Alexandria University
Faculty of Agriculture- (Saba-Basha)

EFFECT OF MYCORRHIZA ON THE UPTAKE AND BIOREMEDIATION OF SOME ESSENTIAL HEAVY ELEMENTS FOR PLANT UNDER CALCAREOUS SOIL CONDITIONS

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(SOIL AND WATER)

BY

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CHAPTER ١
INTRODUCTION

Ecosystems have been contaminated with heavy metals due to various human and natural activities. The sources of metals in the soil are diverse, including burning of fossil fuels, mining and smelting of metalliferous ores, municipal wastes, fertilizers, pesticides, sewage sludge amendments, the use of pigments and batteries. All these sources cause accumulation of metals and metal-loids in our agricultural soils and pose threat to food safety issues and potential health risks due to soil-to-plant transfer of metals (Khan, ٢٠٠٥). Some of Heavy metals at low available concentration in soils such as Cu, Fe, Mn, Ni and Zn are essential for normal growth and development of plants. On the other hand most of heavy metals are toxic to plants at higher available concentrations in soils and plant becomes chlorotic, plants exhibit altered photosynthetic physiology, and growth is reduced (Borkert *et al*., ١٩٩٨). and endoplasmic reticulum swelling and chloroplastic starch accumulation (Slivinskaya ١٩٩١)

The remediation of such soils is important because these usually cover large areas that are rendered unsuitable for agricultural and other human use. Conventional soil remediation practices in the past have relied mainly on the excavation of the contaminated soil. However, physical displacement, transport and storage or alternatively soil washing are expensive procedures and leave a site behind devoid of any soil microflora. In contrast plants offer an inexpensive and sustainable on-site approach (Kramer, ٢٠٠٥), which relates to heavy metal detoxification mechanisms (Hall, ٢٠٠٢). Arbuscular mycorrhizal (AM) fungi occur in the soil of most ecosystems, including polluted soils. In some cases mycorrhizal plants can show enhanced uptake and root-to-shoot transport (phytoextraction) while in other cases AM fungi contribute to heavy metal immobilization within the soil (phytostabilization).

In the same line, Jakobsen et al. (١٩٩٢) reported that, the total length of the external hyphae differs much between AM species as well as spread of the hyphae in the soil and their uptake rate .Elemental localization studies in AMF had indicated a selective immobilization of metals within the root tissues containing fungal structures (Kaldorf et al., ١٩٩٩) and sequestration of metals by polyphosphate granules in fungal vacuoles (Turnau et al., ١٩٩٣). The significance of AM fungi in soil remediation has lately been recognized (reviewed in Gaur and Adholeya, ٢٠٠٤). Galli *et al*. (١٩٩٤) suggested that AM fungi can play a crucial role in protecting roots from heavy metals, the efficiency of protection, however, differs between distinct isolates of AM and different heavy metals.

The aims of this work were:

١) to test the ability of four AM fungi species to colonize wheat grown in contaminated soil; ٢) to evaluate the influence of the tested mycorrhizae species on plant growth and uptake of heavy metals by wheat plants grown on soils across a gradient of Zn, Cu, and Ni concentrations from uncontaminated to potentially toxic levels and; ٣) to confirm whether AM fungi can be applied as an aid in amelioration toxicity produced by Zn, Cu, and Ni contamination under calcareous soil conditions.