Synergistic interaction of Rhizobium leguminosarum bv. viciae and arbuscular mycorrhizal fungi as a plant growth promoting biofertilizers for faba bean (Vicia faba L.) in alkaline soil

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Abstract:

Egyptian soils are generally characterized by slightly alkaline to alkaline pH values (7.5–8.7) which are mainly due to its dry environment. In arid and semi-arid regions, salts are less concentrated and sodium dominates in carbonate and bicarbonate forms, which enhance the formation of alkaline soils. Alkaline soils have fertility problems due to poor physical properties which adversely affect the growth and the yield of crops. Therefore, this study was devoted to investigating the synergistic interaction of Rhizobium and arbuscular mycorrhizal fungi for improving growth of faba bean grown in alkaline soil. A total of 20 rhizobial isolates and 4 species of arbuscular mycorrhizal fungi (AMF) were isolated. The rhizobial isolates were investigated for their ability to grow under alkaline stress. Out of 20 isolates 3 isolates were selected as tolerant isolates. These 3 rhizobial isolates were identified on the bases of the sequences of the gene encoding 16S rRNA and designated as Rhizobium sp. Egypt 16 (HM622137), Rhizobium sp. Egypt 27 (HM622138) and Rhizobium leguminosarum bv. viciae STDF-Egypt 19 (HM587713). The best alkaline tolerant was R. leguminosarum bv. viciae STDF-Egypt 19 (HM587713). The effect of R. leguminosarum bv. viciae STDF-Egypt 19 and mixture of AMF (Acaulospora laevis, Glomus geosporum, Glomus mosseae and Scutellospora armeniaca) both individually and in combination on nodulation, nitrogen fixation and growth of Vicia faba under alkalinity stress were assessed. A significant increase over control in number and mass of nodules, nitrogenase activity, leghaemoglobin content of nodule, mycorrhizal colonization, dry mass of root and shoot was recorded in dual inoculated plants than plants with individual inoculation. The enhancement of nitrogen fixation of faba bean could be attributed to AMF facilitating the mobilization of certain elements such as P, Fe, K and other minerals that involve in synthesis of nitrogenase and leghaemoglobin. Thus it is clear that the dual inoculation with Rhizobium and AMF biofertilizer is more effective for promoting growth of faba bean grown in alkaline soils than the individual treatment, reflecting the existence of synergistic relationships among the inoculants.

Keywords:

Arbuscular mycorrhizal fungi Alkalinity stress Nodulation Nitrogenase activity Rhizobium Vicia faba

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