Arbuscular Mycorrhizae as Biofertilizers for Wheat Crop

Thesis

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5. Summary

This investigation was focused on two different parts including biodiversity of arbuscular mycorrhizal fungi in different wheat fields at Assiut Governorate. The second part focuses on some physiological studies and application of arbuscular mycorrhizal fungi as biofertilizers for wheat plants as well as treatment with different concentrations (25, 50 and 75%) of super phosphate and rock phosphate from recommended rate (200 kg/fed).

Part I:

1. Soil texture of cultivated soils varied from loamy clay, sandy clay and loamy 73.33%, 13.33% and 13.33% of soil samples, respectively.

2. Soils of the fifteen sites were slightly alkaline with pH 7.82 to 8.01. The electrical conductivity values (EC) differed from 0.80 to 2.25 dS m^{-1} which could be considered non-saline soil. On the other hand, the organic matter content (OM) in cultivated soils fluctuated between 0.82 – 3.9 %.

3. The value of total nitrogen content in fifteen sites fluctuated between 50 and 171 mg/kg soil, total phosphorus content ranged from 0.92 to 5.74 mg/kg soil and total potassium content ranged from 49.2 to 250.2 mg/kg soil.

4. Analysis of anions and cations composition showed that Ca^{++} value fluctuated between 1.0-7.4 mg/L, while Mg^{++} value ranged from 0.2-3.0 mg/L g. The value of Na^{+} markedly varied from 3.1 to 10.7 mg/L. Chloride (Cl^{-}) content ranged from 4.6-14.6 mg/L.

Iron contents varied from 9.43 to 25.52 mg/kg soil. The mean value for Zn ranged between 0.67 and 6.54 mg/kg soil.

5. A total of 83 morphotypes of AMF were recovered from 45 soil samples obtained from within 15 sites of wheat fields in Assiut Governorate during the present investigation, of which 51 species of them (61%) were identified to known species, *Glomus* was the dominant genus, followed by *Acaulospora* belonging to the families Claroideoglomeraceae, Glomeraceae, Acaulosporaceae, Diversisporaceae, Gigasporaceae, Pacisporaceae, Ambisporaceae and Paraglomeraceae.

6. With regard to species spectrum, twenty-one were members of *Acaulospora*, twenty-four belong to *Glomus,* five were attributed to each of *Claroideoglomus, Funneliformis* and *Scutellospora,* four in each of *Rhizophagus, Diversispora,* and *Pacispora,* three in *Gigaspora,* two in each of *Corymbiglomus* and *Racocetra* and one in each of *Dominikia*, *Ambispora* and *Paraglomus*.

7. Twenty-two species would be considered as new records to the AMF in Assiut Governorate, these include: *Acaulospora cavernata, A. gedanensis, A. lacunosa, A. mellea, Ambispora fennica, Claroideoglomus claroideum, C. drummondii, C. walkeri, Corymbiglomus corymbiforme, C. tortuosum, Diversispora aurantia, D. eburnea, D. gibbosa, Scutellospora pellucida, Dominikia aurea, Glomus deserticola, G. macrocarpum, G. microcarpum, G. spinuliferum, G. glomerulatum, Pacispora scintillans* and *Paraglomus laccatum.*

8. The root colonization percentage in cultivated wheat fields ranged between 50 and 100%, of which the highest value in Agricultural Research Station, Al-Wasta Island and Bani Adyat and mycorrhizas were represented by all typical structures *viz*. arbuscules, vesicles and hyphae.

9. Maximum mean spore density recorded was in El-Ghoraieb (276 spores/100 g soil), followed by Al-Besary (273 spores/100 g soil). Minimum spore density was observed in Manqbad (59 spores/100 g soil).

10. Number of taxa was diverse in which Koom Abo-Sheil showed 24 taxa while Agricultural Research Station came second by showing 23 taxa. The least number of taxa were recorded in Manqabad (twelve taxa).

11. The species richness ranged from 1 to 31, of which *Acaulospora koskei* came first followed by *Funneliformis mosseae* (27).

Part II:

1. Eleven rhizosphere non-mycorrhizal fungal species belonging to five genera were isolated during the present investigation from 10 treatments of wheat plants grown under different levels of super phosphate (P_1) and rock phosphate (P_2) and inoculated with mycorrhizal fungi (M) at 45 days and harvest stage at 28±1 ℃. *Aspergillus* sp. was the most abundant genera in all treatments then *Penicillium* sp., *Rhizopus* sp., *Fusarium* sp. and *Botrytrichum* sp.

2. Twenty rhizoplane fungal species belonging to seven genera were isolated during the present investigation from 10 treatments of wheat roots grown under different levels of super phosphate (P_1) and rock phosphate (P_2) and inoculated with mycorrhizal fungi (M) at 45 days and harvest stage at 28±1 ℃. *Aspergillus* sp. was the most abundant genera in all treatments then *Penicillium sp.*, *Fusarium* sp., *Alternaria* sp. and *Cochliobolus* sp.

3. The mycorrhizal colonization of wheat plants increased as P level decreased and the highest value of infection was recorded at low and moderate levels (25, 50%) of super phosphate and rock phosphate.

4. After 45 days, a reduction in fresh and dry weights of shoots and roots were observed in non-mycorrhizal wheat plants treated with super phosphate and rock phosphate.

5. At harvest stage, the fresh and dry weights of shoots and roots showed an increase in mycorrhizal wheat plants treated with 25% super phosphate, and 50% rock phosphate.

6. The various yield components of wheat plants were significantly reduced as P level raised in the soil. Inoculation of wheat plants with AMF significantly ($p<0.05$) increased yield components especially at low concentration of rock phosphate (25%).

7. In mycorrhizal wheat plants the highest significant ($P<0.05$) value of total pigments was recorded. The total pigments of mycorrhizal wheat plants treated with superphosphate at all levels and rock phosphate at 50% and 75% levels, were significantly higher than those of their respective control level of non-mycorrhizal counterparts.

8. The total N-content, the obtained data showed significant increasing in N-uptake of both grains and shoots compared to control treatment. The obtained results indicated that using mycorrhizal fungi combined with low concentration of rock phosphate (25%) gave the highest value of N in grains.

9. The data revealed that significantly increased in P content of both grains and shoots in mycorrhizal wheat plants under high level of superphosphate (75%) compared to other treatments and control. P content in shoots was non-significantly between treatments.

10. The highest value of potassium content in grains and shoots was in mycorrhizal plants under low level of rock phosphate (25%). The lowest value shown of potassium content in grains and shoots was recorded in non-mycorrhizal wheat plants with 100% rock phosphate compared to other treatments and control plants.

11. In conclusion, the present study suggested that: the combined application of AMF (*A. bireticulata, F. coronatum, F. mosseae, G. spinuliferum, G. gigantea* and *S. armeniaca*) and low levels of phosphorus fertilizers of wheat plants is more effective than single treatment where, there was a significant improvement in plant growth, biomass and yield components.

12. The results also indicated that use high P concentration reduce the beneficial mycorrhizal effect on plant growth, yield production and nutrient uptake. Wherefore, treatment with high levels of P fertilizers is not recommended because they reduce the beneficial mycorrhizal of plant.

13. The results showed that AMF increased the nutrient uptake of N, P and K in grains and shoots with low levels fertilizers. With the continued rise in phosphorus fertilizer levels, the nutrient uptake of these elements was decreased compared to non- mycorrhizal and control treatments.

14. It is important that phosphate management balances the goal of providing sufficient phosphate to the crop to optimize crops yield.