Effects of Selected Functional Bacteria on Maize Growth and Nutrient Use Efficiency

ABSTRACT

Plant growth-promoting rhizobacteria (PGPR), which include isolates from genera Paraburkholderia, Burkholderia and Serratia, have received attention due to their numerous plant growth-promoting mechanisms such as their ability to solubilize insoluble phosphates and nitrogen-fixation. However, there is a dearth of information on the potential plant growth-promoting effects of these three groups of bacteria on non-legumes such as maize. This study determined the influences of the aforementioned strains on soil properties, maize growth, nutrient uptake and nutrient use efficiency. A pot trial using maize as a test crop was done using a randomized complete block design with 7 treatments each replicated 7 times. The treatments used in this study were: Control (no fertilizer), chemical fertilizer (CF), organic-chemical fertilizers combination without inoculum (OCF) and with inocula consisting of single strains [cellulolytic bacteria (TC), organic fertilizer and chemical fertilizer with N-fixing bacteria (TN), organic fertilizer and chemical fertilizer with P-solubilizing bacteria (TP)) and three-strain inocula (TCNP), respectively. The variables measured included plant growth and nutrient content, soil nutrient content and functional rhizospheric bacterial populations. Paraburkholderia nodosa NB1 and Burkholderia cepacia PB3 showed comparable effects on maize biomass and also improved N and P use efficiencies when compared to full chemical fertilization. Nitrogen-fixing rhizobacteria had a positive effect on above-ground biomass of maize. Paraburkholderia nodosa NB1 improved soil total C and organic matter contents, besides being the only bacterial treatment that improved K use efficiency compared to OCF. The results suggest that P. nodosa NB1 and B. cepacia PB3 have potential usage in bio-fertilizers. In contrast, treatments with Serratia nematodiphila C46d and consortium strains showed poorer maize nutrient uptake and use efficiency than the other single strain treatments. Bacterial treatments generally showed comparable or higher overall N and P use efficiencies than full chemical fertilization. These findings suggest that at least half the amounts of N and P fertilizers could be reduced through the use of combined fertilization together with beneficial bacteria.