

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

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## Introduction

*Trigonella* seeds are widely cultivated in Mediterranean countries. Seeds are rich in protein, carbohydrates, vitamins, alkaloids (*trigonelline*) and free amino acids. *Trigonella* seeds were used for medical purposes such as reduce the blood sugar.

Soil microbial population are immersed in a framework of interaction known to affect plant fitness and soil quality. They are involved in fundamental activities that ensure the stability and production of both agricultural systems and natural ecosystems.

## Materials & Methods

*Trigonella* seeds were inoculated with *Rhizobium meliloti*, *Glomus etunicatum* and biological potassium fertilizer *Bacillus circulans* as single inoculant or mixed in the presence of different levels of NPK mineral fertilizers. Nitrogen fertilizer was added at zero, 25, 50, 75 and 100% of the recommended dose (238 kg ammonium nitrate / ha) in case of inoculated seeds with *Rhizobium*. Recommended dose for both P and K fertilizers were used. Phosphorus fertilizer was added at the rate of zero , 25, 50, 75 and 100% of the recommended dose of P (476 kg mono calcium phosphate / ha) in case of inoculating the seeds with *Glomus etunicatum*. N and K fertilizers were applied at the recommended dose. Potassium fertilizer was used at different levels zero, 25, 50 ,75 and 100 % of the recommended dose of fertilizer ( 238 kg potassium sulphate/ ha) in case of inoculated seeds with *Bacillus circulans*. N and P fertilizers were used at the recommended dose. NPK fertilizers were added at the above levels in case of using mixed inoculations.

The aim of the work was :

To study the effect of microorganisms under the different levels of fertilizers on nodulation, yield, infected root length and NPK uptake on fenugreek plants in calcareous soil.

To determine the suitable quantity of NPK fertilizers in the presence of microorganisms to save money are protect the environment from chemical pollutions .

## Results

### Yield ( kg / ha)

Data in Fig.1 show that inoculated seeds with single microorganism significantly increased the yield more than un-inoculated plants. Mixed biofertilizer inoculations obtained the highest average of *Trigonella* yield in both seasons in the presence of 75 % of the recommended dose of NPK fertilizers.

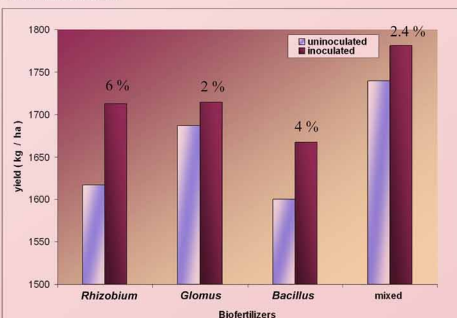


Fig.1. Effect of inoculated *Trigonella* seeds with *Rhizobium meliloti*, *Glomus etunicatum* and *Bacillus circulans* on the average of yield ( kg / ha ) during two seasons in the presence of 75% of the recommended dose of NPK fertilizers

## Number of nodules / plant

The number of nodules per plant was significantly affected with *Rhizobium* and *Glomus* inoculation, but the most pronounced effect was in mixed biofertilizer inoculations in the presence of 75% of the recommended dose of NPK fertilizers ( Fig. 2).

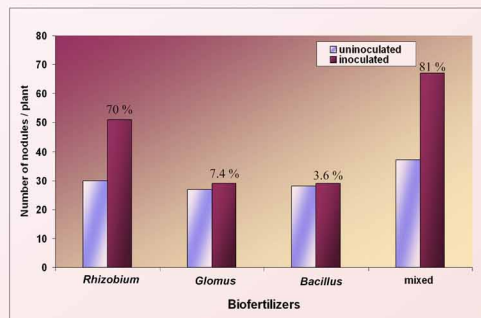


Fig.2. Effect of inoculated *Trigonella* seeds with *Rhizobium meliloti*, *Glomus etunicatum* and *Bacillus circulans* on the average number of nodules per plant during two seasons in the presence of 75% of the recommended dose of NPK fertilizers

## Infected root Length % :

The highest infected root length with *Glomus etunicatum* was in the presence of 25 % of the recommended dose of phosphorus fertilizer (Fig. 3).Whereas the highest infected root length with mixed biofertilizer inoculations was in the presence of 75 % of the recommended dose of NPK fertilizers (Fig.4).

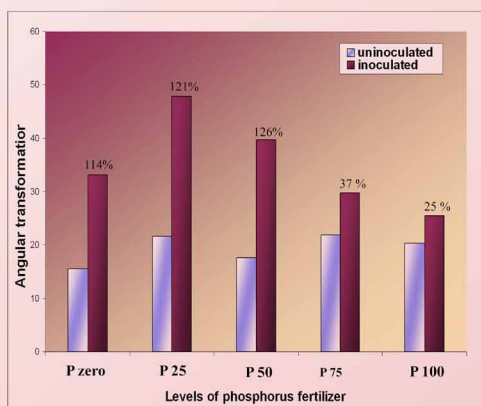


Fig.3. Effect of inoculated *Trigonella* seeds with *Glomus etunicatum* on the infected root length % (angular transformation) in the presence of different levels of phosphorus fertilizer

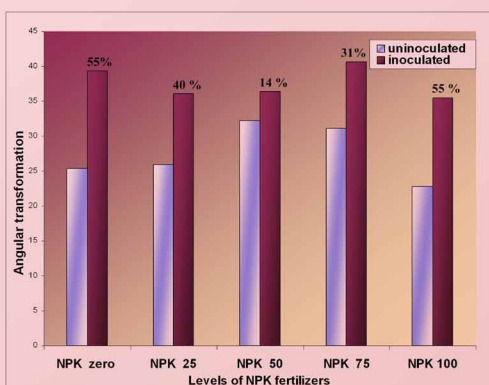


Fig.4. Effect of inoculated *Trigonella* seeds with *Glomus etunicatum*, *Rhizobium meliloti* and *Bacillus circulans* on the infected root length % (angular transformation) in the presence of different levels of NPK fertilizers

## NPK uptake kg / ha

NPK uptake (kg/ ha) was significantly increased due to the inoculation more than the un-inoculated plants in the presence of 75 % of the recommended dose of NPK fertilizers ( Fig 5 , 6 , 7).

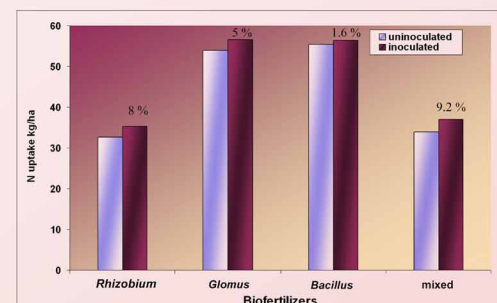


Fig.5. Effect of inoculated *Trigonella* seeds with *Rhizobium meliloti*, *Glomus etunicatum* and *Bacillus circulans* on the average of N uptake ( kg / ha ) during two seasons in the presence of 75% of the recommended dose of NPK fertilizers

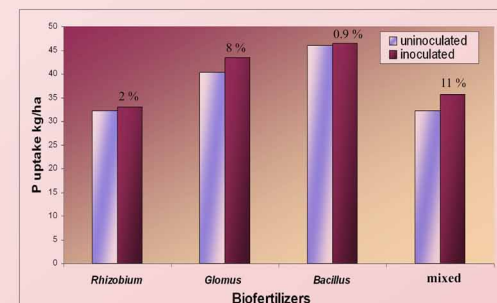


Fig.6. Effect of inoculated *Trigonella* seeds with *Rhizobium meliloti*, *Glomus etunicatum* and *Bacillus circulans* on the average of P uptake ( kg / ha ) during two seasons in the presence of 75% of the recommended dose of NPK fertilizers

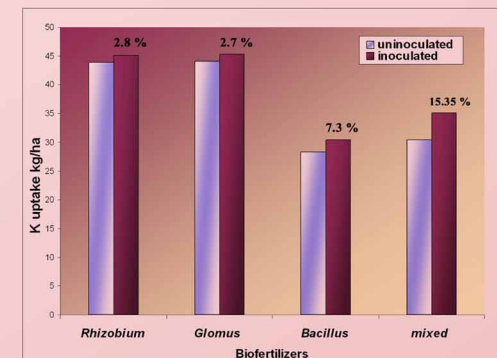


Fig.7. Effect of inoculated *Trigonella* seeds with *Rhizobium meliloti*, *Glomus etunicatum* and *Bacillus circulans* on the average of K uptake ( kg / ha ) during two seasons in the presence of 75% of the recommended dose of NPK fertilizers

## Conclusion

- Mixed inoculations between *Rhizobium meliloti*, *Glomus etunicatum* and *Bacillus circulans* obtained the highest yield of *Trigonella foenum-graecum* in the presence of 75 % of the recommended dose of N,P and K fertilizers .
- Microorganisms interaction appear to be essential to promote plant growth and increase the yield.

## References

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