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Possible Phosphate Solubilisation Mechanism and Growth Promotion of Wheat through *Bacillus megaterium* and *Bacillus subtilis*

Zafar Iqbal[1,2], Frank Rasche[2], Maqshoof Ahmad[1], Thomas Hilger[2]

[1] *The Islamia University of Bahawalpur, Department of Soil Science, Pakistan*

[2] *University of Hohenheim, Inst. of Agric. Sci. in the Tropics (Hans-Ruthenberg-Institute), Germany*

Abstract

Phosphorous is the second most limiting mineral nutrient in agriculture. Being an integral part of photosynthesis, DNA, RNA, ATPs and the energy transfer chain, its deficiency causes reduction of growth, yield and most importantly quality of grains in cereals. It is acknowledged that large amounts of P are fixed in soils. Hence, there is need to search for sustainable options to make these fixed P resources accessible for plant uptake. A diverse group of microorganisms has the ability to release P from the fixed pool of soil-borne P. Consequently, the present study was conducted to evaluate the potential phosphate solubilising mechanism adopted by plant-associated bacteria. For this purpose, growth behaviour of four bacterial strains (*Bacillus subtilis* ZE15 and ZR3and *Bacillus megaterium* ZE32 and ZR19) were observed in P amended and unamended Pikovskaya's broth culture. In unamended media, most of the bacterial strains reached at stationary phase at 3rd day after incubation, while they behave differently in P amended media. Inoculation of strains ZE15, ZE32, ZR3 and ZR19 in P amended media has maximum increase up to 47 %, 62 %, 33 % and 31 % in bacterial population over unamended P media, respectively. Strain ZE15 has been recorded for maximum P solubilisation up to 130 μg mL^{-1} *in vitro*. A possible mechanism of P solubilisation might be the secretion of organic acids in P amended media, because a depletion of pH was recorded. Strains ZE32 and ZR3 were able to grow at a wide pH range (~ 3.0 – 10). Maximum phosphate esterase activity (insoluble vs soluble P, e.g. 3.65 and 1.08 nmol g^{-1} dry matter) was recorded for strain ZE15, while maximum ß-D glucosidase activity (insoluble vs soluble P, e.g. 2.81 and 0.81 nmol g^{-1} dry matter) was observed for strain ZE32. The phosphate solubilisation ability of *Bacillus* sp. and increase in soil exoenzyme activities in the rhizosphere supported P uptake through improved solubilisation and mineralisation. The tested strains proved their ability to promote growth and might thus represent candidates for effective biofertilisation in P deficient soils after inclusive assessment under field conditions.

Keywords: *Bacillus* sp., mechanism, mineralisation, phosphate esterase

Contact Address: Zafar Iqbal, The Islamia University of Bahawalpur, Department of Soil Science, 63100 Bahawalpur, Pakistan, e-mail: zaferiqbal31205@gmail.com