

## SOIL TAXONOMIC UNITS AND MICRONUTRIENTS CONTENT OF BAHARIYA OASIS, EGYPT

Hegazi, I. ; A. M. Abd-ElGhane ; G. F. El-Shiekh and M. K. Nasef  
Soil, water and Environment Research Institute – ARC, Giza, Egypt

### ABSTRACT

The relationship between some extractable micronutrient contents *i.e.*, Fe, Mn, Zn, Cu and B and their relation to the soil taxonomic units of an area south east El-Bahariya in El-Bahariya Oasis, Egypt are study. Twenty one representative soil profiles and eighteen pits were dug in the study area and classified to the soil family level according to the Soil Taxonomy USDA (2010). The obtained results are summarized as follows:

- The studied area belongs to tow orders, four suborder, sixteen families as follow:
  - *Order Aridisols* includes two suborders *i.e.*, *salids* and *gypsid*s
  - *Order Entisols* has two sub orders *orthents* and *psammets*.
- *Order Aridisols* covers ten soil families, their texture range from loamy sand to clayey, whereas order *Entisols* contains six families their soil texture is sandy to sandy loam soils.
- Generally the soils of order *Entisols* have high percent of sand fraction and Fe content, averages are 74.6 % and  $4.93 \mu\text{g g}^{-1}$  respectively, but have low averages of organic matter, gypsum, lime contents and other micronutrients. Whereas soils of order *Aridisols* have high averages of clay content and all other variables except Fe.
- Soils of *Aridisols* contain higher amounts of micronutrients Mn, Zn, Cu and B than in soils families of *Entisols*, but in contrast values of Fe are much higher in *Entisols* as compared to *Aridisols* .
- Averages of DTPA extractable amounts of Fe, Mn, Zn, Cu and B in *Aridisols* samples ranged between 2.9, 3.2, 2.1, 1.1 and  $2.5 \mu\text{g g}^{-1}$  respectively, while the corresponding values in *Entisols* are 5.6, 2.7, 1.9, .6 and  $1.3 \mu\text{g g}^{-1}$ , respectively.
- Some values are greater than the marginal levels reported in the literature *i.e.* about 12 % for Fe, 84 % for Mn, 20 % for Zn, 36 % for Cu and 8 % for B in soil families of *Aridisols* respectively, whereas in *Entisols* soils were 40.9, 95.5, 9.1, 4.6 and 5.2 % for Fe, Mn, Zn, Cu and B, respectively.
- Both orders have averages of some micronutrients lower than the critical levels *i.e.* about 43.9 % for Fe, 81.2 % for Zn, 64.9 % for Cu and 33.5 % for B.

**Keywords:** Soil taxonomy, soil fertility, micronutrients and Bahariya Oasis.

### INTRODUCTION

*Aridisols* that have a Salic, gypsic and calcic horizons within 100 cm of the soil surface USDA (2010).

Shehata (1992), studied the different landscape features of El Bahariya Oases and reported that the oases contains six geomorphic units, *i.e.*, plains, man-made terraces, marshes, pediplains, sand dunes and mountains or hills. He also reported that the soils related limitations affecting crop

productivity include nutritional disorders, and can be detected by evaluating the fertility status of the soil.

Duarah *et al.*, (2011) mentioned that the application of mineral fertilizers is the most advantageous and the fastest way to increase crop yields and their deficiency leads to various types of disorders in many crops.

Characteristics of soils that can be changed in a short time by land use are dynamic soil quality indicators (Chan *et al.*, 2001).

Adesanwo *et al.*, (2009) revealed that the management of soil fertility is the first condition for sustainable crop production and can reduce food importation in Nigeria and African countries

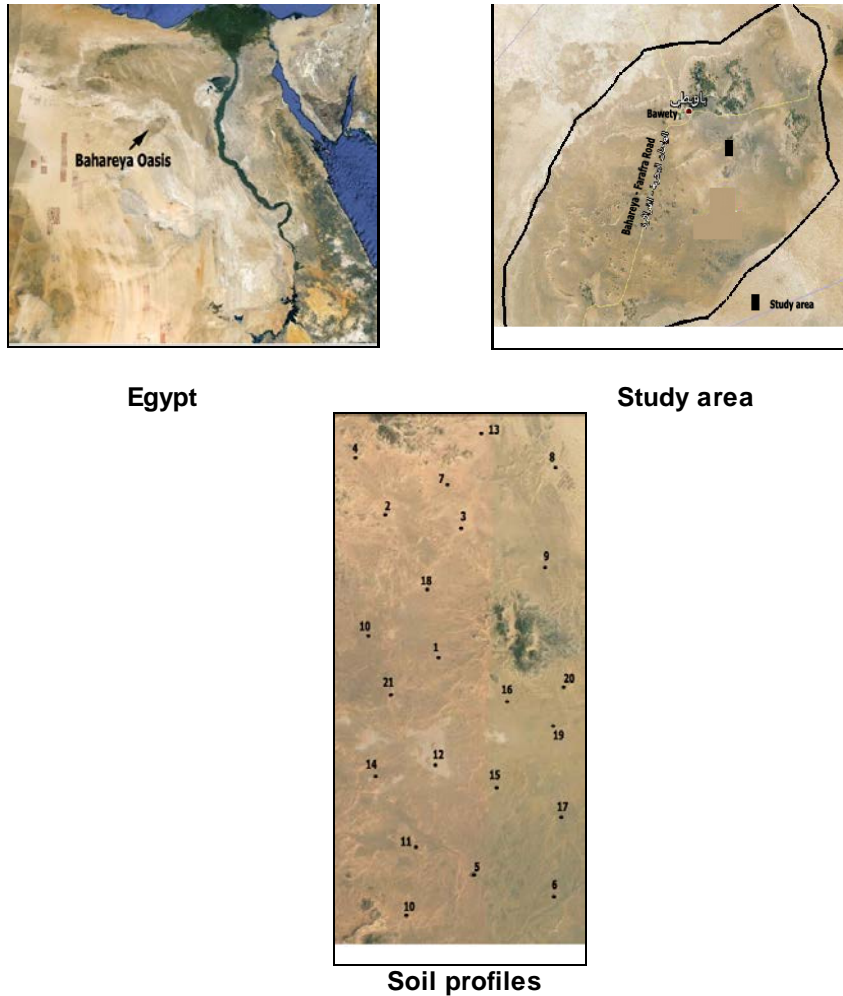
In Egyptian soils, the levels of micronutrients elements can be used as a guide for substantiating the nature of parent material together with the pedogenic aspects, which lead to the prediction of soil genesis and formation (Grais, 2006).

The current study represents an attempt for evidence pertaining the distribution mode of some essential micronutrients for plant (Fe, Mn, Zn, Cu and B) as related to some soil units and physical and chemical properties of some soils in El-Wahat El-Bahariya (Oasis). In other words, this work is a trial to use such micronutrients as criteria for soil genesis and formation.

## **MATERIALS AND METHODS**

The studied area is about 5000 hectares located east of El-Bahariya Oasis road, about 25 km south east of El-Bawity district. Twenty-one soil profiles as well as eighteen pits were dug to identify the different soil taxonomic units (Fig 1), and morphological description according to USDA (2003), Table 1. The soil samples are air-dried, crushed and passed through a 2 mm sieve and were kept for the following analysis.

Particle size distribution, organic matter content,  $\text{CaCO}_3$  and  $\text{CaSO}_4$  percent are carried out as described by Page *et al.* (1982). Electrical conductivity (EC) is measured in the soil water extract 1:1 and soil pH according to the U.S. Salinity Laboratory Staff, Richards (1954). Available micronutrients were extracted with DTPA (Diethylene Triamine Penta Acetic acid) according to Lindsay and Norvell (1978), while B is extracted by hot water according to Mahler *et al.* (1984).



**Fig 1: Location of the study area and sites of the soil profiles**

## **RESULTS AND DISCUSSION**

The soils under study are classified according to USDA (2010) into two orders; *Aridisols* and *Entisols* and include two suborders *Salids* & *Gypsic* for *Aridisols* and *Psammets* & *Orthents* for *Entisols*. Each suborder resembles one great group i.e. *Haplosalids* and *Haplogypsid* and *Torripsammets* & *Torriorthents*, Table 2. *Aridisols* order include ten soil families which range in soil texture from sandy to sandy loam and are represented by soil profiles nos. 1 to 10.

*Entisols* order includes two sub orders; *orthents* and *psammets*, and associated with six soil families that range between loamy sand to clayey, represented with profiles no.11 to 21.

**Table 1: Morphological description of the studied soil profiles soil**

Profile No.	depth cm	color (moist)	Textural class	Structure	Consistency	Effervescence	Boundary	Soil classification
1	0-25	10YR6/4	SL	gr	sl.h	w	as	Gypsic Haplosalids, fine loamy over sandy
	25-65	10YR6/4	CL	csb	h	w	cw	
	65-105	10YR7/6	LS	sg	lo	w	—	
2	0-25	10YR6/4	SL	gr	sl.h	w	as	Typic Haplogypsisds, clayey
	25-90	10YR6/4	CL	csb	h	m	cw	
	90-150	10YR6/4	SL	gr	sl.h	m	—	
3	0-30	10YR7/6	LS	sg	lo	w	as	Typic Haplogypsisds, fine loamy
	30-90	10YR6/4	CL	csb	h	w	cw	
	90-140	10YR6/4	SL	gr	sl.h	w	—	
4	0-30	10YR6/4	SL	gr	sl.h	w	cw	Lithic Haplosalids, coarse loamy
	30→	—	—	—	—	w	—	
5	0-30	10YR6/4	CL	csb	h	w	cw	Typic Haplosalids, clayey
	30-100	10YR6/4	C	csb	h	w	cw	
	100-150	10YR6/4	SL	csb	sl.h	w	—	
6	0-30	10YR7/6	LS	sg	lo	w	cw	Typic Haplogypsisds, coarse loamy over sandy
	30-65	10YR6/4	SL	gr	sl.h	w	as	
	65-140	10YR7/6	LS	sg	lo	w	—	
7	0-25	10YR6/4	SL	gr	sl.h	w	as	Lithic Haplosalids, fine loamy
	25-50	10YR6/4	CL	csb	h	w	—	
8	0-20	10YR7/6	LS	sg	lo	w	as	Typic Haplogypsisds, coarse loamy
	20-50	10YR6/4	SL	gr	sl.h	m	cw	
	50-130	10YR6/4	SL	gr	sl.h	w	—	
9	0-20	10YR6/4	SL	gr	sl.h	w	cw	Typic Haplogypsisds, loamy skeletal
	20-100	10YR6/4	SL	gr	sl.h	w	as	
	100-140	10YR7/6	LS	sg	lo	w	—	
10	0-45	10YR6/4	C	csb	h	m	cw	Lithic Haplogypsisds, clayey
	45→	—	—	—	—	w	—	
11	0-25	10YR7/6	S	sg	lo	w	cw	Typic Torripsammentes, sandy
	25-140	10YR7/6	LS	sg	lo	w	—	
12	0-25	10YR7/6	LS	sg	lo	w	cw	Typic Torriorthents, sandy
	25-70	10YR7/6	LS	sg	lo	w	cw	
	70-150	10YR7/6	LS	sg	lo	w	—	
13	0-20	10YR6/4	SL	gr	sl.h	w	cw	Lithic Torriorthents, coarse loamy
	20→	—	—	—	—	w	—	
14	0-35	10YR6/4	CL	csb	h	w	cw	Typic Torriorthents, coarse loamy
	35-90	10YR6/4	SL	gr	sl.h	w	cw	
	90-135	10YR6/4	SL	gr	sl.h	w	—	
15	0-130	10YR7/6	S	sg	lo	w	cw	Typic Torripsammentes, sandy
16	0-20	10YR7/6	LS	sg	lo	w	cw	Lithic Torripsammentes, sandy
	20→	—	—	—	—	w	—	
17	0-35	10YR6/4	SL	gr	sl.h	w	cw	Typic Torriorthents, sandy
	35-140	10YR7/6	LS	sg	lo	w	—	
18	0-30	10YR7/6	S	sg	lo	w	cw	Typic Torriorthents, sandy
	30-100	10YR7/6	S	sg	lo	w	cw	
	100-140	10YR7/6	S	sg	lo	w	—	
19	0-20	10YR6/4	SL	gr	sl.h	w	cw	Typic Torriorthents, coarse loamy
	20-60	10YR6/4	SL	gr	sl.h	w	cw	
	60-140	10YR6/4	SL	gr	sl.h	w	—	
20	0-40	10YR7/6	LS	sg	lo	w	cw	Lithic Torripsammentes, sandy
	40→	—	—	—	—	w	—	
21	0-70	10YR6/4	SL	gr	sl.h	m	cw	Typic Torriorthents, coarse loamy
	70-130	10YR7/6	S	sg	lo	m	—	

The soils families of *Entisols* are characterized by high percent of both sand fraction and Fe content with an average about 74.6 % and 4.93  $\mu\text{g g}^{-1}$  respectively, and have low averages of organic matter, gypsum, lime content and other micronutrients.

Whereas the soils families of *Aridisols* are characterized with high average of clay content and all variables except Fe element, Table 3.

**Table 2: Soil taxonomic units of the studied soil profiles**

Order	Sub-order	Great group	Sub-group	Soil families	Profiles Nos.
Aridisols	Salids	Haplosalids	<i>Gypsic Haplosalids</i>	<i>Gypsic Haplosalids, fine loamy over sandy</i>	1
			<i>Lithic Haplosalids</i>	<i>Lithic Haplosalids, fine loamy</i>	7
				<i>Lithic Haplosalids, coarse loamy</i>	4
			<i>Typic Haplosalids</i>	<i>Typic Haplosalids, clayey</i>	5
				<i>Typic Haplosalids, loamy skelatat</i>	9
	Gypsids	Haplogypsids	<i>Lithic Haplogypsids</i>	<i>Lithic Haplogypsids, clayey</i>	10
			<i>Typic Haplogypsids</i>	<i>Typic Haplogypsids, coarse loamy over sandy</i>	6
				<i>Typic Haplogypsids, clayey</i>	2
				<i>Typic Haplogypsids, coarse loamy</i>	8
				<i>Typic Haplogypsids, fine loamy</i>	3
Entisols	Psamment	Torripsamments	<i>Typic Torripsamments</i>	<i>Typic Torripsamments, sandy</i>	11 and 15
				<i>Typic Torripsamments, coarse loamy</i>	14
	Orthents	Torriorthents	<i>Lithic Torriorthents</i>	<i>Lithic Torriorthents, sandy</i>	16 and 20
				<i>Lithic Torriorthents, coarse loamy</i>	13
			<i>Typic Torriorthents</i>	<i>Typic Torriorthents, sandy</i>	12, 17 and 18
				<i>Typic Torriorthents, coarse loamy</i>	19 and 21

**Micronutrient in the taxonomic units**

**1. Iron (Fe):**

Data presented in Table 4 reveal that the lowest value of Fe content for order *Aridisols* is recorded in the deepest layer of profile No. 6, representing subgreat group *Typic Haplogypsids* which has coarse fraction i. e., soil family sandy texture. Whereas the highest value also detected in the deepest layer of profile 6, which is classified as family level as *Gypsic Haplosalids clayey*.

The studied profiles of *Aridisols* have Fe content range between 1.4 and 8.5  $\mu\text{g g}^{-1}$  with an average 2.85  $\mu\text{g g}^{-1}$ , and an irregular distribution pattern with depth. Similar results were reported by Bassirani et al. (2011).

According to Lindsay and Norvell (1978), values of available Fe extracted from soils ranged between Low < 2.5  $\mu\text{g g}^{-1}$ , marginal 2.5-4.5  $\mu\text{g g}^{-1}$  and adequate > 4.5  $\mu\text{g g}^{-1}$  Fe soil, Table 4.

Accordingly in order *Aridisols* about 56 % of soil samples have critical levels of available Fe 32 % represent marginal levels of available Fe and 12 % have sufficient levels. Whereas available Fe values in soils of *Entisols* order, about 31.8 % of soil samples contain critical levels, 27.3 % marginal levels and 40.9 % have sufficient limits.

Available iron content is 4.67  $\mu\text{g g}^{-1}$  Fe in order *Entisols* It is high in coarse textured soils, i.e., sandy and loamy sand than in soils of fine texture i.e., clay loam and clayey soils. Gheith (1955) mentioned that the reason may be attributed to the formation of Bahariya Oasis soils, known as Farafra – Bahariya Facien. The obtained results are harmony with their found by Abdel Razik (1999) in the soils of El Fayoum Governorate which are in the range of 3.02 to 23.43  $\mu\text{g g}^{-1}$ .

Simple correlation coefficients between available Fe and pH is found, negative highly significant with pH ( $r=-0.6457$ ), but are high significantly positive with Mn ( $r = 0.8142$ ), Zn ( $r = 0.6537$ ) and Cu ( $r = 0.5097$ ).

### 2. Manganese (Mn)

Lindsay and Norvell, (1978) considered the values of available Mn higher than 2  $\mu\text{g g}^{-1}$  are sufficient; accordingly about 90 % of the studied soils have available Mn. In the soil families of *Aridisols* about 16 % soil samples have marginal contents of available Mn, the corresponding value in soil families of *Entisols* is 4.2 %.

Soils data of *Entisols* order Table 3 reveal that available Mn ranges from 1.55 to 6.25  $\mu\text{g g}^{-1}$  with an average 2.55  $\mu\text{g g}^{-1}$ . While the soils of *Aridisols* have available Mn values range between 1.95 and 18.05  $\mu\text{g g}^{-1}$  with an average of 3.0  $\mu\text{g g}^{-1}$ .

Available Mn in *Aridisols* is higher than *Entisols*, *Aridisols* are recorded higher average and highest value of Mn (18.05  $\mu\text{g g}^{-1}$ ) is detected in profile No. 5 and which is the fine clayey textured. Results are reported by Abdel Razik (1999) have similar trend who stated that available Mn extracted by DTPA method varied from 0.8 to 30  $\mu\text{g/g}^{-1}$ .

Available Mn has positive significant correlations with Fe ( $r=0.8142$ ), Zn ( $r=0.5986$ ) and Cu ( $r=0.5097$ ). On the other hand it has available Mn showed highly significant and negative correlation with pH ( $r = -0.8175^{**}$ ).

### 3. Zinc (Zn):

The results in Table 4 reveal that available Zn content in the studied soil samples range between 0.16 and 1.8  $\mu\text{g g}^{-1}$  with an average 0.57  $\mu\text{g g}^{-1}$  in families of *Entisols* and from 0.2 to 17.8  $\mu\text{g g}^{-1}$  with an average 1.99  $\mu\text{g g}^{-1}$  for families of *Aridisols*. The lowest value is shown in the deepest layer of profile No.12 representing soils of *Typic Torripsammments sandy*, coarse textured, while the highest value is found in the surface layer of profile No.10, which is

fine textured and classified to soil families as *Lithic Haplogypsis clayey*, Tables 3 and 4.

The average value of available Zn content for soil families of *Entisols* is lower than that in *Aridisols*. FAO (1983) mentioned that coarse soil fractions contain and retain low Zn, therefore light textured soils are generally suffering of Zn deficient.

Simple correlation coefficients between available Zn and some soil factors are high negatively significant with soil pH ( $r=-0.8450$ ) but high positive significantly correlated with the clay content ( $r=0.6422$ ) and micronutrients i.e., Cu ( $r=0.8613$ ), Fe ( $r=0.6537$ ) and Mn ( $r=0.5986$ ).

According to Soltanpour and Schwab (1977), the index values for available Zn are as follows: Low ( $0-0.9 \mu\text{g g}^{-1}$ ), marginal ( $1-1.5 \mu\text{g g}^{-1}$ ) and adequate ( $> 1.5 \mu\text{g g}^{-1}$ ). The studied soil families of *Aridisols* contain 76 % and 4 % Low and marginal extractable Zn respectively. Whereas the soils families of *Entisols* have 86 % Low and 4.5 % marginal. The soils of *Aridisols* have sufficient amounts (20%) of available Zn greater than in *Entisols* (9.1%).

#### **4. Copper (Cu):**

Data in Tables 3 and 4 reveal that available Cu content extracted with DTPA varied from 0.13 to  $0.35 \mu\text{g g}^{-1}$  with an average  $0.18 \mu\text{g g}^{-1}$  for soil families of *Entisols* and from 0.09 to  $7.5 \mu\text{g g}^{-1}$  with an average  $1.17 \mu\text{g g}^{-1}$  for soil families of *Aridisols*. The lowest value is present in the deepest layer of profile No. 12, representing soils of *Typic Torriorthents sandy* which have coarse loamy texture i.e., sandy loam, whereas the highest value is found in the surface layer of profile No. 2, representing soils of *Lithic Haplogypsis clayey* which have a fine texture. The results are in harmony with that found by Ismail *et al.* (2012), who stated that available Cu extracted by DTPA method varied from 0.5 to  $8.1 \mu\text{g g}^{-1}$ .

The index values used for available Cu recorded by Lindsay and Norvell (1978) are critical ( $<0.2 \mu\text{g g}^{-1}$ ), marginal ( $0.2-0.5 \mu\text{g g}^{-1}$ ) and high ( $> 0.5 \mu\text{g g}^{-1}$ ). The critical values of available Cu in soil families of *Entisols* and *Aridisols* are 81 % and 48 % respectively. The sufficient values of Cu are 31.5 % and 6.9 % in families of the tow orders respectively.

Highly negative significant correlations are found between available Cu and both pH ( $r=-0.8172$ ) and sand fraction ( $r=-0.5499$ ). On the other side highly positive significant correlation with available Zn content ( $r=0.8613$ ) and positively significant with both available Mn ( $r=0.6489$ ) and Fe ( $r=0.5097$ ).

**Table 3 : Particles size distribution , CaCO<sub>3</sub> , CaSO<sub>4</sub> and soil classification of the studied soil profiles.**

Soils of order <i>Aridisols</i>									
Profile No.	depth cm	Particals size distribution %			Textural class	Gravel %	CaCO <sub>3</sub> %	Gypsum %	Soil classification
		Sand	Silt	Clay					
1	0-25	65.9	18.8	15.3	SL	2	2.4	3.4	<i>Gypsic Haplosalids, fine loamy over sandy</i>
	25-65	28.9	22.9	48.2	CL	3	3.3	16	
	65-105	81	9.3	9.7	LS	3	3.1	4.9	
2	0-25	65.3	18.2	16.5	SL	4	3.8	2.7	<i>Typic Haplogypsid, clayey</i>
	25-90	32.8	31.1	36.1	CL	20	4.4	24.9	
	90-150	64.6	17.2	18.2	SL	6	4.6	6.6	
3	0-30	82.1	8.4	9.5	LS	4	3.3	3.9	<i>Typic Haplogypsid, fine loamy</i>
	30-90	38	32	30	CL	15	3.5	25.6	
	90-140	62.7	19.7	17.6	SL	4	3.5	8.9	
4	0-30	66.9	17	16.1	SL	2	1.9	0.5	<i>Lithic Haplosalids, coarse loamy</i>
	30 →	—	—	—	—	—	—	—	
5	0-30	38.9	26.3	34.8	CL	2	1.7	1.5	<i>Typic Haplosalids, clayey</i>
	30-100	27.9	21.3	50.8	C	2	1.9	1.6	
	100-150	65.4	17.2	17.4	SL	3	1.2	0.5	
6	0-30	78.9	12.1	9	LS	14	3.3	4.9	<i>Typic Haplogypsid, coarse loamy over sandy</i>
	30-65	58.9	25.9	15.2	SL	12	3	19.6	
	65-140	80.5	9.9	9.6	LS	4	3.7	8	
7	0-25	63.9	20.9	15.2	SL	13	3.2	5.7	<i>Lithic Haplosalids, fine loamy</i>
	25-50	33.1	31.5	35.4	CL	5	3.7	28.5	
8	0-20	79.1	12.6	8.3	LS	5	3.5	3.4	<i>Typic Haplogypsid, coarse loamy</i>
	20-50	58.9	24.9	16.2	SL	3	4.3	23.5	
	50-130	63.9	19.1	17	SL	4	3.9	17.5	
9	0-20	63.1	19.2	17.7	SL	4	2.5	4.4	<i>Typic Haplogypsid, loamy skeletal</i>
	20-100	63.9	18.6	17.5	SL	38	2.4	20.4	
	100-140	82	7	11	LS	4	3	9.4	
10	0-45	27	28	45	C	2	7.2	10.3	<i>Lithic Haplogypsid, clayey</i>
	45 →	—	—	—	—	—	—	—	
Soils of order <i>Entisols</i>									
11	0-25	89.2	6.6	4.2	S	2	1.9	0.3	<i>Typic Torripsamment, sandy</i>
	25-140	81.1	13	5.9	LS	4	2.5	0.9	
12	0-25	81.3	11.6	7.1	LS	2	3.8	3	<i>Typic Torriorthents, sandy</i>
	25-70	80.9	11.1	8	LS	4	3.2	3.9	
	70-150	81.8	10.8	7.4	LS	3	2.9	4.5	
13	0-20	65	19	16	SL	0	2.1	1.8	<i>Lithic Torriorthents, coarse loamy</i>
	20 →	—	—	—	—	—	—	—	
14	0-35	36.9	28.9	34.2	CL	2	3.7	3.9	<i>Typic Torriorthents, coarse loamy</i>
	35-90	66.6	17.9	15.5	SL	3	3.1	3.8	
	90-135	64.7	20.4	14.9	SL	3	3.4	3.5	
15	0-130	87.1	7.1	5.8	S	2	2.1	0.5	<i>Typic Torripsamment, sandy</i>
16	0-20	79	11.7	9.3	LS	0	3.5	0.8	<i>Lithic Torripsamment, sandy</i>
	20 →	—	—	—	—	—	—	—	
17	0-35	63.9	20.8	15.3	SL	2	2.6	5.3	<i>Typic Torriorthents, sandy</i>
	35-140	78.1	12.2	9.7	LS	2	2.6	3.9	
18	0-30	86.9	6.5	6.6	S	2	1.9	3.8	<i>Typic Torriorthents, sandy</i>
	30-100	87.8	5.4	6.8	S	5	2.3	4.8	
	100-140	85.4	7.2	7.4	S	3	2.9	2.9	
19	0-20	63.9	17.9	18.2	SL	2	2.7	3.6	<i>Typic Torriorthents, coarse loamy</i>
	20-60	59.9	25.3	14.8	SL	4	2.8	1.8	
	60-140	66.9	17.1	16	SL	4	2.3	3.5	
20	0-40	81.4	8.9	8.5	LS	2	1.1	0.4	<i>Lithic Torripsamment, sandy</i>
	40 →	—	—	—	—	—	—	—	
21	0-70	65.1	17.3	17.6	SL	4	4.1	4.2	<i>Typic Torriorthents, coarse loamy</i>
	70-130	89.1	5.4	5.5	S	3	4.9	4.1	



### **5. Boron (B):**

Reisenauer *et. al.*, (1973) revealed that the index values of boron extracted from soils are nonsufficient for  $B < 1.0$ , sufficient  $1.0-5.0$  and toxic B concentrations which  $> 5.0 \mu\text{g g}^{-1}$ . Accordingly about 4% and 63% of the soil samples under study contain nonsufficient available boron for soil families of *Aridisols* and *Entisols* respectively. FAO (1983) revealed that soils having less than 0.5 ppm hot water soluble B are considered incapable of supplying sufficient B to support normal plant growth.

About 8% and 4.2 % represent the soils containing toxic limits of extractable B for families of *Aridisols* and *Entisols* respectively. FAO (1983) Mentioned that boron toxicity occurs in arid soils and soils containing more than  $> 5$  ppm water soluble B.

Available B detected in the studied soil profiles range from 0.95 to  $7.3 \mu\text{g g}^{-1}$  with an average  $2.53 \mu\text{g g}^{-1}$  for *Aridisols* and from 0.25 to  $5.5 \mu\text{g g}^{-1}$  with an average  $1.14 \mu\text{g g}^{-1}$  for soils of *Entisols*, Table 4.

The average value of B content in soil families of *Aridisols* is associated with medium to fine texture which is much higher than that noticed in *Entisols* which have coarse texture. Katyal *et. al.* (1983) mentioned that arid soils show exceptionally high B values but their availability decreases soil coarse texture of soils associated with low organic matter. Available B has positive and significant correlations with electric conductivity ( $r=0.7635$ ) and clay content ( $r=0.5948$ ).

Table 4: Some chemical characteristics of the studied soil profiles

Soils of order <i>Aridisols</i>									
Profile No.	depth cm	pH	EC dSm <sup>-1</sup>	OM %	Micronutrients mg/kg				
					Zn	Fe	Mn	Cu	B
1	0-25	7.9	5.7	1.61	0.5	2.4	1.85	0.2	3.05
	25-65	7.7	55	1.22	0.5	3	2.45	0.15	7.3
	65-105	8	12	0.91	0.5	2.8	2.15	0.2	3.25
2	0-25	8.1	6.6	0.91	0.3	1.6	1.65	0.21	1.75
	25-90	8.4	7.3	0.79	0.2	1.6	1.75	0.15	3
	90-150	8.2	5.5	0.61	0.2	3.4	2.15	0.09	2.35
3	0-30	8	4.4	0.21	0.2	1.5	2.25	0.25	3.05
	30-90	8.1	5.4	0.59	0.3	1.8	2.25	0.15	3.45
	90-140	8.3	2.8	0.31	0.2	1.7	2.25	0.15	2.95
4	0-30	8.2	32.4	0.69	2.5	2.1	2.55	3.65	2.6
	30→	Rock land							
5	0-30	6.5	23	1.01	4.5	3.1	5.25	3.05	2.45
	30-100	8.4	41	0.68	6.1	7.5	4.55	0.45	6.6
	100-150	4.6	4.8	0.6	9.7	8.5	18.05	5.05	1.1
6	0-30	8	7.5	0.3	0.6	2.5	2.05	0.25	1.05
	30-55	8.4	8	0.41	0.4	2.9	2.35	0.17	1.35
	55-140	8	6.2	0.26	0.4	1.4	2.45	0.13	1.25
7	0-25	8.1	6	0.61	1.1	1.6	1.95	0.85	3.25
	25-50	8.3	17.2	0.77	0.7	2	2.25	0.95	4.35
8	0-20	8.1	4.9	0.49	0.3	2.8	2.45	0.15	1.65
	20-50	8.1	5.1	0.31	0.2	3	2.15	0.21	1.45
	50-130	7.7	5.4	0.21	0.2	2.4	2.05	0.11	1.65
9	0-20	8.4	4.4	0.71	0.9	2.1	2.15	1.07	1.35
	20-100	8.2	4.8	0.51	0.7	2.4	2.25	2.05	1.05
	100-140	8.4	5.2	0.51	0.7	2.2	2.45	2.25	1
10	0-45	4.7	15.3	0.67	17.8	5.1	6.25	7.5	0.95
	45----	Rock land							
Soils of order <i>Entisols</i>									
11	0-25	7.9	3	0.26	1.6	8.9	2.95	0.25	0.75
	25-140	7.9	3.2	0.21	1.1	6.1	2.05	0.15	0.65
12	0-25	7.9	3.6	0.21	0.2	2.1	2.15	0.15	0.75
	25-70	8	4.5	0.21	0.2	3.9	2.35	0.15	0.75
	70-150	8.2	3.4	0.21	0.1	1.7	2.25	0.13	0.65
13	0-20	8.1	3.2	0.78	0.4	2	2.15	0.27	5.5
	20 →	Rock land							
14	0-35	8.3	5.9	0.6	0.9	6.5	2.25	0.15	2.5
	35-90	8.2	4.6	0.41	0.5	3.9	2.15	0.15	1.75
	90-135	8	5.5	0.31	0.4	2.7	2.35	0.14	1.35
15	0-130	8.1	4.3	0.15	0.3	5.1	2.35	0.16	0.6
16	0-20	8.4	3.5	0.23	0.6	6.7	2.35	0.14	1.4
	20 →	Rock land							
17	0-35	8.4	2.3	0.25	0.3	2.7	2.45	0.15	1.3
	35-140	8.2	3.2	0.21	0.2	2.9	2.25	0.15	1.15
18	0-30	8.5	1.8	0.37	0.8	22.9	3.65	0.15	0.25
	30-100	8.2	1.4	0.31	0.7	10.6	2.65	0.15	0.3
	100-140	8.3	1.6	0.21	0.4	6.7	2.85	0.14	0.35
19	0-20	8.3	7.1	0.31	0.3	2.3	2.45	0.15	1
	20-60	8	8.5	0.31	0.6	1	2.25	0.15	0.88
	60-140	8.1	14	0.41	0.7	2.9	2.65	0.14	0.95
20	0-40	5.5	5.4	0.57	1.8	2.1	3.9	0.35	1.1
	40 →	Rock land							
21	0-70	9.5	1.6	0.32	0.16	2.3	1.55	0.35	0.9
	70-130	8.4	1.8	0.26	0.6	2.2	2.15	0.14	0.65

## CONCLUSIONS

Leaching requirements are very necessary to remove salts out of root zone and reducing the toxic amounts of micronutrients. Continuous additions

of organic matter are very important to remediation many physical and chemical properties as well as fertility status. The soils containing more than 5 ppm water soluble B must be have leaching processing and cultivated with high B tolerant crops.

## REFERENCES

- Abdel Razik, S.A. (1999). Trace nutrients status and its relation to some soil variables in sandy and calcareous soils of Egypt. *J. Agric. Sci. Mansoura Univ.*, 24 (3): 1441-1451.
- Abdel Razik, S.A. (1999). Micronutrients status and its relation to some soil variables in the soils of El-Fayoum Governorate, Egypt. *Egypt. J. Appl. Sci.*, 17 (11): 291.
- Adesanwo, O.O., Adetunji, M.T., Adesanwo, J.K., OSiname, O.A., Diatta, S., Torimiro, D.O. (2009). Evaluation of traditional soil fertility management practises for rice cultivation in southwestern Nigeria. *Am. Eurasian J. Agron.*, pp.45-49.
- Bassirani N, Abolhassani M, Galavi M (2011). Distribution of available micro-nutrients as related to the soil characteristics of Hissar; Haryana (India). *Afr. J. Agric. Res.* 6:4239-4242.
- Chan, K.Y., Bowman, A., and Oates, A., (2001). Oxidizable organic carbon fractions and soil quality changes in an oxic paleustalf under different pasture leys. *Soil Science* 166, 61–67.
- Duarah I, Deka M, Saikia N, Deka Boruah HP (2011). Phosphate olubilizers enhance NPK fertilizer use efficiency in rice and legume cultivation. *3 Biotech.* 1(4):227-238.
- FAO (1983). " Micronutrients " Fertilizer and plant nutrition. *Soil Bull.*, No.7 Rome.
- Gheith, M.A., (1955). Classification and review of Egyptian iron deposits" symposium *Appl. Geol. In the Near East, UNESCO Ankara, 1955, P 106 – 113.*
- Grais, Y.L. (2006). Trace elements distribution relation to geomorphology of some soils along the North Western Coastal of Egypt. *Egypt. J. of Appl. Sci.*, 21 (4A): 315-331.
- Ismail M., Abou El-Hag G.T.I. and Soliman Y.R.I. (2012). Distribution mode of some essential micronutrients for plant as related to the different taxonomic units of soils developed on the west Nile delta area Egypt. *J. Agric. Sci. Mansoura Univ.*, 25 (2): 450-452.
- Katyal J. K. and Randhawa N. S. (1983). " Micronutrients " fertilizer and plant nutrition. *FAO Bulliten* 7
- Lindsay, W.L. and W.A. Norwell (1978). Development of a DTPA soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. Am. J.*, 42: 421-428.
- Mahler, R. L., D. V. Naylor, and M. K. Fredrickson (1984). Hot water extraction of boron from soils using sealed plastic pouches. *Comm. Soil Sci. Plant Anaysis* 15:479- 492.
- Page, A.L.; R.M. Milner and D.R. Kenney (1982). *Methods of Soil Analysis. Part 2-Chemical and Microbiological Properties*, 2<sup>nd</sup> Ed., Amer. Soc. of Agronomy Series 9, SSA, Madison, Wisconsin, USA, 53711.

- Reisenauer, H. M., Walsh, I. M. and Hoefft, r. C. (1973). Testing soils for Sulfur, Boron, Molybdenum and Chlorine " chapter 12 in Soil Testing and Plant Analysis " Walsh et al (eds), Soil Sci. Soc, Am, Inc. Madison, wisc.
- Richards, L.A. (1954). Diagnosis and Improvement of Saline and Alkali Soils. U.S.D.A. Handbook No. 60, Washington D.C., U.S.A.
- Shehata, R.B. (1992). Pedological studies land evaluation of El-Bahariya oasis soils. *Ph.D. Thesis*, Fac. of Agric, Menofiya Univ., Egypt.
- Soltanpour, P.N. and A.P. Schwab (1977). A new test for simultaneous extraction of macro and micronutrients in alkali soils. *Common. Soil Sci. and Plant Anal.*, 8: 195-207.
- USDA (2003). "Soil Survey Manual" United States Department of Agriculture, Handbook No. 18 US Gov. Print. Off Washington D.C., USA.
- USDA (2010). "Keys to Soil Taxonomy " 11<sup>th</sup> Ed., Soil Survey Staff, United States Department of Agriculture, USA

**الوحدات التقسيمية والعناصر المغذية الصغرى لبعض أراضي الواحات البحرية – مصر**  
**إبراهيم محمد عبد العزيز حجازي، أشرف محمد عبد الغني، جمال فريد عثمان الشيخ و محمود كامل ناصف**  
**معهد بحوث الأراضي والمياه والبيئة – مركز البحوث الزراعية – جيزة – مصر**

- يهدف البحث إلى دراسة حالة بعض العناصر المغذيات الصغرى مثل الحديد والمنجنيز والزنك والنحاس واليورون في بعض أراضي منطقة الواحات البحرية ، ومدى ارتباط قيم هذه العناصر بتقسيم وتصنيف وحدات التربة بمنطقة الدراسة وعلاقتها ببعض خواص التربة. ولتحقيق ذلك تم اختبار ٢١ قطاعاً أرضياً تم تصنيفها حتى مستوى عائلات التربة المصاحبة لمنطقة الدراسة ، وكانت النتائج المتحصل عليها كالتالي :-
- ١ - احتوت أراضي منطقة الدراسة على رتبتين من الأراضي هما رتبة *Aridisols* ورتبة *Entisols*.
  - ٢ - احتوت أراضي الـ *Aridisols* على تحت رتبتين هما : *Salids* ، *Gypsid* ، بينما احتوت أراضي رتبة الـ *Aridisols* على الـ *Orthents* ، *Psamments* .
  - ٣ - اشتملت رتبة الـ *Aridisols* على عشرة عائلات تربة *Soil families* تراوح قوامها من القوام الرملي الطمي حتى القوام الطيني ، بينما وجد ست عائلات تربة في رتبة أراضي الإنتيسول *Entisols* تراوح قوامها من القوام الرملي إلى الطمي الرملي .
  - ٤ - اتصفت عائلات تربة الإنتيسول باحتوائها على نسبة عالية من مكون الرمل وذات محتوى قليل من المادة العضوية والجير والجبس ، على العكس من ذلك احتوت عائلات تربة الأريديسول على نسب عالية من مكون الطين والمادة العضوية والجير والجبس.
  - ٥ - تراوحت قيم عناصر الحديد والمنجنيز واليورون والزنك والنحاس في عائلات رتبة الإنتيسول من ١ - ٢٠,٩ ، ١,٥٥ - ٦,٢٥ ، ٠,٢٥ - ٥,٥ ، ٠,١٦ - ١,٨ ، ٠,١٥ - ٠,٣٥ ملليجرام عنصر / كيلو جرام تربة على التوالي. بينما كانت نسب العناصر في رتبة الأريديسول كالتالي من ١,٤ - ٨,٥ للحديد ، ١,٩٥ - ١٨,٥ للمنجنيز ، ٠,٩٥ - ٧,٣ لليورون ، ٢ - ٢١,٢ ، ٠,١٥ - ٧,٠ ملليجرام نحاس / كيلو جرام تربة.
  - ٦ - متوسط قيم عنصر الحديد مرتفعة في عائلات رتبة أراضي الـ *Entisols* ، بينما كانت منخفضة في الـ *Aridisols* .
  - ٧ - كان متوسط قيم عناصر المنجنيز والزنك والنحاس واليورون منخفضة في عائلات رتبة أراضي الـ *Entisols* عنها في عائلات رتبة في أراضي الـ *Aridisols* .
  - ٨ - كانت قيم العناصر المغذية الصغرى المدروسة لعائلات الأريديسول أعلى من الكميات الموصى بها لدرجة (Marginal limit) ، حيث وجد تركيز كل من الحديد والمنجنيز والزنك والنحاس واليورون بزيادة قدرها ١٢ % ، ٨٤% ، ٢٠% ، ٣٦% ، ٨% على التوالي. وكانت في المقابل ٤٠,٩ % ، ٩٥ % ، ٩ % ، ٤,٦ % ، ٥,٢ % لعائلات الإنتيسول.