The Golden Jubilee Congress on Soil and Sustainable Agriculture in the New Century. Egyptian Soil Science Society (ESSS) and held in Cairo from 23 – 25 October / 2000.

Status of some micro nutrients in soils of Kaluobia Governorate

By

Esmat, H. A. Noufal*, Hassuna, H. H., Abbas, H. H.* and Abd El - Kader, G. A****

* Faculty of Agriculture at Moshtohor, Zagazig University (Bnha Branch) - Egypt.

** Agricultural Res. Center, Giza.

Abstract

- This work aims at studying and evaluating the relation between status of total and DTP A extractable Fe, Mn, Zn, Cu and Mo and some soil variables i.e soil texture, $CaCO_2$ content, O,M and CEC, of the different soil types of Kaluobia governorate.
- To fulfill these purposes, seventeen soil profiles representing the main soil types of El - Kaluobia Governorate were examined and status of some nutritive heavy elements were evaluated. The obtained results of the studied nutrients in the tested soil samples could be summarized as follows:-
- Total iron content ranged from 10200 to 66000 mg kg^{-1} whereas DTP A extractable Fe ranged between 4.4 and 18.5 mg kg"[1].
- Total manganese content ranged from 0.5 to 985 mg kg^{-1}, this wide range of total Mn attributed to the difference in the type and nature of soil materials. DTPA extractable Mn ranged frome 0.4 to 9.5 ppm.
- Total zinc content ranged from 0.32 to 159.0 mg kg"[1] and the DTPA extractable Zn varied between 0.3 to 4.2 mg kg"[1] depending on soil texture. Total copper content ranged between 17.7 and 97.5 mg kg"[1], whereas DTPA extractable Cu varied from 1.1 to 9.9 mg kg^{-1} with an increase in the surface layers.
- Total Mo content varied widely, ranging from 2.9 to 21.4 mg kg^{-1},and DTPA extractable Mo ranged from 0.02 to 1.24 mg kg"[1]. The vertical distribution of DTPA extractable Mo indicate a relative increase of Mo in the top surface layers.
- Highly significant positive correlations were found between total soil content of the most studied elements and each of $CaC0_3$, silt %, clay %, and CEC, whereas highly significant negative correlation was found with sand %.
- In the most studied soil profiles, soil contents of available Fe and Mn are considered to be adequate whereas that of available Cu is high and that of Zn is adequate and marginally.
- The trend T indicates that some of the soil profiles are highly symmetric with respect to Fe, Mn, Zn, Cu than with Mo, whereas the specific range (R), shows the homogenity of some soil profiles with respect to some elements and heterogenity with respect to others.

Introduction

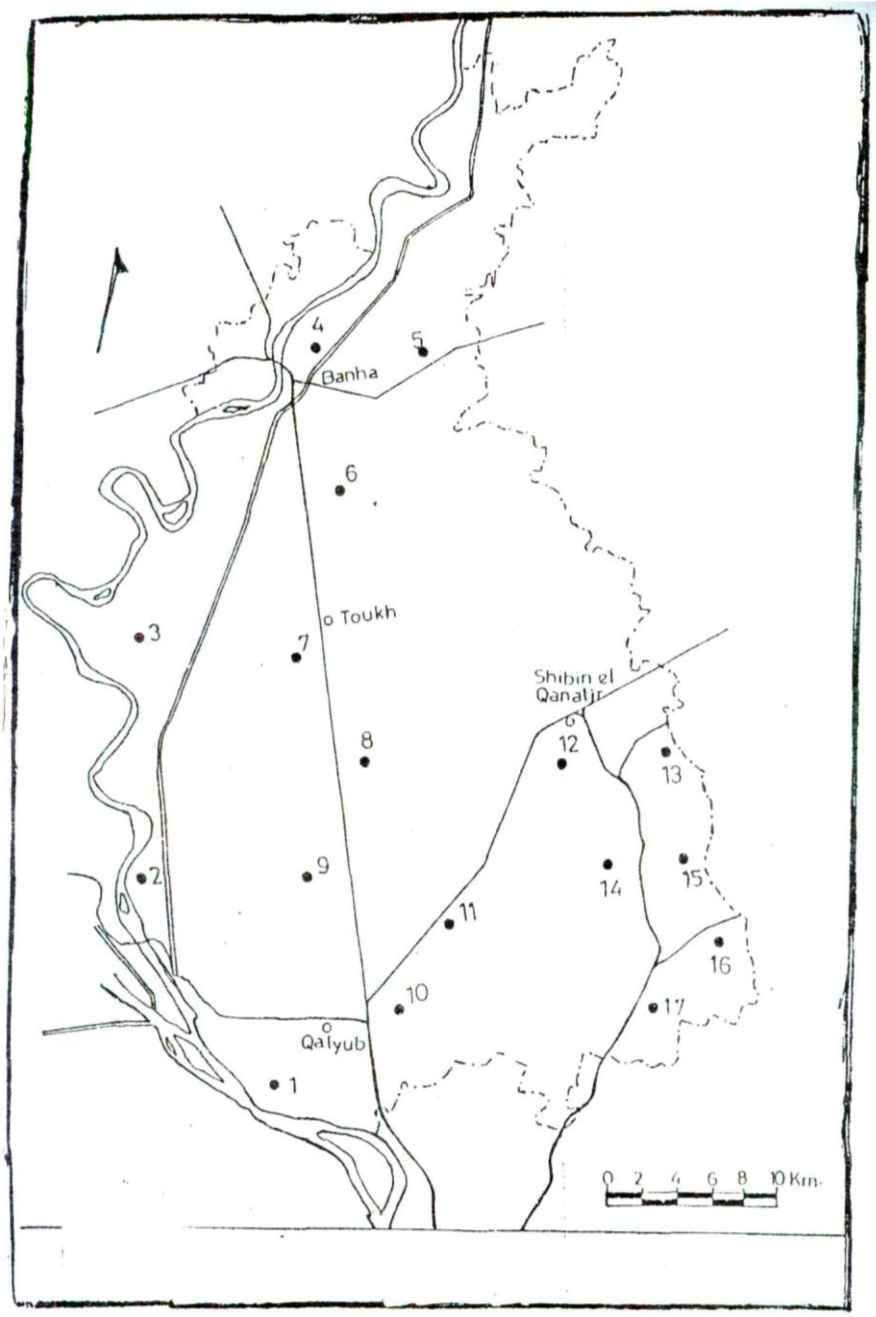
Micronutrients status in soil are dependent almost entirely on the bed rock from which soil parent material was derived. Both geochemical and weathering processes are responsible for formation of soil materials as a final product upon time. Micronutrients are present in all types of soils in the whole world. However, their contents and status vary considerably from one soil to another and even in the subsequent layers of the same soil profile. These variations are surely controlled by several soil and environmental factors. Therefore, it is of interest to delineate these factors and to determine their relative contribution to micro-nutrient forms in soils

The aim of the present work is to describe the micronutrients status in the different soil types of El-Kaluobia Governorate. Moreover some factors controlling micronutrient status i.e. soil texture, $CaCO_3$ and organic matter contents, salinity, soil reaction and exchange characteristics are also considered.

Materials and Methods

The current agricultural study was carried out to study the status of some micronutrients in soils of El - Kaluobia Governorate. To fulfill this purpose, seventeen soil profiles were dug at different locations of El - Qalubia Governorate to represent most soils in the area (Map 1). Table (1) shows some physical and chemical properties, of the studied soils, determined according to the methods outlined by Jackson (1973).

Total Fe, Mn, Zn, Cu and Mo in the soils were extracted by digestion in HF-$HClO_4$ acids mixture in platinum crucibles, (Jackson 1973) whereas available Fe, Mn, Cu, Zn and Mo were extracted by DTPA, according to Lindsay and Norvell (1978). Both total and extractable Fe, Mn, Cu, Zn and Mo were determined by Atomic - Absorptions - Spectrophotometer, Perkin Elmer, model 3110.



Map.1. Locations o the studied soil profiles.

Table (1) Some physical and chemical properties of the studied soil horizons

Prof. No.	Location	Depth (cm)	Particle size distribution				Textural class	O.M %	$CaCO_3$ %	pH	EC dSm^{-1}	Soluble cations (me/L)				Soluble cations (me/L)				CEC (me /100 g soil)
			C Sand %	F Sand %	Silt %	Clay %						Ca^{2+}	Mg^{2+}	Na^+	K^+	Cl^-	HCO_3^-	$CO_3^=$	$SO_4^=$	
		0 – 25	2.3	42.4	36.5	18.8	C.L.	1.7	2.1	7.3	0.97	3.5	3.7	4.7	0.7	4.0	4	-	4.6	32
1	Abu El	25-75	0.7	35.7	38.3	25.3	L.C.	0.9	2.8	7.1	0.94	3.5	1.6	3.4	0.2	3.1	5	-	0.6	38.4
	Ghait	75-125	1.6	23.9	41.6	32.9	L.C.	0.9	3.6	7.3	0.98	3.5	2.7	4.8	0.2	4.0	3.6	-	3.6	40
		0-20	1.1	35.5	34.5	28.9	C.L.	1.7	1.2	7.5	0.65	4.6	0.5	2.9	0.2	3.2	4.6	-	0.4	39.2
2	El Munira	20-50	0.5	47.4	32.2	19.9	C.L	0.9	2.6	7.2	0.84	3.5	2.7	4.5	0.2	4.0	4	-	2.9	35.2
		50-100	0.3	39.8	40.3	19.6	C.L.	1.4	2.3	7.5	0.64	4.6	0.5	3.4	0.1	3.2	3.2	-	2.2	33.6
		100-150	0.4	40.9	37.9	20.8	C.L	1.2	2.9	7.5	0.70	3.5	1.6	3.9	0.2	3.2	3.8	-	2.2	39.2
		0-30	38.5	30.5	15.5	15.5	S.C.L.	1.7	0.95	7.4	0.76	3.5	2.7	3.0	1.0	3.1	5.8	-	1.3	23.2
3	Kafr El-	30-70	79.1	9.7	3.2	8.0	L.S.	0.9	0.21	7.4	0.61	1.2	2.9	2.4	0.6	2.3	3.2	-	1.6	13
	Ragalat	70-120	86.6	6.3	2.3	4.8	S.	0.3	0.32	7.5	0.34	1.2	1.9	2.9	0.4	2.3	3.0	-	1.1	8.4
		0-20	2.6	62.6	18.9	15.9	S.C.L.	2.3	2.6	7.4	1.6	4.6	5.6	7.6	0.5	6.0	5.6	-	6.7	32.8
4	Kafr Saad	20-50	32.3	37.5	14.9	15.3	S.C.L.	0.6	2.1	7.6	0.98	1.2	2.9	5.6	0.2	6.0	3.4	-	0.5	24.8
		50-90	8.4	67.6	12.5	11.5	S.L.	1.2	0.43	7.6	0.67	2.3	2.8	4.8	0.2	5.0	2.8	-	2.3	18.4
		90-120	1.1	89.3	4.7	4.9	S.	0.6	2.3	7.6	0.65	1.2	3.0	3.9	0.2	4.0	3.0	-	1.3	27.2
		0-20	4.1	55	24.1	16.8	C.L.	1.8	3.3	7.9	1.3	3.5	2.6	10	0.2	9.0	5.2	-	2.1	47
5	Shiblanga	20-60	4.2	54.5	20.5	20.8	C.L.	1.7	2.9	7.8	1.8	2.3	3.8	12.3	0.1	10.0	3.8	-	4.7	47
		60-110	5.2	43.5	19.6	31.7	C.L.	1.7	1.2	7.8	2.2	2.3	3.3	19.5	0.1	18.0	5.0	-	2.2	49
		0-20	4.6	59.8	17	18.6	S.C.L.	1.9	3.2	7.6	0.78	2.3	4..3	3.9	0.4	3.3	5.0	-	2.6	36
6	Sandanhor	20-50	3.5	61.7	16.4	18.4	S.C.L.	1.7	3.3	7.6	0.91	4.6	2.5	5.0	0.2	4.1	7.0	-	1.2	39.2
		50-100	4.3	59.9	16	19.8	S.C.L.	1.7	3.1	7.5	1.1	4.6	2.5	7.2	0.2	8.0	3.8	-	2.7	36.2
		100-150	2.6	61.1	17.2	19.1	S.C.L.	1.4	3.1	7.5	1.4	2.3	3.3	9.4	0.2	8.0	3.8	-	3.4	52.1
		0-20	1.9	69.7	3.7	24.7	S.C.L.	1.9	2.2	7.5	0.66	2.3	4.3	2.0	0.6	2.1	5.0	-	2.1	46.3
7	Kafr	20-60	0.9	73.8	17.9	7.4	S.L.	1.9	2.5	7.5	0.66	2.3	2.2	2.7	0.3	2.3	4.0	-	1.2	28.0
	El Gemal	60-90	0.5	85.2	9.6	4.7	L.S.	1.7	0.5	7.5	0.62	2.3	2.3	2.8	0.1	2.3	3.2	-	2	35.2
		90-120	0.9	64.9	16.4	17.8	S.C.L.	1.7	1.6	7.5	1.5	4.6	3.5	10	0.4	8.0	4.2	-	6.3	38.4
		0-25	6.4	62.4	15.4	15.5	S.C.L.	2.2	6.1	7.6	0.69	2.3	2.8	3.9	0.1	3.3	3.3	-	2.6	38.4
8	Qaha	25-60	3.1	29.5	15.1	52.3	C.	1.2	2.5	7.5	2.1	5.7	5.4	13.8	0.3	11.0	4.0	-	10.2	50.2
		60-90	3.7	33.7	16.8	45.8	C.	1.2	4.5	8.0	1.2	1.2	1.9	12.0	0.1	11.0	3.0	-	1.2	50.2
		90-120	1.8	36.2	19.3	42.7	C.	1.2	2.3	8.3	1.2	1.2	1.9	11.3	0.1	10.0	4.3	-	0.5	40.0

Table (1) Cont.

Prof. No.	Location	Depth (cm)	Particle size distribution: C Sand %	F Sand %	Silt %	Clay %	Textural class	O.M %	$CaCO_3$ %	pH	EC dSm^{-1}	Soluble cations (me/L): Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Soluble cations (me/L): Cl^{-}	HCO_3^{-}	$CO_3^{=}$	$SO_4^{=}$	CEC (me /100 g soil)
		0-25	2.1	28.6	24.7	44.6	C.	1.4	2.4	7.5	0.59	2.9	2.2	2.8	0.2	3.0	3.0	-	2.1	50.9
9	Sindiyun	25-75	1.4	29.4	21.8	47.4	C.	0.9	2.9	7.6	0.69	2.9	2.7	3.5	0.1	3.0	2.6	-	3.6	38.4
		75-110	1.9	30.6	22.9	44.6	C.	1.2	2.8	7.4	0.96	2.3	3.8	6.8	0.1	6.0	2.2	-	4.8	36
		0-25	2.9	42.9	29.0	25.2	L.C.	2.2	3.1	7.4	1.1	5.2	4.5	4.7	0.5	4.0	4.8	-	6.1	37.6
10	Qalyub	25-50	3.5	36.5	21.3	38.7	C.	1.2	3.3	7.5	0.65	3.5	1.6	2.9	0.3	3.0	2.4	-	1.9	45.0
		50-90	4.3	39.3	20.4	36	C.	1.2	2.3	7.4	0.84	4.0	2.1	3.8	0.3	3.0	2.8	-	4.4	36.0
		90-120	2.9	35.5	17.2	44.4	L.C.	0.9	2.2	7.4	0.70	3.5	2.7	3.6	0.2	3.0	2.9	-	4.2	37.6
		0-30	5.3	29.6	21.5	43.6	C.	1.9	3.7	7.6	1.2	2.3	2.8	9.2	0.3	8.0	4.4	-	2.2	39.2
11	Nawa	30-60	5.8	24.5	19.9	51.8	C.	1.7	3.5	7.9	1.5	1.7	1.8	14.0	0.2	12.0	5.0	-	0.7	35.2
		60-90	5.2	31.1	16.7	47	C.	1.4	3.2	8.1	1.6	1.2	0.9	17.3	0.2	16.0	3.0	-	0.6	37.6
		90-120	5.7	29.6	24.7	40	C.	1.4	3.3	7.8	1.9	1.2	1.9	19.0	0.2	18.0	3.4	-	0.9	27.2
		0-20	4.5	34.7	32.7	28.1	C.	2.3	4.3	7.7	1.4	3.5	3.7	9.4	0.6	8.0	5.0	-	4.2	24
12	Kafr	20-60	2.5	38.9	28.7	29.9	L.C.	0.9	2.9	7.8	1.1	2.3	1.8	7.4	0.3	7.0	4.0	-	0.8	24.4
	Shibin	60-90	1.9	44.1	26.4	27.6	L.C.	0.9	2.8	7.7	1.1	2.3	1.8	8.8	0.2	8.0	2.8	-	2.3	24.8
		90-120	1.8	41.7	25.2	31.6	L.C.	1.1	2.3	7.7	1.3	2.9	2.7	9.0	0.2	9.0	3.8	-	2.0	32.4
	Abu	0-25	68	18.3	4.7	9.0	L.S.	0.9	1.1	7.2	1.2	3.5	5.7	4.8	0.4	4.0	3.0	-	7.4	17.2
13	Zaaba	25-50	76.3	11.4	6.2	6.1	L.S.	0.6	2.2	7.3	0.9	3.5	4.7	2.8	0.3	3.0	3.0	-	5.3	9.2
	I	50-75	88.4	5.1	2.4	4.1	S.	0.6	1.1	7.4	0.7	2.3	2.8	2.5	0.3	2.0	2.2	-	3.7	4.8
		0-25	21.2	26.5	23.3	29	L.C.	1.7	2.6	7.4	1.1	3.5	3.7	6.0	0.3	6.0	4.4	-	3.1	25.6
14	Abu	25-60	21.5	20.2	23.4	34.9	L.C.	1.4	3.6	7.4	1.9	3.5	8.8	11.3	0.2	10.4	3.2	-	0.2	34.0
	Zaabal	60-90	8.9	22.9	26.6	41.6	C.	1.2	3.4	7.5	1.8	2.3	3.8	15.6	0.1	14.0	3.0	-	4.8	23.4
	II	90-120	4.7	30.6	25.8	38.9	C.	1.4	3.7	7.5	1.8	1.2	3.9	16.4	0.1	16.0	3.6	-	2.0	16.8
		0-20	62.5	27.8	4.3	5.4	L.S.	1.7	4.3	7.4	5.8	6.9	16.5	43.5	1.1	43.0	6.4	-	18.6	37.0
15	El-Khanka	20-75	74.4	10.2	6.8	8.6	S.L	0.9	1.4	7.6	3.4	6.9	4.3	27.5	1.0	25.0	3.4	-	11.3	15.6
		75-120	96.3	0.5	1.3	1.9	S.	0.9	0.3	7.8	2.0	2.9	3.3	12.3	0.5	12.0	2.0	-	5.0	1.2
		0-20	45.5	41.7	8.6	4.2	L.S.	1.9	0.40	7.1	0.93	3.5	2.2	4.8	0.75	4.0	4.0	-	3.3	23.4
16	El-Gabal	20-60	78.4	14.2	2.4	5	L.S.	1.2	0.30	7.3	0.71	2.3	2.3	3.9	0.5	3.0	2.2	-	3.8	8.6
	El –Asfar	60-100	91.2	4.3	0.2	4.3	S.	0.9	0.2	7.3	0.75	2.3	2.8	3.9	0.5	3.0	2.4	-	4.1	3.2
		0-25	67.1	11.9	5.7	15.3	S.C.L	1.7	1.6	7.1	0.96	3.5	3.7	3.7	0.73	3.0	6.0		2.63	20.0
17	El – Qalag	25-60	84.6	5.9	0.3	9.2	L.S.	1.2	0.30	7.1	0.51	2.3	1.8	2.6	0.22	3.0	2.0	-	0.92	12.8
		60-90	81.6	11.7	1.4	5.3	L.S.	0.6	0.10	7.3	0.96	4.6	2	4.6	0.22	3.0	2.8	-	5.62	8.4

L.S. = Loamy sand S. = Sand S.L. = Sandy Loam C. = Clay S.C.L. = Sandy Clay Loam

Results and Discussion

Status of micronutrients

Data in Table (2) show the total and available Fe Mn, Cu, Zn and Mo contents in the studied soil profiles.

Total iron

The data show that total Fe content of the studied soils ranges between 10200 and 66000 mg kg"[1]. The lowest values characterize the deepest layers of profiles 3 and 5 due to their high content of sand which is very poor in its iron content. On the other hand, the highest content of total Fe was found in the surface layer of profile 12 (Kafr Shibin).

The wide range of Fe content is apparently associated with soil texture and is probably dependent on the type of parent materials from which the soil was formed. It is worthy to note that soils of El-Monira, Qaha. Qalyub, Kafr Shibin and Abu Zabal contained amounts of total Fe exceeding 50000 mg kg"[1]. These soils are caracterized by their low content of $CaCO_3$ and fairly high content of clay. The lowest value of total iron (< 10200 mg/kg'[1]) are found in coarse textured soils represented by profiles 5, 6, 7, 13 and 17, while the medium textured soils represented by profiles 1, 3, 4, 9, 11, 16 and 17 have moderate amounts of total Fe.

Statistical analysis shows that total Fe is positively and high significantly correlated with $CaCO_3$ % (r = 0.499**), silt % (r = 0.599**) and clay % (0.652**) but negatively and significantly correlated with sand % which is in accordance with results of **El - Falaky (1981), and Hassona et al (1996).**

DTP A - extractable iron

Data presented in Table (2) show that the values of chemically available (DTP A - extractable) Fe renges between 4.4 and 18.5 mg kg"[1]. The highest value of DTPA-extractable Fe is found in the surface layer of profile 16 that represents the soil of El - Gabal El - Asfar, while the lowest one belongs to the coarse-textured soils of Kafr El - Ragalat, profile (3).

Considering the critical level of DTP A- extractable Fe which has been proposed by soltanpour and Schwab (1977), the index values of DTP A-extractable Fe are as follows:

low, 0 -2 mg kg^{-1}, marginal, 2.1 - 4.0 mg kg^{-1}, adequate, > 4 mg kg^{-1}.

The values of the studied soil profiles indicate that the studied soils belong to the adequate level.

The vertical distribution of DTP A- extractable Fe reveals a tendency for accumulation of available Fe in the surface layers, this behaviour may be due to continuous addition of fertilizers and manures, which is in a good agreement with **El-Saadani et al (1987).**

The statistical analysis shows that DTP A- extractable Fe is significantly, positively correlated with soil content of $CaCO_3$ (r - 0.331*), andOM(r= 0.422*) as well as CEC (r = 0.322*) and positive high significantly correlated with silt % (r - 0.340**) and clay % (r = 0.319**). In contrast, available Fe is negative high significantly correlated with sand % (r = - 0.373**). Almost similar trends were obtained by **Kishk et al (1980) and Hafez et al (1992).**

<u>Depthwise distribution of total iron:</u>

Data in Table (3) show that the weighted mean (W) for total Fe in the studied profiles varies between 12936.36 and 60716 mg kg^{-1}.

The lowest values of (W) for total Fe are associated with the light - textured soils i.e. those of Kafr El-Ragalat, Shiblanga, Sandanhor, Abu Zabal and El - Khanka. The highest values of (W) range between 41916.67 and 60716 mg kg'[1] and characterize the soils derived from fine textured Nile sediments. The soils of profile 1, 4, 7, 16 and 17 have moderate values of (W) ranging between 23625 % to 35968 % Fe.

The wide variations of weighted mean in the studied soil profiles may be attributed to geogenic factors rather than pedogenic ones, i.e., may be ascribed to the changes in, the nature of parent material rather than to soil formation processes of local conditions prevailing in each profile site.

Considering the trend (T), data indicate that the soils represented by profiles 6, 8, 11 and 14 display the highest symmetric values of total Fe among the studied profiles. The results also show that Fe in most of the studied profiles is usually higher in the surface layers than the deeper ones as indicated by the negative value for the trend.

Specific range for total Fe is generally larger than 0.08 and less than 1.72 which may suggest that these profiles are derived from uniform parent materials or to the mild effect of pedogenic processes. In other words, the specific range of total Fe indicates that the soil materials of profiles 6, 8, 10, 11, 12 and 14 are homogeneous, whereas the other profiles are probably formed from heterogeneous soil materials.

Total manganese:

The data presented in Table (2) show that total manganese contents range from 0.5 to 985 mg kg''[1]. The highest total Mn value is that recorded for the surface layer of profiles 14 (Abu Zabal), while the lowest is that of the 75-150 cm layer of profile 15 (El Khanka).

Generally, the wide range of total Mn in the studied soils can be attributed to the differences in the type and nature of soil materials. The sandy soils, (profiles 3, 4, 13, 15, 16 and 17) are characterized by the lowest contents of Mn, while the heavy textured ones (profiles 1, 2, 5, 6, 7, 8, 9, 10, 11, 12 and 14) have a fairly high content of Mn. These results could be ascribed to the parent materials of these soils.

Statistical analysis shows that Mn is positively and highly significantly correlated with soil contents of $CaC0_3$ % (r = 0.620**), MO % (r = 0.411**), CEC (r = 0.661**), silt % (r = 0.687**) and clay % (r-0.802**). Similar results were reported by Ghanem et al. (1971) for OM and clay % and Abdel - Razik (1994) for clay, clay + silt and organic matter. On the other hand, total Mn is negatively and highly, significantly correlated with sand (r = - 0.857**) content and negatively correlated with pH (r = - 0.262*).

DTPA - extractable Mn

Data presenred in Table (2) show that the values of chemically available (DTPA - extractable) Mn renge between 0.4 and 9.5 mg kg^{-1}. The highest value of DTPA -extractable Fe is found in the surface layer of profile 3 (Kafr El - Ragalat), while the lowest one belongs to the deepest layer of profile 8 (Qaha).

Regarding the influence of profile depth on the available Mn, higher values are found in the surface layers than the subsurface ones in the most of the studied soil profiles, this is ascribed to surface applications of both fertilizers and manures.

According to **Soltanpour and Schwab (1977),** the critical values of DTP A-extractable Mn are as follows: low, 0 -1.8 mg kg''[1], adequate > 1.8 mg kg''[1] Mn. The results of the studied soil profiles indicate that the studied soil samples belong to either the low or the adequate levels (9.9 and 90.1 %, respectively).

The statistical analysis shows that DTPA- extractable Mn is highly, significantly but negatively correlated with soil pH (r = - 0.379**). No significant correlation could be detected with all the other tested factors.

Deptltwise distribution of total Mn:

Data in Table (3) show that the weighted mean (W) of total Mn in the studied profiles ranges between 126.2 and 877.4 mg kg^{-1}. It shows also, the similarly of values of weighted mean (W) for total Mn within some of the studied profiles, for instance, the weighted means of Sandanhor and Qaha soils (profiles 6 and 8) Qalyub and Abu Zaabal soils (profiles 10 and 14) and Shiblanga and Sindiyun soils (profiles, 5 and 9). On the other hand, the rest of the studied soil profiles show a wide range of the considered weighted mean within the studied area.

The values of trend (T) show that the soils of Abu El-Ghait, Shiblanga, Sandanhor, Qalyub, Nawa, Abu Zaabal and El - Gabal El - Asfar (profiles, 1, 5, 6, 10, 11, 14 and 16) are of highly symmetrical Mn values as the T - values range between - 0.10 and - 0.12. In addition,, the values of specific range (R) for the studied profiles show that soil materials of profiles 1, 5, 8, 9,10, 11 and 15 are homogeneous whereas those of the other profiles are heterogeneous ones, Table (3).

Total copper:

The data presented in Table (2) show that total copper content in the studied soils varies widely, ranging from 17.7 to 97.5 mg kg"[1]. The highest value is found in the surface layer of profiles 11 (Nawa), while the lowest was detected in the deepest layer of profile 15 (El Khanka).

From the above mentioned presentation, one can conclude that the fine textured alluvial soils are relatively higher in their total Cu content than the coarse textured soils.

The vertical distribution of total Cu content in the soils under consideration indicates no specific pattern that could be used to distinguish one soil from another except for profiles 15 and 16 in which Cu decreased with depth.

Statistical analysis reveals positive and highly significant correlations between total Cu soil content and each of $CaCO_3$ % (r = 0.486**), CEC (r = 0.394**), silt % (r = 0.641**) and clay % (r = 0.709**). The data on the other hand, reveal a highly significant but negative correlattion between soil total Cu content and sand content (r = -0.775**).

DTP A - extr actable copper

Data presented in Table (2) show that the value of soil chemically available (DTPA - extractable) Cu varies from 1.1 to 9.9 mg kg^{-1}. These data indicate that the highest value of DTPA - extractable Cu is associated with the soils of El - Gabal El - Asfar (profile, 16) which are irrigated with sewage water, while the lowest DTPA - extractable Cu values occurred in the soils of El - Khanka (profile, 15).

Depthwise distribution of available Cu indicates that, in most cases, extractable Cu increases in the surface layers and tendes to decrease with depth.

According to **Soltanpour and Schwab (1977),** the index values used for DTPA-extractable Cu are as follows: low, 0 -0.05 mg kg^{-1}, high > 0.5 mg kg^{-1} Cu. The results of the studied soil profiles indicate that the studied soils are of high available copper content.

The statistical evaluation of available Cu in relation to soil variables indicates that the extractable Cu is positively and high significantly correlated with each of $CaCO_3$ % (0.362**), OM % (r - 0.629**) and CEC (r = 0.736**) and positively, significantly correlated with silt % (r = 0.334*) and clay % (r = 0.279*). On the other hand, available Cu correlated negatively and high significantly with sand content % (r =-0.356*).

Depthwise distribution of total Copper:

Table (3) shows that the weighted mean (W) of total Cu in the studied profiles varies widely between 12.09 and 66.96 mg kg"^{1}. The lowest values of (W) are associated with the low percent of silt and clay fractions. The highest values of (W) characterize the soils derived from fine textured Nile sediments. The wide variations encountered within or between profiles may reflect the variations in parent materials as affected by both geogenic or pedogenic processes.

Considering the trend (T) and specific range (R), data reveal that the computed trend indicates more symmetrical Cu disturibution in profiles 1, 2, and 9 as indicated by the smallest values of (T). The specific range (R) indicates that the soil profiles 1, 2, 3 ,5, 6, 8, 11, 13 and 15 are formed of homogeneous materials, while the other profiles are constituted from heterogeneous soil materials.

Total Zn

Table (2) show that total zinc content of horizons ranges from 32.0 to 159.5 mg kg^{-1}. The highest value characterizes the surface layer of profiles 14 (Abu - Zaabal), while the lowest value characterizes the deepest layer of profile 15 (El Khanka).

From these data, it seems that the wide range of total Zn is correlated with soil texture, for instance, the highest total Zn is found in the heavy textured soils, while the lowest values are detected in the sandy textured soils.

According to Chapman (1965), the levels of total Zn content below 50 mg/kg^{-1} could be considered low and those above 100 mg kg^{-1} could be considered high.

The results indicated that the soils belonging to medium and high Zn levels groups represented 43.3% and 43.4 %, respectively, whereas 13.3 % only belongs to the low level.

Distribution of total Zn through the studied soils may be influenced bu some factors, relationships between total Zn and some of these factors were computed. The obtained correlation coefficients indicate that total Zn
positively and high significantly correlated with $CaCO_3$ % (r = 0.505**), OM % (r = 0.452**), CEC r = (0.565**), silt % (r = 0.428**) and clay % (r = 0.544**), while it is showing a highly significant but negative correlation with sand content % (r = -0.536**). These findings are in agreement with those of Metwally et al. (1977) and Kamh (1981).

DTPA - extractable Zn

Data presented in Table (2) show that the values of chemically available (DTPA - extractable) Zn in the soils under consideration vary between 0.3 to 4.2 mg kg^{-1}. The highest value is presented in the surface layer of profile 10 (Qalyub), while the lowest one is that of the deepest layer of profile 15 (El - Khanka).

Regarding the influence of depth on soil content of available Zn, it could be noticed that the highest values are found in the surface soil layers while the lowest ones are generally detected in the deepest ones, this is true in all the studied profiles except in the 75 - 125 cm and 50 - 100 cm layers of profiles 1 and 2, respectively.

The tendency of Zn to accumulate in the surface layers may be due to the presence of the organic matter in these layers in relatively higher amounts besides of the added fertilizers and manuers.

According to Soltanpour and Schwab (1977), the index values used for DTPA-extractable Cu are as follows: low 0 - 0.9 mg kg^{-1}, marginal 1 - 1.5 mg/kg^{-1}, adequate > 1.5 mg/kg^{-1}. The obtained results indicate that the studied soil are belonging to adequate, marginal and low groups represented by 66.7 %, 16.6 % and 16.7 % of the studied soils,respectively.

The statistical evaluation of available Zn in relation to soil variables indicates that the DTPA - extractable Zn is correlated positively and high significantly with the percentages of $CaCO_3$ (r = 0.614**), OM (r = 0.398**), silt (r = 0.521**), clay (r = 0.574**) and CEC (r = 0.497**), and negatively, high significantly correlated with sand content % (r = - 0.627**).

Depthwise distribution of total Zn

Data in Table (3) reveal that the majority of the studied profiles have an irregular vertical distribution of soil total Zn with depth, which is probably associated with the changes in soil texture.

The value of weighted mean (W) of total Zn in the studied profiles varies between 36.7 and 151.1 mg kg^{-1}. The lowest values of (W) characterize the sandy and light textured soils, while the rest of the studied soil profiles are characterized by high weighted mean values of total Zn.

Considering the trend (T), the values presented in Table (3) show that the computed trend of the soils of profiles 1, 2, 5, 6, 8, 9, 10, 12, 14 and 16 are of more symmetrical Zn distribution than other profiles. The specific range (R) of Zn shows that the soil materials of profiles 2, 3, 6, 12, 13 and 16 are homogeneous, whereas the other soil materials of the other profiles are heterogeneous regarding Zn content. Also the relative values of trend (T) show that in most of the studied profiles, total Zn is usually higher in the surface layers than in the deeper ones.

Total Mo

The distribution and levels of total Mo content in the studied soil horizons are shown in Table (2). Total soil Mo ranges from 2.9 to 21.4 mg kg^{-1}. The highest value characterizes the surface layer of profile 16 representing the soils of El - Gabal El Asfar, while the lowest value characterizes the deepest layer of profile 17 representing the soil of El - Qalag. The studied area can be described as follows.

The highest Mo content in the soil profiles of Abu El Ghait, Kafr El Ragalat, Shiblanga, Qaha, Abu Zaabal and El Gabal El Asfar is probably due to the presence of either colloidal particles in the clay fraction of the soil or higher content of organic matter.

The vertical distribution of total Mo content in the soils under consideration indicates no specific pattern that may distinguish one soil from another, except for soils of Kafr El - Ragalat, Nawa, Abu Zabal, El - Gabal El - Asfar and El Qalag in which total Mo tended to decrease with depth.

Computed correlation coefficients between total Mo content and soil variables, indicate that total Mo is positively and significantly correlated with OM % (r = 0.311*), CEC (r = 0.305*), silt % (r = 0.279*) and clay % (r = 0.277*). On the other hand, sand content is negatively and significantly correlated with total Mo (r = - 0.316*).

DTPA - extractable Mo

Data presented in Table (2) show that the amounts of DTPA - extractable Mo in the soils under consideration range from 0.07 to 1.24 mg kg^{-1}. The lowest value is found in the deepest layer of profile (15) representing the soil of Qaha, while the highest value is detected in the subsurface layer of profile (7) representing the soils of Kafr El - Gemal.

The vertical distribution of extractable Mo indicates a relative increase of Mo in the top surface layer or the subsurface one with a tendency to decrease downwards in the soil profiles. This could be explained by the presence of favourable soil variables governing extractable Mo in the uppermost surface layers of each soil profile.

The statistical evaluation of available Mo in relation to soil variables indicates that the DTPA - extractable Mo is correlated negatively and significantly with EC (r = - 0.327*). In contrast, DTPA - extractable Mo is insignificantly correlated with the other investigated factors.

Depthwise distribution of total Molybdenum

Considering the weighted mean (W) of total Mo, data in Table (3) show that it varies between 4.5 and 18.2 mg kg^{-1}. The lowest values (5.4 and 8.8 mg/kg^{-1}) characterize the soils of Kafr El-Ragalat, Kafr El - Gemal, Abu Zabal, El Khanka and El Qalag which have coarse texture, while the highest values (10.4 to 18.2 mg/kg^{-1}) are those of the alluvial soils. The wide variation in the values of (W) within each of these profiles are either attributed to the depositional regime or to the variation within the parent materials from which the soils were derived.

The values of the trend (T) in Table (3) show that the soils of Abu El - Ghait, Sandanhor, Qaha, Qalyub, Kafr Shibin and Abu Zaabal are highly symmetrical as the T - values range from - 0.03 and 0.01. The rest of soils are less symmetric as T - values range from - 0.25 to 0.57. The values of the specific range (R) of total Mo in the studied soil profiles range between 0.14 and 1.93. The low values are associated with the soils of Qaha (profile, 8) having highly symmetrical distribution of Mo, while those of high R values belong to the soils of Kafr El - Ragalat.

The statistical measures could be taken as indicators of the possible variations in parent sediments, depositional regime as well as the pedogenic processes prevailing during soil formation.

Table (2) .Total and available (DTPA - extractable) Fe, Mn, Zn, Cu and Mo (mg kg^{-1}) of the studied soil horizons

Prof. No.	Location	Soil depth (cm)	Fe Total	Fe Available	Mn Total	Mn Available	Cu Total	Cu Available	Zn Total	Zn Available	Mo Total	Mo Available
		0 - 25	21120	11.2	720.0	5.4	68.6	8.2	105.0	3.6	16.5	0.84
1	**Abu El**	**25-75**	38210	10.0	890.0	3.5	81.5	7.3	124.0	1.8	11.0	0.30
	Ghait	**75-125**	41150	10.7	790.0	6.8	85.4	5.4	130.0	3.6	20.5	1.04
		0-20	55600	13.4	820.0	4.5	59.9	6.9	80.0	2.5	16.0	0.80
2	**El Munira**	**20-50**	51200	8.9	650.0	3.4	67.7	4.8	71.0	2.2	9.5	0.83
		50-100	54200	11.2	540.0	3.9	70.2	4.5	55.0	2.9	11.5	0.38
		100-150	41300	15.6	619.0	2.9	68.5	5.2	60.0	1.4	7.5	0.54
		0-30	43200	12.5	650.0	9.5	49.6	9.2	100.0	1.9	20.5	0.78
3	**Kafr El-**	**30-70**	12300	11.1	190.0	7.2	29.8	5.8	60.0	1.9	6.5	0.34
	Ragalat	**70-120**	10200	4.4	145.5	1.5	30.9	2.8	25.0	0.4	3.5	0.36
		0-20	44500	12.5	550.0	4.3	52.3	9.3	155.0	2.3	8.5	0.62
4	**Kafr Saad**	**20-50**	41300	8.9	559.0	7.5	58.5	4.4	105.2	2.2	5.5	0.16
		50-90	12200	5.6	220.0	2.4	29.4	5.5	40.0	0.5	20.5	0.30
		90-120	11500	8.9	180.0	1.5	29.5	6.2	59.0	1.4	17.0	0.80
		0-20	12500	13.5	820.0	2.3	33.6	8.9	140.0	2.6	8.0	0.66
5	**Shiblanga**	**20-60**	10200	10.2	710.0	1.6	24.5	8.8	158.0	2.3	21.0	0.16
		60-110	15300	12.3	720.0	2.4	24.6	7.5	150.0	2.3	20.0	0.76
		0-20	21500	9.2	560.0	3.7	32.4	7.9	102.5	3.0	9.78	0.22
6	**Sandanhor**	**20-50**	19000	8.9	650.0	2.5	35.9	8.6	92.3	2.6	18.0	0.91
		50-100	19500	10.2	520.0	8.4	38.9	7.5	97.1	1.3	4.0	0.36
		100-150	19500	10.2	770.0	4.9	24.8	8.9	93.7	1.2	14.0	0.26
		0-20	54300	12.3	775.0	5.2	53.3	9.1	175.0	3.2	15.0	0.9
7	**Kafr**	**20-60**	16500	9.5	250.5	6.2	22.4	8.3	80.5	1.5	5.0	1.26
	El Gemal	**60-90**	15100	4.5	190.0	4.6	21.5	7.9	45.1	0.5	5.0	0.42
		90-120	21200	8.2	790.0	8.2	53.9	8.7	58.9	1.4	6.0	0.14
		0 - 25	55600	10.8	755.0	3.7	54.7	8.1	91.0	4.0	15.5	0.32
8	**Qaha**	**25-60**	51200	11.2	890.0	4.0	89.6	7.5	14.2	3.6	13.5	0.32
		60-90	54500	13.4	870.0	0.5	82.7	9.04	115.0	3.8	14.4	0.32
		90-120	54300	9.4	820.0	0.4	91.5	8.9	98.0	2.9	17.0	0.02

Table (2) Cont.

Prof. No.	Location	Soil depth (cm)	Fe		Mn		Cu		Zn		Mo	
			Total	Available	Total	Available	Total	Available	Total	Available	Total	Available
		0-25	20500	11.7	790.0	5.4	23.9	8.8	102.0	3.8	7.0	0.54
9	**Sindiyun**	**25-75**	55000	8.5	725.0	8.1	85.4	8.6	97.5	2.5	12.0	0.30
		75-110	41500	8.9	720.0	6.3	74.1	7.2	85.7	1.9	11.0	0.34
		0-25	59200	9.8	980.0	7.2	91.1	6.5	140.1	4.2	15.4	0.59
10	**Qalyub**	**25-50**	54000	11.2	890.0	6.5	69.8	6.3	125.0	1.9	15.4	0.66
		50-90	55000	10.7	810.0	3.7	74.9	5.5	120.1	2.2	14.4	0.88
		90-120	52000	11.2	850.0	5.6	65.1	5.1	97.9	2.8	9.0	0.75
		0-30	54200	13.4	940.0	7.1	97.5	7.2	146.9	3.8	17.5	0.91
11	**Nawa**	**30-60**	50500	13.3	824.0	5.6	66.4	5.4	65.3	2.9	15.4	0.56
		60-90	50200	11.9	820.0	5.4	60.1	5.1	80.2	1.4	8.0	0.30
		90-120	44500	10.3	790.0	5.6	66.4	4.4	88.5	2.2	4.0	0.36
		0-20	66000	15.6	960.0	4.9	78.3	7.5	115.0	4.1	15.0	0.08
12	**Kafr**	**20-60**	58200	12.3	750.0	2.0	63.7	4.3	102.0	3.3	5.0	0.12
	Shibin	**60-90**	55000	11.2	780.0	2.8	72.6	4.1	102.0	3.9	14.0	0.90
		90-120	55000	7.9	770.0	9.4	71.6	3.4	100.0	1.2	17.0	0.08
	Abu	**0-25**	1950	8.5	250.0	6.2	46.1	1.2	75.0	3.5	11.0	0.12
13	**Zaabal**	**25-50**	1220	10.1	175.0	3.7	23.7	1.5	54.0	1.5	9.0	0.31
	I	**50-75**	1150	4.5	87.0	1.2	27.4	1.4	30.0	0.5	5.0	0.76
		0-25	63500	11.2	985.0	6.2	79.4	5.8	159.0	3.9	17.0	0.24
14	**Abu**	**25-60**	62500	12.2	840.0	3.0	58.4	5.8	135.0	3.2	15.0	0.38
	Zaabal	**60-90**	58200	15.5	840.0	3.3	56.9	4.1	130.0	2.7	14.2	0.24
	II	**90-120**	59100	7.9	870.0	3.5	63.1	4.1	140.0	2.4	16.0	0.16
		0-20	21500	11.2	189.0	6.0	24.3	4.9	55.0	1.5	7.7	0.08
15	**El-Khanka**	**20-75**	19200	10.3	145.5	1.9	22.3	1.2	42.0	0.9	4.3	0.07
		75-150	12300	5.5	105.0	2.6	17.7	1.1	32.0	0.3	5.5	0.62
		0-20	42300	18.5	440.0	7.3	51.5	9.9	52.1	1.6	21.4	0.72
16	**El-Gabal**	**20-60**	28900	10.2	395.0	5.3	28.4	4.1	45.0	0.7	16.0	0.18
	El -Asfar	**60-100**	17500	12.5	385.0	5.2	20.4	2.7	48.9	0.7	12.0	0.34
		0-25	512	10.2	750.4	9.3	58.3	2.9	152.0	3.7	9.0	0.56
17	**El - Qalag**	**25-60**	210	10.2	179.3	4.8	22.6	1.2	55.5	0.4	7.3	0.47
		60-90	135	7.6	175.5	5.5	24.1	1.9	51.9	0.4	2.9	0.47

Table (3). Weighted mean, (W) trend (T) and specific range (R) of total Fe, Mn, Cu, Zn and Mo in the studied soil profiles.

Prof. No.	Location	Fe			Mn			Cu			Zn			Mo		
		W	T	R	W	T	R	W	T	R	W	T	R	W	T	R
1	Abu El – Ghait	35968	0.41	0.56	813	0.12	0.21	67.0	- 0.02	0.25	122.6	0.14	0.20	15.9	- 0.04	0.60
2	El Munira	49486	- 0.11	0.29	625.8	- 0.24	0.45	43.5	- 0.27	0.23	63.2	- 0.21	0.40	10.4	- 0.35	0.82
3	Kafr El - Ragalat	19150	- 0.56	1.72	286.6	- 0.56	1.76	25.3	- 0.48	0.043	55.4	- 0.45	1.4	8.8	- 0.57	1.93
4	Kafr Saad	24683	- 0.45	1.34	315.8	- 0.43	1.20	16.1	0.- 69	1.80	76.7	- 0.51	1.5	13.9	0.39	1.08
5	Shiblanga	12936	0.034	0.39	734.5	- 0.10	0.15	17.3	- 0.48	0.52	151.1	0.14	0.12	18.2	0.56	0.71
6	Sandanhor	19666	- 0.09	0.13	634.8	0.12	0.41	12.6	- 0.61	1.11	96.3	- 0.10	0.11	10.9	0.10	1.28
7	Kafr El - Gemal	23625	- 0.56	1.66	457.8	- 0.41	1.31	13.6	- 0.74	2.38	82.0	- 0.53	1.94	6.9	- 0.54	1.45
8	Qaha	53716	- 0.04	0.08	634.5	- 0.19	0.21	34.3	- .037	1.07	114.3	0.20	0.5	15.0	- 0.03	0.14
9	Sindiyun	42863	0.52	0.80	738.2	- 0.76	0.14	29.0	0.17	2.12	95.7	- 0.11	0.17	10.5	0.33	0.48
10	Qalyub	41916	- 0.29	0.17	872.1	- 0.11	0.19	35.3	- 0.61	0.74	119.7	- 0.15	0.42	13.5	- 0.12	0.48
11	Nawa	49850	- 0.08	0.19	843.5	- 0.10	0.18	40.9	- 0.58	0.91	95.2	- 0.35	0.86	11.2	- 0.36	1.21
12	Kafr Shibin	57900	- 0.12	0.19	797.5	- 0.17	0.33	31.0	- 0.60	0.47	103.7	- 0.18	0.11	11.9	- 0.21	1.01
13	Abu Zaabal I	14400	- 0.26	0.56	170.8	- 0.32	0.95	24.5	- 0.46	0.91	53	- 0.33	0.85	8.3	- 0.25	0.72
14	Abu Zaabal II	60716	- 0.04	0.09	877.4	- 0.11	0.25	33.5	- 0.57	0.67	140	- 0.12	0.21	15.5	- 0.09	0.18
15	El - Khanka	16056	- 0.25	0.57	126.2	- 0.33	0.67	12.1	- 0.50	0.54	38.7	- 0.36	0.59	5.4	- 0.30	0.62
16	El Gabal El Asfar	27020	- 0.36	0.92	400	- 0.10	0.14	18.5	- 0.64	1.68	48.8	- 0.13	0.11	15.5	- 0.28	0.61
17	El - Qalag	26888	- 0.47	14	336.7	- 0.55	1.71	24.2	- 0.58	1.47	81.1	- 0.57	1.2	6.3	- 0.30	0.97

References

Abdel-Razik, S. M. (1994). Evaluation of some newly reclaimed soils in Eastern Delta, Egypt. Ph. D. thesis Fac. Agric. Zagazig Univ.

Chapman, H. D. (1965). Diagnostic criteria for plant and soils. Univ. of California division of Agric. Sci.

El-Falaky, A. A. (1981). Studies on iron in some soils of Egypt. Ph. D. Thesis, Fac. of Agric. Cairo Univ., Egypt.

El-Saadani, A. M., Rabie, A. H.; Abdel-Latif, E. A. and Abdel-Hadi, A. H. (1987). Status of chemicaly available nutrients in some cultivated sandy soils of Ismailia Governorate. Soils and water Res. Inst. Agric. Res. Center.

Ghanem, I., Hassan, M. N, Khedr, H. and Tradras, H. (1971). Studies on manganese in soils: I - Status of Mn in some selected soils of Egypt. Egypt J. Soil Sci., 11: 113-120.

Hafez, I. W., Abd El- Hamid, E. A., Tag El-Din, A. S. and Aser, N. M. (1992). Available iron and manganese as affected by soil variables in calcareous soils. Egypt J. Soil Sci., 32: 423-436.

Hassona, H. H., Guindy, M. M., Abdel Nabi, A. O. and Abdel Razik, S. A. (1996). Micronutrient status as related to soil texture in the east of Komombo, Aswan area J. Agric. Sci., Mansoura Univ., 21 (11) 4219.

Jackson, M. L. (1973). Soil chemical analysis: Prentic Hall, India Private, LTD, New Delhi.

Kamh, R. N., (1981). Supplying power of soils of Sinai for some micro-elements. Ph. D. Thesis, Fac. Agric. Ain Shams Univ. Egypt.

Kishk, M. A., Ghoneium, M. F., Orabi, A. A. and Ismail, S. A. (1980). Status of iron in the soils of El -Menia Governorate. El Menia J. Agric. Res Div, Res Bull No 13.

Lindsay, W. L. and Norvell, W. A. (1978). Development of a DTPA soil test for zinc, iron, manganese and copper. Soil Sci. Soc. Am. J. 42: 421- 428.

Metwally, A. I. Omar, M. A. and Abd El-Latief, E. A. (1977). Zinc status in highly calcareous soils of A.R.E. Egypt. J. Soil Sci., 17 (1) 45 - 55.

Soltanpour, P. N. and Schwab, A, A. P. (1977). A new soil test for simultaneous extraction of macro and micro-nutrients in alkaline soils. Common Soil Sci: Plant Anal. 8: 195-207.

حالة بعض المغذيات الصغرى فى أراضى محافظة القليوبية

عصمت حسن عطسة نوفل* – حسنى حسين حسونة – حسن حمزة عباس* – غادة عبد العزيز عبد القادر****

*** قسم الأراضى والكيمياء الزراعية – كلية الزراعة بمشتهر – جامعة الزقازيق (فرع بنها) – مصر**

**** معهد بحوث الأراضى والمياه – الجيزة – مصر**

يهدف هذا البحث إلى دراسة حالة بعض المغذيات الصغرى فى أنواع الأراضى المختلفة فى محافظة القليوبية وكذلك إيجاد العلاقة بين الكميات الكلية والميسرة لكل من الحديد ، المنجنيز، الزنك، النحاس والموليبدينم وبين بعض المتغيرات (كربونات الكالسيوم، المادة العضوية، قوام التربة، السعة التبادلية الكاتيونية) فى أراضى المحافظة.

ولتحقيق الهدف من البحث أختير سبعة عشرة قطاعا أرضيا لتمثل أنواع الأراضى المختلفة بالمحافظة وقدر بها بعض الخواص الطبيعية والكيميائية وكذلك تركيز العناصر السابقة ويمكن تلخيص النتائج المتحصل عليها فيما يلى:

- تراوح تركيز الحديد الكلى فى الأراضى المدروسة ما بين ١٠٢٠٠ و ٦٦٠٠٠ ملليجرام/كجم بينما تراوح تركيز الحديد المستخلص بالـ DTPA بين ٤.٤ و ١٨.٥ ملليجرام/كجم .
- تراوح تركيز المنجنيز الكلى فى الأراضى المدروسة ما بين ٠.٥ و ٩٨٥ ملليجرام/كجم وقد أعزى المدى الواسع من محتوى الأرض من المنجنيز إلى الإختلاف فى طبيعة ونوع مواد التربة، بينما تراوح تركيز المنجنيز المستخلص بالـ DTPA بين ٠.٤ و ٩.٥ ملليجرام/كجم .
- تراوح تركيز الزنك الكلى فى الأراضى المدروسة ما بين ٠.٣٢ و ١٥٩.٠ ملليجرام/كجم بينما إختلف تركيز الزنك المستخلص بالـ DTPA بين ٠.٣ و ٤.٢ ملليجرام/كجم متوقفا على قوام التربة.
- تراوح تركيز النحاس الكلى فى الأراضى المدروسة ما بين ١٧.٧ و ٩٧.٥ ملليجرام/كجم بينما إختلف تركيز النحاس المستخلص بالـ DTPA بين ١.١ و ٩.٩ ملليجرام/كجم مع زيادة تركيزه فى الطبقات السطحية
- إختلف محتوى قطاعات التربة المدروسة من الموليبدينوم الكلى كثيرا فقد تراوحت كميته من ٢.٩ إلى ٢١.٤ ملليجرام/كجم بينما إختلف تركيز الموليبدينوم المستخلص بالـ DTPA بين ٠.٠٢ و ١.٢٤ ملليجرام/كجم وقد أظهر التوزيع الرأسى للموليبدينوم المستخلص بالـ DTPA زيادة تركيزه نسبيا فى الطبقات السطحية
- أظهر التحليل الإحصائى وجود إرتباط موجب عالى المعنوية بين محتوى التربة من معظم العناصر المدروسة ومحتوى التربة من كل من كربونات الكالسيوم، % للسلت ، % للطين والسعة التبادلية الكاتيونية بينما وجدت علاقة سالبة عالية المعنوية مع % للرمل.
- وجد أن معظم القطاعات المدروسة ذات محتوى كافى من الحديد والمنجنيز الميسر وذات محتوى على من النحاس الميسر بينما كانت ذات محتوى كافى وحدى من الزنك
- يشير الإتجاه T إلى أن معظم قطاعات التربة كانت عالية التناسق بالنسبة لكل من الحديد ، المنجنيز، الزنك، والنحاس بينما أظهر النطاق النوعى تجانس بعض قطاعات التربة بالنسبة لبعض العناصر وعدم التجانس بالنسبة للبعض الأخر.