Assessment of plant growth-promoting rhizobacteria (PGPR) and rhizobia as multi-strain biofertilizer on growth and N2 fixation of rice plant

ABSTRACT

Recently, there has been much interest on the application of PGPR-rhizobia multi-strain biofertilizer to enhance growth and yield of agricultural crops. A glasshouse experiment on rice plants was conducted to quantify the uptake of N derived from N2 fixation by multi-strain inocula consisting of a locally isolated PGPR, UPMB19 (‘Lysinibacillus’ xylanilyticus), and an indigenous rhizobia, UPMR30 (‘Bradyrhizobium japonicum’). 15N isotope dilution technique was used to elucidate the N2-fixing and plant growth-promoting efficiency of the inocula through single and mixed applications. The mixed inocula significantly promoted plant and root growth, tiller numbers, plant dry weight, nutrient accumulations and produced a lower 15N enrichment than uninoculated control that received similar N-fertilizer (33% N). The lower 15N enrichment indicates the occurrence of biological N2 fixation. The proportion of N uptake from atmosphere was estimated at 22%. The single inoculation of UPMB19, UPMR30 and the mixed inocula could fix N up to an extrapolated 43, 56, 63 kg ha-1, respectively, within the 65-day period. The combined inocula consistently performed better than single inoculum (15-30% higher root average diameter, 15% more tillers, 9-13% higher P in tissue, 9-16% higher Ca in tissue, 2-4% higher Mg in soil), on the rice plants, thus providing evidence that this treatment stimulated synergistic activities which enhanced the combined performance and cumulative beneficial effects of the respective strains. These beneficial effects were achieved with a minimal usage of N-fertilizer application. The study revealed a possible new and beneficial biofertilizer formulation to promote growth and yield of rice plants at reduced chemical N-fertilizer input in a sustainable and environmental-friendly agricultural system.

Keyword: Biological N2 fixation; Multi-strain biofertilizer; 15N isotope dilution; Oryza sativa cv. MR219; PGPR; Rhizobia