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Phosphate Solubilization Potential of *Penicillium* species Inhabiting the Hilly Terrains of Pachmarhi (India)

KAVITA SHARMA

Department of Botany, Arts and Commerce Girls College, Raipur (India).
E-mail: drktsharma@gmail.com

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ABSTRACT

The importance of Phosphate solubilization by microorganisms is well established in agriculture and dephosphorization of mineral ores. Ten species of *Penicillium* inhabiting the soils of Pachmarhi hills (1108-1287m above msl) have been tested for their capacity of Phosphate solubilization using two samples of rock Phosphate and three of iron ores. The rock phosphate was solubilized upto 61.6% gm biomass in 10 days at 30æ%c and the Phosphorus content of the iron ores was reduced upto 47.6% gm biomass. The fungi *P.restrictum, P.rugulosum , P.citrinum , P.islandicum* and *P.melinii* utilized the solubilized Phosphate for their growth and liberated the Phosphorus in cultural broths. They appeared promising candidates as biofertilizer in agriculture and in metallurgical processing for dephosphorization of iron ore. It was also evidenced that Phosphate solubilization potential of these *Penicillia* was related with their microhabitate where soluble Phosphate is scarcely available.

Key words: Rock Phosphate, *Penicillium* sp, Pachmarhi, Iron ore.

INTRODUCTION

Phosphorus is an essential element classified as a macronutrient because of the relatively large amounts of phosphorus required by plants. Phosphorus is one of the three nutrients generally added to soils in fertilizers. One of the main roles of phosphorus in living organisms is in the transfer of energy. Organic compounds that contain phosphorus are used to transfer energy from one reaction to drive another reaction within cells. The role of Phosphorus in plant growth is an essential nutrient both as apart of several key plant structure compounds, as a catalyst in the conversion of numerous key alchemical reactions in plants. 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.

MATERIAL AND METHODS

Ten species of *Penicillium* inhabiting the soils of Pachmarhi(M.P.) were taken for this study. They were *P. restrictum, P. rugulosum, P. citrinum ,*

P. islandicum, *P. melinii, P. chrysogenum, P. herquie,P. olivicolor, P. spinulosum* and *P. vinaceum.* Cultures were grown in Czapek-Dox broth medium containing Rock phosphate and Iron ore 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). The data has been expressed as % solubilization/gm fungal biomass.

RESULTS AND DISCUSSION

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 fungi *P.restrictum, P.rugulosum , P.citrinum , P.islandicum* and *P.melinii* utilized the solubilized Phosphate for their growth and liberated the Phosphorus in cultural broths. Phosphate solubilizing efficiency of *P.islandicum* was the best (61.2 %, 59.2% and 60.0% respectively) followed by *P. restrictum and P.melinii* / *herquei* with different samples (Table 1). In their study Deshpande *et al.,* (1986) have found that *Aspergillus* sp. were able to dephosphorizing manganese ore upto 39.6 % and 18.4 % respectively. In all the test broth media the final pH was considerably lower. Several similar observations have been recorded by Abd-Alla, M.H., 1994, Caravaca *et al.,* 2004, El-Katatny, M.S., 2004, Khan *et al.,* 2007, Richa *et al.,* 2007 and Wakelin *et al.,* 2004 .From this study, *P.restrictum, P.rugulosum , P.citrinum , P.islandicum* and *P.melinii* get distinguished as the potential fungi for solubilization and dephosphorization of the native phosphates.

Table 1: Growth of Fungi

S. No.	Name of fungi	Lohara rock Phosphate %per-gm biomass	Jhamarkotra Rock phosp. %per-gm biomass	Iron ore A %per-gm biomass	Iron ore B %per-gm biomass	Iron ore C %per-gm biomass
1	*P.chrysogenum*	18.09	0.11	27.7	6.4	4.3
2	*P.citrinum*	28.26	0.28	33.2	0.0	11.8
3	*P.herquei*	28.46	0.42	34.4	35.7	19.1
4	*P.islandicum*	52.94	2.52	61.2	59.2	60.0
5	*P.melinii*	20.82	0.82	39.3	16.6	25.3
6	*P.olivicolor*	34.61	0.50	59.4	34.3	14.4
7	*P.restrictum*	45.45	1.18	59.4	57.6	56.5
8	*P.rugulosum*	31.20	0.80	19.2	20.0	10.7
9	*P.spinulosum*	17.16	0.30	21.3	18.9	19.3
10	*P.vinaceum*	15.56	0.09	35.5	30.3	8.6

CONCLUSION

The tests Penicillia were selected for this study because of the very fact that they inhabited the soils of Pachmarhi hills. It is well known that the hill soils are formed from the original rock formations which mostly contain Phosphorus in native state. Ability of a microorganism which colonizes such habitats must include efficiency in respect of Phosphorus solubilization .It may be concluded that the phosphorus used by fungi for their growth was made available only from the rock phosphate or iron ore which has it in an insoluble form. These fungi exhibited their ability to bring the bound phosphorus into soluble form for their utilization. It can be suggested that *P.islandicum, P.olivicolor and P.restrictum* cvan successfully be exploited further as biofertilizer and for dephosphorization of iron ore in metallurgical processing.

REFERENCES

1. Abd-Alla, M.H., Phosphates and the utilization of organic phosphorus by *R. leguminosarum*biovar *viceae. Letters of Applied Microbiol*., **18**: 294-296 (1994).
2. Caravaca, F., M.M. Alguacil, R. Azcón, G. Diaz and A. Roldan, 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 (2004).
3. Deshpande A and H.F. Daginawala biome **1**(1): 37-41 (1986).
4. El-Katatny, M.S., Inorganic phosphate solubilization by free or immobilized *Trichoderma harzianum* cells in comparison with some other soil fungi. *Egypt. J. Biotechnol*., **17**: 138-153 (2004).
5. Jeffery P.G., Chemical methods of rock analysis. **36**: 362-64 (1970).
6. Khan, M.S., A. Zaidi and P.A. W ani, Role of phosphate-solubilizing microorganisms in sustainable agriculture – *A review. Agron. Sustain. Dev*. **27**: 29-43 (2007).
7. Richa, G., B. Khosla and M. Sudhakara Reddy, Improvement of maize plant growth by phosphate solubilizing fungi in rock phosphate amended soils. *World J. Agric. Sci*., **3**(4): 481-484 (2007).
8. Wakelin, S.A., R.A. W arren, P.R. Harvey and M.H. Ryder, Phosphate solubilization by *Penicillium* spp. closely associated with wheat roots. *Biology and Fertility of Soils*, **40**: 36-43 (2004).