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STUDIES ON THE STATUS OF SOME MICRONUTRIENTS IN SOILS OF KALUBIA GOVERNORATE

By

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B.Sc. Agric. (Soils), Cairo university, (1970)

A THESIS

Submitted in Partial Fulfilment of the
Requirements for the Degree of

MASTER OF SCIENCE

In

SOIL SCIENCE

Department of Soils and Agricultural Chemistry
Faculty of Agriculture, Moshtohor
Zagazig University
(Banha Branch)

1997

APPROVAL SHEET

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LIST OF CONTENTS

Subject	Page
1. INTRODUCTION	1
2. REVIEW OF LITERATURE	2
2.1. Occurrence and forms of micronutrients in soil	2
2.1.1. Iron (Fe)	3
2.1.2. Manganese (Mn)	6
2.1.3. Zinc (Zn)	8
2.1.4. Copper (Cu)	10
2.2. Micronutrients fractions in soil	13
2.2.1. Soluble and exchangeable micronutrients	13
2.2.2. Micronutrients bound by inorganic sites	15
2.2.3. Micronutrients bound by organic sites	16
2.2.4. Occluded micronutrients	18
2.3. Main factors affecting status of micronutrients in soil.	19
2.3.1. Soil organic matter	19
2.3.2. Soil reaction (pH)	21
2.3.3. Soil $CaCO_3$	23
2.3.4. Soil texture	24
2.3.5. Soil C.E.C.	26
2.4. Micronutrients in plant	27
2.4.1. Iron	27
2.4.2. Manganese	28
2.4.3. Zinc	30
2.4.4. Copper	31
3. MATERIALS AND METHODS	33
3.1. Soil sampling and routine analyses	33
3.2. Experimental procedures	42
3.2.1. Total and available micronutrients in the tested soils.	42
3.2.2. Fractionation of soil micronutrients	42
3.2.3. Greenhouse experiment	44

Subject	Page
3.2.3.1. Plant analyses	44
3.2.4. Micronutrients determination	44
4. RESULTS AND DISCUSSION	45
4.1. Iron	45
4.1.1. Total and available iron in the tested soils	45
4.1.2. Iron fractions in some tested soils	47
4.1.3. Effect of some soil characteristics on iron status in soil	50
4.1.3.1. Soil organic matter	50
4.1.3.2. Soil reaction (pH)	51
4.1.3.3. Soil $CaCO_3$	51
4.1.3.4. Soil texture	51
4.1.3.5. Soil C.E.C.	52
4.1.4. Iron effect on barley plants	52
4.1.4.1. Dry matter yield	52
4.1.4.2. Iron concentration and uptake	54
4.2. Manganese	54
4.2.1. Total and available manganese in the tested soils.	54
4.2.2. Manganese fractions in some tested soils	58
4.2.3. Effect of some soil characteristics on manganese status in soil	60
4.2.3.1. Soil organic matter	60
4.2.3.2. Soil reaction (pH)	61
4.2.3.3. Soil $CaCO_3$	61
4.2.3.4. Soil texture	62
4.2.3.5. Soil C.E.C.	62
4.2.4. Manganese effect on barley plants	63
4.2.4.1. Dry matter yield	63
4.2.4.2. Manganese concentration and uptake	63
4.3. Zinc	65
4.3.1. Total and available zinc in the tested soils	65
4.3.2. Zinc fractions in some tested soils	67

Subject	Page
4.3.3. Effect of some soil characteristics on zinc status in soil	70
4.3.3.1. Soil organic matter.	70
4.3.3.2. Soil reaction (pH)	70
4.3.3.3. Soil $CaCO_3$	71
4.3.3.4. Soil texture.	71
4.3.3.5. Soil C.E.C..	71
4.3.4. Zinc effect on barley plants.	71
4.3.4.1. Dry matter yield.	71
4.3.4.2. Zinc concentration and uptake.	72
4.4. Copper.	74
4.4.1. Total and available copper in the test soils.	74
4.4.2. Copper fraction in some tested soils.	76
4.4.3. Effect of some soil characteristics on copper status in soil	79
4.4.3.1. Soil organic matter.	79
4.4.3.2. Soil reaction (pH).	80
4.4.3.3. Soil $CaCO_3$ %	80
4.4.3.4. Soil texture.	80
4.4.3.5. Soil C.E.C..	81
4.4.4. Copper effect on barley plants.	81
4.4.4.1. Dry matter yield.	81
4.4.4.2. Copper concentration and uptake.	81
5. SUMMARY	83
6. REFERENCES.	90
7. ARABIC SUMMARY	

ACKNOWLEDGMENT

The author wishes to express her sincere appreciations and deep gratitudes to Prof. Dr. Raafat Sorour E. Abd El Aal, Professor of Soil Science, Fac. of Agric., Moshtohor; Prof. Dr. Mohamed N. A. Hegazy, Professor of Soil Science, Soils, Water and Environment Research Institute, Agric. Research Center, Giza, Egypt, and Dr. Soltan A. Soltan, Lecturer of Soil Science, Fac. of Agric., Moshtohor for their valuable supervision, guidance and continuous encouragement during this course of this study and preparing the manuscript..

Thanks are also due to Dr. O. El-Hussieny, Lecturer of Soil Science, Fac. of Agric., Moshtohor for his valuable help during conducting laboratory experiment.

The author is also thankful for the staff members of Soils, Water and Environment Research Institute, Agric. Research Center for their cooperation and facilities provided through this work.

INTRODUCTION

Soil is a natural body, having distinict mineral and organic composition as well as physical, chemical and biological properties. Soil is composed of three phases, i.e., solid (mineral and organic), liquid and gaseous and exhibits general properties affected by the status of equilibrium between these phases. Not only the chemical composition of the soil solids but also their mineral structure and the state of dispersion of such components are factors involved in determining soil properties. Although the trace elements are minor components in the soils, they play a determinant role in their fertility. A knowledge of the association of trace elements with particular soil phases and their affinity to each soil constituent is the key to a better understanding of the principles controlling their behaviour in soil.

Micronutrients serve mainly as constituents of prosthetic groups in metalloprotiens and hence the transition elements i.e., Fe, Mn, Cu and Mo catalyze the redox processes taken place in soils through the electron transfer phenomenon. Micronutrients act also as activators of enzyme reactions and are involved in forming enzyme-substrates.

The normal concentrations of trace elements in soil are of great interest as background values needed for any assessment of degree of the soil contamination.

The present work aims at gaining more informations about the total and available amounts of micronutrients; Fe, Mn, Zn and Cu in the soils of Kalubia Governorate. Micronutrients fractions were also extracted to study their relationships in some of the investigated soils with the main chemical and physical properties. A Neubauer pot experiment was conducted using barley as a test plant to study the biological availability of the tested micronutrients in soil.

2. REVIEW OF LITERATURE

2.1. Occurrence and forms of micronutrients in soil:

The micronutrient cations in soil occur mainly in the pools; water soluble, free cations and complexes with organic or inorganic ligands on the exchange sites of clay minerals, specifically adsorbed (some trace elements are retained by clay minerals and/or Fe and Mn oxides), adsorbed or complexed by organic matter, and insoluble precipitates involving the primary minerals and as cations that have undergone isomorphous substitution for Fe and Al octahedral positions of silicate clay (***Viets, 1962***).

McLaren and Crawford (1973) showed that in most soils, only very minute amounts of plant micronutrients occur in soils in available forms consisting mainly of the water-soluble and exchangeable forms. However, these pools are involved in the reversible equilibrium with specifically adsorbed and organically bound pools.

Knezek and Ellis (1980) mentioned that concentrations of micronutrients in soils vary from a few mg's Cu or Zn per kg soil to very large quantities of Fe. The low solubility and availability of Fe, Mn, Zn and Cu and their small requirements for most plants place them in the category of micronutrients.

Murthy (1982) pointed out that as the concentration of micronutrients in the soil solution is reduced by plant consumption, or diluted by excess moisture due to rainfall (or irrigation), readily release of micronutrients from the insoluble to soluble forms may take place. In many soils, the organic pool is of a considerable significance because of its large size.

Stevenson (1986) reported that distribution of a micronutrient in soil may reflect, to some extent, the amount contained in the parent material from which the soil was formed. However, the micronutrients exist in somewhat different chemical forms. During the various stages of soil formation micronutrients released from the primary minerals and incorporated into other forms, such as structural components of secondary silicates (clay), complexes with organic matter, and occlusion in Fe and Mn oxides.

The four elements concerned herein; Fe, Mn, Zn and Cu are reviewed separately in the following:

2.1.1. Iron (Fe):

The common minerals of Fe in soils are olivin $(Mg, Fe)_2SiO_4$, Pyrite (FeS_2), siderite $(FeCO_3)$, hematite (Fe_2O_3), geothite (FeOOH), magnetite (Fe_3O_4) and limonite $(FeO(OH).nH_2O + Fe_2O_3.nH_2O)$ ***(Tisdale et al, 1985)***

Among the various micronutrients, Fe is by far the most abundant element. It ranks the fourth in occurrence among the lithosphere elements, i.e., after O, Si and Al.

2.1.1.1. Total iron:

Krauskopf (1972) showed that the total iron values are 27.0, 86.0, 3.8, 9.8 and 47.0 g-kg^{-1} in granite, basalt, limestone, sand stone and shale, respectively. ***Knezek and Ellis (1980)*** indicated that Fe content of soils varies from 10,000 to 100,000 mg-kg^{-1} soil meanwhile, ***Stevenson (1986)*** reported that total Fe content in soil varies from about 200 mg-kg^{-1} in coarse textured soils to well over 10% (100,000 mg-kg^{-1}) in ferruginous latosols tropical soils. Almost comparable figures were reported by