



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**

A Thesis

Presented to the Graduate School

Faculty of Agriculture, Alexandria University

In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

In

(SOIL AND WATER)

BY

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August ٢٠١٠



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ACKNOWLEDGEMENT

First of all, ultimate thanks are due to Allah, without his help, this work could not be done.

I am grateful to my supervisor **Prof. Dr. Maher Georgy Nasseem**, Professor of Soil Science, Soil and Agricultural Chemistry Department, Faculty of Agriculture, Saba Basha, Alexandria University, Egypt, for his guidance and continued assistance in writing and revising this thesis.

Great thanks are due to **Prof. Dr. Essam A. Koreish**, Professor of Soil Microbiology, Soil and Water Department, Faculty of Agriculture (EL-Shatby), Alexandria University, Egypt, for his supervision and assistance in preparing this thesis.

Special thanks for **Prof. Dr. Abdallah Kamel**. For helping me to understand the statistical analysis.

I would like to express my deep gratitude to my mother, my sons, and my wife, who have given me the inspiration and made my life worth while.

I also appreciate the collaboration of all the staff members and colleagues at Department of Soil and Agricultural Chemistry for their kindness, help and admirable features.

Lastly, My Sincere thanks are due to the Secretariat of higher education and Gayarouns University, Libya for their support given to this study.

CONTENTS

Contents	<u>Page No.</u>
ACKNOWLEDGEMENT	i
LIST OF CONTENT	ii
LIST OF TABLES	v
LIST OF FIGURES	viii
1. CHAPTER 1: INTRODUCTION.....	1
2. CHAPTER 2: REVIEW OF LITERATURE.....	2
2.1. Heavy metals in the soils	2
2.1.1. Definition	2
2.1.2. Sources of pollution in soils.....	3
2.1.3. Soil Pollution with some heavy metals.....	3
2.1.3.1. Zinc (Zn).....	3
2.1.3.2. Nickel (Ni).....	4
2.1.3.3. Copper (Cu).....	5
2.1.4. The relationship between soil and plant content of heavy metals.	5
2.1.5. The Mobility of heavy metals in soils.....	5
2.1.6. Effect of heavy metal on plant growth.....	7
2.2. Remediation technologies.....	7
2.2.1. Bioremediation.....	8
2.2.2. Phytoremediation.....	8
2.2.2.1. Phytoextraction.....	8
2.2.2.2. Phytodegradation.....	8
2.2.2.3. Rhizofiltration.....	8
2.2.2.4. Phytostabilization.....	8
2.2.2.5. Phytovolatilization.....	9
2.3. Mycorrhizal fungi.....	9

۲.۳.۱. Mycorrhizal types.....	۹
۲.۳.۲. Beneficial Effects of AM fungi.....	۹
۲.۳.۳. Factors affecting mycorrhizal infection.....	۱۰
۲.۳.۳.۱. Nutrients.....	۱۰
۲.۳.۳.۲. Organic matter.....	۱۰
۲.۳.۳.۳. Plant genotype.....	۱۱
۲.۳.۳.۴. Metals.....	۱۱
۲.۳.۳.۵. pH.....	۱۱
۲.۳.۴. Symbiotic mycorrhiza with plants.....	۱۲
۲.۳.۵. Mycorrhiza and plant elements content.....	۱۳
۲.۳.۶. Mycorrhiza confer tolerance to plants grown in heavy-metal contaminated soil.....	۱۴
۲.۳.۷. Mycorrhiza and translocation of heavy metal to shoots of host plants.....	۱۵
۲.۳.۸. Effect of heavy metal stress on spore germination and presymbiotic of mycorrhizal fungi.....	۲۰
۳. CHAPTER ۳: MATERIALS AND METHODS.....	۲۳
۳.۱. Soil.....	۲۳
۳.۲. Cultivar.....	۲۳
۳.۳. Mycorrhizal inocula.....	۲۳
۳.۴. Experimental procedures.....	۲۴
۳.۵. Plant analysis.....	۲۴
۳.۶. Soil Analysis.....	۲۵
۳.۷. Determination of infection with arbuscular mycorrhizae (VAM)	۲۶
۳.۷.۱. Clearing and staining specimens	۲۶
۳.۷.۲. Infection % measurement.....	۲۶
۳.۸. Mycorrhizal dependency.....	۲۶
۳.۹. The increase/decrease of (HM) uptake.....	۲۶
۳. ۱۰. Aspects of plant heavy metal efficiency.....	۲۷
۳.۱۱. Statistical analysis	۲۷

٤. CHAPTER ٤: RESULTS AND DISCUSSION.....	٣٠
٤.١. Contaminated soil with Zinc.....	٣٠
٤.١.١. Soil extractable Zinc.....	٣٠
٤.١.٢. Root colonization rate.....	٣٠
٤.١.٣. Plant growth	٣١
٤.١.٤. Zinc content of wheat Plants.....	٣٣
٤.١.٥. Zinc uptake.....	٣٨
٤.٢. Contaminated soil with Copper.....	٥١
٤.٢.١. Soil extractable Copper.....	٥١
٤.٢.٢. Root colonization rate.....	٥١
٤.٢.٣. Plant growth.....	٥٣
٤.٢.٤. Copper content of wheat Plants.....	٥٧
٤.٢.٥. Copper uptake.....	٥٨
٤.٣. Contaminated soil with Nickel.....	٧٠
٤.٣.١. Soil extractable Nickel.....	٧٠
٤.٣.٢. Root colonization rate.....	٧٠
٤.٣.٣. Plant growth.....	٧٢
٤.٣.٤. Nickel content of wheat Plants.....	٧٣
٤.٣.٥. Nickel uptake.....	٧٧
٥. CHAPTER ٥: SUMMARY AND CONCLUSION.....	٨٩
٦. CHAPTER ٦: REFERENCES.....	٩٥
٧. CHAPTER٧: ARABIC SUMMARY	

List of Tables

No	Tables	Page
(۱)	Initial physical and chemical properties of soil.	۲۸
(۲)	Available Zn in soil after cropping of wheat as affected by arbuscular mycorrhizal fungi (AMF) species inoculation.	۳۲
(۳)	The effect of Zn rates and inoculation with different arbuscular mycorrhizal fungi (AMF) species on mycorrhizal infection and wheat growth.	۳۴
(۴)	Regression analysis of whole plant growth of wheat non-inoculated or inoculated with the tested <i>Glomus</i> species, versus Zn addition to soil.	۳۶
(۵)	Zinc content of wheat plants as affected by arbuscular mycorrhizal fungi (AMF) species and Zn application rate.	۳۹
(۶)	Regression analysis of Zn Shoots and roots concentrations of wheat Plants non-inoculated or inoculated with the tested arbuscular mycorrhizal fungi (AMF) species, versus Zn addition to soil.	۴۱
(۷)	Phosphorus content of wheat plants as affected by arbuscular mycorrhizal fungi (AMF) species and Zn application rate.	۴۲
(۸)	Means of Zinc uptake as affected by arbuscular mycorrhizal fungi (AMF) species and Zn application rate.	۴۴
(۹)	Means of Phosphorus uptake as affected by arbuscular mycorrhizal fungi (AMF) species and Zn application rate.	۴۶

(١٠)	Zinc Uptake efficiency(ZnU.E),Phytoextraction efficiency (ZnP.E) Translocation efficiency (ZnT.E) of wheat plants as affected by Zn rate and arbuscular mycorrhizal fungi species.	٤٧
(١١)	Available Cu in soil after cropping of wheat as affected by arbuscular mycorrhizal fungi (AMF) species inoculation.	٥٢
(١٢)	The effect of Cu rates and inoculation with different arbuscular mycorrhizal fungi (AMF) species on mycorrhizal infectionand wheat growth.	٥٤
(١٣)	Regression analysis of whole plant growth of wheat non-inoculated or inoculated with the tested <i>Glomus</i> species, versus Cu addition to soil.	٥٦
(١٤)	Copper content of wheat plants as affected by arbuscular mycorrhizal fungi (AMF) species inoculation and Cu application rate.	٥٩
(١٥)	Regression analysis of Cu Shoots and roots concentrations of wheat Plants non-inoculated or inoculated with the tested arbuscular mycorrhizal fungi species, versus Cu addition to soil.	٦١
(١٦)	Phosphorus content of wheat plants as affected by arbuscular mycorrhizal fungi (AMF) species and Cu application rate.	٦٢
(١٧)	Means of Copper uptake as affected by arbuscular mycorrhizal fungi (AMF) species and Cu application rate.	٦٤
(١٨)	Means of Phosphorus uptake as affected by arbuscular mycorrhizal fungi (AMF) species and Cu application rate.	٦٥
(١٩)	Copper Uptake efficiency (CuU.E), Phytoextraction efficiency (NiP.E) Translocation efficiency (CuT.E) of wheat plants as affected by Cu rate and arbuscular mycorrhizal fungi (AMF) species.	٦٦

(۲۰)	Available Ni in soil after cropping of wheat as affected by arbuscular mycorrhizal fungi (AMF) species inoculation.	۷۱
(۲۱)	The effect of Ni rates and inoculation with different arbuscular mycorrhizal fungi (AMF) species on mycorrhizal infection and wheat growth.	۷۴
(۲۲)	Regression analysis of whole plant growth of wheat non-inoculated or inoculated with the tested <i>Glomus</i> species, versus Ni addition to soil.	۷۶
(۲۳)	Ni content of wheat plants as affected by arbuscular mycorrhizal fungi (AMF) species and Ni application rate.	۷۸
(۲۴)	Regression analysis of Ni Shoots and roots concentrations of wheat Plants non-inoculated or inoculated with the tested arbuscular mycorrhizal fungi (AMF) species, versus Ni addition to soil.	۸۰
(۲۵)	Phosphorus content of wheat plants as affected by arbuscular mycorrhizal fungi (AMF) species and Ni application rate.	۸۱
(۲۶)	Means of Nickel uptake as affected by arbuscular mycorrhizal fungi (AMF) species and Ni application rate.	۸۳
(۲۷)	Means of Phosphorus uptake as affected by arbuscular mycorrhizal fungi (AMF) species and Ni application rate.	۸۴
(۲۸)	Nickel Uptake efficiency (NiU.E), Phytoextraction efficiency (NiP.E) and Translocation efficiency (NiT.E) of wheat plants as affected by Ni rate and arbuscular mycorrhizal fungi (AMF) species.	۸۵

List of Figures

No	Title	Page
(١)	Section of a root of ٦٠ days-old wheat (<i>Triticum aestivum</i> L.) infected with arbuscular mycorrhizal fungi (AMF). spores, showing vesicles in the cortical cells.	٢٩
(٢)	Section of a root of ٦٠ days-old wheat (<i>Triticum aestivum</i> L.) infected with arbuscular mycorrhizal fungi (AMF). spores, showing arbuscular in the cortical cells.	٢٩
(٣)	Available Zn in soil before cropping of wheat.	٣٢
(٤)	The effect of Zn rates and inoculation with different arbuscular mycorrhizal fungi (AMF) species on (a) Root and (b) Shoot dry weights of wheat growth.	٣٥
(٥)	Zinc content of wheat plants in (a) Root and (b) Shoot as affected by arbuscular mycorrhizal fungi (AMF) species and Zn application rate.	٤٠
(٦)	Zn update efficiency (A), phytoextraction efficiency (B) and translocation efficiency (C) of wheat plants under inoculation with four mycorrhizal fungus.	٤٨
(٧)	Comparison between (a) non- inoculation and inoculation with mycorrhizal species (b) <i>G. spp</i> (mixed), (c) <i>G. intraradiaces</i> , (d) <i>G. fasciculatum</i> and(e) <i>G. macrocarpium</i> –treated wheat plants with lowest and highest Zinc levels (mM/kg soil)	٥٠
(٨)	Available Cu in soil before cropping of wheat.	٥٢

(٩)	The effect of Cu rates and inoculation with different arbuscular mycorrhizal fungi (AMF) species on (a) Root and (b) Shoot dry weights of wheat growth.	٥٥
(١٠)	Copper content of wheat plants in (a) Root and (b) Shoot as affected by arbuscular mycorrhizal fungi (AMF) species and Cu application rate.	٦٠
(١١)	Cu uptake efficiency (A), phytoextraction efficiency (B) and translocation efficiency (C) of wheat plants under inoculation with four mycorrhizal fungus.	٦٧
(١٢)	Comparison between(a) non- inoculation and inoculation with mycorrhizal species (b) <i>G. spp</i> (mixed), (c) <i>G. intraradiaces</i> , (d) <i>G. fasciculatum</i> and(e) <i>G. macrocarpium</i> –treated wheat plants with lowest and highest Copper levels (mM/kg soil)	٦٩
(١٣)	Available Ni in soil before cropping of wheat.	٧١
(١٤)	The effect of Ni rates and inoculation with different arbuscular mycorrhizal fungi (AMF) species on (a) Root and (b) Shoot dry weights of wheat growth.	٧٥
(١٥)	Nickel content of wheat plants in (a) Root and (b) Shoot as affected by arbuscular mycorrhizal fungi (AMF) species and Ni application rate.	٧٩
(١٦)	Ni uptake efficiency (A), phytoextraction efficiency (B) and translocation efficiency (C) of wheat plants under inoculation with four mycorrhizal fungus.	٨٦
(١٧)	Comparison between(a) non-inoculation and inoculation with mycorrhizal species (b) <i>G. spp</i> (mixed), (c) <i>G. intraradiaces</i> , (d) <i>G. fasciculatum</i> and (e) <i>G. macrocarpium</i> –treated wheat plants with lowest and highest Nickel levels (mM/kg soil)	٨٨

CHAPTER 1

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, 2005). 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.*, 1998). and endoplasmic reticulum swelling and chloroplastic starch accumulation (Slivinskaya 1991)

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, 2005), which relates to heavy metal detoxification mechanisms (Hall, 2002). 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.* (1992) 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.*, 1999) and sequestration of metals by polyphosphate granules in fungal vacuoles (Turnau *et al.*, 1993). The significance of AM fungi in soil remediation has lately been recognized (reviewed in Gaur and Adholeya, 2004). Galli *et al.* (1994) 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:

1) to test the ability of four AM fungi species to colonize wheat grown in contaminated soil; 2) 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; 3) 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.