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MICRONUTRIENTS AS CORRELATED TO SOME SOIL VARIABLES OF WADI EL-LAQITA SOILS, QINA GOVERNORATE, EGYPT.

Gendy, O. S.

Soils, Water and Environment Res. Institute, A.R.C. Giza, Egypt.

ABSTRACT

The current study was carried out to evaluate the relation between total and available of some micronutrients (Fe, Mn, Zn and Cu) with some soil variables *i.e.* pH, ECe values, Organic matter %, Soil texture, $CaCO_3$ % and soil fractions (sand, silt and clay %). Forty three soil samples were collected from sixteen soil profiles which represented five physiographic units of Wadi El- Laqita soils, Qina governorate.

Total Fe contents of the soil profiles for the studied units were ranged from 37200 to 52100; 34800 to 40600; 24900 to 38920; 31560 to 71120 and from 55800 to 59200 mg/kg. While, total Mn contents ranged from 340 to 430; 280 to 385; 170 to 350; 260 to 630 and between 390 to 420 mg/kg. Whereas, total Zn contents ranged between 34 to 75; 29 to 41; 30 to 62; 30 to 85 and between 59 to 69 mg/kg. But, total Cu contents ranged between 27 to 58; 47 to 75; 29 to 61; 30 to 79 and between 34 to 49 mg/kg for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively.

Available Fe ranged from 6.5 to 10.8, 5.7 to 9.2, 4.8 to 8.5, 5.9 to 14.8 and from 13.4 to 16.2 mg/kg. Whereas, available Mn values ranged between 2.8 to 4.4, 2.1 to 7.2, 1.6 to 3.8, 3.2 to 7.9 and between 1.9 to 2.4 mg/kg. But, available Zn ranged from 0.5 to 2.1; 0.3 to 0.7; 0.3 to 0.9; 0.3to 2.5 and from 1.0 to 2.1 mg/kg. While, available Cu ranged from 0.4 to 1.5; 0.3 to 0.7; 0.4 to 1.2; 0.3 to 2.2

and from 0.7 to 1.6 mg/kg for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively.

The relationships between total and available micronutrients with some soil variables observed that pH values, Organic matter %, $CaCO_3$ %, and soil fractions (sand, silt and clay %). play an important role in the concentration of micronutrients in the studied soils

The narrow variations of weighted mean (W) between the most of the soil profiles may be attributed to pedogenic factors rather than geogenic ones, or may be attributed to the same nature of parent material from which the soils are derived, the trend (T) indicate that most of soil profiles are highly symmetric with respect (Fe, Mn, Zn and Cu),whereas the specific range (R) show homogeneity of some soil profiles with respect to some micronutrients and heterogeneity with others of soil profiles.

Key words: soil properties, Qena, total and available micronutrients, Wadi El- Laqita.

INTRODUCTION

Wadi El-Laqita in the Eastern desert at Qina governorate, is considered an important situation and a promising area for cultivation, this is due to its location near to eastern portion of Nile valley and its irrigation source is either from River Nile or artesian wells. This area was covered about 89500 feddens with an average 373.7 Km^2

The distribution of micronutrients (Fe, Mn, Zn and Cu) in soil is dependent almost on the bedrock from which soil parent material was derived. Both geochemical and weathering processes are responsible for forming of soil materials as a final product upon time. Macro and micronutrients are present in all types of soils in the whole. 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 controlled by several soil environmental factors. **(Stevenson,1986)**. The variations are controlled by several soil environmental factors. Therefore, it is of interest to delineate these factors and to determine their relative contribution to macro and micronutrient forms in soils.

Under the Egyptian soil consideration the pedochemistry of such micronutrients were given under consideration with particular emphases on soil genesis and formation. Moreover, the factors controlling micronutrients status such as soil fractions (sand, silt and clay %), $CaCO_3$ % and O.M contents, salinity, are also considered. **(El-Demerdashe *et al;* 1980, Hassona *et al.*, 1996; Abdel-Razik 2002; Garis 2006; Abd- Alla *et al.* 2009 and Soliman *et al.*, 2015).**

The objective of this work points to an evaluation of some micronutrients distribution in the main physiographic units of wadi El-Laqita, Qena governorate which are considered as promising potential soils for horizontal agricultural expansion. Also, to shed light on the relationship between total and chemically extractable micronutrients and some soil characteristics.

MATERIALS AND METHODS

Forty three soil samples were collected from sixteen soil profiles represent five physiographic units in wadi El-Laqita, south of Qena governorate and east of Qaft center at the eastern part of Wadi El-Nile as shown in **Fig.(1).** Soil samples were collected, air dried, crushed, sieved through a 2 mm sieve and subjected to different physical and chemical analyses which determined according to the methods outlined in **Jackson (1973)** and **Loveday (1974).**

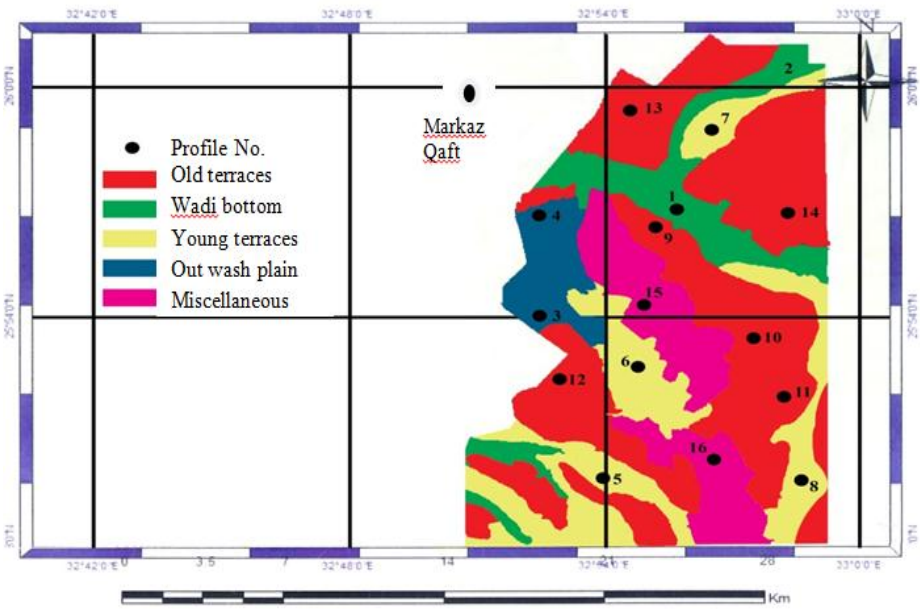

Fig.(1): Physiographic units and locations of the studied soil profiles.

The studied soil profiles of this area were categorized into five physiographic units, Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land (**EL-Tapey *et al*., 2018)**

-For determination of total soil Fe, Mn, Zn and Cu of the studied soil samples, were digested in HF-HCLO4 acids mixture in a Teflon crucible **Jackson (1973).**Whereas available soil Fe, Mn, Zn and Cu were extracted by diethylene triamine penta acetic acid (pH=7.3) according to (**Lindsay** and **Norvell 1978).** Total and available micronutrients were measured by Atomic – spectrophotometer. Statistical analysis for obtained values were carried out according to (**Soltanpour and Schwab, 1977**).

RESULTS AND DISCUSSION

General view on the representative soil profiles of the studied units.

1) Wadi bottom

Data presented in **Table (1)** showed that, the soils of that unit which are represented by (profiles Nos.1and 2) have soil texture class variable from sandy loam, loamy sand and sand. These soils were characterized with deep soil depth, soil reaction is slightly to moderately alkaline where pH values varied from 7.65 to 8.37. These soils are characteristics with non-saline as indicated by EC values which varied from 0.43 to 1.26 *dS*/m. Organic matter % contents were ranged from 0.03 to 0.12. $CaCO_3$ % contents were varied between 2.19 and 10.27 % with an irregular distribution pattern with depth.

2) Fans and outwash plain.

Soil of profiles Nos. 3 and 4 are represented this mapping unit as shown in **Fig (1),** the soils of this unit were deep soil depth which varied from 140 to 150 Cm**.** Texture classes of all profiles were sandy in this entire mapping unit.

Soil reaction (pH) varied from slightly alkaline level (7.5) to moderately alkaline level (8.0). Soil salinity ranged between 2.70 and 7.60 *dS/*m, which changed from slight saline to moderate saline. Organic matter contents varied between 0.06 and 0.14%. $CaCO_3$ % contents varied from 9.65 to 13.83 %. The distribution of $CaCO_3$ does not portray any specific pattern with soil depths.

3) Young terraces.

Soils of profiles Nos. 5,6,7 and 8 are representative profiles for this unit. Soil reaction (pH) tends to be slightly to moderately alkaline which ranged from (7.46 to 8.10)**.** Soil salinity values were ranged from 1.90 to 9.11 *dS/*m, which revealed that it varied from non-saline to moderately saline. The soil texture classes varied between sand, sandy loam and sandy. Organic matter contents varied from 0.04 to 0.27%, $CaCO_3$ % contents ranged between 4.18 and 19.85 %.

4) Old terraces.

Soils of old terraces are represented by profiles Nos. 9, 10, 11, 12, 13 and 14 as shown in **Fig (1).** The main characteristics of this unit have moderated deep to deep depths; Texture classes were varied between sandy clay loam, loamy sand and sandy loam throughout the other different representative soil profiles depth. The chemical properties as shown in **Table (1)** revealed that soil reaction (pH) values varied from slightly alkaline level (7.41) to moderately alkaline one (7.90). Soil salinity values varied between 0.90 and 49.0 *dS/*m, which revealed that it varied from non-saline to extremely saline. Organic matter contents ranged between 0.05 and 0.22% and $CaCO_3$ % varied between 1.09 and 26.72 %.

5) Miscellaneous land.

Soil profiles Nos. 15 and 16 were represented this studied unit as shown in **Fig (1).** Soil reaction (pH) values tends to be slightly to moderately alkaline which ranged from (7.63 to 7.90)**.** Soil salinity ranged between 6.2 and 27.0 *dS/*m, which changed from moderately saline to extremely saline.

Table 1: Some chemical and physical properties of the studied soil profiles.

Physiographic Units	Prof. No	Depth (cm)	pH	EC *dS*/m	Particle size distribution C. Sand %	F. Sand %	Silt %	Clay %	Texture class	O.M %	$CaCO_3$ %
Wadi bottom	1	0 – 20	7.65	1.26	41.25	36.50	7.90	14.35	SL	0.12	2.39
		20– 80	7.82	1.00	41.31	45.64	4.15	7.90	LS	0.05	2.19
		80 -150	7.91	1.00	31.20	46.85	5.65	16.30	LS	0.05	2.92
	2	0 – 25	7.91	0.94	15.10	52.50	15.30	17.10	SL	0.10	7.87
		25– 70	8.37	0.43	35.00	58.60	4.10	2.30	S	0.06	10.27
		70 -130	8.27	0.53	33.90	54.70	5.30	6.10	S	0.03	4.76
Fans and out wash plain	3	0 – 30	7.50	3.40	36.90	51.40	6.40	5.30	S	0.12	11.26
		30– 70	7.70	4.30	37.20	52.40	4.30	6.10	S	0.08	9.65
		70 -140	8.00	2.70	31.30	57.20	5.20	6.30	S	0.06	10.43
	4	0 – 20	7.55	5.80	28.80	59.30	4.70	7.20	S	0.14	12.18
		20– 80	7.80	5.80	34.20	57.40	3.20	5.20	S	0.08	13.83
		80 -150	7.90	7.60	36.10	57.30	2.20	4.40	S	0.06	9.85
Young terraces	5	0 – 30	7.65	3.57	31.20	53.30	4.20	11.30	SL	0.27	5.06
		30– 90	7.68	2.07	36.90	52.50	3.30	7.30	S	0.18	5.02
		90 -150	7.68	2.62	33.10	56.30	4.40	6.20	S	0.10	4.18
	6	0 – 25	7.80	5.20	34.30	50.20	4.30	11.20	SL	0.17	11.02
		25– 70	7.62	8.50	39.20	48.60	7.10	5.10	S	0.15	8.78
		70 -120	7.79	7.60	33.90	58.20	3.20	4.70	S	0.10	12.78
	7	0 – 35	7.68	1.90	40.30	52.30	2.10	5.30	S	0.14	19.85
		35– 70	8.10	3.10	39.10	54.80	2.50	3.60	S	0.06	17.29
		70 -120	7.46	3.32	35.90	55.10	6.30	2.70	S	0.04	7.85
	8	0 – 30	7.90	5.72	37.15	51.45	3.30	8.10	S	0.16	4.36
		30– 60	7.91	9.11	40.09	45.81	7.00	7.10	S	0.10	4.71
		60 -130	7.75	4.41	38.11	47.89	7.40	6.60	S	0.04	5.64

Count: Table(1)

Physiographic Units	Prof. No	Depth (cm)	pH	EC dS/m	Particle size distribution				Texture class	O.M %	$CaCO_3$ %
					C. Sand %	F. Sand %	Silt %	Clay %			
Old terraces	9	0 – 30	7.51	8.91	30.10	46.90	7.90	15.10	SL	0.20	26.72
		30– 75	7.59	49.00	30.90	44.10	10.30	14.70	SL	0.11	6.90
	10	0 – 20	7.41	42.30	33.10	46.50	12.10	11.30	SL	0.13	4.68
		20– 80	7.52	43.50	29.40	46.20	13.30	11.10	SL	0.05	7.02
	11	0 – 30	7.46	12.20	25.10	26.10	16.80	32.0	SCL	0.13	8.06
		30– 60	7.61	12.15	35.20	31.7.	13.40	19.70	SL	0.06	11.06
	12	0 – 20	7.72	20.50	31.20	33.30	18.40	17.10	SL	0.22	6.16
		20– 80	7.84	26.80	33.10	49.20	9.40	8.30	LS	0.10	9.70
		80 -120	7.75	21.20	35.50	46.20	9.20	9.10	LS	0.05	9.51
	13	0 – 35	7.60	4.00	38.40	51.30	3.80	6.50	S	0.12	1.09
		35 – 60	7.70	1.80	55.40	37.10	3.20	4.30	S	0.08	1.84
		60 - 90	7.80	1.30	56.20	36.10	2.90	4.80	S	0.06	1.64
	14	0 – 30	7.80	2.80	29.20	59.80	5.80	5.20	S	0.12	2.35
		30 – 55	7.90	1.60	56.60	34.50	4.60	4.30	S	0.07	1.81
		55 – 90	7.65	0.90	38.80	51.80	2.20	7.20	S	0.05	2.00
Miscellaneous Land	15	0 – 15	7.90	7.13	36.49	31.26	9.95	22.30	SCL	0.31	23.04
		15 – 40	7.93	11.35	30.90	29.00	23.70	16.40	SL	0.25	5.61
	16	0 – 25	7.63	6.20	33.71	42.89	9.60	13.80	SL	0.32	20.50
		25 – 45	7.80	27.0	30.44	44.66	10.80	14.10	SL	0.18	3.87

The soil texture classes varied between sandy clay loam and sandy loam. Organic matter contents were highest slightly than these of all units and ranged between 0.18 and 0.32%, $CaCO_3$% contents varied between 3.87 and 23.04 %.

In general, Organic matter contents of the studied area still very low , never exceeding 0.32% of the soil components, the low content of organic matter of these soils is a common feature in the arid and semi-arid regions due to their quick decomposition and high oxidation potential arid climatic conditions.

Total and available micronutrients in the studied soil profiles.

1-Iron (Fe)

A- Total Fe

Total Fe contents of the studied soil profiles as shown in **Table (2)** were ranged from 37200 to 52100; 34800 to 40600; 24900 to 38920; 31560 to 71120 and from 55800 to 59200 mg/kg for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively.

The lowest values of Fe contents were found in soil of Young terraces (prof. Nos. 5,6,7 and 8) due to their high content of sand. The wide range of total Fe content in the studied soil samples is apparently associated with soil texture and is probably dependent on the type of parent materials from which soil was formed.

Based on the abovementioned results, it is clear that, the values of total Fe content in the different studied physiographic units are of the following descending order: Old terraces > Miscellaneous land > Wadi bottom > Fans and outwash plain > Young terraces.

Statistical analysis as shown in **(Table 3)** showed that total Fe content in these soils is positively highly significant correlated with clay % (r = 0.416**) and positively significant correlated with silt % (r = 0.324*). In contrast, total Fe content is negatively significant correlated with sand % (r = - 0.332*). These results are coordinated with those reported by **Hassona *et al*., (1996), Abdel Razik *et al*., (2002)** and **Abdel-Aziz *et al*., (2007)**

B- Available Fe

Data presented in **Table (2)** showed that, the values of chemically available (DTPA-extractable) Fe ranged from 6.5 to 10.8; 5.7 to 10.2; 4.8 to 8.5; 5.5 to 19.8 and from 13.4 to 16.2 mg/kg for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively.

These values of available Fe in the studied soil profiles means that, these soils belong to the adequate level from available iron according to **Soltanpour** and **Schwab (1977).**

The highest value of available Fe content was found in Miscellaneous land (profiles Nos.15& 16) this may be due to their high contents of organic matter. Whereas, the lowest value was found in Young terraces soils due to their high contents of $CaCO_3$ %.

Regarding to the abovementioned results, the values of available Fe content are of the following descending order: Miscellaneous land > Old terraces > Wadi bottom > Fans and outwash plain > Young terraces.

Statistical analysis as shown in **(Table 3)** showed that available Fe content in these soils is positively highly significant correlated with O.M % (r = 0.399**) and is negatively significant correlated with

$CaCO_3$ % (r = - 0.315*). These results are coordinated with those reported by **Hafez *et al*., (1992)** and **Barakat, (1998).**

Table 2: Total and available micronutrients (mg/kg) of the studied soil profiles.

Physiog-raphic Units	Prof. No.	Depth (cm)	Iron (Fe)		Manganese (Mn)		Zinc (Zn)		Copper (Cu)	
			Total	Avai.	Total	Avai.	Total	Avai.	Total	Avai.
Wadi bottom	1	0 – 20	41600	10.7	360	2.90	75	1.9	58	1.5
		20– 80	37200	9.6	340	3.10	38	0.6	51	0.8
		80 -150	52100	6.5	430	4.40	40	0.8	49	1.1
	2	0 – 25	50900	10.8	420	3.90	54	2.1	36	1.3
		25– 70	48600	8.4	410	2.80	34	0.5	27	0.4
		70 -130	46700	7.2	390	3.10	39	0.6	42	0.5
Fans and out wash plain	3	0 – 30	37300	8.8	340	6.20	35	0.6	75	0.4
		30– 70	35900	7.4	290	5.90	38	0.6	68	0.6
		70 -140	35000	6.9	280	4.80	41	0.7	72	0.7
	4	0 – 20	34800	10.2	385	6.60	35	0.6	54	0.5
		20– 80	40600	7.9	350	7.20	32	0.4	47	0.4
		80 -150	39800	6.5	320	5.40	29	0.3	51	0.3
Young terraces	5	0 – 30	29200	7.8	220	1.60	42	0.7	44	0.8
		30– 90	29450	7.3	210	1.80	31	0.4	39	0.4
		90 -150	33040	7.2	250	3.00	33	0.5	41	0.5
	6	0 – 25	31600	6.0	240	2.30	62	0.9	53	1.2
		25– 70	26830	6.2	180	1.90	37	0.5	61	0.7
		70 -120	27950	5.4	190	1.80	32	0.3	56	0.5
	7	0 – 35	24900	4.8	170	2.20	30	0.5	37	0.4
		35– 70	29600	5.1	210	2.60	32	0.4	34	0.4
		70 -120	28200	7.8	230	1.90	44	0.6	29	0.5
	8	0 – 30	37500	6.7	350	3.20	35	0.5	44	0.6
		30– 60	38920	8.2	330	3.60	47	0.6	42	0.8
		60 -130	36150	8.5	340	3.80	42	0.5	38	0.7

Count: Table(2)

Physiog-raphic Units	Prof. No.	Depth (cm)	Iron (Fe)		Manganese (Mn)		Zinc (Zn)		Copper (Cu)	
			Total	Avai.	Total	Avai.	Total	Avai.	Total	Avai.
Old terraces	9	0 – 30	61700	12.3	590	6.80	80	2.3	44	1.6
		30– 75	65000	11.4	630	7.60	71	1.8	37	1.5
	10	0 – 20	62600	10.9	610	7.10	64	1.4	43	1.2
		20– 80	58900	9.8	480	4.10	60	1.2	30	1.1
	11	0 – 30	71120	13.5	610	7.90	85	2.5	35	2.2
		30– 60	69460	19.8	600	6.90	62	1.8	31	1.7
	12	0 – 20	49800	11.8	510	4.80	84	1.5	37	0.8
		20– 80	39200	8.4	370	4.10	67	0.7	33	0.9
		80 -120	40400	9.3	350	3.80	51	0.8	34	0.6
	13	0 – 35	31560	5.7	260	2.10	41	0.9	79	0.4
		35 – 60	36830	5.9	310	2.60	30	0.7	66	0.5
		60 - 90	35950	5.5	290	3.40	33	0.4	68	0.6
	14	0 – 30	36500	7.3	320	3.80	48	0.7	59	0.4
		30 – 55	36110	6.4	330	2.90	36	0.5	69	0.3
		55 - 90	36200	9.2	340	3.30	42	0.8	63	0.6
Miscellaneous Land	15	0 – 15	57900	15.6	420	2.40	67	2.1	37	0.9
		15 – 40	55800	14.9	410	2.10	69	1.4	34	0.7
	16	0 – 25	56400	16.2	390	1.90	59	1.1	49	1.6
		25 – 45	59200	13.4	440	2.20	61	1.0	42	1.4

Depthwise distribution of total Fe values.

Oertal and Gilles (1963) suggested three measures for element content, namely the weighted mean (W), trend (T) and specific range (R). These measures could be written as follows:

1- $W = [\sum (c \times d)/p]$ Where, W = weighted mean. p = depth of profile.

c = concentration of elements in the layer. d = thickness of the layer.

2- $T = (W-S)/W$ when $W > S$. or $T = (W-S)/S$ when $S > W$.

Where T = trend W = weighted mean. S = the concentration in the surface layer.

3- $R = (H-L)/W$. Where R= specific range, H = the highest concentration, L = the lowest concentration

W = weighted mean

Data presented in Table 4 show that, the weighted mean (W) for total Fe in the studied soil profiles varied from 44740 to 48165; 35750 to 39453; 26290 to 37100; 34487 to 70390 and from 56588 to 57644 for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively. The lowest value was found in Young terraces soils which associated with the light texture soil where has the low percent of silt and clay fractions. The highest values of (W) characterized the soils derived from fine textured soils as present in Old terraces soils. The narrow variations encountered within or between some of the soil profiles of the same unite may be attributed to pedogenic factors rather than geogenic ones, this may be attributed to the same nature of parent material from which the soils are derived, the rest of the soil profiles show a wide range.

Moreover, the studied soils can be categorized according to the weighted mean of Fe of each location in the following orders: Old terraces > Miscellaneous land > Wadi bottom > Fans and outwash plain > Young terraces.

While, the values of trend (T) were calculated, the data indicates that the most of soil profiles have highest symmetric values of total Fe. The results also showed that Fe content in many of the studied soil profiles is usually higher in the surface layers than in the deeper ones as indicated by the negative values of the trend.

With regard to specific range (R) for the total iron (Fe) data in **Table (4)** revealed that the specific range for total iron varied from 0.04 to 0.33 for all studied area, which may be suggest that, most of these soil profiles are drived from a uniform parent material or can indicate pedogenic processes as a result of the narrow variations. In other words, the specific range of the total Fe indicates that the soil of the most soil profiles are homogeneous in depth, whereas soil profiles Nos 1,12 and 13 are probably formed from heterogeneous soil materials.

Table 3: Correlation coefficient between some soil variables with total and available micronutrients contents for the studied soils.

Soil properties	Fe		Mn		Zn		Cu	
	Total	Available	Total	Available	Total	Available	Total	Available
Clay %	0.416**	- 0.124	0.215	0.138	0.399**	0.438**	- 0.074	0.327*
Silt %	0.324*	0.098	0.173	0.298	0.279	0.299	0.015	0.097
Sand %	- 0.332*	0.115	- 0.362*	- 0.124	- 0.158	- 0.197	- 0.128	- 0.173
$CaCO_3$ %	0.279	- 0.315*	- 0.094	- 0.165	- 0.336*	- 0.098	0.311*	- 0.273
O.M %	- 0.261	0.399**	- 0.103	0.256	- 0.248	0.326*	- 0.189	0.452**
pH	0.015	- 0.025	0.311*	- 0.415**	0.029	- 0.205	- 0.205	0.266
EC *dS*/m	0.136	0.036	0.065	- 0.032	- 0.115	0.082	0.089	- 0.195

* Significant at 5% (r = 0.301) ** Highly significant at 1% (r = 0.389)

2- Manganese (Mn)

A- Total Mn

Data presented in **Table (2)** show that, the total Mn contents of the studied soil profiles ranged from 340 to 430; 280 to 385; 170 to 350; 260 to 630 and from 390 to 420 mg/kg for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively.

Regarding for the abovementioned results, it is clear that, the values of the total Mn contents in the different studied physiographic units are the same trend of of Fe contents and they are in the following descending order: Old terraces > Miscellaneous land > Wadi bottom > Fans and outwash plain > Young terraces. The variations of the total Mn contents for different physiographic units could be ascribed to the parent materials of these soils.

Statistical analysis shows that the total Mn contents in these soils is positively significant correlated with pH (r = 0.311**). In contrast, the total Mn contents are negatively significant correlated with sand % (r = - 0.362*). Similar results were reported by **Ghanem *et al*., (1971)** and **Abdel-Aziz *et al*., (2007)**

B- Available Mn

DTPA-extractable Mn content as shown in **(Table, 2)** recorded values ranged from 2.8 to 4.4; 4.8 to 7.2; 1.6 to 3.8; 2.1 to 7.9 and from 1.9 to 2.4 mg/kg for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively.

The abovementioned results of available Mn values are in the following descending order: Old terraces > Fans and outwash plain > Wadi bottom > Young terraces> Miscellaneous land.

According to **Soltanpour** and **Schwab (1977)**, who pointed out that the critical values of DTPA-extractable Mn are as follows: low (from 0 to 1.8 mg/kg) and adequate > 1.80 mg/kg. The results of the studied soil profiles indicate that, all the studied soil samples belong to the adequate level.

The statistical analysis shows that DTPA-extractable Mn is negatively and highly significant correlated with pH (r = - 0.415**). No significant correlation could be detected with all the other soil variables. These relations are in agreement with those reported by **Abbas *et al*., (2003)**

Depthwise distribution of total Mn values.

Data in **Table 4** revealed that, narrow variations of the weighted mean (W) for total Mn within the studied soil profiles, which ranged from 384.7 to 402.7; 295.7 to 340.7; 196.7 to 340; 383.9 to 614 and from 412.2 to 413.8 for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively. The lowest value was found in Young terraces soils. Whereas, the highest values of (W) was present in Old terraces soils.

With regard to trend values (T) as shown in **Table (4),** data indicate that Wadi bottom soil, Fans and outwash plain soil, and Miscellaneous land have the highest symmetric values of total Mn. Whereas, Young terraces and Old terraces showed symmetrical values of total Mn. The results also showed that, total Mn content in the most of the studied soil profiles were higher in the surface layers than in the deeper ones.

As for specific range (R) for the total Mn as shown in **Table (4),** data showed that, it varied from 0.017 to 0.360, for all the studied soil profiles which may be suggest that, most of these soil profiles are derived from a uniform parent material or can indicate pedogenic processes as a result of the narrow variations. In other words, the specific range of total Mn indicates the most soil profiles are homogeneous in depth, whereas soil profiles Nos 2,8,9,11 and 15 are probably formed from heterogeneous soil materials.

Notwithstanding that the layers within each profile are also involved such variations. It seems evident that the depositional mode and environments played a paramount role in soils formation. This is truly reflected on the status of Mn as indicated by the statistical measures.

3-Zinc (Zn)

A- Total Zn

Total Zn contents of the studied soil profiles as shown in **Table (2)** were ranged from 34 to 75; 29 to 41; 30 to 62; 30 to 85 and from 59 to 69 mg/kg for the soil of Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively. The lowest values of total Zn content was found in the soil of Fans and outwash plain (prof. Nos 3 and 4).While the highest one was found in the soil of Old terraces, it is clear that, the values of total Zn content in the different studied physiographic units are in the following descending order: Old terraces > Miscellaneous land > Wadi bottom > Young terraces > Fans and outwash plain.

Table 4: Weighted mean (W), Trend (T) and Specific range(R) of total micronutrients in the studied soil profiles.

Physiographic Units	Prof. No	Fe			Mn			Zn			Cu		
		W	T	R	W	T	R	W	T	R	W	T	R
Wadi bottom	1	44740	0.07	0.33	384.7	0.064	0.234	43.87	-0.42	0.84	51.00	-0.12	0.18
	2	48165	-0.05	0.09	402.7	-0.041	0.075	40.15	-0.26	0.50	35.65	-0.01	0.17
Fans and out wash plain	3	35750	-0.04	0.06	295.7	-0.130	0.203	38.86	0.10	0.15	71.50	-0.05	0.10
	4	39453	0.12	0.15	340.7	-0.115	0.191	31.00	-0.11	0.19	49.80	-0.08	0.14
Young terraces	5	30836	0.05	0.12	228.0	0.035	0.175	34.00	-0.19	0.32	40.80	-0.08	0.12
	6	26290	-0.17	0.18	196.7	-0.180	0.254	40.13	-0.32	0.75	57.25	0.07	0.20
	7	27646	0.10	0.17	206.7	0.178	0.290	36.42	0.18	0.38	32.79	-0.11	0.24
	8	37100	-0.01	0.07	340.0	-0.029	0.059	41.54	0.16	0.29	40.31	-0.08	0.15
Old terraces	9	63680	0.03	0.05	614.0	0.039	0.065	74.60	-0.07	0.21	39.80	-0.10	0.18
	10	59825	-0.04	0.06	512.5	-0.160	0.254	61.00	-0.05	0.41	33.25	-0.23	0.39
	11	70390	-0.01	0.02	605.0	-0.008	0.017	73.5	-0.14	0.31	33.00	-0.06	0.12
	12	41367	-0.17	0.26	445.0	-0.127	0.360	64.50	-0.23	0.51	34.00	-0.08	0.12
	13	34487	0.08	0.15	283.9	0.084	0.176	35.28	-0.14	0.31	71.72	-0.09	0.18
	14	36275	0.01	0.01	330.6	0.032	0.060	42.33	-0.12	0.28	63.33	0.07	0.16
Miscellaneous Land	15	56588	-0.02	0.04	413.8	-0.015	0.024	75.75	-0.13	0.24	35.13	-0.06	0.08
	16	57644	0.02	0.05	412.2	0.054	0.121	54.33	0.10	0.22	45.89	0.06	0.15

Considering to the abovementioned results, it is observed that, theses soils belonging to low and medium Zn levels groups according to (**Chapman, 1965**) who stated that when total soil Zn content is below 50 mg/kg could be considered low level of Zn and those above 100 mg/kg could be considered high level of Zn.

The relationships between total Zn contents and some soil variables were computed as shown in **(Table 3)** which showed that total Zn content in these soils is positively highly significant correlated with clay % (r = 0.399**) and negatively significant correlated with $CaCO_3$ % (r = - 0.336*). These results are coordinated with those reported by **(Abd Alla *et al.* 2009 and Soliman *et al.*, 2015)**

B- Available Zn

Data present in **Table (2)** showed that, the value of available Zn values ranged from 0.5 to 2.1; 0.3 to 0.7; 0.3 to 0.9; 0.3to 2.5 and from 1.0 to 2.1 mg/kg for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively.

These values of available Zn contents of that studied soil profiles, show that, these soils belong to the low , marginal and adequate level from available Zn according to **Soltanpour** and **Schwab (1977)** who, stated that the level of DTPA-extractable Zn content is low from 0.0 to 0.9 mg/kg, marginal from 1.0 to 1.5 mg/kg and adequate > 1.5 mg/kg.

The highest value of available Zn content is found in Miscellaneous land (profiles Nos.15& 16) this may be due to their high contents of clay % and organic matter. Whereas, the lowest value of available Zn content is found in Fans and outwash plain soils may be due to their content of $CaCO_3$% were high. Regarding to the abovementioned results, the values of available Zn contents are in the following descending order: Miscellaneous land > Old terraces > Wadi bottom > Young terraces > Fans and outwash plain.

Statistical analysis as shown in **(Table 3)** showed that available Zn content in these soils is positively highly significant correlated with clay % (r = 0.438**) and positively significant correlated with O.M % (r = 0.326*). These results are coordinated with those reported by **Hafez *et al*., (1992), Barakat, (1998)** and **Abbas, *et al*., (2003).**

Depthwise distribution of total Zn values.

Data presented in Table 4 show that, the weighted mean (W) for total Zn in the studied soil profiles varied from 40.15 to 43.87; 31.00 to 38.86; 34.00 to 41.54; 35.28 to 74.60 and from 54.33 to 75.75 for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively. The lowest value was found in Fans and outwash plain soils which associated with the low percent of silt and clay fractions. The highest values of (W) characterized the soils derived from fine textured soils as present in both Old terraces soils and Miscellaneous land.

Considering the values of trend (T) were calculated, data indicate that the most of soil profiles have highest symmetric values of total Zn. The negative values of the trend, reflect that total Zn content in the most of the studied soil profiles are usually higher in the surface layers than in the deeper ones.

With regard to specific range (R) for the total Zn, data in **Table (4)** revealed that the specific range for the total Zn varied from 0.15 to 0.84, which may be suggest that, most of these soil profiles are drived from a uniform parent material as a result of the narrow variations. In other words, the specific range of the total Zn indicates that the soil of the most soil profiles are homogeneous in depth, whereas soil profiles Nos. 1, 2,6 and 12 are probably formed from heterogeneous soil materials.

4-Copper (Cu)

A- Total Cu

Total Cu contents of the studied soil profiles as shown in Table (2) were ranged from 27 to 58; 47 to 75; 29 to 61; 30 to 79 and from 34 to 49 mg/kg for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively.

The lowest values of Cu contents are found in the soil of Wadi bottom (prof. Nos 1 and 2). Whereas, the highest values were found in the soil of Fans and outwash plain (prof. Nos 3 and 4)

Based on the abovementioned results, it is clear that, the values of total Cu content in the different studied physiographic units are in the following descending order: Fans and outwash plain > Old terraces > Young terraces, > Miscellaneous land > Wadi bottom.

Statistical analysis as shown in **(Table 3)** show that total Cu content in that soil is positively significant correlated with $CaCO_3$% (r = 0.311*).No significant correlation could be detected with all the other soil variables. These results are coordinated with those reported by **Abbas, *et al*., (2003)** and **Abdel-Aziz *et al*., (2007)**

B- Available Cu

Data presented in Table 2 show that, the values of available Cu ranged from 0.4 to 1.5; 0.3 to 0.7; 0.4 to 1.2; 0.3 to 2.2 and from 0.7 to 1.6 mg/kg for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively.

These values of available Cu in the studied soil profiles indicate that, most of these soils belong to the high level of available Cu according to **Soltanpour** and **Schwab (1977)** who reported that, the index values used for DTPA-extractable Cu from the soils are as follows: low level from 0.0 to 0.05 mg/kg, medium level from 0.05 to 0.5 mg/kg and high level more than 0.5 mg/kg

The highest value of available Cu contents are found in Miscellaneous land, this may be due to their high contents of organic matter % and clay %. Whereas, the lowest value of available Cu contents are found in Fans and outwash plain soils due to their high contents of $CaCO_3$ %.

Regarding to the abovementioned results, the values of available Cu content are in the following descending order: Miscellaneous land > Old terraces > Wadi bottom > Young terraces > Fans and outwash plain.

Statistical analysis as shown in **(Table 3)** show that available Cu content in these soils is positively highly significant correlated with O.M % (r = 0.452**) and positively significant correlated with clay %(r = 0.327*). These results are coordinated with those reported by **Hafez *et al*., (1992)** and **Barakat, (1998).**

Depthwise distribution of total Cu values.

Data presented in Table 4 showed that, the weighted mean (W) for total Cu in the studied soil profiles varied from 35.65 to 51.0; 49.8 to 71.5; 32.79 to 57.25; 33.25 to 71.72 and from 35.13 to 45.89 for Wadi bottom, Fans and outwash plain, Young terraces, Old terraces and Miscellaneous land, respectively. The lowest value is found in Miscellaneous land. While,the highest values of (W) characterized the soils have enrichment with $CaCO_3$% as present in Fans and outwash plain soils. The narrow variations encountered within or between some of the soil profiles of the same unite may be attributed to pedogenic factors rather than geogenic ones, *i.e.,* may be attributed to the same nature of parent material from which the soils are derived, the rest of the soil profiles show a wide range.

The values of trend (T) were calculated, data indicate that the most of soil profiles have highest symmetric values of total Cu. The results also show that Cu content in many of the studied soil profiles are usually higher in the surface layers than in the deeper ones as indicated by the negative values of the trend.

Regarding for specific range (R) of total (Cu), data in **Table (4)** reveal that the specific range for total Cu varied from 0.08 to 0.39, which may be suggest that, most of these soil profiles are drived from a uniform parent material or can indicate pedogenic processes as a result of the narrow variations. In other words, the specific ranges of total Cu indicate that the most soil profiles are homogeneous in depth, whereas in the soil profile No.10 is probably formed from heterogeneous soil materials.

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حالة العناصر الغذائية الصغرى وعلاقتها ببعض متغيرات التربه في أراضى وادي اللقيطه بمحافظة قنا- مصر

أسـامة صـادق جنـدى

معهد بحوث الأراضي والمياه والبيئة ، مركز البحوث الزراعية ، الجيزة ، مصر

يهدف هذا البحث لدراسة كل من المحتوى الكلي والميسرلبعض العناصر الغذائية الصغرى مثل الحديد والمنجنيز والزنك والنحاس فى أراضي وادي اللقيطة بمحافظة قنا لتحديد مدى تجانس التربة بها وكذلك العلاقة بين الكميات الكلية والميسرة ببعض متغيرات التربة. ولتحقيق هذا الهدف تم أختيار43 عينه تربه من 16 قطاع أرضي تمثل خمس وحدات فزيوجرافيه لمنطقة الدراسة والتي تقع في الجزء الشرقي لوادي النيل جنوب محافظه قنا كمنطقة واعدة للاستغلال الزراعي. حيث تم تقدير الخواص الطبيعية والكيميائية وكذلك تركيز العناصرالغذائية المشار اليها سابقا.وقد أوضحت نتائج الدراسه أن محتوى التربه من هذة العناصر كما يلي:-

الحديد الكلي يتراوح مابين (37200 - 52100)، (34800 – 40600)، (24900 - 38920)، (31560 - 71120) ومن (55800 – 59200) ملليجرام / كجم. بينما المنجنيزالكلي يتراوح مابين (340 - 430)، (280 – 385)، (170 - 350)، (260 - 630) ومن (390 – 420) ملليجرام / كجم. اما الزنك الكلي يتراوح مابين (34 - 75)، (29 – 41)، (30 - 62)، (30 - 85) ومن (59 – 69) ملليجرام / كجم. فى حين ان النحاس الكلي يتراوح مابين (27 - 58)، (47 – 75)، (29 - 61)، (30 - 79) ومن (34 – 49) ملليجرام / كجم. وذلك في أراضي وحدات قاع الوديان ، أراضي المروحيات وسهل الغسيل، أراضي المصاطب الحديثه، أراضي المصاطب القديمة و الأراضي المختلطة على الترتيب. وقد تميزت أراضي المصاطب القديمة والأراضي المختلطة بمحتوى عالي من هذه العناصر.

أما الكميات الميسرة من تلك العناصر والمستخلصة بواسطة مركب داي ايثلين تراي أمين بنتا أسيتك أسد (DTPA) فهي كما يلي:-

الحديد الميسر يتراوح مابين (6,5 – 10,8)، (5,7 – 9,2)، (4,8 – 8,5)، (5,9 – 14,8) ومن (13,4 – 16,2) ملليجرام / كجم. أما المنجنيز الميسر يتراوح مابين (2,8 – 4,4)، (2,1 – 7,2)، (1,6 – 3,8)، (3,2 – 7,9) ومن (1,9 – 2,4) ملليجرام / كجم. فى حين ان الزنك الميسر يتراوح مابين (0.5 – 2,1)، (0,3 – 0,7)، (0,3 – 0,9)، (0,3 – 2,5) ومن (1,0 – 2,1) ملليجرام / كجم. بينما النحاس الميسر يتراوح مابين (0.4 – 1,5)، (0,3 – 0,7)، (0,4 – 1,2)، (0,3 – 2,2) ومن (0,7 – 1,6) ملليجرام / كجم. وذلك لأراضي قاع الوديان ، أراضي المروحيات وسهل الغسيل، أراضي المصاطب الحديثه، أراضي المصاطب القديمة و الأراضي المختلطة على الترتيب.

كما أوضحت النتأئج أن أراضي المصاطب القديمة والأراضي المختلطة تتميز بتركيز عالي من الحديد والزنك والنحاس الميسر. بينما أراضي المصاطب القديمة و أراضي المروحيات وسهل الغسيل تميزت بتركيز عالي للمنجنيز الميسر.

وقد اجريت المقاييس الإحصائية وهي المتوسط الوزني (W) والاتجاه (T) والنطاق النوعي (R) للمحتوي الكلي من هذه العناصر وتم مناقشه النتائج لتحديد أصل ومنشأ وتكوين هذه الأراضي ومدى تجانسها. كما أجري التحليل الإحصائي لتحديد مدى الارتباط بين المحتوى الكلي والميسر من هذه العناصر وبعض متغيرات التربة كالتوزيع الحجمي للحبيبات (نسبه الطين والسلت والرمل) ورقم الحموضة (pH) والاملاح الذائبة (ECe) كذلك محتوى الأرضي من المادة العضوية وكربونات الكالسيوم.