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STATUS OF SOME MICRONUTRIENTS IN SOME SOILS OF EGYPT

BY

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CONTENTS

1- INTRODUCTION

During the last decades, the Egyptian population is increasing at a straggly rate. The area of arable land per capita is therefore decreasing. Thus, lateral and vertical agricultural expansion are considered the main pathways for tackling this dilemma.

In Arab Republic of Egypt, horizontal agricultural expansion aims at reclaiming and cultivating more than two millions feddan of barren lands situated in the east and west of the Nile valley and Delta fringes. The proposed areas include both alluvial and calcareous soils. Also, calcareous soils are repeatedly considered to be a suitable area for the extension of agricultural lands in the A.R.E.

One of the most interesting subjects for study is the problem connected with micronutrients in these soils. The deficiencies or unavailability of most micronutrients have been found in calcareous soils containing much calcium carbonate, these problems are the result of many physical, chemical and biological factors which rarely act individually or mostly large interactions.

The present work was carried out to study the status of Fe, Mn, Zn and Cu in some soils of Egypt . Also, the study has included evaluation of some methods used for determining available Fe, Zn, Mn and Cu.

2. REVIEW OF LIETRATURE

2.1. Status of some micronutrient elements:

The nutrient elements (Fe, Mn, B, Mo , Cu, Zn, Cl, and Co) are used by higher plants in very little amounts thereby justifying the name micronutrients. Such a designation does not mean that they are less essential than the so called macronutrients. In fact, the micronutrients are fundamentally just as important (Buckman and Brady, 1969). Their contents of soils depend on the parent rocks from which these soils are derived by weathering processes (Mitchell, 1955).

2.1.1.1. Iron

Total iron is the most abundant micronutrients in the plant as awhole and the fourth most abundant in rocks forming earth crust. Bear (1977) reported that Fe content in earth crust ranges from 0.1% to 7.0% Nevertheless due to differences in soil parent material and formation processes, the total iron content of soils is variable from as low as 0.02% to more than 50%. Dixon and Weed (1977) reported that granite and basalt contain 27000 and 5000 mg Fe/kg rock, respectively, while sedimentary rocks (limestone , sandstone and shale) contain 17000, 29000 and 48000 ppm Fe, respectively.

The greatest part of soil's iron usually occurs in the crystal lattices of numerous minerals related to ferromagnesian silicates, such as olivine, augite, hornblende and biotite as well as primary Fe oxides including hematite (Fe_2O_3), ilmenite ($FeTiO_2$) and magnetite (Fe_3O_4). In sedimentary rocks, Fe oxides and siderite ($FeCO_3$) are usually the most common primary Fe forms. Iron also occurs in the lattice. of some secondary minerals and is considered as an essential element in large group of clay minerals (Mengel and Kirby 1978) .

Concerning iron status in the soils of Egypt , Labib (1970) found a considerable amount of total iron in the alluvial soils (3.96 to 11.48 %) with an average of 10 percent. El-Gala and Hendawy (1972) showed that the total iron ranged from 5400 to 34000 ppm with the lowest amount in the calcareous soil and the highest amount in the alluvial one. Abdel-Kader and Abu-Ghalwa (1973) reported that total iron content varied between 1.7 to 12.9%. The heavy clay soils contained the highest total iron percentage, while the saline soils contained a lower total iron content, and the calcareous soils showed the lowest total iron percentage. The results obtained by El-Rashidi et al, (1978), El-Sayad (1988) and Hegazy et al., (1991) showed that the total Fe content in some soils of Egypt ranged from 0.55 to 2.4%. The highest values were found in the alluvial soils (average of 2.05%) and the lowest values in the sandy soils (average of 0.07%). The calcareous soils came in between with an average of 0.37 % Fe.

Hassona et al (1996) in their study on the alluvial soils found that total iron content ranged from 15000 to 50000 ppm. The wide range of total iron seems to be associated with variations in soil texture and /or calcium carbonate content. Barakate (1998) indicated that total iron content ranged from 3583 to 85000 ppm, being dependent upon the clay + silt percentage rather than the clay content alone.

Available iron:

Concerning available iron, variable amounts have been reported by different investigators , depending on soil characteristics and the extracting solution. Holah (1977) indicated that the average values of available iron were

5.3 ppm in the Nile alluvial soils and 4.6 ppm in the sandy soils. These value, reveal, that such soils are marginal with respect to their iron content according to the limits proposed by lindsay and Norvell (1978). El-Toukhy (1987); stated that the DTPA extractable Fe ranged from 2 to 15 ppm, with an average of 8.3 ppm. Also, Mohamed (1982) in his study of the DTPA extractable Fe of soils of five regions in Egypt found that these values of this element is relatively higher in the clay and silt fractions, composed to their values in sand fraction. He concluded that soil texture is the most important factor affecting the content and availability of this element. Mohamed (1990) found that the available Fe ranged between 6.0 and 2.0 ppm in alluvial soils and 1.4 to 7.6 ppm in the calcareous ones.

The difference in the amounts of extractable Fe manifests the effectiveness of extractants for the recovery of Fe from some calcareous soils. The results obtained by El-Demerdashe et al(1991) revealed that the extraction power of the employed extracts in most of the tested soil could be arranged in the following order

$HCl > NH_4\ HCO_3 + DTP > EDTA \geq NH_4OA_C > DTPA > H_2o$

As to the percentage of extracted Fe to total Fe, the extracted Fe forms 0.001 to 0.25, 0.01 to 0.4, 0.01 to 0.4, 0.01 to 0.21, 0.02 to 0.52 and 0.003 to 0.37% of total Fe when extraction was conducted by

DTPA, NH_4OA_C, EDTA, $NH_4^{\cdot}\ HCO_3$ + DTPA, HCl and H_2O, respectively.

Hegazy et al(1991) found that the extracting power of the employed reagents could be arranged in the following order:

Acid ammonium acetate + EDTA (AAAC + EDTA) > EDTA+ $CaCl_2$> ammonium bicarbonate + DTPA (AB+ DTPA) > EDTA > NH_4OA_C; pH 4.8 > Mg $(NO_3)_2$ > Ca (NO_3)> NH_4OA_C – hydroquinone. Also they reported that the average values of extractable Fe as, a percentage of total Fe that acid ammonium acetate EDTA (AAAC + EDTA) solution extracted were about 1.1, 1.9 and 0.4% of total Fe from the calcareous, sandy and alluvial soils, respectively. Whereas, DTPA a solution extracted about 0.09, 0.3 and 0.07% of total Fe and ammonium bicarbonate + DTPA (AB + DTPA) extracted about 0.15, 0.3 and 0.1 % of total Fe from the previously mentioned soils, respectively.

Total Manganes:

Manganese occurs in many primary rocks, particularly in ferromagnesian rocks rich in iron. It may be present in soils in non-exchangeable, exchangeable and soluble form. The main part is present as insoluble oxides, the most common of which seems to be pyrolausite with tetravalent Mn, both in a hydrated and active forms, MnO_2, $2H_2O$, and in a crystallized and inert forms, MnO_2 (Wiklander, 1958).

The total Mn content in soils varies widely from traces to 10000 ppm, but most soils contain an average from 500 to 1000 ppm. The variations noticed can rarely be correlated with soil typology, but they are often high between soil of the same type in a given climatic region (Aubert and Pinta, 1977).

With respect to the soils of Egypt, Ghanem et al., (1971) studied the status of Mn in 30 soil samples representing different geographical areas and mode of formation ,. They recorded that total Mn ranged from 116 to 1300 ppm. Their data showed that the alluvial soils have the highest Mn content