STUDIES ON CERTAIN MICRONUTRIENTS IN SOME EGYPTIAN SOILS UNDER RECLAMATION

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CONTENTS

I. INTRODUCTION

During the last decades, the Egyptian population is increasing at a straggler 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 agriculture expansion aims at reclaming and cultivating more than two millions feddan of barren lands situated in the East or West of the Nile Valley and Delta fringes. The proposed areas include both sandy soils and heavy textural ones that are mainly saline. Also, colcareous 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 under reclamation. The deficiencies or unavailability of most micronutrients have been found in calcareous soils containing much calcium carbonate, and also on light sandy soils as well as on the salt affected ones. These problems are the result of many physical, chemical and biological factors which rarely act individually or mostly large interactions.

In view of the aforementioned reasons, the present work was carried out to study the status of Zn, Mn and Fe in some Egyptian soils under reclamation namely; Calcareous, Sandy and Salt-affected soils. Also, the study has included the effect of soaking barley seeds in variable concentrations of either single or mixed salts of micro-nutrients ($ZnSO_4$, $MnSO_4$ and $FeSO_4$) on the dry matter and nutritional status of these micronutrients.

2. REVIEW OF LITERATURE

2.1. Status of Micronutrients in Soils:

2.1.1. Water soluble forms

Powers and Pang (1947) reported that about 5% of the total Zn in silt loam soil is water soluble. Wright et al. (1955) and Thorne (1957) demonstrated that solubility of Zn was proportional to the solubility of the complexes formed. Massev (1964) added that water soluble Zn was not found in most soils and the exchangeable Zn was lacking or very low in most soils. Hodgson et al. (1966) observed that the presence of soluble carbonate in alkali soil resulted in precipitation of the soluble Zinc (Zn^{++}) added.

Bradford et al. (1971) found that Zn concentration in the saturation extracts of some california soils was in the range of 0.01 - 0.40 ppm. Arneonu et al. (1971) added that on a weakly acid leached chernozem, Fe and Mn solubility increased whereas Zn solubility decreased under excessive moisture conditions.

Ferrous (divalent iron) salts are considerably more soluble than ferric salts and hence result in increased concentration of soluble Fe available for plant uptake.

Solubility of Ferrous salts may also explain why Fe-chlorosis disappears when soils are subjected to reducing conditions by flooding, Brown et al., (1955).

Martinez (1970) studied the content of soluble and extractable Fe in 15 Argentinian soils and found that values for extractable and soluble Fe ranged from 2-16.8 ppm and 2 - 28 ppm. respectively. Elgalal and Hendawy (1972) reported, that water-soluble Fe content in the soils ranged from 1.6 to 3.5 ppm. with the highest values associated with sandy and calcareous soils. They added that extractable Fe indicated that the solubility of Fe was not completely related to the total amount in the soils; however, the alluvial soil contains relatively more Fe that can easily be released in solution. Kabata and Galczynska (1965) reported that weathering and soil forming processes resulted in a higher trace elements content in the sandy soils than their parent material from which they are derived. Solubilities of the elements Mn and Zn were found to be relatively high in the upper soil horizons. El-Damaty et al. (1971) found that water-soluble Mn was completely absent from some soils of Egypt.

Recently, Kukurenda and Gladych (1975) found a positive correlation between soil moisture and amounts of the water-soluble, exchangeable and easily reducible Mn forms; a negative correlation was found, however, between soil moisture and the reduction resistant fraction.

2.1.2. Exchangeable forms

SWaine (1950) reported that exchangeable Zn is usually less than one ppm in various soils. Thorne & Wallace (1942), El-Gabably & Jenn (1943), El-Gabaly (1950) and Mitchell (1955) demonstrated that part of Zn adsorbed on several primary and secondary soil minerals was not replaceable by ammonium acetate; therefore, it is considered fixed by the minerals.

Demumbrum and Jackson (1956) pointed out that Ca-Montmorillonite and Ca-peat accumulated considerable quantities of exchangeable Zn.

Sutcliffe (1962) has classified the forms of Fe as a) water soluble, b) exchangeable (including sparingly soluble some insoluble substances), and c) non-exchangeable. Water soluble ions are immediately available for nutrient uptake while exchangeable and non-exchangeable sources allow for the replenishment of the soil solution when it is depleted by ion uptake (Khasawneh, 1971).

Takkar (1969) found that exchangeable Fe forms 17.6% of the extractable Fe with 1 N. NaOAc (pH 2.8). Exchangeable Fe^{2+} forms a major portion (90%) of the total exchangeable Fe, but extractable Fe^{2+} forms only 49% of the total extractable Fe. He also found significant correlations between exchangeable Fe and pH (r =-0.8759), and between exchangeable and extractable Fe (r = + 0.7822).

Exchangeable and easily reducible Mn varied from 12 to 142 ppm and were related to soil pH., Vuletic and Mijatovic (1967). Under the prevailed conditions in Egypt, Ghanem et al. (1971) found that soluble plus exchangeable Mn ranged from 0.2 to 11.0 ppm. These forms of Mn were generally higher in alluvial soils than in calcareous and sandy ones. Mishra and Tripathi (1972) in their studies on the distribution of Mn in soils of Uttar Pradesh reported that exchangeable form constituted 2.69% of the total Mn and tended to decrease with profile depth.

2.1.3. Available forms

Nair and Mehta (1959) reported that Zn is known to exist in the soil in three forms, water soluble, replaceable and nonreplaceable forms. They found that available Zn is undoubtedly held as cation on the exchange sites of both clay and organic matter in soils. Savic and Jakic (1968) found that available Zn was variable between 0.32-6.25 ppm, the lower amounts occurring in calcareous soils of pH 7.3-7.4; the deeper layers contain less available Zn.

Ravikovich et al. (1968) in 15 calcareous soils found that the chemically available Zn ranged between 0.1 and 0.2ppm as extracted by KCl, 5.4 ppm as extracted by dithizone and between 1.4 - 3.5 ppm when extracted by Na-EDTA. Kudryavtseva (1970) added that the contents of available Zn and Mn increased in soil under the effect of cultivation and was directly related to the increase of humus in soil, improvement of soil physical properties and intensity of microbiological processes in the soil.

Prasad and Pagel (1970) indicated that available Zn contents in the studied soils (fersiallitic, ferrallitic, vertisols, rendzina, and Sub-arid soils) were 0.364, 0.370, 0.878, 1.100 and 2.160 ppm, respectively. The availability of Zn was directly proportional to the amount of silt, clay and humus in soil. The Zn content decreased with the increase in pH, exchangeable calcium and total exchangeable bases. They added that the greater content of available Zn was found in the top layers of profiles as compared with the deeper ones.

Recently, El-Sayed (1971) reported that values of dithizone extractable Zn vary between 0.15 and 10.33 ppm in some alluvial soils of A.R.E. Shanker and Dwivedi (1972) also pointed out that available Zn ranged from 3.1 to 7.2 ppm with an average of 4.11 ppm.

Rai *et al.* (1970) studied the availability of Fe, Mn and Zn in 184 surface samples of soils. They found significant positive correlations between available Fe and both exchangeable Mn and organic C. Ladha and Baser (1971) added that available Fe in samples taken from seven soil groups ranged from 0.3 to 15.7 ppm.

Purtova (1969) reported that available Mn changed according to soil type and depended on the nature of the