Effect of vegetation (palm trees) on some of the physical and chemical properties for the ancient Babylon soil

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ABSTRACT

The current study included the selection of four regions of Babylon's archaeological soils located between two longitudes (32 ° 33 '0 ”-32 ° 33'55” north), and between two latitudes (44 ° 05' 03 '- 44 ° 25' 37 'east). 22 samples were taken at the surface depth of (0-30 cm) and the rhizosphere of (50-60 cm) in order to study some of the physical and chemical properties of Babylon's archaeological soils through palm trees with long age. The volumetric distribution of the soil separates and its textures were varied at the two depths, even in one soil, and the dominance of the sand, silt and clay content alternated. As for the soil interaction (pH) ranged between 6.9-7.6 and 7-7.9, and the electrical conductivity (1.7-12.1 and 1.3-13.0 $dS.m^{-1}$), respectively at soil depth 0-30 cm and the rhizosphere 50-60 cm. The soil content of the organic matter in the soil of the surface depth amounted to (1.85-27.42) at the rhizosphere soil (1.60-18.6 $g.kg^{-1}$). The amount of humic acid ranged from 0.70-8.33, fulvic 0.23-1.23 and humin 0.92-12.33 $k.kg^{-1}$ in the soil of surface depth, and between 0.60-6.83, 0.20-2.27 and 0.70-9.50 $g.kg^{-1}$ in rhizosphere soils. The different forms for the soluble potassium ranged from 2.1-4.9 and 2.1-3.9, exchangeable potassium (0.05-1.18 and 0.0-1.13), fixed potassium between layers (2.02-4.70 and 2.30-5.90), mineral potassium (14.44-24.22 and 13.44-24.50) and for total potassium (12.35- 31.73 and 12.96-32.83 $cmol.kg^{-1}$), respectively at the depths of (0-30) and the rhizosphere of (50-60 cm). While the different magnesium forms were for soluble between (1.22-14.90 and 1.53-12.76), the exchangeable of (1.94-12.50 and 1.54-14), the fixed magnesium of (2.51-17.70 and 2.71-16.90) and the mineral magnesium of (17.02-23.10 and 18.88-25.44 $cmol.kg^{-1}$), respectively at the depths of (0-30) and the rhizosphere of (50-60 cm).

Keywords: soil separates, palm trees, organic matter, electrical conductivity, degree of interaction, forms of elements (potassium and magnesium), soil depths, Babylon's archaeological soils.

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تأثير الغطاء النباتي (اشجار النخيل) على بعض الخصائص الفيزيائية والكيميائية لتربة بابل الاثرية

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المستخلص

تضمنت الدراسة الحالية اختيار اربع مقاطعات من تربة بابل الأثرية تقع بين خطيّ طول "0 '33°32-"55'33°32 شمالا، وبين دائرتي عرض"03 '05°44 -"37 '25 °44 شرقا. وأخذت منها 22عينة عند العمق السطحي0-30 سم والرايزوسفير50-60 سم لأجل دراسة بعض الخصائص الفيزيائية والكيميائية لتربه بابل الاثرية من خلال أشجار النخيل ذات العمر الزمني الطويل. تباين التوزيع الحجمي للمفصولات وصنف النسجة عند العمقين حتى في التربة الواحدة وتناوبت سيادة كل من محتوى الرمل والغرين والطين. وفي ما يخص تفاعل التربة(pH) تراوح بين 6.9-7.6 و7.1-7.9، والإيصالية الكهربائية 1.7-12.1و1.3-13.0دي سيمينز م-1على التتابع عند تربة العمق 0-30سم والرايزوسفير 50-60سم. وكان محتوى الترب من المادة العضوية في تربة العمق السطحي1.85-27.42 عند تربه الرايزوسفير1.60-18.6غم كغم-. وتراوحت كميه حامض الهيوميك 0.70-8.33، الفولفيك 0.23-1.23 ومادة الهيومين 0.92-12.33غم كغم-1 عند تربة العمق السطحي، وبين0.60-6.83، 0.20-2.27 و0.80-9.50غم كغم-1 عند تربة الرايزوسفير. تراوحت صور البوتاسيوم المختلفة للذائب بين2.1-4.9 و2.1-3.9، المتبادل 0.05-1.18 و0.05-1.13، المثبت بين الطبقات 2.02-4.70 و2.30-5.90، المعدني 14.44-24.22و13.44-24.50 وللكلي 12.35-31.73 و12.96-32.83سنتيمول كغم-1على التتابع عند تربتي العمق0-30 والرايزوسفير 50-60سم. بينما صور المغنيسيوم المختلفة كانت للذائب بين 1.22-14.90

و12.76-1.53، المتبادل 12.50-1.94 و14-1.50، المثبت 17.70-2.51 و16.90-2.71 والمعدني 23.10-17.02 و18.88-25.44سنتيمول كغم-1على التتابع عند تربتي العمق السطحي والرايزوسفير.

الكلمات المفتاحية: مفصولات التربة، أشجار النخيل ،ماده عضويه ،الايصالية الكهربائية ،درجة التفاعل، صور العناصر(البوتاسيوم والمغنيسيوم)،أعماق التربة، تربة بابل الاثرية.

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1. INTRODUCTION

The nature of the taproot system for palm trees on the movement of soil components causes a change in some physical, chemical, and biological soil properties (9), and as considering vegetation from the type of trees with deep and renewable roots according to the time period it spends with growth and long age, it mainly affects the Physical and chemical properties due to the growth of plants and secretions of roots and their decomposition led to the activity of microorganisms and the decomposition of organic matter and its acids, and due to occurring the interaction between physical and chemical processes accompanied by a clear change in the physical and chemical properties of study soils (5). Soil is a three-phase system (solid, gas, liquid), it is a media for plant growth and a natural body consisting of a mixture of mineral and organic materials, covering the earth in layers and stabilizing planted plants and equipping them with the necessary needs for growth, the ideal soil consists of 45% mineral materials, 5% organic matter, 25% water and 25% air. As a result of the three phases of the soil, physical and chemical properties are created. The type and amount of clay minerals in the soil determine the physical, chemical and fertile properties of the soil (5). The biological factor among these factors (14) plays an effective role in soil development through the accumulation of organic materials due to plant death and degradation by microorganisms. Therefore, most of the successive processes for plant influence in the change in minerals are most severe in the upper horizons, and in the rhizosphere, the speed of weathering for minerals is affected by the effectiveness of fine roots and the activity of growing Biological groups densely in this region (16). Thus, the current research aims to:

1- Estimating some physical and chemical properties for Babylon's archaeological soil according to laboratory tests for the mentioned properties.
2- The effect of vegetation (palm trees) on the physical and chemical properties for Babylon's archaeological soil.

2. MATERIALS AND METHODS

Field procedures

Four locations of ancient Babylon soil were chosen in Babylon province, 90 km from the capital (Baghdad), and 5 km from the center of Hilla city, between two longitudes (32 ° 33'0 "-32 ° 33'55" north), and two latitudes (44 ° 05'03 "-44 ° 25'37 East). It was determined by a Japanese-made GPS Map 76 CSX GPS device and by a UTM coordinate system belonging to the Directorate surveyor of Agriculture in Babylon. The current study area is characterized by vegetation, palm trees form a large part of its actual area, plots from parks gardens and buildings, as well as a group of ancient Babylonian archaeological constructs, with geological formations that extend from the era of the Sumerians, Babylonians, and Assyrians to the present day, interspersed with some archaeological highlands similar to low-altitude plateaus. The samples selected were long-age palm tree soil in region 39 Bernon, which is symbolized by (TL1), region 19 Al-Jamjama Al-Shamalia, which is symbolized by (TL2), region 16 Kwarysh, which is symbolized by (TL3), region 15 Al-Jamjama Al-Janubia, which is symbolized by (TL4), and The two soil of control without vegetation was in the region 39 Bernon, which is symbolized by (SC1), and region 15 Al-Jamjama Al-Janubia, which is symbolized by (SC2).

Laboratory procedures

Samples were brought from the study area to the graduate laboratory in the College of Agriculture, Al-Qasim Green University for conducting the drying, milling, sieving and storage processes. It is prepared to estimate some of the physical and chemical properties of study soils

Physical properties

The International Pipette Method (19) was used in estimating the volumetric distribution of soil separates, using acidified sodium acetate at pH = 5 to remove calcium carbonate and organic matter by hydrogen peroxide (N10), and adding sodium hexametaphosphate.

Chemical properties

The reaction of soil in the paste extract of saturated soil with WTW pH-Meter was estimated according to the described method (12). The electrical conductivity (ECe) was also estimated by the WTW EC-Meter according to the mentioned method (21). As for the organic matter by wet oxidation method, using potassium dichromate according to the mentioned method in (12). Its components that represented by humic acid and fulvic was divided, it was extracted from organic matter according to the described method (11), by treating 10 gm of dried and ground soil sample with less than 2 mm, and 200 cm3 of sodium hydroxide solution with a concentration of (0.5 mol) was added, and the contents were shaken with a vibrator. It was then separated by a centrifuge at a speed of (2000 rpm). Potassium forms were estimated using a Flame photometer (Biotech AFB l00 type), After obtaining the saturated paste extract to estimate the dissolved potassium according to the described method (18). The exchangeable potassium from the extract solution for each soil sample with the ammonium acetate solution (NH_4OAC) neutralized at pH = 7, while another solution was extracted from the soil sample using boiled nitric acid, and through the difference between the amount extracted with ammonium acetate and nitric acid, the non-exchangeable potassium was obtained (20). As for the total potassium extract solution, a mixture of concentrated hydraulic acid with a concentration of 48% was used and nitric acid at a concentration of 97%, with perchloric acid at a concentration of 62%, according to the method (18). While mineral potassium is quantified according to the method (17) and by the following equation (1):

Mineral Potassium = Total Potassium - (soluble + exchangeable + Non-exchangeable) ...... (1)

The soluble magnesium was estimated by titration with disodium EDTA at a concentration of (0.01N) in saturated paste extract (21). The exchangeable Magnesium was extracted using ammonium acetate (1 N), and it was estimated by titration with disodium EDTA at a concentration of (0.01N) in the saturated paste extract (12). Whereas the non-exchangeable magnesium was extracted by boiling nitric acid at a concentration of (1 molar), the filtered soil sample was then washed four times from the same acid at a concentration of (0.01 molar) (15, 18). The total magnesium was estimated by the digestion method (22). The total non-exchangeable magnesium was estimated by the atomic spectrometer (PG-990 type). As for the mineral magnesium was calculated according to the following equation (2):

Mineral = Total magnesium - (soluble + exchangeable + Non-exchangeable)....... (2).

3. RESULTS AND DISCUSSION

Physical properties:

Volumetric distribution of soil separates:

Table (1) shows the results of the volumetric distribution for the studied soil separates, which shows there was a state of variance in their content of the soil separates, which is reflected on the texture class, and this achieved in the soil of the region 39, where the dominance for the separated sand followed by clay, then the silt, and for both depths at the soil has long-age trees, the texture class has become a sandy clay loam. As for the control soil in the same region, it was with a texture of sandy clay loam, due to dominance for the sand followed by clay, then the silt at depths of (0-30 and 50-60 cm), while the soil of region 19 cultivated with long-age trees at depth of (0-30 cm), The silt occupied the first rank, followed by clay, and then sand to form soil with silty clay texture, and at the depth of 50-60 cm the dominance was for clay, and then sand and silt, with a clay loam texture, While soil of the region 16 that cultivated with long-age trees, the dominance was for clay followed by silt and sand, with texture classified by silty clay loam and clay at both depths. The results of the volumetric distribution for the studied soil separates agree with (Al-Aqidi, 1986) that there is no specific pattern for the distribution of the soil separates affected by water currents and the diversity in their mineral components. Thus, the textures class varies even in the two depths of one soil, as well as the presence of effect for air currents that transmit types of these sediments on the impact of human activity in digging streams and forming qanats to irrigate crops, which led to the presence of different layers of mineral formation even in one soil according to the intensity and method of carrying particles from one period to another by means of water currents that drive clay particles to long distances, and air currents have the ability to carry sand particles (7).

Table 1: Volumetric distribution for the studied soil separates and texture class.

Region	Sample	Depth (cm)	Volumetric distribution for the soil separates (g.kg^{-1})			Texture
			Sand	Silt	Clay	
39 Bernon	TL_1	30-0	501.0	199.0	300.0	SCL
		60-50	500.5	198.0	301.5	SCL
	SC_1	30-0	520.8	151.1	328.1	SCL
		60-50	580.5	98.0	321.5	SCL
19 Al-Jamjama Al-Shamalia	TL_2	30-0	124.80	463.90	411.30	SiC
		60-50	331.10	314.09	354.81	CL
	SC_2	30-0	90.8	486.8	422.4	SiC
		60-50	103.4	486.0	410.6	SiC
16 Kwarysh	TL_3	30-0	60.0	620.0	320.0	SiCL
		60-50	120.0	180.0	700.0	C
15 Al-Jamjama Al-Janubia	TL_4	30-0	29.30	591.78	378.92	SiCL
		60-50	180.0	426.0	394.0	SiCL

Chemical properties:

Table (2) shows the values of the study soil interaction ranged between 6.9-7.6 at the surface depth of (0-30 cm) and the soil of the rhizosphere of (50-60 cm) ranged between 7-7.9. These results indicate that the soil of the study is tilted to the basicity as a result of the soil origin material rich in lime (8). The electrical conductivity in Table (2) ranged between 1.7-12.1 dS.m^{-1} at the surface depth for the soil of palm tree and 1.3-13.0 dS.m^{-1} at the soil of the rhizosphere. While the control soils without vegetation at depth (0-30 and 50-60 cm) ranged between (17.5-18.3 and 9-12-12.9 dS.m^{-1}), respectively. This is due to the accumulation of salts in the surface layer, which is considered characteristic of the soil of the dry region due to the lack of rain and the high level of groundwater, as well as the decrease of vegetation especially some soils were characterized by a dark color as a result of the dominance of the Magnesium chloride salts with Sabkha type. In general, the interaction of the soil has an inverse relationship with the values of electrical conductivity (2). Table (2) shows that the amount of organic matter ranged between 1.85-27.42 g.kg^{-1} at the surface soil with a depth of (0-30 cm), and at the soil with a depth of (50-60 cm) ranged between (1.60-18.6

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g.kg^{-1}). The results indicate the accumulation of organic matter in soils planted with palm trees, some weeds, and crops that increase the residues of the organic material, especially in the surface layer of the soil (13). While the amount of organic matter amounted to (1.22-1.30 and 0.21-0.14 g.kg^{-1}), respectively at the control soil, and for both depths. which confirms the results of control soils on the role of vegetation and its residues in increasing the accumulation of organic matter.

Table 2: Some chemical properties and organic acids in the study soils.

Region	Sample	Depth (cm)	pH	Electrical conductivity (dS.m^{-1})	Organic matter (g.kg^{-1})	Ingredients of organic matter (g.kg^{-1})		
						Humic acid	Fulvic acid	Humin
39 Bernon	TL_1	30-0	7.6	6.3	1.85	0.70	0.23	0.92
		60-50	7.4	6.5	1.60	0.60	0.20	0.80
	SC_1	30-0	7.9	17.5	1.22	0.19	0.12	0.92
		60-50	8.2	12.9	0.14	0.03	0.01	0.10
19 Al-Jamjama Al-Shamalia	TL_2	30-0	7.5	8.3	7.84	3.26	1.08	3.50
		60-50	7.6	7.2	5.60	1.85	0.65	3.10
	SC_2	30-0	7.4	18.3	1.30	0.50	0.09	0.71
		60-50	7.4	9.1	0.21	0.10	0.01	0.10
16 Kwarysh	TL_3	30-0	7.5	12.1	7.39	2.63	0.86	3.90
		60-50	7.7	9.1	5.76	2.10	0.56	3.10
15 Al-Jamjama Al-Janubia	TL_4	30-0	7.4	10.0	11.20	3.72	1.23	6.25
		60-50	7.7	13.0	7.41	2.64	0.87	3.90

Forms of potassium in the soil:

Table (3) shows the values of soluble potassium in the study soil ranged from 2.1-4.9 cmol.kg^{-1} at soil depth, and ranged from 2.1-3.9 cmol.kg^{-1} at the soil of the rhizosphere. As for the control soil for regions of (39 and 19), it was 1.8-2.5 and 2.1 cmol.kg^{-1}, respectively for both depths. The results indicate that the values of soluble potassium are higher than its medium averages in Iraqi soil mentioned by (1, 4, 3). The reason is attributed to the content of the organic matter, which is a source of potassium and some other elements, as well as the presence of transformations in mica minerals towards clay minerals (1: 2) as a result of the displacement of potassium from its structural composition and the formation of interstratified minerals, which contribute to the release of potassium and its availability in the soil solution.

Forms of magnesium in the soil:

Table (4) shows the values of soluble magnesium in the study soil ranged from 1.22-14.90 and 1.53-12.76, the exchangeable ranged from 1.94-12.50 and 1.54-14.66 cmol.kg-1, while in the non-exchangeable, the fixed magnesium ranged from 2.51-17.70 and 2.71-16.90, and the mineral ranged between 17.02-23.10 and 18.88-25.44 cmol.kg^{-1}, respectively at the two soil of surface and Risosphere depth. As for the control soil, the concentration of soluble magnesium ranged between (6.27-8.04 and 8.90-10.33), and exchangeable (6.90-8.23 and 5.82-11.86) and fixed magnesium (11.9.9.91 and 10.83-12.79), and the mineral (19.30-23.02 and 18.09-19.15 cmol.kg^{-1}), respectively at the depths of (0-30 and 50-60 cm). The results indicate that there is a variation in the different forms of magnesium, some of which may have depended on the quantity and type of accumulated salts shown by the electrical conductivity values in Table (2) (6, 10).

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Table 3: Different potassium forms in the study soils and for both depths.

Region	Sample	Depth (cm)	Different potassium forms ($cmol.kg^{-1}$)				
			Soluble	Exchangeable	Non-exchangeable		Total
					Fixed	Mineral	
39 Bernon	TL_1	30-0	4.9	1.18	4.70	14.44	25.22
		60-50	3.2	0.30	5.90	17.02	26.42
	SC_1	30-0	2.5	0.21	2.90	14.70	20.31
		60-50	2.1	0.25	2.30	19.41	24.06
19 Al-Jamjama Al-Shamalia	TL_2	30-0	3.0	0.05	2.30	21.51	26.86
		60-50	2.8	0.70	2.90	22.55	28.95
	SC_2	30-0	1.8	0.19	1.90	15.10	18.99
		60-50	2.1	0.66	1.60	17.20	21.96
16 Kwarysh	TL_3	30-0	3.1	0.30	3.90	24.22	31.52
		60-50	3.9	0.68	4.10	18.90	27.58
15 Al-Jamjama Al-Janubia	TL_4	30-0	2.1	0.75	2.90	23.0	28.75
		60-50	3.8	1.13	5.70	13.44	24.07

Table 4: Different magnesium forms in the study soils and for both depths.

Region	Sample	Depth (cm)	Different magnesium forms ($cmol.kg^{-1}$)				
			Soluble	Exchangeable	Non-exchangeable		Total
					Fixed	Mineral	
39 Bernon	TL_1	30-0	8.01	8.11	11.10	22.89	50.11
		60-50	11.03	10.91	10.72	25.44	58.92
		60-50	1.90	2.11	5.35	20.54	29.99
	SC_1	30-0	6.27	8.23	9.91	19.30	43.71
		60-50	8.90	5.82	10.83	18.09	43.64
19 Al-Jamjama Al-Shamalia	TL_2	30-0	14.11	12.50	17.70	19.95	63.61
		60-50	11.02	13.01	16.90	20.01	60.94
	SC_2	30-0	8.04	6.90	8.11	23.02	46.07
		60-50	10.33	11.86	12.79	19.15	54.13
16 Kwarysh	TL_3	30-0	9.21	11.01	14.02	21.16	55.40
		60-50	12.30	14.66	16.90	25.10	68.96
15 Al-Jamjama Al-Janubia	TL_4	30-0	14.90	11.12	13.10	19.44	45.56
		60-50	12.76	9.11	9.90	20.50	52.27

CONCLUSIONS

1- Variation of the volumetric distribution for the studied soil separates due to the absence of a specific pattern on the effect of water and air currents that vary in the susceptibility and intensity of carrying the particles.

2- The interaction of the soil and the electrical conductivity. Their values varied at both the surface depth and the rhizosphere according to the prevailing environmental conditions and factors.

3- The amount of organic matter and its acids, as well as the substance of humin, was in the surface depth soil higher than

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the soil of the rhizosphere for palm trees with varying chronological age.

4- Various forms of potassium were dissolved, with good concentrations in the soil solution, and not Non-exchangeable and total, and in quantities that indicate that the soil of the study is rich in minerals carrying potassium.
5- Various magnesium forms indicated that the soil of the study was rich in minerals containing magnesium, and to the environmental conditions that encourage the dominance of magnesium ions in dry soils.

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