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The Interaction Between Arbuscular Mycorrhizal Fungi, *Rhizobium meliloti* and *Bacillus circulans* on *Trigonella foenum-graecum* L. in a Calcareous Soil

AMAL ABOUL-NASR¹, MOHAMED ESSMAT EL-FAYOUMY², ESSAM KOREISH¹, AMAL ABOUL GOUD³

¹Alexandria University, Saba-Bach, Agricultural Microbiology, Egypt

²Soil & Water and Environmental Research Institute, Soil Science, Egypt

³Alexandria University, Soil Science, Egypt

Abstract

Two field experiments were carried out during two winter seasons of 2002–2003 and 2003–2004 at the Farm of Nubaria, Agriculture Research Station, Egypt. *Trigonella* seeds were inoculated with *Rhizobium meliloti*, *Glomus etunicatum* and biological potassium fertilizer (BPF) *Bacillus circulans* as a single inoculant or mixed in the presence of different levels of NPK mineral fertilizers. Nitrogen fertilizer was added at different levels in the case of *Rhizobium* inoculation. Recommended dose for both phosphorus and potassium fertilizers were used. Phosphorus fertilizer was added at different levels in the case of inoculating the seeds with *G. etunicatum*. Nitrogen and potassium fertilizers were applied at the recommended dose (N=240, P=480 and K=240 kg ha⁻¹).

Potassium fertilizer was used at different levels in the case of inoculating the seeds with *B. circulans*. Nitrogen and phosphorus fertilizers were used at the recommended dose.

NPK fertilizers were added at different levels in the case of using mixed inoculation.

The experiments were arranged as split plot design in randomized complete blocks with four replicates. Main plot was mineral fertilizer treatments and subplots were the inoculations. Growth parameters, yield and protein content in *Trigonella* seeds were studied in calcareous soil.

Inoculated plants with *Rhizobium* or *G. etunicatum* increased the yield of *Trigonella* 2–4% above those of the non-inoculated plants in the presence of 75 and 50% of the recommended dose of nitrogen and phosphorus fertilizers, respectively. Mixed inoculation with *Rhizobium*, *Glomus* and *Bacillus* had the highest seed yield (1779 kg ha⁻¹) in the presence of 75% of the mineral NPK fertilizers recommended.

Percentage of protein content in seeds were not significantly increased due to the inoculations.

NPK uptake (kg ha⁻¹) were significantly increased in the presence of mixed inoculations using 75% of the recommended dose. Generally, in case of seeds inoculation with *Rhizobium* or *Bacillus* separately, 25% of mineral fertilizers of N or K were saved, while inoculating seeds with *G. etunicatum* can save 50% of the phosphorus fertilizer. Mixed inoculations can save 25% of the NPK mineral fertilizers.

Keywords: *Bacillus circulans*, calcareous soil, Fenugreek seeds, *Glomus etunicatum*, NPK fertilizers, *Rhizobium meliloti*