

Development of a hydroponic test system for rapid screening of plant growth promoting microorganisms

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Plant-growth-promoting microorganisms (PGPMs) have become increasingly important in the agricultural production of many crops. It is envisioned that in the not too distant future, PGPMs will begin to replace the use of chemicals in agriculture, horticulture, silviculture, and environmental cleanup strategies. Nutrient mobilization, stimulation of root growth, enhanced resistance to environmental stress factors are discussed as possible mechanisms of plant growth promotion. The development of rapid screening tests to demonstrate the principle effectiveness of biofertilizers prior to set-up of laborious pot or field experiments is urgently required.

In this study, a hydroponic-test system for rice plant was developed and verified to evaluate the effectiveness of plant growth promoting diazotrophic bacterial strains. Seven putative plant growth promoting diazotrophic bacterial (PGPB) strains (IN003, IN006, IN007, INS008, INS009, INS015, INS018) were tested as parameters based on their biochemical characteristics such as nitrogen fixation, acid and gas production, production of ammonia from urea using germination rate, average root and shoot length, average dry/fresh weight of roots and shoots, number of roots and average coleoptile length. The experiment was designed with three replicates. Hoagland's solution was used as a hydroponic culture. Nitrogen-free broth media was used to grow diazotrophic bacterial strains. Equal volumes of bacterial cultures grown overnight were used as the inoculum. Rice seeds were inoculated for 6 hours before germination by immersing rice seeds in broth cultures and seeds treated with heat killed bacterial strains were used as a control. Seed trays with equal volume of Hoagland's solution were used to grow the germinated rice seeds after inoculation. After 12 days of culture period, germination rate of rice seeds, number of roots, shoot length, root length, dry/fresh weight of shoots, and dry/fresh weight of roots, average length of coleoptile of the rice seedlings were measured. Inoculation of seeds with plant growth promoting bacteria did not show significant increase ($p \leq 0.05$) in the germination rate of rice seeds compared to the control seeds. Strains INS015 and INS018 showed a significant increase ($p \leq 0.05$) in shoot root dry/fresh weights compared to other strains. The highest average shoot length ($0.23 \pm 3.4 \times 10^{-2}$) m was recorded in seeds treated with bacterial stain INS015.

The results of this study indicate that certain plant growth promoting bacterial strains used in this study can promote the growth and vigor of rice seedlings which benefit early seedling development consequently the crop growth and development. Hydroponic test system is an effective and rapid method to study the effect of plant growth promoting bacteria on the growth and vigor of rice seedlings.

Keywords: Biofertilizer, Endophytic diazotrophs, Plant growth promoting bacteria