. Cultures were grown in Czapek-Dox broth medium containing Rock phosphate as the sole source of Phosphorus. After 10 days of incibation, the amount of phosphorus (as Pi) was estimated both in the culture filtrate and mycelia biomass according to the Vanadomolybdate method of Jeffrey (1970). Formation of a clear halo zone around the fungal growth after 5 days of incubation indicates phosphate solubilizing ability.

Solubilization of phosphorus from rock phosphate

Rock phosphate sample (RP-270) having P_2O_5 content about 10 % was used for the study with selected fungi.

Estimation of phosphorus

Cultures were harvested after different growth periods in order to record the change in pH and concentration of P released in the medium. After centrifugation at 3000-4000 rpm for 20 min, the pH of the culture medium was measured with a pH meter equipped with a glass electrode. Dissolved phosphate concentration in the culture filtrate was determined by vanado-molybdate method.

Results and Discussion

Microorganisms

No extraneous phosphorus is added to the nutrient medium, the fungi use the phosphorus from the rock phosphate or iron ore sample for growth. A part of the phosphorus is released in the medium due to the activities of *Penicillium* species. Differences in their growth (biomass) on rock phosphate were directly proportional to the relative phosphate solubilization capacity of these fungi. The fungal strains were identified as *Aspergillus fumigatus* and *Penicillium* sp. based upon their colony morphology, spore characteristics and microscopic studies and finally from N.C.F.T.,Delhi. Conodiophores of *A. fumigatus* are short, smooth walled and have conical shaped terminal vesicle which support a single row of phialides on the upper two third of the vesicle. Conodial heads are green echinulate columnal and uniseriate. Conodia are produced in basipetal succession forming long chains, globuse, green and rough walled. *Penicillium* sp. show green colour colonies on PDA plates consisting of a dense felt of conidiophores. Microscopically, conodiophores show branching, and phialides produced in groups from branched metulae, giving brush-like appearance. Conodia are globuse, greenish and smooth.

Solubilization of insoluble phosphates

Phosphate solubilization was accompanied by a decrease in the pH of the medium by both the strains. Phosphorus solubilizing microorganisms are reported to dissolve insoluble phosphates by the production of inorganic or organic acids and/or by the decrease of the pH (Whitelaw, 2000). Most of the previous reports state that calcium phosphates are dissolved by acidification.

Therefore, any microorganism that acidifies its external medium will show some level of phosphorus solubilising activity. This finding was in agreement with data obtained earlier reports (Abd Alla, 1994; Whitelaw, 2000; Caravaca,et al 2004; El-Katatny, M.S., 2004 ;khan et al 2007; richa et al 2007 and Wakelin et al 2004.).

References

Abd Alla MH (1994). Phosphatases and the utilization of organic phosphorus by Rhizobium leguminosarum biovar viceae. Lett. Appl. Microbiol. 18 : 294–296.

Caravaca, F., M.M. Alguacil, R. Azcón, G. Diaz and A. Roldan, 2004. Comparing the effectiveness of mycorrhizal inoculation and amendment with sugar beet, rock-phosphate and *Aspergillus niger* to enhance field performance of the leguminous shrub *Dorycnium pentaphyllum* L. Appl. Soil Ecol., 25: 169-180.

El-Katatny, M.S., 2004. Inorganic phosphate solubilization by free or immobilized *Trichoderma harzianum* cells in comparison with some other soil fungi. Egypt. J. Biotechnol., 17: 138-153.

Jeffery P.G.1970 chemical methods of rock analysis vol.36,362-64.

Khan, M.S., A. Zaidi and P.A. W ani, 2007. Role of phosphate-solubilizing microorganisms in sustainable agriculture – A review. Agron. Sustain. Dev. 27: 29-43.

Richa, G., B. Khosla and M. Sudhakara Reddy, 2007. Improvement of maize plant growth by phosphate solubilizing fungi in rock phosphate amended soils. W orld J. Agric. Sci., 3(4): 481-484.

Omar SA (1998). The role of rock-phosphate-solubilizing fungi and vesicular-arbusular-mycorrhiza (VAM) in growth of wheat plants fertilized with rock phosphate. World J. Microbiol. Biotech. 14 : 211–218.

Vassileva M, Vassilev N, Fenice M, Federici F (2001). Immobilized cell technology applied in solubilization of insoluble inorganic (rock) phosphate and P plant acquisition. Bioresource Technol. 79: 263-271.

Wakelin, S.A., R.A. W arren, P.R. Harvey and M.H. Ryder, 2004. Phosphate solubilization by *Penicillium* spp. closely associated with wheat roots. Biology and Fertility of Soils, 40: 36-43.

Whitelaw MA (2000). Growth promotion of plants inoculated with phosphate solubilizing fungi. Edited by Donald L. Sparks. Advances in Agronomy, Academic press 69 : 99-151.