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IMPACT OF PHYSICAL AND CHEMICAL PROPERTIES OF SOIL ON THE GROWING PLANT IN EL MOUNIRA – EL QATTARA NEW VALLEY.

Abd El Salam M. Elwa[1*]; Ahmed M. Abou-Shady[1]; Ahmed Sayed [2] and Hossam Showman[3]

1- Soil Physics and Chemistry Department, Water Resources and Desert Soils Division, Desert Research Center, El-Matariya 11753, Cairo, Egypt
2- Pedology Department, Water Resources and Desert Soils Division, Desert Research Center, El-Matariya 11753, Cairo, Egypt
3- Environmental and Desert Agriculture Division, Desert Research Center, El-Matariya 11753, Cairo, Egypt.

1* E-mail - abdelsalamelwa33@yahoo.com

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ABSTRACT

In the preset work, seven soil profiles were taken from El Qattara, New Valley, to evaluate the physical and chemical properties and it relationship with existing heavy metals and its possibility for growing various crops. In general, the New Valley Governorate is considered one of most promising areas for the agricultural development in Egypt. So that, it was very important to quantify the variability of heavy metals containing cultivated soils in New Valley area. The obtained results showed that different soil map units were represented in the studied soil profiles such as 1) moderately deep coarse textured soils, 2) moderately deep and moderately coarse textured soils, and 3) deep and moderately to fine textured soils.

The concentrations of available heavy metals including Fe, Cu, Zn, and Mn were relatively low. The correlation between the studied chemical and physical properties were found to be osculated *among* the positively and negatively values, and there was no stable tendency observed within the studied available and total heavy metals. The concentrations of available heavy metals were relatively low and were ranged among 8.15 – 10.48 mg kg^{-1} for Fe, 0.18 – 0.23 mg kg^{-1} for Cu, 0.41- 0.65 mg $kg^{-1}$for Zn, and 1.01 – 2.59 mg kg^{-1} for Mn. It was noticed that the concentrations of available Mn, total Zn, total Ni, total Pb, and total Cr in the studied soil profiles were the most heavy metals that correlated positively with soil chemical properties. All the surface layer in all profiles suffer increasing in EFs of heavy metals from significant to very high and extremely enrichment.

1. INTRODUCTION

One of the most challenges that facing Egyptian government is the requirement for better development and management of the current natural resources to be ultimately capable of overcoming the increased annual consumption of food and feed simultaneously with the incredibly growth of

Egyptian population. The relationship between land and human resources is Egypt is considered the most critical issue **(Sayed, 2013).** The continuously increases of Egyptian population resulted in a big gap between the total production of food and feed and the real consumption. This issue has created a big pressure on Egyptian government to increase the total area of reclaimed land via stablished several mega projects within the last decades such as El Sallam Canal project, Toshka project, 1.5 Acres Project, Sharq Al-Owainat project, New Villages project, and Darb El Arbaeen project **(Abou-Shady, 2016 a and b; Abou-Shady, 2017; Abou-Shady,etal., 2020).** Generally, the Egyptian soils may be divided into two main categories as follows a) desert sandy and calcareous soils and b) the transported alluvial origin. Owing to the severe deficiency of water supply in Middle East and North Africa counters it was observed that the alluvial soils have been already received excessive continuous amounts of heavy metals and micro-nutrients via both wastewater reuse, intensive agriculture, and excessive fertilization. Whereas, the opposite trend was observed in the desert sandy and calcareous soils in which a very low content of either heavy metals or micro-nutrients were exist **(Khalil et al., 2009; Ramadan et al., 2020; Bahnasawy et al., 2020; Hegab et al., 2016; Abou-Shady, 2016a and b; Abou-Shady, 2017; Abou-Shady et al., 2018 a, b, and c; Eissa ei al., 2018; Khalfa et al., 2018).**

Most of Egyptian soils are characterized by a comparatively high concentrations of the total amounts of Fe, if it compared with other micro nutrients. Whereas, it was reported that the concentrations of other forms such as soluble and exchangeable of Fe are exist in a relatively low concentrations particularly in well-drained soils **(Abd Elrahman, 2005).** In general, it was found that the concentrations of Mn in different locations exist in El-Fayoum Governorate, Egypt were varied to be between 280-840 mg kg^{-1}, whereas the concentrations of available Mn were varied between 2.0-12.9 mg kg^{-1}. Regarding, the concentrations of Zn it was found to be among 20.7-55.1 mg kg^{-1}. The maximum values of total Zn were explored to be depend on soil texture and complied with the following sequence of clay texture clay > loam > clay loam > sandy clay loam > sandy clay > sandy loam. This is owing to the fact that the fine particles soils involved relatively high amounts of organic matter. In the same locations of El-Fayoum governorate, Egypt, it was explored that the total concentrations of Cu were varied between 58-104 mg kg^{-1}, whereas the values of the extractable form of Cu were varied between 1.6-8.4 mg kg^{-1}. It was also reported that, the total or available concentrations of Cu in different soils were mainly correlated according to the following factors $CaCO_3$ concentrations, soil texture, and organic matter content. **(Elgala et al., 1986; Abd Elrahman, 2015).** The total concentrations of Ni in different alluvial soils located at El-Fayoum Governorate, Egypt, was explored to be varied between 33.5-77 mg kg^{-1}, whereas the amounts of available extraction showed the lower concentrations of Ni in which the concentrations were varied between 0.44-1.34 mg kg^{-1}. In El-Gabal El-Asfar area, in which the largest wastewater treatment plant is exist it was reported that, the available concentrations of Pb were exist in the following range of concentrations 0.26 to 37.4 mg kg^{-1}. Also, it was reported that the relatively high concentrations of Pb in El-Gabal El-Asfar area may be owing to the relying on irrigation with sewerage water for a long period. It was demonstrated that the concentrations of available Pb in the surface layers of soils that were under intensive irrigation for 10 years were close to 11.8 mg kg^{-1}. The total concentrations of Co were investigated via collecting different soils samples from Delta, Egypt in which the degree of pollution was differ to be non-polluted, moderately, and highly polluted soils. The obtained results revealed that the concentrations of Co were varied between 13.12-23.20 mg kg^{-1} and (26.5-30.0 mg kg^{-1}) for the non-polluted and moderately polluted soils, respectively. However, it was reported that the highest values of Co were varied between 36-64.69 mg kg^{-1} **(Abd Elrahman, 2015).**

The research aims to shed light on the most important factors that hinder or reduce soil productivity, as well as the spatial distribution of heavy metals for lands irrigated with deep irrigation water (low salinity) and surface water (highly saline). With a vision of how to overcome these units in line with the strategy The state to raise the efficiency of land and water units.in the preset work, we have investigated seven soil profiles located in El Qattara New Valley, Egypt. Soil chemical and physical properties was determined in the collected soil samples, however, heavy metals concentrations were detected in the soil surfaces. Also, soil characteristics and general land classification (capability and suitability for crops) have been discussed.

2. MATERIAL AND METHODS

2.1. Description of the study area

New Valley Governorate may is considered one of the part of the Western Desert in addition to it lies within the South-Western part of Egypt. It covers a locality of concerning of a total area of 440,098 km^2 that represents approximately a quarter mile of the total area of Egypt. New valley Governorate includes five massive central specifically areas as follows El-Kharga, Bareis, Balat, El-Dakhla, and El-Farafra. It was noticed that agriculture is considered the main occupation of inhabitants in New Valley Governorate. The New Valley Governorate climate is extremely arid with long hot and rainy weather in summer and mild rainfall in winter. The groundwater is considered the only water resource for all activities in these oases **(Swify et al., 2017).**

The studied area is bounded by longitudes among 30°40'20"E and 30°35'40″ E and latitudes among 25°37'14 N and 25°31'0″ N, that covers a surface area of approximately 7330 hectares as it presented in Figure. 1. The Lower Cretaceous-Lower Tertiary sedimentary sequence overlies unconformably the geology of the Western Desert, including Kharga Oasis. This sedimentary sequence includes the Nubian sandstone that overlaid by variegated shale rock groups, which are well exposed to form much of the depression floor bedrocks. Nearby the Kharga Desert spring in Egypt, the Quseir Formation is considered a topographical development as it shown in Figure 2. The lithology comprises generally of delicate shale with hard sandstone groups.

In the present work seven soil profiles were chosen to represent the different soil mapping units as it depicted in Figure (3). Data presented in Table (1) shows the chemical analysis of the studied seven soil profiles. Nineteen samples were collected from the studied soil profiles in which two samples were taken from to depths (0-25 cm and 25- 70 cm) from soil profiles numbers 1, 2, and 6. There samples were taken vertically from the surface layer until 120 cm depth from the studied soil profiles numbers 3, 4, and 5. Finally, four samples were taken vertically from soil profile number 6 as follows (0-20 cm, 20- 40 cm, 40-85 cm, and 85-120 cm). The soil chemical analysis were carried out according to methods mentioned in our previous studies **(Abou-Shady et al 2012 a and b; Abou-Shady and Peng, 2012; Eisaa, et al., 2018; Kalifa et al., 2018; Ramadan et al., 2020; Bahnasawy et al., 2020; Abou-Shady,et al,. 2020).** The soil profiles were wide open to a depth of approximately 70 to 150 cm. Soil profiles were expected to reflect the wide variations in soil texture and soil salinity.

A morphological description of the studied soil profiles was carried out according to the criteria that has been established by FAO guidelines for soil description **(Jahn et al., 2006).**

In the Cervatana model, a land capability model is built to define the capacity of the represented map units in the study area. The program works through a sequence to match the land characteristics with the conditions required for each capacity class. The model of soil suitability was based on a study of edaphic factors influencing the production of typical annual crops such as wheat, maize, melon, potatoes, soybeans, cotton, sunflower, and sugar beet. Semi-annual or perennial crops such as alfalfa, peach, citrus, and olive were selected, however, the Almagra model was used to determine the suitability of agricultural soils for crop production **(De la Rosa, et al., 2004).**

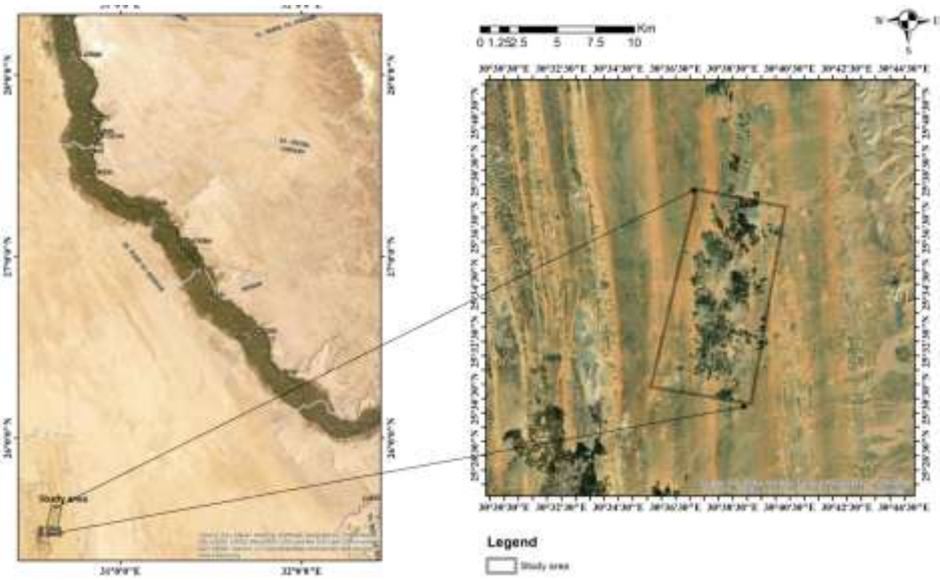

Figure. 1 . Maps show the locations of the studied area.

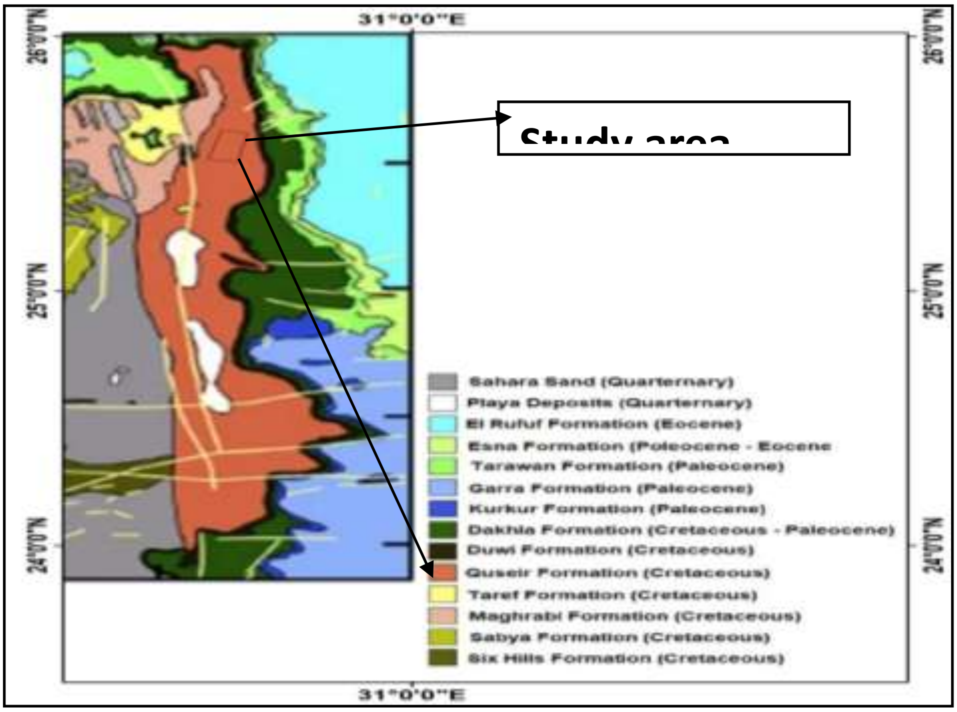

Figure 2 . Map shows the geological of the study area **(after CONOCO, 1987 and Abu Seif and sedek , 2013).**

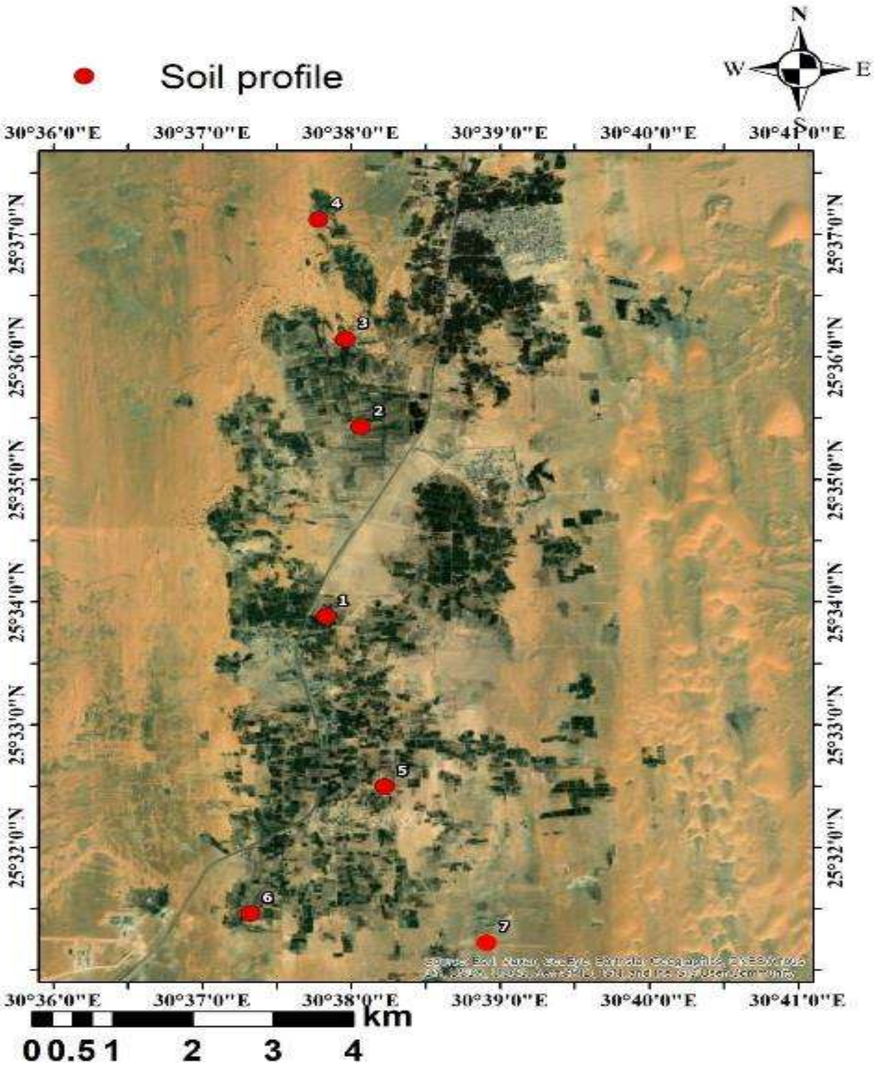

Figure. 3. Map shows the location of studied soil profiles.

3.RESULTS AND DISCUSSION

3.1. Soil characteristics.

The current study explain the effect of physical and chemical properties of the studied area on the growing plant in El Mounira – El Qattara New Valley, Egypt and study some of heavy metals in the cultivated soils of the studied region. Consequently, it is essential to throw light on the relevant physical and chemical properties of the investigated soils. Besides, heavy metals content of irrigation water as only source of metals and their bearing on crops grown on soils will be considered.

The soil pH values were varied among the lowest values of 7.23 in the surface layer of soil profile number 4, whereas the highest values were detected in the deep layer of soil profile number 5 that was 8.82 which indicate the neutral effects of pH values. The electrical conductivity values for soil-water extract were ranged among 0.21-6.80 dS m^{-1}. The highest values were detected in the deep layers of soil profiles number 4 and 2, however the rest of electrical conductivity values were less than 2.30 dS m^{-1}. The electrical conductively values were increased in the soil past extraction, and ranged among 0.70-22.67 dS m^{-1} which indicate the bad effect of salinity on the grown crops. Regarding the value of soluble Na in soil water extract 1:2.5 it was noticed that the lowest values was obtained in the surface layer of soil profile number 5 (1.75 meq L^{-1}), whereas the highest value was observed in the deep layer of soil profile number 7 to be 68.0 meq L^{-1}. The values of soluble K were varied among 0.02 meq L^{-1} to 33.74 meq L^{-1} in the deep layer of soil profile number 7 and surface layer of soil profile number 2, respectively. The values of soluble Ca were varied among 0.36 meq L^{-1} to 18.45 meq L^{-1} in the deep layer of soil profile number 7 and deep layer of soil profile number 4, respectively. The values of soluble Mg were varied among zero to 9.86 meq L^{-1} in the second layer of soil profile number 6 and deep layer of soil profile number 2, respectively. The values of soluble Cl were varied among 0.31 meq L^{-1} to 17.97 meq L^{-1} in the second layer of soil profile number 1 and second layer of soil profile number 2, respectively. The values of soluble SO_4 were varied among 0.08 meq L^{-1} to 47.46 meq L^{-1} in the surface layer of soil profile number 4 and surface layer of soil profile number 2, respectively. The values of soluble HCO_3 were varied among 0.13 meq L^{-1} to 6.87 meq L^{-1} in the second layer of soil profile number 1 and deep layer of soil profile number 2, respectively. The SAR values were varied among 7.17 to 10.23 in the second layer of soil profile number 1 and second layer of soil profile number 2, respectively. The ESP were varied among the lowest value detected in the second layer of soil profile number 1 and 7 to be 9.34, whereas the highest value was observed in the second layer of soil profile number 2 to be 12.49.

Data explored in Table (2) reveals the vertical distribution of $CaCO_3$, gypsum, gravels, clay, sand, and soil texture in the studied soil profiles. The $CaCO_3$ percentages were varied among the lowest value that has been detected in the third layer of soil profile number 3 to be 3.57 %, whereas the highest value was observed in the third layer of soil profile number 5 to be 24.25 %.

Table (1) Chemical properties of the studied soils.

Prof.	Samp.	Depth	pH	EC(1:2.5)	Ec (soil past)	Cations (meq L^{-1})				Anions (meq L^{-1})					
NO.	NO.	(cm)		ds/m-1	ds/m	Na^+	K^+	Ca^{++}	Mg++	CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}	SAR	ESP
1	1	0 - 25	8.05	1.39	4.63	2.41	0.13	3.29	2.31	0.00	1.51	3.02	3.60	7.72	9.90
	2	25 - 70	8.39	0.21	0.70	0.68	0.02	0.36	0.22	0.00	0.13	0.31	0.82	7.17	9.34
		70+			Water table										
2	3	0 - 25	7.82	2.44	8.13	6.32	33.74	13.71	8.22	0.00	6.31	8.22	47.46	8.21	10.41
	4	25 - 70	7.85	6.80	2.67	11.74	0.69	10.01	9.86	0.00	6.87	17.97	18.46	10.23	12.49
		70 +			Water table										
3	5	0 - 20	7.39	2.30	7.67	7.68	1.05	4.11	3.29	0.00	2.46	10.89	2.77	8.14	10.34
	6	20 - 45	7.35	0.85	2.83	2.64	0.31	1.46	0.73	0.00	0.73	3.52	0.89	7.47	9.65
	7	45 - 80	7.26	1.95	6.50	5.60	0.35	3.68	1.84	0.00	1.10	6.53	3.84	7.98	10.17
		80+			Water table										
4	8	0 -30	7.23	0.75	2.50	1.75	0.25	1.08	0.43	0.00	1.89	2.99	0.08	7.43	9.60
	9	30 - 75	7.70	1.89	6.30	2.51	0.18	0.99	3.29	0.00	1.00	7.65	6.20	7.95	10.14
	10	75 - 120	7.35	5.19	17.30	3.61	0.85	2.21	1.11	0.00	3.46	12.11	24.67	9.49	11.72
		120+			Water table										
5	10	00 - 30	8.09	0.62	2.07	1.75	0.25	1.08	0.43	0.00	0.86	1.13	1.52	7.36	9.54
	11	30 - 60	8.53	0.98	3.27	2.51	0.18	0.99	3.29	0.00	0.66	1.85	4.46	7.53	9.71
	12	60 -120	8.82	1.55	5.17	3.61	0.85	2.21	1.11	0.00	2.21	4.98	0.59	7.80	9.98
		120+			Water table										
6	13	0-20	7.20	1.61	5.37	4.17	0.46	2.56	2.84	0.00	0.85	5.69	3.49	7.82	10.01
	14	20-40	8.23	1.77	5.90	3.85	1.70	6.64	0.00	0.00	5357	6.08	0.53	7.90	10.09
	15	40-85	8.49	1.12	3.73	3.65	0.50	1.12	1.12	0.00	1.36	3.33	1.71	7.60	9.77
	16	85-120	8.03	1.52	5.07	5.61	0.56	1.84	1.38	0.00	1.84	5.41	2.14	7.78	9.97
		120+			Water table										
7	17	0-25	8.20	1.88	6.40	6.10	1.56	5.82	2.64	0.00	1.50	12.50	3.60	0.00	9.90
	18	25-80	8.46	0.65	2.12	4.60	1.20	4.20	2.60	0.00	0.80	10.20	8.24	0.00	9.34
		80+			Water table										

Table (2) Chemical and physical properties in the studied soil.

Prof. No.	Samp. No.	Depth (Cm)	$CaCO_3$ (%)	Gypsum (%)	Gravel (%)	Clay (%)	Sand (%)	Silt (%)	Soil texture
1	1	0 - 25	7.66	tr.	n.d.	7.14	82.32	10.54	Loamy Sand
	2	25 - 70	5.14	tr.	n.d.	9.18	82.32	8.50	Loamy Sand
2	3	0 - 25	7.66	tr.	n.d.	5.10	79.38	15.52	Sandy Loam
	4	25 - 70	20.76	tr.	n.d.	30.60	34.30	35.10	Clay Loam
3	5	0 - 20	6.21	tr.	n.d.	13.26	63.70	23.04	Sandy Loam
	6	20- 45	7.23	tr.	n.d.	4.08	87.22	8.70	Fine Sand
	7	45 - 80	3.57	1.40	3.00	4.08	90.16	5.76	Fine Sand
4	8	0 - 30	14.47	tr.	n.d.	28.56	57.82	13.62	Sandy Clay Loam
	9	30 - 75	18.72	tr.	n.d.	25.50	60.76	13.74	Sandy Clay Loam
	10	75 - 120	17.14	tr.	n.d.	32.64	37.24	30.12	Clay Loam
5	11	0 - 30	9.02	tr.	n.d.	9.18	65.66	25.16	Sandy Loam
	12	30 - 60	14.89	tr.	n.d.	27.54	58.80	13.66	Sandy Clay Loam
	13	60 - 120	24.25	2.20	n.d.	29.58	54.88	15.54	Sandy Clay Loam
6	14	0- 20	10.21	tr.	n.d.	24.48	61.74	13.78	Sandy Clay Loam
	15	20 – 40	14.64	tr.	n.d.	30.60	60.76	8.64	Sandy Clay Loam
	16	40 – 85	12.17	tr.	n.d.	33.66	37.24	29.10	Clay Loam
	17	85 – 120	13.62	tr.	n.d.	24.48	58.80	16.72	Sandy Clay Loam
7	18	0- 25	6.58	tr.	n.d.	7.24	80.12	12.64	Loamy Sand
	19	25 - 85	5.61	tr.	n.d.	9.02	82.32	8.66	Loamy Sand

The majority of samples have $CaCO_3$ a percentage higher than 10, which indicates that these soils are belongs to calcareous soils. The percentages of gypsum were almost traces in all layer except for the third layer of soil profile number 3 and 5, in which gypsum percentages were found to be 1.40% and 2.20%, respectively. The gravel percentages did not detect in all layer of the studied soil profiles except for the third layer of soil profile number 3. The clay percentages were varied among the lowest value detected in the second and third layer of soil profile number 3 to be 4.08 %, whereas the highest value was observed in the third layer of soil profile number 6 to be 33.66%. The sand percentages were varied among the lowest value detected in the second layer of soil profile number 2 to be 34.30 %, whereas the highest value was observed in the second layer of soil profile number 3 to be 87.22%. The silt percentages were varied among the lowest value detected in the third layer of soil profile number 3 to be 5.76 %, whereas the highest value was observed in the second layer of soil profile number 2 to be 35.10%.

Data listed in Table (3) shows the total percentages of organic carbon, organic matter, available P, and available K in the surface layer of the studied soil profiles. The organic carbon percentages were varied between 0.21% and 0.67% in soil profiles number 5 and 2, respectively. The organic matter percentages were varied between 0.36% and 0.65% in soil profiles number 4 and (6 and 7), respectively. The total N percentages were varied between 0.02% and 0.06% in soil profiles number (3, 4, and 5) and soil profile number 2, respectively. The total percentages of available P were varied between 5.74 mgkg-1 and 18.16 mgkg-1 in soil profiles number (6 and 7) and soil profile number 5, respectively. The total percentages of available K were varied between 233.60 ppm and 384.20 ppm in soil profiles number (6 and 7) and soil profile number 3, respectively.

Several categories of soil texture were found in the studied soil profiles including loamy sand (soil profile numbers 1 and 2), sandy loam (surface layer of oil profiles numbers 2, 3, and 5), clay loam (second layer of soil profile number 2, deep layer of soil profile number 4, and third layer of soil profile number 6), fine sand (second and third layers of soil profile number 3) , and sandy clay loam (first and second layer of soil profiles numbers 4 and 6, second and third layers of soil profile number 5, and the deep layer of soil profile number 6).

Table (3) Analytical data of the studied soil profiles representing fertility.

Prof. No.	Depth (Cm)	O.C (%)	OM (%)	Total N (%)	(Available - P Mgkg-1	(Available - K Mgkg-1
1	0 - 25	0.63	1.08	0.05	7.56	315.80
2	0 - 25	0.67	1.15	0.06	7.86	384.20
3	0 - 20	0.25	0.43	0.02	6.02	235.00
4	0 - 30	0.21	0.36	0.02	7.50	301.50
5	0 - 30	0.25	0.43	0.02	8.16	375.20
6	0- 20	0.38	0.65	0.03	5.74	233.60
7	0- 25	0.38	0.65	0.03	5.74	233.60

3.2 .Water irrigation characteristics

Other important data relevant to water quality in the irrigated water, drainage water, and water table are presented in Table (4). In the soil profile number 1 the irrigated water pH was 6.9 which was almost neutral. On the other hand, the drainage water pH was 7.7, whereas the water table pH was 7.64. The electrical conductivity values for irrigated water, drainage water, and water table were 704, 31100, and 1870 $\mu S\ m^{-1}$, respectively. The pH values of the irrigated water, drainage water, and water table were 7.2, 7.41 and 7.5, respectively, on the other hand, the electrical conductivity values were 8.8, 2008, and 27400 µS m^{-1}. In the profile number 3 the pH values of the irrigated water, drainage water, and water table were 7.2, 7.41 and 7.26, respectively, whereas, the electrical conductivity values were 8.8, 9120, and 7020 µS m^{-1}. The pH of irrigated water, drainage water, and water table for studied soil profile number 4 were 7.56, 7.34, and 7.6, respectively, whereas the electrical conductivity values were 770, 24400, and 1780 µS m^{-1}. The pH of irrigated water, drainage water, and water table for studied soil profile number 5 were 7.3, 7.42, and 7.41, respectively, whereas the electrical conductivity values were 988, 5213, and 6200 µS m^{-1}. The pH of irrigated water, drainage water, and water table for studied soil profile number 6 were 7.2, 7.4, and 7.5, respectively, whereas the electrical conductivity values were 900, 3600, and 5500 µS m^{-1}. Finally, the pH of irrigated water, drainage water, and water table for studied soil profile number 7 were 7.2, 7.25, and 7.34, respectively, whereas the electrical conductivity values were 109, 740, and 6400 µS m^{-1}.

Table 4. Analytical data of the water samples representing studied area

Prof. No.	Depth (Cm)	Water Type	pH	EC (micro S)
1	0 - 25	Irrigation Water	6.90	704
		Drainage	7.70	31100
		water table	7.64	1870
2	0 - 25	Irrigation Water	7.20	808
		Drainage	7.41	2008
		water table	7.50	27400
3	0 - 20	Irrigation Water	7.20	808
		Drainage	7.41	9120
		water table	7.26	7020
4	0 - 30	Irrigation Water	7.56	770
		Drainage	7.34	24400
		Water table	7.60	1780
5	0 - 30	Irrigation Water	7.30	988
		Drainage	7.42	5213
		Water table	7.41	6200
6	0- 20	Irrigation Water	7.20	900
		Drainage	7.40	3600
		water table	7.50	5500
7	0- 25	Irrigation Water	7.20	709
		Drainage	7.25	740
		water table	7.34	6400

3.3. Soil mapping units

Based on the specific soil attributes, soil depth and texture of the studied soil profiles, the morphological, and physical and chemical properties of each soil mapping unit are given in the following subsections:

3.3.1. Moderately deep coarse textured soils.

The soils in this mapping unit represented by soil profile numbers (1 , 3 and 7), the common features of this soil mapping unit are moderately deep (<100 cm), a coarse texture (fine sand to loamy sand) with slightly to moderately calcium carbonate contents (3.57 to 7.23 %) and well to poor drained. Soil reaction is slightly alkaline to strongly alkaline, as indicated by pH values which ranged between (7.4 to 8.5). Electrical conductivity values ranged between 0.71 and 7.67 dS m^{-1}, indicating non saline to moderately saline soils, the highest values are mostly detected in the surface soils and increased throughout the entire soil depth.

Table (5) Total heavy metals content in profiles in this mapping unit

Prof. No.	Depth (Cm)	Fe	Cu	Zn	Ni	Pb	Co	Cr	Cd
		mg/kg							
1	0 - 25	1661.60	40.20	85.60	25.30	20.80	16.91	31.49	0.88
3	0 - 20	1277.20	30.30	60.12	19.40	15.50	1.80	25.33	0.66
7	0- 25	1751.14	38.20	84.2.60	26.30	22.80	16.00	28.25	0.46
P.M.limits(mg/kg)			100.0	300.0	100.0	100.0	50.0	100.0	5.0

The Maximum permissible concentrations of heavy metals in agricultural soils reported by (Kabata-Pendias and Pendias 2001) are in mgkg-1: Cd (cadmium) 5, Co (cobalt) 50, Cr (chromium) 100, Cu (copper) 100 , Ni (nickel) 100 , Pb (lead) 100, and Zn (zinc) 300 .

According to the permissible limits data in table (5), the soil in this mapping unit is free in contamination by heavy metals under study.

3.3.2.Moderately deep and moderately coarse textured soils

The soils in this mapping unit represented by soil profile number (2). The landscape has an almost flat to nearly level sloping plain surface. The common features of this soil mapping unit are moderately deep (70 cm), soil texture throughout the entire depth is sandy loam to clay loam. Calcium carbonate contents are moderately to extremely calcareous (7.66 to 20.76 %). Soil reaction mostly was slightly alkaline. Electrical conductivity values of the soils varied from 8.13 to 22.67dS m^{-1}, indicating free to strongly saline to extremely saline soils. The lowest EC values are mostly detected in the surface layer and increased with depth.

Table (6) Total heavy metals content in profile in this mapping unit .

Prof. No.	Depth (Cm)	Fe	Cu	Zn	Ni	Pb	Co	Cr	Cd
		mg/kg							
2	0 - 25	1445.60	30.30	60.12	19.40	15.50	1.80	25.33	0.66
P.M.limits(mg/kg)			100.0	300.0	100.0	100.0	50.0	100.0	5.0

Data in table (6) also the soil in this mapping unit is free in contamination by heavy metals under study.

3.3.3.Deep and moderately to fine textured soils

The common features of this soil mapping unit are depth (120 cm), soil texture throughout the entire depth is sandy loam, sandy clay loam to clay loam in the deeper layers. The soils in this mapping unit represented by soil profile numbrs (4, 5 and 6). Calcium carbonate contents are moderate to extremely calcareous (9.02 to 24.25 %), soil reaction is slightly alkaline to strongly alkaline, as indicated by pH values which ranged from 7.2 to 8.82. Soil salinity was slight to moderately saline as indicated by the EC, which ranged from 2.07 to 5.9 dSm^{-1}.

Table (7) Total heavy metals content in profiles in this mapping unit

Prof. No.	Depth (Cm)	Fe	Cu	Zn	Ni	Pb	Co	Cr	Cd
		mg/kg							
4	0-30	1391.60	49.32	53.50	15.40	9.60	15.13	22.11	0.42
5	0-30	1752.12	32.88	42.80	14.30	12.80	35.60	19.43	0.52
6	0-20	1661.82	41.10	84.60	24.60	19.90	17.02	30.18	0.56
P.M.limits(mg/kg)			100.0	300.0	100.0	100.0	50.0	100.0	5.0

Data in table (7) the heavy metal content below the permissible limits. So this soil in this mapping unit is free contamination.

3.3.4.Heavy metals concentrations in the surface layers of the studied soil profiles

Data listed in Table (8) shows the available and total concentrations of some heavy metal existed in the surface layers of the studied soil profiles. The studied heavy metals were Fe, Cu, Zn, and Mn that represented the available forms of heavy metals, whereas the total content of heavy metals were carried out for the following elements Fe, Cu, Zn, Ni, Pb, Co, Cr, and Cd. The highest values of Fe were detected in the surface layers of soil profile number 2 and 5 to be 10.08 and 10.48 mg kg^{-1}, respectively, whereas the lower values of available Fe were detected in the surface layer of soil profiles numbers 6 and 7, respectively. Generally, the concentrations of available Cu were less than 1 mg kg^{-1}, and the detected values were among 0.18 to 0.23 mg kg^{-1}. The same tendency that was observed with the available concentrations of Cu was also observed with the available concentrations of Zn in which the concentrations values were ranged among 0.41 to 0.65 mg kg^{-1}.

Table (8): Total heavy metals content in the surface layers of the studied soil profiles

Prof. No.	Depth (Cm)	Fe	Cu	Zn	Ni	Pb	Co	Cr	Cd
		mg/kg							
1	0-25	1661.60	40.20	85.60	25.30	20.80	16.91	31.49	0.88
2	0-25	1445.60	30.30	60.12	19.40	15.50	1.80	25.33	0.66
3	0-20	1277.20	32.88	77.04	24.20	9.60	26.70	28.81	
4	0-30	1391.60	49.32	53.50	15.40	9.60	15.13	22.11	0.42
5	0-30	1752.12	32.88	42.80	14.30	12.80	35.60	19.43	0.52
6	0-20	1661.82	41.10	84.60	24.60	19.90	17.02	30.18	0.56
7	0-25	1751.14	38.20	84.2.60	26.30	22.80	16.00	28.25	0.46
P.M.limits(mg/kg)			100.0	300.0	100.0	100.0	50.0	100.0	5.0

Data in table (9) the concentrations of available Mn were higher than 1 mg kg^{-1} that existed among the lower and higher concentrations of available Cu and Zn, and Fe, respectively. The lowest values of Mn were obtained in the surface layer of soil profiles numbers 6 and 7, respectively to be 1.88 mg kg^{-1}, whereas the highest values were obtained with soil profile number 1 to be 2.59 mg kg^{-1}. Regarding, the total concentrations of heavy metal data presented in Table 5 shows that the total concentrations of Fe were ranged among 1752.12 mg kg^{-1} in the surface layer of soil profile number 5 and 16616 mg kg^{-1} in the surface layers of soil profiles number 1, 6, and 7, respectively. On the other hand, the total concentrations of Cu in the studied soil profiles were among 32.88 mg kg^{-1} in the surface layer of soil profile numbers 3 and 5, respectively and 49.32 mg kg^{-1} in the surface layer of soil profile number 4. The total concentrations of Zn was among 42.80 mg kg^{-1} and 77.04 mg kg^{-1} in the surface layer of soil profiles number 5 and 3, respectively. The total concentrations of Ni were among 14.30 mg kg^{-1} and 25.30 mg kg^{-1} in the surface layer of soil profiles numbers 5 and (1,6, and 7), respectively. The total concentrations of Pb were among 9.60 mg kg^{-1} and 20.80 mg kg^{-1} in the surface layer of soil profiles number (3 and 4) and (1,6, and 7), respectively. The total concentrations of Co were among 15.13 mg kg^{-1} and 35.60 mg kg^{-1} in the surface layer of soil profiles numbers 4 and 5, respectively. The total concentrations of Cr were among 19.43 mg kg^{-1} and 31.49 mg kg^{-1} in the surface layer of soil profiles numbers 5 and (1,6, and 7), respectively. The total concentrations of Cd were lower than 1 mg kg^{-1} and ranged among 0.15 mg kg^{-1} and 0.88 mg kg^{-1} in the surface layer of soil profiles numbers 3 and (1,6, and 7), respectively.

Table (9) chemical extractable (Mgkg-1 **)in the studied soils.**

Prof. No.	Depth (Cm)	Fe	Cu	Zn	Mn
1	0-25	8.70	0.19	0.51	2.59
2	0-25	10.08	0.19	0.43	1.70
3	0-20	8.62	0.19	0.41	1.61
4	0-30	9.30	0.23	0.47	1.06
5	0-30	10.48	0.22	0.45	1.01
6	0-20	8.15	0.18	0.65	1.88
7	0-25	8.24	0.24	0.56	1.78

3.4.5. Currently land classification (capability and suitability for crops)
General land capability (Cervatana model)

Applying the Land Capability Model known as (CERVATANA), concerning the weighted mean of soil properties of soil profile represented are under study, Table 6 reveals that, these soils could be pleased into the following orders and classes: Moderately suitable S3: these soils are characterized by deep and moderately deep soils, coarse to moderate fine textured soils throughout the effective root zone depth, and have slight saline to strongly saline content. The soils of this class could be distinguished into (S3I and S3Ir) sub classes0. These soils are characterized by moderate severe to severe limitations in their soil factors (l) or/ erosion risk factors (r).

Agricultural soil suitability: (Almagra model)

The soil suitability ALMAGRA model is based on analysis of edaphic factors which affect the productivity of perennial, annual and semiannual crops. Land suitability evaluation of the studied area was performed. Useful depth, texture, drainage, carbonate, salinity, sodium saturation and profile development were selected as limitation factors for crop's development. Twelve crops (annual and semi-annual / perennial crops, table 10) were selected and evaluated according to their requirements with the land characteristics of the mapping units. For semi-annual / perennial crops, the main limitation factor for suitability classes are soil texture, calcium carbonate, drainage, soil depth and some soils have very severe limitation in salinity. However, the main limitation factors for annual crops suitability classes are soil texture (t), calcium carbonate (c), soil salinity (s) and alkalinity (a).

Table (10). General land capability classification of some plants. (Land capability and suitability for crops using MicroLEIS DSS system).

Profile No.	General land Capability classification	Wheat	Maize	Melon	Potatoe	Soybean	Cotton	Sunflower	Sugar beet	Alfalfa	Peach	Citrus	Olive
Profile 1	S3I	S3td	S3t	S3t	S3t	S3td	S3t	S3t	S3td	S3td	S4d	S4d	S4d
Profile 2	S3I	S4d	S3tda	S3ptd	S3td	S4d	S3ptd	S3ptd	S4d	S4d	S5d	S5d	S5d
Profile 3	S3I	S4td	S4t	S4t	S4t	S4td	S4t	S4t	S4td	S4td	S5d	S5d	S5d
Profile 4	S3Ir	S3d	S3a	S2dcs	S2dcs	S3d	S2dc	S2tds	S3d	S3d	S4d	S4d	S4d
Profile 5	S3Ir	S3d	S3a	S2dcs	S2dcs	S3d	S2dc	S2tds	S3d	S3d	S4d	S4d	S4d
Profile 6	S3Ir	S3d	S3a	S2tdc	S2tdc	S3d	S2tdc	S2dsa	S3d	S3d	S4d	S4d	S4d
Profile 7	S3Ir	S3d	S3a	S2tdc	S2tdc	S3d	S2tdc	S2dsa	S3d	S3d	S4d	S4d	S4d

Accordingly, the soils of the studied area associated with the type of the mapping units are classified into four classes of land suitability as follows:

- **Suitable (S2):** In the area under study, soils of this class cover a small area for annual crops, including water melon, potato, cotton and sunflower as it presented in Table 6. These soils were represented by deep to moderately deep soils and moderately fine textured soils.
- **Moderately suitable (S3):** These are good soils with few limitations such as; coarse texture, soil depth, drainage, and high salinity. In the area under study, soils of this class covered an area for annual and semi-annual/perennial crops, such as wheat, maize, watermelon, potato, cotton, soybean, sunflower, sugar beet, and alfalfa.
- **Marginally suitable (S4):** Soils that are belonging to this class are those of moderately deep coarse textured soils, deep moderately coarse textured soils and deep coarse textured soils. The soils are marginally suitable for annual crops and semi-annual/perennial crops as it shown in Table 6.
- **Not suitable (S5):** The lands that are belonging to this class is devoid of any current potentialities that allow agriculture use. These soils were represented by moderately deep coarse textured soils (70 cm).

Potential land capability and suitability

Currently land capability and land suitability for crops using CERVATANA and ALMAGRA MecroLIES are not suitable soils including highly saline content and drainage. Once the land unit data have been entered, ALMAGRA gives an on-screen evaluation based on the criterion of the maximum limitation and verification of the degree of a single variable is sufficient to classify the soil in the corresponding category. The most limiting chemical factor being considered is soil salinity which can be removed by reclaiming these soils through leaching, especially as the good quality irrigation water is available and applied management programs, which can decrease the salinity. The suitability classes will be identified with attention to the land characteristics. From results, the most soil profiles repressive were coarse to medium fine texture soils. So that, after leaching of salt with well drainage system, potential land capability for different soil profiles which have highly saline were moderate (S3) could be change to highly suitable (S1) and suitable (S2). On the other hand, current land suitability for the most irrigated crops in the study area, which has highly saline and water table after 70 cm, were not suitable (S5) and marginally suitable (S4) for mostly crops. Potential land suitability for the same soil profiles after leaching of salt was moderate (S3) to suitable (S2).

Correlation between heavy metals concentrations in the surface layer and soil chemical properties

Data presented in Table (11) shows the correlation between the available and total concentrations of heavy metals in the surface layer and its correlation to soil chemical properties. It was noticed that all chemical properties were correlated positively with the available concentrations of Fe except for electrical conductivity values in either 1:2.5 extract or soil past extract, the concentrations of Na, the concentrations of Cl, SAR values, and ESP values. The order of correlation was found to take the following sequence Cl < Na < EC (soil past) < EC (Extract) < SAR < ESP < < total N < Mg < Ca < pH < HCO_3 < SO_4 < K < available P. Regarding the available Cu in the surface layer it was found that all chemical properties were correlated negatively except for pH, Cl, and available P. The order of sequence was taken the following order SAR< ESP < total N < EC (extract) < EC (soil past) < Mg < SO_4 < K < HCO_3 < Ca=Na < Cl = available p < pH. The studied chemical properties were correlated negatively with the available Zn except for the total N, available p, and Cl. The order of sequence was as follows SAR < HCO_3 < K < SO_4 < Ca < Mg < ESP < Na < pH < EC (extract) < EC (soil past) < Cl < total N < available P. However, the available Mn concentrations were correlated positively with all chemical properties except for the available concentrations of P. The order of sequence was taken the following order available P < HCO_3 < K = SO_4 < Na < Cl < Ca < pH < ESP < SAR < EC (extract) = EC (past) < total N.

Table (11) Correlation between heavy metals concentration in the surface layer and soil chemical properties.

	Available heavy metals (mg kg^{-1})				Total heavy metals (mg kg^{-1})							
Parameters	**Fe**	**Cu**	**Zn**	**Mn**	**Fe**	**Cu**	**Zn**	**Ni**	**Pb**	**Co**	**Cr**	**Cd**
pH	0.26	0.36	-0.12	0.24	-0.67	-0.44	-0.22	0.11	0.49	0.25	-0.06	0.43
EC (1:2.5)	-0.31	-0.43	-0.09	0.43	0.16	-0.37	0.77	0.86	0.26	-0.21	0.77	-0.38
EC Soil Past	-0.32	-0.41	-0.08	0.43	0.14	-0.37	0.77	0.86	0.27	-0.22	0.76	-0.37
Na^+	-0.33	-0.22	-0.16	0.18	-0.07	-0.45	0.50	0.66	0.06	-0.04	0.51	-0.64
K^+	0.47	-0.26	-0.33	0.03	-0.46	-0.40	0.32	0.57	0.26	-0.08	0.31	-0.53
Ca^{++}	0.21	-0.22	-0.25	0.22	-0.19	-0.28	0.82	0.84	0.54	-0.35	0.66	-0.15
Mg^{++}	0.14	-0.41	-0.21	0.25	0.46	-0.03	0.87	0.87	0.28	-0.50	0.86	-0.25
Cl^-	-0.49	0.07	0.02	0.20	-0.21	-0.29	0.53	0.69	0.23	-0.23	0.49	-0.54
SO_4	0.44	-0.31	-0.30	0.09	0.08	-0.41	0.85	0.91	0.79	-0.21	0.85	0.30
HCO_3	0.40	-0.24	-0.49	0.03	0.24	0.04	0.16	0.17	-0.50	-0.14	0.18	-0.57
SAR	-0.26	-0.74	-0.74	0.42	0.51	-0.36	0.77	0.84	0.08	-0.13	0.77	-0.37
ESP	-0.20	-0.61	-0.18	0.41	0.37	-0.38	0.76	0.77	0.08	-0.12	0.76	-0.38
Total N (%)	0.02	-0.56	0.10	0.74	0.50	0.04	0.68	0.65	0.87	-0.40	0.71	0.84
P (Available)	0.88	0.07	-0.55	-0.26	-0.10	0.10	-0.69	-0.75	-0.36	0.40	-0.64	0.40

Regarding the total concentration of heavy metals including Fe, Cu, Zn, Ni, Pb, Co, Cr, and Cd, it was found that the total concentrations of Fe were correlated positively with all chemical properties except for pH, Na, K, and Ca. The order of correlation was found to take the following sequence pH < K < Cl < Ca < available P < Na < SO_4 < HCO_3 < EC (soil past) EC (extract) < ESP < Mg = total N < SAR. On the other hand, the total concentrations of Cu was correlated negatively with all chemical properties except for available P, and HCO_3. The order of sequence of correlation was found to be as follows Na < pH < SO_4 < K < ESP < EC (soil past) = EC (extract) < SAR < Cl < Ca < Mg < HCO_3 < total N < available P. The total concentration of Zn was found to be correlated positively with all chemical properties except for pH and available P. The order of sequence was found to be as follows: available P < pH < HCO_3 < K < Na < Cl < total N < ESP < SAR = EC (extract) = EC (soil past) < Ca < SO_4 < Mg. The total concentrations of Ni were found to be correlated positively with all studied chemical properties except for the available P, and the order of correlation was found to take the following sequence available P < pH < HCO_3 < K < total N < Na < Cl < ESP < Ca < EC (extract) = EC (soil past) < Mg < SAR < SO_4. The total concentrations of Pb was found to be osculated among the positively and negatively values in which the correlations were positively with pH, Na, K, Cl, and P, however the order of sequence was as follows HCO_3 < available P < K < Na < SAR = ESP < Cl < K = EC (extract) < EC (soil past) < Mg < pH < Ca < SO4 < Total N. The total concentrations of Co were correlated positively with pH, and available P, however the rest of chemical properties were correlated negatively. The order of sequence of correlation was found to be as follows Mg < total N < Ca < Cl < EC (soil past) < EC (extract) SO_4 < HCO_3 < SAR < ESP < K < Na < pH < available P. It was noticed that the concentrations of total Cr were almost positively correlated with all studied chemical properties except of the effect of pH and available P. The order of sequence was found to be as follows available P < pH < HCO_3 < K < Cl < Na < Ca < ESP = EC (soil past) total N < < SAR = EC (extract) < SO_4 < Mg. The effect of soil chemical properties on total Cd concentration in the surface layer of the studied soil profiles was osculated among the positively and negatively values. The positively correlation values were relevant to pH, SO_4, available P, and total N, however the sequence of order was as follows Na < HCO_3 < Cl < K < ESP = EC (extract) < SAR = EC (soil past) < Mg < Ca < SO_4 < available P < pH < total N.

In general the effect of pH was found to be more correlated with total concentrations of Pb, however the lowest value was observed with total Fe. The effects of EC (extract or soil past) were found to be more correlated with total amounts of Ni, however the lowest values were obtained with the available Cu. The effect of Na was found to be more correlated with total amounts of Cr, however the lowest values were obtained with the total Cd. The effect of K was found to be more correlated with the total concentrations of Ni, however the lowest value was obtained with the total concentrations of Fe. The effects of Ca were found to be more correlated with total concentrations of Zn, however the lowest value was obtained with the total concentrations of Co. The effects of Mg were found to be more correlated with total concentrations of Ni and Zn, however the lowest value was obtained with the total concentrations of Co. The effects of Cl were found to be more correlated with total concentrations of Ni, however the lowest values were obtained with the total concentrations of Cd. The effects of SO_4 were found to be more correlated with total concentrations of Ni, however the lowest values were obtained with the total concentrations of Cu. The effects of HCO_3 were found to be more correlated with available concentrations of Fe, however the lowest value was obtained with the total concentrations of Cd. The effects of SAR were found to be more correlated with total concentrations of Ni, however the lowest values were obtained with the available concentrations of Cu and Zn. The effects of ESP were found to be more correlated with total concentrations of Ni, however the lowest value was obtained with the available concentrations of Cu. The effects of total N were found to be more correlated with total concentrations of Pb, however the lowest values were obtained with the available concentrations of Cu. The effects of available P were found to be more correlated with the available concentrations of Fe, however the lowest values were obtained with the total concentrations of Ni

Correlation between heavy metals concentration in the surface layer and soil chemical and physical properties

Data presented in Table (12) reveals that the correlation between some soil physical properties such as soil texture and some chemical properties such as $CaCO_3$ (%), organic carbon (OC) %, and organic matter (OM) %. The available concentrations of Fe were correlated negatively with clay content, however it correlated positively with the content of sand, slit, OC %, OM %, and $CaCO_3$ %. The order of correlation was taken the following order clay content < OC % < OM % < $CaCO_3$ % < sand content < silt content. The available concentrations of Cu were correlated negatively with sand content, however it correlated positively with clay and slit content. The order of correlation was taken the following order OC % = OM % < sand content < silt content < clay content < $CaCO_3$ %. The available concentrations of Zn was correlated negatively with sand content, OC, OM, and silt content, however it correlated positively with clay content and $CaCO_3$. The order of correlation was taken the following order silt content < sand content < OC% = OM % < $CaCO_3$ % < clay content. The available concentrations of Mn was correlated negatively with silt content, $CaCO_3$ %, and clay content, however it correlated positively with sand content, OC %, and OM %. The order of correlation was taken the following order silt content < $CaCO_3$ % < clay content < sand content < OC % = OM %.

The total concentrations of Fe were correlated negatively with silt content, however it correlated positively with sand and clay content, $CaCO_3$ %, OM %, and OC %. The order of correlation was taken the following order silt content < sand content < $CaCO_3$ % < OC %= OM % < clay content. The total concentrations of Cu was correlated negatively with silt content and sand content, however it correlated positively with clay content, OC, OM, and $CaCO_3$ %. The order of correlation was taken the following order silt content < sand content < OC % = OM %< clay content < $CaCO_3$ %. The total concentrations of Zn were correlated negatively with silt and clay content and $CaCO_3$ %, however it correlated positively with sand content, OC %, and OM %. The order of correlation was taken the following order silt content < $CaCO_3$ % < clay content < sand content < OC % = OM %. The total concentrations of Ni were correlated negatively with silt and clay content and $CaCO_3$, however it correlated positively with sand content, OC %, and OM %. The order of correlation was taken the following order $CaCO_3$ % < silt content < clay content < sand content < OC % = OM %. The total concentrations of Pb were correlated negatively with silt content and clay content and $CaCO_3$%, however it correlated positively with sand content, OM %, and OC %. The order of correlation was taken the following order $CaCO_3$% < silt content < clay content < sand content < OC %= OM%.

Table (12): Correlation between heavy metals concentration in the surface layer and soil chemical and physical properties

	Available heavy metals (mg kg^{-1})				Total heavy metals (mg kg^{-1})							
Parameters	**Fe**	**Cu**	**Zn**	**Mn**	**Fe**	**Cu**	**Zn**	**Ni**	**Pb**	**Co**	**Cr**	**Cd**
$CaCO_3$ (%)	0.07	0.28	0.21	-0.47	0.30	0.81	-0.45	-0.66	-0.39	-0.28	-0.50	0.06
Clay (%)	-0.27	0.02	0.34	-0.36	0.53	0.71	-0.07	-0.33	-0.40	-0.37	-0.18	-0.25
Sand (%)	0.17	-0.42	-0.15	0.70	0.18	-0.22	0.44	0.47	0.64	-0.07	0.49	0.74
Silt (%)	0.52	-0.03	-0.59	-0.61	-0.42	-0.71	-0.54	-0.47	-0.65	0.94	-0.55	-0.58
OC (%)	0.04	-0.45	0.08	0.73	0.33	0.03	0.68	0.63	0.76	-0.41	0.71	0.83
OM (%)	0.04	-0.45	0.08	0.73	0.33	0.03	0.68	0.63	0.76	-0.41	0.71	0.83

The total concentrations of Co were correlated negatively with all studied factors except for silt content. The order of correlation was taken the following order OC % = OM % < clay content < $CaCO_3$ % < silt content < sand content. The total concentrations of Cr were correlated positively with sand, OC %, and OM %, however it correlated positively with $CaCO_3$ %, clay, and silt content. The order of correlation was taken the following order silt content < $CaCO_3$ % < clay content < sand content < OC % = OM %. The total concentrations of Cd were correlated negatively with silt content and clay content, however it correlated positively with sand content, OM %, $CaCO_3$ %, and OC %. The order of correlation was taken the following order silt content < clay content < $CaCO_3$ % < sand content < OC % = OM %.

4/8-Enrichment factor.

The process of standardization helps in evaluating the anthropogenic component over and above the natural components. The enrichment factor is calculated to drive the degree of soil contamination and trace metals accumulation in soils and plants growing on contaminated soils with respect to soils and plants growing on uncontaminated soils **(Kisku et al., 2000).**This factor is calculated according to the equation generalized form **(Zoller et al,1997).**

Where EFs is the enrichment factor, C/Fe (sample) is the ratio of metal and Fe concentration of the sample and C/Fe (earths crust) is the ratio of metal and Fe concentration of the earth crust.Fe contamination categories are recognized on the basis of the enrichment factor; EFs< 2 states deficiency to minimal enrichment; EFs = 2 – 5 moderate enrichment; EFs = 5 – 20 significant enrichment; EFs= 20–40 very high enrichment and, EFs>40 extremely high enrichments **(Sutherland 2000).**

It can be noted that the EFs values significantly higher than 1 indicate an origin of trace metals and may not come from local soil background. but other natural and / or anthropogenic sources in urbanized areas including vehicle emissions, industrial discharges and other activities **(Thornton, 1991).**

The earth' s crust data of **Riley and Chester (1971)** were used. and **Fergusson, (1994)** proposed Fe as an acceptable normalization element to be used in calculation of enrichment factor they considered the Fe distribution was not related to other trace metals.

In this regard, **Eric (2007)** reported the concentration of these metals (Fe, Zn, Cu, Ni, Co, Cr, Cd) in the earth' s crust as (50,000, 80,70, 100, 40, 200, 0.2 mg/kg) respectively.

Appling the EFs on the obtained results of the studied heavy metals gives the following interpretation:

Table (13): Enrichment factor (E.Fs, mg/kg) of trace metals in the studied soils

Prof. No.	Depth (Cm)	Fe	Cu	Zn	Ni	Pb	Co	Cr	Cd
		mg/kg							
1	0-25	1661.60	17.14	32.500	7.50	14.4	12.50	4.75	125.00
2	0-25	1445.60	15.00	26.25	6.50	12.20	15.00	4.50	125.00
3	0-20	1277.20	18.27	37.50	9.50	8.90	25.00	5.75	25.00
4	0-30	1391.60	25.00	23.75	5.50	7.80	13.75	4.00	75.00
5	0-30	1752.12	13.57	15.00	4.00	7.80	25.40	2.77	74.20
6	0-20	1661.82	17.67	31.88	7.50	13.31	12.80	4.54	84.24
7	0-25	1751.14	15.58	30.18	7.51	14.42	11.40	4.03	65.67

Data in table (13) four Cu EFs range from 13.57 mg/dl to 25.00mg/dl indicating significant to very high enrichment of Cu in the surface layer in all profiles of the studied soils.

For Zn EFs range from 15.00mg/dl mg/dl to 37.00mg/dl indicating significant to very high enrichment of Zn in the surface layer in all profiles of the studied soils.

For Ni EFs range from 4.00mg/dl mg/dl to 9.50 mg/dl indicating moderate to significant enrichment of Ni in the surface layer in all profiles of the studied soils.

For Pb EFs range from 7.80 mg/dl mg/dl to 14.42 mg/dl indicating to significant enrichment of Pb in the surface layer in all profiles of the studied soils.

For Co EFs range from 11.40 mg/dl mg/dl to 25.40 mg/dl indicating significant to very high enrichment of Co in the surface layer in all profiles of the studied soils.

For Cr EFs range from 2.77 mg/dl mg/dl to 5.75 mg/dl indicating moderate to significant enrichment of Cr in the surface layer in all profiles of the studied soils.

For Cd EFs range from 25.00 mg/dl mg/dl to 125.00 mg/dl indicating very high to extremely high enrichment of Cd in the surface layer in all profiles of the studied soils.

In the end all the surface layer in all profiles suffer increasing in concentration of heavy metals from significant to very high and extremely enrichment. This actually derived agrochemicals (fertilizers ,pesticides) mainly from anthropogenic factors , industrial discharges, urbanization .

CONCLUSION

The main objective of our work was to study the physical and chemical properties of seven soil profiles were taken from El Qattara, New Valley and it relationship with existing heavy metals and its possibility for growing various crops. Generally, the New Valley Governorate is considered one of most promising areas for the agricultural development in Egypt. So that, it was very important to quantify the variability of heavy metals containing cultivated soils in New Valley area. The obtained results showed that different soil map units were represented in the studied soil profiles such as 1) moderately deep coarse textured soils, 2) moderately deep and moderately coarse textured soils, and 3) deep and moderately to fine textured soils.

The concentrations of available heavy metals including Fe, Cu, Zn, and Mn were relatively low in the surface layer of the studied soil profiles. The correlation between the studied chemical and physical properties were found to be osculated among the positively and negatively values, and there was no stable tendency observed within the studied available and total heavy metals. The concentrations of available heavy metals were relatively low and were ranged among 8.15 – 10.48 mg kg^{-1} for Fe, 0.18 – 0.23 mg kg^{-1} for Cu, 0.41- 0.65 mg kg^{-1} for Zn, and 1.01 – 2.59 mg kg^{-1} for Mn. It was noticed that the concentrations of available Mn, total Zn, total Ni, total Pb, and total Cr in the studied soil profiles were the most heavy metals that correlated positively with soil chemical properties. All the surface layer in all profiles suffer increasing in EFs of heavy metals from significant to very high and extremely enrichment. This actually derived agrochemicals (fertilizers ,pesticides).

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REFERENCES

Abd Elrahman, S. (2015): Heavy metals in soils with special reference to Egyptian soils and their characteristics. 10.13140/RG.2.1.3234.0564.

Abou-Shady, A. (2016a): Reclaiming salt-affected soils using electro-remediation technology: PCPSS evaluation. Electrochemical Acta., 190: 511-520.

Abou-Shady, A. (2016b): Effect of separated cathode on the removal of dissolved organic carbon using anode oxidation, Fenton oxidation, and coagulation, Journal of Environmental Chemical Engineering, 4 (1): 704-710.

Abou-Shady, A. (2017): Recycling of polluted wastewater for agriculture purpose using electrodialysis: Perspective for large scale application, Chemical Engineering Journal, 323: 1–18.

Abou-Shady, A. and C. Peng (2012): New process for ex-situ electro-kinetic pollutant removal I: process evaluation. J. Ind. Eng. Chem., 18: 2162-2176.

Abou-Shady, A. ; C. Peng ; J. Almeria and H. Xu (2012a): Effect of pH on separation of Pb (II) and NO_3 from aqueous solutions using electro-dialysis. Desalination, 285: 46–53.

Abou-Shady, A. ; C. Peng ; J. Bi ; H. Xu and J. Almeria (2012b): Recovery of Pb (II) and removal of NO3 from aqueous solutions using integrated electro-dialysis, electrolysis, and adsorption process. Desalination, 286: 304-315.

Abou-Shady, A. ; D. Eissa ; O. Abdelmottaleb and H. Rehab (2018a): New approaches to remediate heavy metals containing polluted soil via improved PCPSS. Journal of Environmental Chemical Engineering, 6: 1322-1332.

Abou-Shady, A. ; D. Eissa ; O. Abdelmottaleb and H. Rehab (2018b): Effect of electrokinetic pollutant removal on the status of some macro and micro elements in saline soil. Alexandria Exchange Science Journal, 39 (1): 65-73.

Abou-Shady, A. ; D. Eissa ; O. Abdelmottaleb and H. Rehab (2018c): Behavior of V, Cr, Li, and Ba during electrokinetic pollutant removal: Comparison of PCPSS and VA-PCPSS. Alexandria Exchange Science Journal, 39 (2): 189-196.

Abou-Shady, A. ; N. Bahnasawy and D. Eissa (2020): Effects of Fenton oxidation on soil mineral stability determined by the Taguchi approach. Journal of the Saudi Society of Agricultural Sciences, 19: 270-275.

Abu Seif, A. and E.S. Sedek (2013): Performance of cement mortar made with fine aggregates of dune sand, Kharga Oasis, Western desert, Egypt: An experimental study. Jordan Journal of Civil Engineering, 159(3164): 1-15.

Bahnasawy, N. ; M. El Kady and A. Abou-Shady (2020): Impact of Land Slope and Mineralogical Composition on the Spatial Distribution of Related Elements in some Soils South-east of El-Qattara Depression, Egypt, Middle East Journal of Applied Sciences,10 (1): 26-33.

CONOCO, (1987): Geological map of Egypt (scale 1:500,000).

De la Rosa, D. ; F. Mayol ; E. Diaz-Pereira ; M. Fernandez and D. de la Rosa Jr (2004): A land evaluation decision support system (Micro LEIS DSS) for agricultural soil protection: With special reference to the Mediterranean region. Environmental Modeling and Software, 19(10): 929-942.

Eissa, D. ; A. Abou-Shady and S.Ismail (2018): Environmental behaviour of strontium in some salt affected soils along the western north coast of Egypt. Alexandria Exchange Science Journal, 39 (2): 197-214.

Elgala, A.M. ; A.S. Ismail and M.A. Ossman (1986): Critical levels of iron, manganese and zinc in Egyptian soils, J. of Plant Nutrition. 9(3-7): 267-280.

Eric, Scerri ,. (2007): The Periodic Table, Its Story and Its Significance, Oxford University Press.

Fergusson, J.E.(1994): The heavy elements : chemistry ,environmental impact and health effects. Pergamon Press. Oxford, U.K.

Hegab, R. ; D. Eissa ; A. Abou-Shady and O. Abdelmottaleb (2016): Effect of biochar addition on soil properties and carrot productivity grown in polluted soils. Egyptian Journal of Desert Research, 66 (2): 327-350.

Jahn, R. ; H.P. Blume ; V.B. Asio ; O. Spaargaren and P. Schad (2006): Guidelines for soil description. FAO.

Kabata-Pendias A. and H. Pendias (2001): Trace elements in soils and plants. 3rd edition. CRC Press, Boca Raton, Florida, 413 pp.

Khalfa, R. ; S. Abd El-Aziz ; D. Eissa and A. Abou-Shady (2018): Application of biosurfactant producing microorganisms to remediate heavy metal pollution in El-Gabal El-Asfar area, Alexandria Exchange Science Journal, 39 (1): 17-34.

Khalil, R. ; E. Abou-Hussien ; S. Radwan and A. Abou-Shady (2009): Distribution of humic and fulvic acids in alluvial and calcareous soils. Minufiya J. Agric. Res., 1 (34): 311-324.

Kisku , G.C. ; S.C. Barman and S.K. Bhargava (2000): Contamination of soils plants and with potentially toxic elements irrigated with mixed industrial effluent and its impact on the environment .Water Air Soil Pollut.,120: 121 -137.

Ramadan, W. ; A. Abou-Shady ; N. Bahnasawy and A.B.D. Elwa (2020): Current Status of Some Micro-Nutrients and Heavy

Metals of Al-Hawawer Valley Soils of Marsa Matrouh – Egypt, Alexandria Exchange Science Journal, 41: 225-239.

Riley, J.P. and R. Chestere (1971): Introduction to marine chemistry. Academic Press, London and New York. xiv + 465 p.

Sayed, A.S.A. (2013): Evaluation of the land resources for agricultural development-case study: El-Hammam canal and its extension, NW coast of Egypt. Ph.D Thesis, Department Geowissenschaften, Universität Hamburg, Germany.

Swify, S.S. ; S.H. Abd El-Aziz ; S.A.H. Selmy ; A. Elgharably and H.M.A. Ragheb (2017): Assessment and Spatial Variability Mapping of Soil Available Phos-phorus and Potassium of Coarse-textured Soils in New Valley, Egypt Using Geostatistical Technique.

Zoller, W.H. ; E.S. Gladney and R.A. Duce (1997): Atmosphere concentrations and sources of trace metals at the South Pole. Science, 183: 199-201.

تاثير الخصائص الفيزيائية والكيميائية للتربة على النباتات النامية بالمنيرة – القطارة بالوادى الجديد

عبد السلام علوة[1] ، احمد أبو شادى[1] ، أحمد السيد[2] ، حسام شومان[3]

1- قسم كيمياء وطبيعة الاراضى، شعبة مصادر المياة والاراضى الصحراوية، مركزبحوث الصحراء، القاهرة، مصر

2- قسم البيدلوجى ، شعبة مصادر المياة والاراضى الصحراوية، مركزبحوث الصحراء، القاهرة، مصر

3- شعبة البيئة و الزراعات الصحراوية، مركزبحوث الصحراء، القاهرة، مصر

في هذا البحث تم أخذ سبعة قطاعات أرضية من منطقة القطارة، الوادي الجديد، مصر وذلك لتقييم الخواص الفيزيائية والكيميائية وتقدير مدى علاقتها بالفلزات الثقيلة الموجودة فى هذة القطاعات وإمكانية زراعة المحاصيل المختلفة فى هذة الاراضى. حيث ان محافظة الوادي الجديد تعتبر من أكثر المناطق الواعدة للتنمية الزراعية في مصر. لذلك، كان من المهم جدًا تحديد مدى توزيع الفلزات الثقيلة التي تحتويها التربة المزروعة في منطقة الوادي الجديد. أظهرت النتائج المتحصل عليها أن وحدات خرائط التربة المختلفة تم تمثيلها في قطاعات التربة المدروسة التالية 1) تربة متوسطة العمق والقوام ، 2) تربة متوسطة العمق والقوام إلى حد ما ، و 3) تربة عميقة ومتوسطة إلى ناعمة القوام. كانت التركيزات الميسرة من الفلزات الثقيلة الموجودة فى هذة الاراضى بما في ذلك الحديد ، والنحاس ، والزنك ، والمنجنيز منخفضة نسبيًا. كما وجد أن معامل الارتباط بين الخواص الكيميائية والفيزيائية و الفلزات الثقيلة المدروسة فى القطاعات الارضية المدروسة متذبذبة بين القيم الموجبة والسالبة، بالاضافة الى انة لم يكن

هناك ميل مستقر لوحظ للفلزات الثقيلة المدروسة سوا كانت للتركيذات الميسرة أو التركيذات الكلية. كما وجد أن تركيزات الفلزات الثقيلة الميسرة فى القطاعات الارضية المدروسة منخفضة نسبيًا وتراوحت بين 8.15 – 10.48 مجم / كجم للحديد ، 0.18 – 0.23 مجم / كجم للنحاس ، 0.41 – 0.65 مجم / كجم للزنك ، و 1.01 – 2.59 مجم / كجم. لمنغنيز. كما لوحظ أن تراكيز كل من المنجنيز الميسر، والزنك الكلي، والنيكل الكلي، والرصاص الكلي، والكروميوم الكلي في الطبقة السطحية للقطاعات الارضية المدروسة أكثر الفلزات الثقيلة ارتباطًا بصورة إيجابية بالخصائص الكيميائية للتربة. كل الطبقات السطحية فى جميع القطاعات تعانى زيادة فى معامل الأثراء بالعناصر الثقيلة فى التربه من ارتفاع كبير إلى مرتفع للغاية وشديدة الأرتفاع.