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Effectiveness of Commercial Bio-Fertilisers for Improved Phosphorus Acquisition: Use of Rapid Screening Tests

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Abstract

Phosphorus (P) is a limiting nutrient for crops in most tropical soils, though often present abundantly, yet in forms scarcely plant accessible. P-fertilisation may enrich the soil with P, but also cause ecological damage.

Even more worrying is that rock phosphates, mined for fertiliser production, are likely to be exploited within few decades, while the pressure to raise global food production implies an increasing P-fertiliser demand. Thus, interest is growing to use soil and fertiliser P more efficiently. Coherently, various "bio-fertilisers" for a high P-acquisition are increasingly offered worldwide. Many bio-fertilisers contain phosphate-solubilising bacteria like *Bacillus* and *Pseudomonas* spp. for an improved chemical P-availability or phytohormone active algae extracts to stimulate root development for a better spatial P-acquisition. However, insufficient quality standards, inconsistent performance and weak knowledge limit their successful application. Therefore, simple methods to assess their principal effectiveness are required.

In this study a set of rapid bio-tests with *Cucumis sativus* L. and *Triticum aestivum* L. as indicator plants will be implemented to characterise the principal effectiveness of three commercial bio-fertilisers based on *Bacillus amyloliquefaciens* strain FZB42 (RhizoVital®, ABiTEP, Berlin, Germany), *Pseudomonas proradix* (Proradix®, Sourcon-Padena, Tübingen, Germany) or liquid extract from brown algae (Kelpak®, Kelp Products, Simon's Town, South Africa). To assess the influence on germination rate and root elongation, seeds will be sown in rolls of filter paper soaked with suspensions containing $1*10^9$ colony- forming units l^{-1} of the bacterial inoculants respectively 10 ml l^{-1} Kelpak®.

The effect on specific root length [m g^{-1}], root hair length, formation of lateral roots and leaf expansion will be studied in hydroponics supplied with the bio-fertilisers at same concentrations. Qualitative *in-vitro* tests, using agar-media clouded by precipitated calcium, iron or aluminum phosphates, will indicate the P-solubilisation ability of the bacterial strains. The achieved data will be discussed regarding the principal effectiveness of the different used bio-fertilisers to improve the P-nutritional status of crops. The rapid bio-tests will allow a better pre-selection of promising bio-fertiliser preparations for following more expensive pot and field trials.

Keywords: Bio-fertiliser, phosphorus-solubilizing bacteria, algae extracts, phytohormones

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