Halotolerant microbial consortia for sustainable mitigation of salinity stress, growth promotion, and mineral uptake in tomato plants and soil nutrient enrichment

ABSTRACT

Salinity significantly impacts the growth, development, and reproductive biology of various crops such as vegetables. The cultivable area is reduced due to the accumulation of salts and chemicals currently in use and is not amenable to a large extent to avoid such abiotic stress factors. The addition of microbes enriches the soil without any adverse effects. The effects of microbial consortia comprising Bacillus sp., Delftia sp., Enterobacter sp., Achromobacter sp., was evaluated on the growth and mineral uptake in tomatoes (Solanum Lycopersicum L.) under salt stress and normal soil conditions. Salinity treatments comprising Ec 0, 2, 5, and 8 dS/m were established by mixing soil with seawater until the desired Ec was achieved. The seedlings were transplanted in the pots of the respective pH and were inoculated with microbial consortia. After sufficient growth, these seedlings were transplanted in soil seedling trays. The measurement of soil minerals such as Na, K, Ca, Mg, Cu, Mn, and pH and the Ec were evaluated and compared with the control 0 days, 15 days, and 35 days after inoculation. The results were found to be non-significant for the soil parameters. In the uninoculated seedlings' (control) seedling trays, salt treatment significantly affected leaf, shoot, root dry weight, shoot height, number of secondary roots, chlorophyll, and mineral contents. While bacterized seedlings sown under saline soil significantly increased leaf (105.17%), shoot (105.62%), root (109.06%) dry weight, leaf number (75.68%), shoot length (92.95%), root length (146.14%), secondary roots (91.23%), and chlorophyll content (−61.49%) as compared to the control (without consortia). The Na and K intake were higher even in the presence of the microbes, but the beneficial effect of the microbe helps plants sustain in the saline environment. The inoculation of microbial consortia produced more secondary roots, which accumulate more minerals and transport substances to the different parts of the plant; thus, it produced higher biomass and growth. Results of the present study revealed that the treatment with microbial consortia could alleviate the deleterious effects of salinity stress and improve the growth of tomato plants under salinity stress. Microbial consortia appear to be the best alternative and cost-effective and sustainable approach for managing soil salinity and improving plant growth under salt stress conditions.

Keyword: Microbial consortia; PGPR; Plant biomass; Salinity stress; Tomato