Geophysical Research Abstracts, Vol. 8, 03129, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03129

The use of arbuscular mycorrhizal fungi to protect plants and soil using contaminated water

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Pot experiment was carried out using polluted sandy soil collected from El-Gabal El-Asfar area. The soil was irrigated with Cairo sewage and fertilized with sewage sludge for more than 80 years. Soybean (*Glycine max* L Clark) was cultivated as a test plant. All plants were inoculated with *Bradyrhizobium japonicum* strain USDA 110. Half of the pots were inoculated with arbuscular mycorrhizal fungi (mixed of *Glomus* spp.). Pots were separated into two main groups to be used as treated and control groups. The first group was again subdivided into two subgroups (inoculated and uninoculated with mycorrhizal fungi). These sub-groups were weekly irrigated using tap water contaminated with 4ug/ml Zn + 0.04ug/ml Cd and 6ug/ml Zn + 0.06ug/ml Cd.

The available lead in soil was decreasing during plant growth in all treatment. The lowest values were found in soil at harvest time. Mycorrhizal inoculation decreased the available iron, zinc, lead and cadmium in soil. Plants irrigated with tap water contaminated with Zn+Cd, however, significantly decreased nodulation in all treatments compared to control treatments. On the other hand, soybean plants inoculated with rhizobia and AM fungi in combination significantly increased nodulation compared to plant inoculated with rhizobia alone and irrigated with tap water contaminated with Zn+Cd. Mycorrhizal root colonization in soybean root and spore numbers inoculated with mycorrhizal fungi and irrigated with tap water contaminated with different concentration from Zn+Cd was similar and not significantly different between them. Increasing heavy metal concentration from 4ug/ml Zn+0.04ug/ml Cd to 6ug/ml Zn + 0.06ug/ml Cd reduced plant dry weight. However, inoculation with AM fungi significantly increased plant dry weight over the uninoculated plant at all levels of heavy

metals. In all treatments, copper contents in seeds are higher than the critical concentrations for plant growth, but in range of critical concentrations for animal feed, while zinc contents in range of critical concentration for plant growth and animal feeds. In case of mycorrhizal plants, seeds are clear from lead and cadmium. Lead content in seed of nonmycorrhizal plants irrigated with 4ug/ml Zn + 0.04ug/ml Cd is more than the critical concentrations for plant growth and in range for animal feeds while cadmium content is lower than the critical concentrations for plant growth or for animal feed. It is suggested that metal-tolerant mycorrhizal inoculants might be considered for soil reclamation, since under adverse conditions AM may be more important for plant metal resistance.

Key words: Arbuscular mycorrhizal (AM) fungi, heavy metals, micronutrients, pollution, soybean plants, soil and water.