Effect of phosphate-solubilizing bacteria and oxalic acid on phosphate uptake from different P fractions and growth improvement of aerobic rice using 32P technique

ABSTRACT

Using the isotope dilution 32P technique, a study was conducted to evaluate the P uptake and growth improvement of aerobic rice genotype (M9) inoculated with phosphate-solubilizing bacteria (PSB16, Bacillus sp.) and applied with Christmas Island Phosphate Rock (CIPR), and oxalic acid (OA). An absence of PSB and OA was considered as control treatment. The inoculation of PSB16 strain and OA application produced lower specific activity (12.57 Bq mg P-1) in aerobic rice. The PSB16 and OA were able to release (82.72%) P either from the added CIPR or from the fixed, less available native soil P. Inoculation of PSB16 along with CIPR and OA enhanced P uptake and simultaneously increased P use efficiency (1.12%). A significantly higher photosynthesis rate (9.29 ε mol CO2m-2-s-1) and indoleacetic acid (0.26 mg kg-1) concentration in soil was found in the PSB16, OA and PR applied treatments. The highest amounts of water soluble P, Ca-P, Fe-P and Al-P were found in PSB inoculated samples along with the PR and oxalic acid treatments, whereas higher soluble P from all fractions was found in PSB16 inoculated and PR applied treatments. Among all of the fractions, the concentration of Fe-P was comparatively higher (237.67 mg kg-1) than the other fractions and the P fractions were ranked in the order of Fe-P > Al-P > Ca-P > soluble P. In conclusion, PSB16 and organic acid have the ability to solubilize sparingly soluble phosphatic fertilizer and mobilize different fractions of fixed P from soil to the plant. The continuous supply of soluble P in soil P pool and phytohormone in the root environment increased the P uptake and improved the growth of aerobic rice.

Keyword: Biomass; Enzymes; Indoleacetic acid; Photosynthesis; Solubilization