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SOIL TAXONOMIC UNITS AND MICRONUTRIENTS CONTENT OF BAHARIYA OASIS, EGYPT

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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-Bauity 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 gypsids
  - *Order Entisols* has two sub orders *orthents* and *psamments*.
- *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 µg 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 µg g^{-1} respectively, while the corresponding values in *Entisols* are 5.6, 2.7, 1.9, .6 and 1.3 µg 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

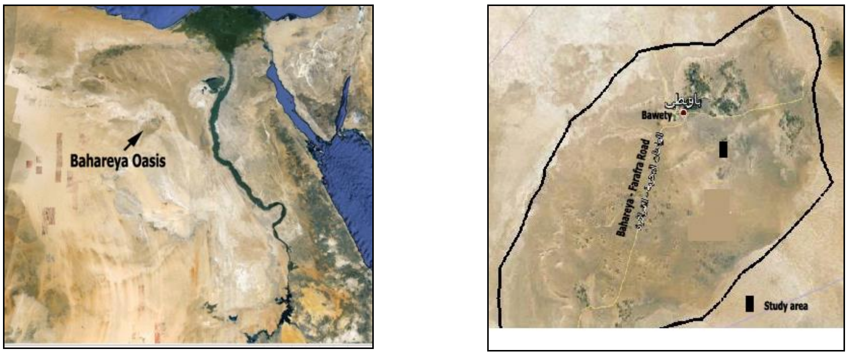
In Egyptian soils, the levels of micronutrients elements can be used as a guide for substantiating the nature of parent material together with the pedogenic aspects, which lead to the prediction of soil genesis and formation (Grais, 2006).

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.

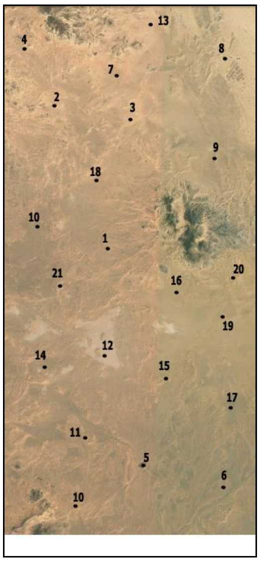
MATERIALS AND METHODS

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, $CaCO_3$ and $CaSO_4$ 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).



Egypt **Study area**



Soil profiles

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 tow orders ; *Aridisols* and *Entisols* and include tow suborders *Salids & Gypsic for Aridisols and Psamments & Orthents for Entisols*. Each suborders resembles one great group i.e. *Haplosalids* and *Haplogypsids* and *Torripsamments* & *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 *psamments*, 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 Haplogypsids, 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 Haplogypsids, 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 Haplogypsids,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 Haplogypsids, 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 Haplogypsids, 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 Haplogypsids,clayey*
	45 →	—	—	—	—	w	—	
11	0-25	10YR7/6	S	sg	lo	w	cw	*Typic Torripsammements, 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 Torripsammements, sandy*
16	0-20	10YR7/6	LS	sg	lo	w	cw	*Lithi Torripsammemtents, 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 Torripsammentents, 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 characteristed by high percent of both sand fraction and Fe content with an average about 74.6 % and 4.93 µg g^{-1} respectively, and have low averages of organic matter, gypsum, lime content and other micronutrients.

Whereas the soils families of *Aridisols* are characteristed 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*	*Gypsic Haplosalids*	*Gypsic Haplosalids, fine loamy over sandy*	1
			Lithic Haplosalids	*Lithic Haplosalids, fine loamy*	7
				Lithic Haplosalids, coarse loamy	4
			Typic Haplosalids	*Typic Haplosalids, clayey*	5
				Typic Haplosalids, loamy skelatat	9
	Gypsids	*Haplogypsids*	*Lithic Haplogypsids*	*Lithic Haplogypsids, clayey*	10
			Typic Haplogypsids	*Typic Haplogypsids, coarse loamy over sandy*	6
				Typic Haplogypsids, clayey	2
				Typic Haplogypsids, coarse loamy	8
				Typic Haplogypsids, fine loamy	3
Entisols	*Psamments*	*Torripsamments*	*Typic Torripsammentents*	*Typic Torripsammentents, sandy*	11 and 15
				Typic Torripsammentents, coarse loamy	14
	Orthents	*Torriorthents*	*Lithic Torriorthents*	*Lithic Torriorthents, sandy*	16 and 20
				Lithic Torriorthents, coarse loamy	13
			Typic Torriorthents	*Typic Torriorthents, sandy*	12, 17 and18
				Typic Torriorthents, coarse loamy	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 µg g^{-1} with an average 2.85 µg 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 µg g^{-1}, marginal 2.5-4.5 µg g^{-1} and adequate > 4.5 µg 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 µg 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 µg 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 µg 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 µg g^{-1} with an average 2.55 µg g^{-1}. While the soils of *Aridisols* have available Mn values range between 1.95 and 18.05 µg $g^{-1}$with an average of 3.0 µg g^{-1}.

Available Mn in *Aridisols* is higher than Entisols, *Aridisols* are recorded higher average and highest value of Mn (18.05 µg 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 µg/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 µg g^{-1} with an average 0.57 µg g^{-1} in families of *Entisols* and from 0.2 to 17.8 µg g^{-1} with an average 1.99 µg g^{-1} for families of *Aridisols*. The lowest value is shown in the deepest layer of profile No.12 representing soils of *Typic Torripsamments 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 Haplogypsids 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 µg g^{-1}), marginal (1-1.5µg g^{-1}) and adequate (> 1.5 µg 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 µg g^{-1} with an average 0.18 µg g^{-1} for soil families of *Entisols* and from 0.09 to 7.5 µg g^{-1} with an average 1.17 µg 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 Haplogypsids 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 µg g^{-1}.

The index values used for available Cu recorded by Lindsay and Norvell (1978) are critical (<0.2 µg g^{-1}), marginal (0.2-0.5 µg g^{-1}) and high (> 0.5 µg 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 , $CaCO_3$, $CaSO_4$ and soil classification of the studied soil profiles.

Soils of order *Aridisols*

Profile No.	depth cm	Particals size distribution %			Textural class	Gravel %	$CaCO_3$ %	Gypsum %	Soil classification
		Sand	Silt	Clay					
1	0-25	65.9	18.8	15.3	SL	2	2.4	3.4	*Gypsic Haplosalids, fine loamy over sandy*
	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	*Typic Haplogypsids, clayey*
	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	*Typic Haplogypsids, fine loamy*
	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	*Lithic Haplosalids, coarse loamy*
	30→	—	—	—	—	—	—	—	
5	0-30	38.9	26.3	34.8	CL	2	1.7	1.5	*Typic Haplosalids, clayey*
	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	*Typic Haplogypsids,coarse loamy over sandy*
	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	*Lithic Haplosalids,fine loamy*
	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	*Typic Haplogypsids, coarse loamy*
	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	*Typic Haplogypsids, loamy skeletal*
	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	*Lithic Haplogypsids,clayey*
	45 →	—	—	—	—	—	—	—	
Soils of order Entisols									
11	0-25	89.2	6.6	4.2	S	2	1.9	0.3	*Typic Torripsammemtents, sandy*
	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	*Typic Torriorthents, sandy*
	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	*Lithic Torriorthents, coarse loamy*
	20 →	—	—	—	—	—	—	—	
14	0-35	36.9	28.9	34.2	CL	2	3.7	3.9	*Typic Torriorthents, coarse loamy*
	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	*Typic Torripsammemtents, sandy*
16	0-20	79	11.7	9.3	LS	0	3.5	0.8	*Lithi Torripsammemtents, sandy*
	20 →	—	—	—	—	—	—	—	
17	0-35	63.9	20.8	15.3	SL	2	2.6	5.3	*Typic Torriorthents, sandy*
	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	*Typic Torriorthents, sandy*
	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	*Typic Torriorthents, coarse loamy*
	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	*Lithic Torripsammentents, sandy*
	40 →	—	—	—	—	—	—	—	
21	0-70	65.1	17.3	17.6	SL	4	4.1	4.2	*Typic Torriorthents, coarse loamy*
	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 µg 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 cantaining 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 µg g^{-1} with an average 2.53 µg g^{-1} for *Aridisols* and from 0.25 to 5. 5 µg g^{-1} with an average 1.14 µg 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=0.0.5948).

Table 4: Some chemical characteristics of the studied soil profiles

Profile No.	depth cm	pH	EC dSm^{-1}	OM %	Micronutrients mg/kg				
					Zn	Fe	Mn	Cu	B
Soils of order *Aridisols*									
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 Entisols									
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.

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الوحدات التقسيمية والعناصر المغذية الصغرى لبعض أراضي الواحات البحرية – مصر

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يهدف البحث إلى دراسة حالة بعض العناصر المغذيات الصغرى مثل الحديد والمنجنيز والزنك والنحاس والبورون فى بعض أراضى منطقة الواحات البحرية ، ومدى ارتباط قيم هذه العناصر بتقسيم وتصنيف وحدات التربة بمنطقة الدراسة وعلاقتها ببعض خواص التربة.

ولتحقيق ذلك تم اختبار 21 قطاعاً أرضياً تم تصنيفها حتى مستوى عائلات التربة المصاحبة لمنطقة الدراسة ، وكانت النتائج المتحصل عليها كالتالى :-

1- إحتوت أراضي منطقة الدراسة على رتبتين من الأراضي هما رتبة *Aridisols* ورتبة *Entisols*.

2- احتوت أراضي الـ *Aridisols* على تحت رتبتين هما : *Salids* ، *Gypsids* ، بينما احتوت أراضي رتبة الـ *Aridisols* على الـ *Orthents* ، *Psamments* .

3- اشتملت رتبة الـ *Aridisols* على عشرة عائلات تربة Soil families تراوح قوامها من القوام الرملي الطمي حتى القوام الطيني ، بينما وجد ست عائلات تربة فى رتبة أراضى الإنتيسول *Entisols* تراوح قوامها من القوام الرملي إلى الطمي الرملي .

4- 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.

5- تراوحت قيم عناصر الحديد والمنجنيز والبورون والزنك والنحاس في عائلات رتبة الإنتيسول من 1 – 20,9 ، 1.55– 6.25، 0.25 – 5.5 ، 0.16 – 1.8 ، 0.15 – 0.35 مليجرام عنصر / كيلو جرام تربة على التوالى. بينما كانت نسب العناصر في رتبة الأريديسول كالتالي من 1.4 – 8.5 للحديد ، 1.95 – 18.5 للمنجنيز ، 0.95 – 7.3 للبورون ، 2 – 21.2 ، 0.15 – 7.0 مليجرام نحاس / كيلو جرام تربة.

6- متوسط قيم عنصر الحديد مرتفعة فى عائلات رتبة أراضى الـ *Entisols*، بينما كانت منخفضة فى الـ *Aridisols* .

7- كان متوسط قيم عناصر المنجنيز والزنك والنحاس والبورون منخفضة فى عائلات رتبة أراضى الـ *Entisols* عنها في عائلات رتبة فى أراضي الـ *Aridisols* .

8- 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 والبورون بزيادة قدرها 12% ، 84% ، 20% ، 36% ، 8% على التوالى. وكانت في المقابل 40.9 % ، 95 % ، 9 % 4.6 % 5.2 % لعائلات الإنتيسول.