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THE EFFECT OF THE SEDIMENTS OF THE HILLA RIVER ON THE CHARACTERISTICS OF THE ADJACENT SOILS (BABYLON GOVERNORATE)

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Abstract:

This study was conducted to investigate the effect of the sediments of the Hilla River on the characteristics of some the sedimentary soils adjacent to the Hilla River, the sampling sites were chosen in the study area along the eastern side of the Hilla River, which extends from the beginning of its branching from the Euphrates River at the front of the Hilla dam in the province of Babil and along the river in the south, all the way to the back of the Sadr al-Daghara regulator, which is located between the provinces of Babel and Al-Diwaniyah. Fifteen pedons were excavated, distributed in five transects perpendicular to the Hilla River. Each transect contains three pedons and represents a unit of shoulder, basin and depression. The results of soil investigations showed that there is a difference in some soil morphological properties among the studied sites according to the shape of the land, it was noted that there was no difference in the Hue through the wavelength of the studied sites and it was 10YR, with a difference in the Value and Chroma among all the pedons of the study area with depth, and indicates that the same sedimentation source (River Hilla). The predominance of the two types of blocky structures (angular blocky and sub angular blocky) and this shows the effect of the type of sediment. The results of the physical analysis showed a variation in the soil texture for both vertical and horizontal directions with the predominance of silt and sand particles and a decrease in the percentage of clay particles and this depended on the sedimentation speed associated with the proximity or distance of the river. As for the bulk density, its values also have changed as a result of a variation in the volume distribution ratio of soil particles of sand, silt and clay. While the results of the chemical analysis indicated that there is a difference in the chemical properties of soils in all study transects with depth, pH values lie between neutral to moderately basic (6.85-8.19) within the normal range of Iraqi soils, the electrical conductivity ranged between (0.68-36.2 ds m-1) from low salinity soils to very high salinity soils. As for SAR, it was low in sodium in most of the study pedons with depth, reaching 2.35, (medium to very high in some sites), and the values of the CEC ranged

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between (7.49- 21.45) Cmol Kg-1, As for the soil content of total calcium carbonate (CaCO3), whose values ranged between (6.52-22.17)%, the highest value of the soil content of organic matter reached in most of the surface horizons compared with the subsurface horizons.

Keywords: Sediments, Hilla River, characteristics of Soil.

Introduction:

Soil is one of the most important natural resources in sustaining human life and describing it as the natural medium upon which agriculture is based. It contains the necessary nutrients for plant growth, and the quantity and quality of which are affected by the physical and chemical properties of the soil, such as the distribution of particle sizes, texture, bulk density, pH, Electrical Conductivity, SAR and other properties. Through these characteristics, it is possible to know the indicators and their favorable and unfavorable effects on plant growth. The soil of the study area was characterized as being transferred soil as a result of the accumulation of various sediments that were carried with river water in addition to wind sedimentation, which made the soil characterized by stratification (Al-Zamili, 2015). The geomorphology of the study area are directly affected by the physical and chemical properties of the soil and indirectly through their influence by the properties of the soil in addition to the properties such as natural vegetation, climate and surface. There are five types of soils in study area (river shoulders, poorly drained basin, silted river basin soils, sand dunes soil, and ancient formations soil) (Al-Shammari et al., 2016). Previous literature has shown (Buringh, 1960) that the soils on the banks of rivers have a coarse texture in relation to the farthest soils, and as a result, the high natural banks will be several meters higher than the land adjacent to them, which is called the river's shoulders, and its height is 2-3 m above the basin. Thus, it will give it different characteristics from the neighboring soils. Revealed (Jdoua, 2020) about the physical and chemical properties of the governorate’s soils and their spatial variance by obtaining qualitative results for these properties, and to show the variance using geographic information systems (modeling) for soil samples. To know the effect of river sediments on some physical, chemical and morphological properties of soil. The aim of the study is to reveal the nature of the distribution of soils affected by the river.

Materials and working methods:

The study area is located physiographically within the central Iraqi alluvial plain area, within the administrative borders of the province of Babylon, which is characterized by normal terrain resulting from the sedimentation of rivers, ancient and modern water channels.

The study area is located between (17'' 40' 44° - 34'' 31' 44°) in the east and latitude (58'' 8' 32° - 4'' 50' 32°) in the north. Sampling sites were selected in the study area along the eastern side of the Hilla River, which extends from The beginning of its branching from the Euphrates River at the front of the Hilla dam in the province of Babylon, the river extends southward to the back of the Nazim Sadr al-Daghara, which is located between the provinces of Babylon and Diwaniyah. As the pedoning sites in the study area were determined based on some aerial photographs and the (Google Earth) program, with fifteen pedons distributed over these sites in five transects perpendicular to the Hilla River. Figure (1) shows the study area and the locations of the pedons

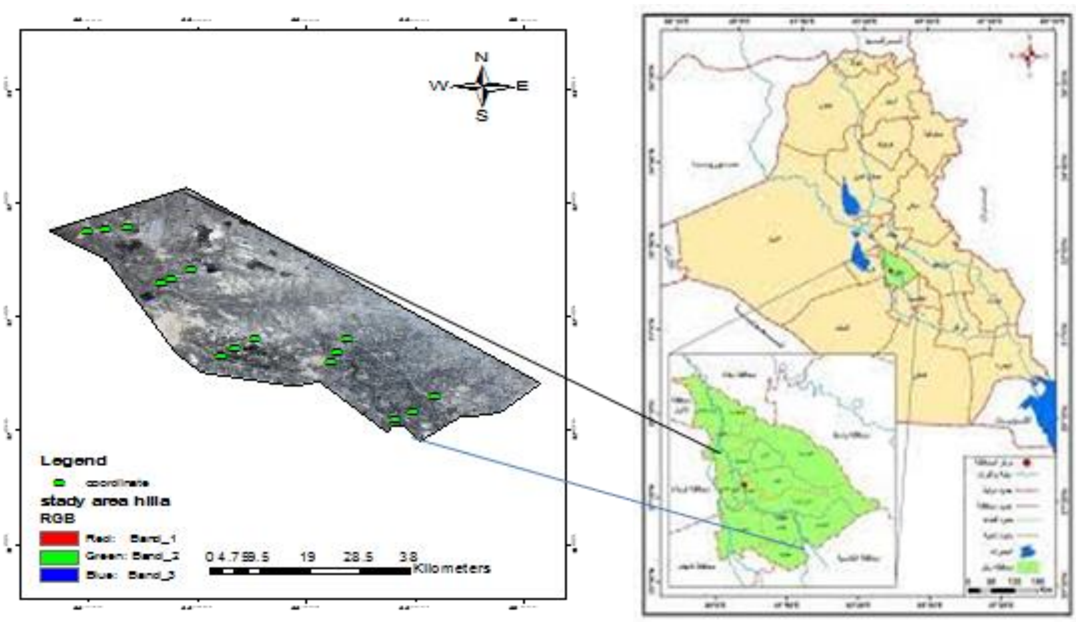

Figure (1) shows the study area and the locations of the pedons.

Soil Samples:

The transect sites for five perpendicular to the length of the eastern river course, which is approximately 101 km long, were determined, and the five transects were distributed into two paths north of the governorate center and three paths south of it.

Table (1) determining the excavation sites of the study area pedons

Transect	**Pedon**	**Zone**	**Coordinate**	
			X	**Y**
T1	1	Nazem al-Hilla's back	44°16'40.9"	32°42'35.6"
	2	Near the right of Sadat Al Hindiya	44°18'35.3"	32°42'52.1"
	3	Near the Prophet's Mosque	44°20'47.4"	32°43'10.4"
T2	1	The beginning of the Bronnon region	44°24'10.9"	32°34'56.6
	2	Near Hawraa Brick Factory, Babylon	44°25'12.9"	32°35'34.9"
	3	Near the Baroudia River	44°27'22.9"	32°36'55.4"
T3	1	Bermana area	44°30'28.8"	32°24'28.2"
	2	Near the tourist mall	44°31'54.7"	32°25'33.0"
	3	No function point	44°33'49.7"	32°26'59.3"
T4	1	Near the shrine of Mr. Al-Alaq	44°41'44.0"	32°23'23.2"
	2	North of the city of Medhetia	44°42'21.0"	32°24'51.1"
	3	Near the shrine of Al-Khidr, peace be upon him	44°43'17.6"	32°27'00.0"
T5	1	The beginning of the dagger regulator	44°48'50.5"	32°14'56.7"
	2	No function point	44°50'04.8"	32°16'12.0"

	3	Near the express line Anwar Babel station	44°52'20.0"	32°18'28.1"

These pedons were morphologically characterized according to the principles adopted in the Soil Survey and Classification Manual (Soil Survey Staff, 1993) to study some of the following morphological characteristics (soil color for each horizon, type of soil structure).

Lab. measurement's:

Soil samples were taken from each horizon and each pedon according to the predetermined locations, collected, preserved, air dried, ground, sifted and passed through a sieve with holes diameter of 2 mm and kept in polyethylene bags for some laboratory measurements (physical and chemical). The physical measurements included using the methods described in (Black, 1965) to estimate the texture, particle size distribution by absorbent method, and bulk density by paraffin wax. As for the chemical measurements, the pH and the electrical conductivity EC were estimated in 1:1 soil suspensions (page et al., 1982). As for the total calcium carbonate, CaCO3, they were estimated using a calciminer, according to the (Hess, 1972) method. using HCL acid. As for the ratio of adsorbed sodium SAR only from the following equation (Al-Zubaidi, 1989)

$$SAR = \frac{Na^{+}}{\sqrt{\frac{(Ca^{+2}+Mg^{+2})}{2}}} \ldots\ldots\ldots\ldots \quad (1)$$

While the cationic exchange capacity of the positive ions CEC of soil samples was estimated according to the method described by (Savant, 1994), while the organic matter was estimated by the dry burning method and the incoming method (page et al., 1982).

Results and discussion

1- **Morphological description:**

The results of the morphological description in Table (2) of the soil investigations for all the studied sites showed that there is a state of heterogeneity in some morphological characteristics, whether it is within the horizons of one pedones or among pedons, the studied sites according to the shape of the land, which is affected by their locations and the nature of the internal factors for each soil, which led to its reflection on the characteristics The morphology or the absence of heterogeneity in some other characteristics because the sedimentation source is the same and represented by the river. The soil of the study area is considered a newly formed, undeveloped sedimentary material transported by the river (Hilla River) and there are no subsurface horizons (B) because it was formed under a dry climate, that is, due to the low amount of rain falling on the area, in addition to the topography of the land from flat to almost flat.

The results of the morphological description of the horizons of soils in the study sites indicate that the dominant characteristic of the boundaries of the land shape (topographic) between the horizons is Smooth due to the nature of sedimentation during the flood period, while the gradient in the nature of the boundaries of these horizons ranged from Abrupt to Clear, through these results there are No noticeable difference for the five transect soils in this capacity (the nature of the boundary). The results also indicated that the soil color was

Table (2) Some morphological characteristics of the peduncles of the study area

Transect	No. of pedons	Horizons	Depth (cm)	Boundary	Colors		Structure	Consistence Wet	
					Dry	Moist		Stickiness	Plasticity
T_1	P_1	Ap	0-27	cs	10YR 5/3	10YR4/3	2cgr – 2msbk	Sli sticky	Sli plastic
		C_1	27-53	gb	---	10YR4/3	3m abk	Sli sticky	Sli plastic
		C_2	53-85	cs	---	10YR3/3	1m sbk	Non sticky	Non plastic
		C_3	+85	----	---	10YR4/4	2m abk	sticky	plastic
	P_2	Ap	0-14	cs	10YR4/2	10YR4/4	2m sbk	sticky	Sli plastic
		C_1	14-30	cs	---	10YR5/2	2mabk – sbk	sticky	Non plastic
		C_2	30-50	cs	---	10YR2/2	2m sbk	Sli sticky	Sli plastic
		C_3	50-67	cs	---	10YR4/2	1m sbk	sticky	plastic
		C_4	+67	----	---	10YR4/4	1m pl	sticky	Sli plastic
	P_3	Ap	0-17	as	10YR6/3	10YR5/4	2m pr	sticky	plastic
		C_1	17-30	cs	---	10YR4/4	1m abk - sbk	V sticky	plastic
		C_2	30-43	cs	---	10YR4/4	2m sbk	Sli sticky	Sli plastic
		C_3	43-65	cs	---	10YR6/4	2m sbk	sticky	plastic
		C_4	+65	----	---	10YR4/4	3m sbk	V sticky	Sli plastic
T_2	P_1 P_2	Ap	0-10	as	10YR6/3	10YR5/4	2m abk	sticky	plastic
		C_1	10-27	cs	---	10YR5/3	1m abk	sticky	plastic
		C_2	27-36	cs	---	10YR4/4	2m sbk	Sli sticky	plastic
		C_3	36-83	cs	---	10YR4/4	3m sbk	sticky	plastic
		C_4	+83	----	---	10YR4/4	3m abk	Sli sticky	plastic
	P_3	Ap	0-11	as	10YR4/3	10YR4/4	1m sbk	sticky	plastic
		C_1	11-31	cs	---	10YR3/3	1m sbk	Sli sticky	Non plastic
		C_2	31-51	cs	---	10YR5/2	2m sbk	Sli sticky	Sli plastic
		C_3	51-74	cs	---	10YR3/2	2m sbk	sticky	plastic
		C_4	+74	----	---	10YR4/4	1m abk	sticky	Sli plastic
		Ap	0-10	as	10YR5/3	10YR3/3	1m sbk	Sli sticky	Sli plastic
		C_1	10-23	cs	---	10YR3/2	1m abk	Sli sticky	Sli plastic
		C_2	23-51	cs	---	10YR4/3	2m sbk	sticky	Non plastic
		C_3	+51	----	---	10YR4/3	1m sbk	sticky	plastic
T_3	P_1	Ap	0-10	as	10YR6/3	10YR3/3	2f abk	sticky	plastic

		C_1	10-40	cs	---	10YR4/3	3m sbk	V sticky	non plastic
		C_2	+40	----	---	10YR3/4	2m sbk	Sli sticky	Sli plastic
	P_2	A_P	0-24	as	10YR6/2	10YR3/2	1m abk	Sli sticky	plastic
		C_1	24-45	cs	---	10YR5/2	1m sbk	Sli sticky	Sli plastic
		C_2	45-69	w	---	10YR3/3	3m sbk	V sticky	V plastic
		C_3	+69	----	---	10YR3/2	3m sbk	Sli sticky	Sli plastic
	P_3	A_P	0-40	as	10YR6/6	10YR4/3	1m abk	Non sticky	Non plastic
		C_1	40-83	cs	---	10YR5/1	Sl	Non sticky	Non plastic
		C_2	83-96	cs	---	10YR3/1	3m sbk	Sli sticky	plastic
		C_3	96-106	cs	---	10YR3/4	2m sbk	sticky	Non plastic
		C_4	+106	----	---	10YR3/3	2m sbk	sticky	plastic
T_4	P_1	A_P	0-18	cs	10YR5/1	10YR3/1	1m sbk	Sli sticky	Non plastic
		C_1	18-43	cs	---	10YR5/4	2m sbk	Non sticky	Non plastic
		C_2	43-70	cs	---	10YR3/3	3m abk	sticky	plastic
		C_3	+70	----	---	10YR4/3	2m sbk	Non sticky	Non plastic
	P_2	A_P	0-28	as	10YR6/3	10YR5/3	1m abk	Sli sticky	plastic
		C_1	28-49	cs	---	10YR5/4	3m pl	V sticky	plastic
		C_2	49-61	cs	---	10YR5/2	2m pl-abk	Sticky	Sli plastic
		C_3	+61	----	---	10YR5/2	2m abk	Sticky	plastic
	P_3	A_P	0-44	as	10YR5/2	10YR4/4	Sl	Non sticky	Non plastic
		C_1	44-62	cs	---	10YR3/2	1m abk	Non sticky	Non plastic
		C_2	62-87	cs	---	10YR5/2	2m sbk	Sli sticky	Sli plastic
		C_3	87-103	cs	---	10YR4/2	1m abk	Sticky	plastic
		C_4	+103	----	---	10YR4/4	1m abk	Sticky	Sli plastic
T_5	P_1	A_P	0-10	as	10YR5/2	10YR3/2	1m abk-sbk	Sticky	plastic
		C_1	10-30	cs	---	10YR5/6	1m sbk	Sli sticky	Sli plastic
		C_2	30-53	cs	---	10YR3/2	3m sbk	V sticky	plastic
		C_3	+53	----	---	10YR4/1	Sl	V sticky	V plastic
	P_2	A_P	0-16	as	10YR6/1	10YR4/3	2m sbk	Sli sticky	Plastic
		C_1	16-45	aw	---	10YR4/2	3m abk	Sticky	Plastic
		C_2	45-60	cs	---	10YR4/3	1m sbk	Sticky	Plastic
		C_3	+60	----	---	10YR4/4	2m sbk	non sticky	Non plastic
	P_3	A_P	0-12	as	10YR5/3	10YR3/3	1m abk-sbk	Sli sticky	Plastic
		C_1	12-44	cs	---	10YR3/2	1f abk	Sli sticky	Plastic

		C_2	44-63	cs	---	10YR3/3	2m sbk	Sticky	Plastic
		C_3	+63	----	---	10YR3/3	2m sbk	Sticky	Plastic

Abbreviations: (Tarim,2010)

Boundary: a= abrupt; c = clear; g = gradual; d = diffuse; s = smooth; w = wavy; I = irregular.

Structure: 1= weak; 2 = moderate; 3= strong; vf = very fine; f = fine; m= medium; c = coarse; gr = granular; pl= plate; pr = prismatic; sl = stractare less ; abk = angular blocky; sbk = sub- angular blocky. Consistence: Sli = slightly; V= very.

homogeneous in the values of the Hue(10YR), and did not notice any variation in its value for both the horizontal and vertical directions and for the dry and wet conditions. The Value is ranged between (2-6) in the dry condition and for the surface layer (tillage horizon AP), while in the wet condition, the Value of the ranged between (2-5) for all study sites in both directions. The degree of chroma ranged between (1-6) in both the dry and wet conditions and in both directions. , This variation indicates the different quality of the sedimentary materials transported by the river at different periods of time, as well as the dark color may reflect the increase in the percentage of organic matter and the degree of its decomposition, as when the humus increases in the soil, the color of the soil becomes blacker

The thickness of the horizons varied from one horizon to another and from one site to another, as some surface horizons were thicker than the subsurface or subsurface horizons less than the surface, so surface horizons appeared in some of the study area's pedons that were thicker, and the reason is attributed to the variation in the intensity of sedimentation and the amount of sedimentary and portable materials (Buringh, 1960).

The results of the morphological description showed that the characteristic of the structure prevailing between the paths of the transects of the studied sites was the dominance of the block structure with quality (from angular blocky to sub-angular blocky) and the degree of clarity of the structure ranged from weak to strong, while the size of the structure was the dominant characteristic is medium .As for the consistency of the soil, it is closely related to the moisture content and soil texture. The adjective was from sticky to slightly sticky , except for some horizons that were between non- sticky to very sticky, as well as plasticity The adjective was from plastic to slightly plastic as well, except for some horizons that were non-plastic to very plastic .

particle size Distribution

Table (3) shows the results of particles size Distribution and their textures for transects for the study areas and for both horizontal and vertical directions, where the first transect and the first and second pedon ranged between silt and sand, while the dominance was for silt particles for the third pedon, as the proportions ranged for the sizes of the particles, so the silt in general was the dominant In this transect and then followed by sand and the least amount represented by clay (206.5-935.5) g kg^{-1}, (53.1-642.7) gm kg^{-1}, (19.6-230.1) gm kg^{-1}, respectively, As for the results of the second transect, the dominance of the first and second pedon was the silt, while the third pedon ranged between clay and silt, with values of (314.7-887.4) g kg^{-1} for silt and (78.9-509.5) gm kg^{-1} for sand and less clay, which ranged between 27.3 - 500.7 g kg^{-1}.

The results of the third transect showed that the dominance of silt for the first and second pedon and sand for the third pedon except for the last horizon C4 was for silt and ranged (11.9-750.1) g kg^{-1}, while for sand it ranged (35.7-959.6) gm kg^{-1} and less for clay it ranged (28.5-448.6)) kg kg^{-1}., The dominance was also for silt in the first and second pedon of the fourth transect, except for the AP horizon (plowing horizon) in the second pedon was clay, while the third pedon ranged from sand and silt, as the values ranged (8.50-803.8) g kg^{-1} and (92.2-945.8) g kg^{-1} for silt and sand, respectively, and the least clay (40.3-513.3) g kg^{-1}.

As for the fifth transect, all pedons were dominant in the silt, except for the surface horizon of the first pedon AP (plowing horizon) sand was dominant, while the third pedon was the most dominant in the first and last horizons A_P and C_3 for silt (332.9-855.4) g kg^{-1} and sand (25.9-460.2) g kg^{-1} and for clay (35.7-641.3) g kg^{-1}, respectively.

In general, we note in all the transects of the study area that the dominance of the silt, followed by the sand and less is the clay with a variation in the quantities of sand, silt and clay in both directions, depending on the proximity or distance of pedons from the source of sedimentation, as well as the proximity or distance of the river from beginning to end. The texture depends on the amount of sedimentary materials and on the speed of the carrier current. In general, coarse materials are deposited, and then medium and fine materials, represented by clay particles, which are deposited in depressions (Al-Agidi, 1986), but we did not notice or significant differences in the content of particles in different soils in both horizontal and vertical directions because the conditions The source of sedimentation is one during the duration of the floods, in addition to the weak activity of pedogenic processes (Al-Atab, 2008). Or, it may be due to its influence by the specific local factors in the soil of each pedons, especially the pedogenic processes prevalent in its horizons (Al-Husseini, 2010),

Table (2) Some morphological characteristics of the peduncles of the study area

Transect	Pedon	Horizon	Depth (cm)	B. D	Sand	Silt	Clay	Texture class
				Mg m^{-3}	g kg^{-1}	g kg^{-1}	g kg^{-1}	
T_1	P_1	A_P	0-27	1.47	383.3	565.3	51.4	Silt Loam
		C_1	27-53	1.38	620.1	328.7	51.2	Sandy Loam
		C_2	53-85	1.41	642.7	307.7	49.2	Sandy Loam
		C_3	+85	1.45	454.5	495.8	49.6	Sandy Loam
	P_2	A_P	0-14	1.39	639.0	290.1	70.5	Sandy Loam
		C_1	14-30	1.31	702.7	206.5	90.8	Sandy Loam
		C_2	30-50	1.09	388.9	585.8	25.0	Silt Loam
		C_3	50-67	1.18	120.7	649.1	230.1	Silt Loam
		C_4	+67	1.05	88.6	888.7	22.6	Silt
	P_3	A_P	0-17	1.43	144.7	530.3	324.8	Silty Clay Loam
		C_1	17-30	1.62	186.8	516.0	297.2	Silty Clay Loam
		C_2	30-43	1.21	68.6	924.1	7.3	Silt
		C_3	43-65	1.22	93.5	897.5	8.3	Silt
		C_4	+65	1.15	53.1	935.5	11.2	Silt
T_2	P_1	A_P	0-10	1.21	358.5	595.7	45.8	Silt Loam
		C_1	10-27	1.25	509.5	490.5	49.6	Sandy Loam
		C_2	27-36	1.19	351.8	440.7	207.5	Loam
		C_3	36-83	0.97	155.9	712.8	131.3	Silt Loam
		C_4	+83	0.92	138.8	678.2	183.0	Silt Loam
	P_2	A_P	0-11	1.13	380.9	494.4	124.7	Loam
		C_1	11-31	1.06	311.9	331.7	356.4	Clay Loam
		C_2	31-51	1.36	205.5	449.5	345.0	Clay Loam
		C_3	51-74	1.07	470.6	487.3	42.2	Sandy Loam
		C_4	+74	1.25	215.2	566.1	218.7	Silty Loam
	P_3	A_P	0-10	1.07	158.69	314.7	526.7	Caly
		C_1	10-23	1.13	109.8	389.4	500.7	Caly
		C_2	23-51	1.08	78.9	887.4	33.7	Silt
		C_3	+51	1.15	102.0	875.7	22.3	Silt
	P1	A_P	0-10	0.91	224.5	639.0	136.4	Silt Loam
		C_1	10-40	1.06	305.7	485.9	208.4	Loam
		C_2	+40	1.11	187.3	455.4	357.3	Silty Clay Loam
		C_3	0-24	0.99	122.2	674.9	202.9	Silt Loam

T3	P2	A_P	24-45	1.15	81.9	750.1	168.1	Silt Loam
		C_1	45-69	1.22	35.7	515.7	448.6	Silty Caly
		C_2	+69	1.16	67.3	494.4	438.3	Silty Caly
	P3	C_3	0-40	1.40	906.6	24.6	68.8	Sand
		A_P	40-83	1.49	959.6	11.9	28.5	Sand
		C_1	83-96	1.48	690.8	259.2	50.0	Sandy Loam
		C_2	96-106	1.25	452.7	364.6	182.7	Loam
		C_3	+106	1.30	320.7	401.0	278.3	Caly Loam
T_4	P_1	A_P	0-18	1.27	307.6	414.2	278.2	Caly Loam
		C_1	18-43	0.76	303.4	350.1	346.4	Caly Loam
		C_2	43-70	0.92	254.8	394.3	350.9	Caly Loam
		C_3	+70	1.17	92.2	521.6	386.3	Silty Caly Loam
	P_2	A_P	0-28	0.97	100.5	386.2	513.3	Caly
		C_1	28-49	1.36	155.8	803.8	40.3	Silt OR Silty Loam
		C_2	49-61	0.99	182.6	562.4	255.0	Silt Loam
		C_3	+61	1.01	226.1	498.4	275.5	Caly Loam OR Silt Loam OR Lo
	P_3	A_P	0-44	1.37	945.8	8.50	45.7	Sand
		C_1	44-62	1.31	912.4	41.0	46.7	Sand
		C_2	62-87	0.90	208.4	492.2	299.4	Caly Loam
		C_3	87-103	0.82	163.0	529.4	307.6	Silt Caly Loam
		C_4	+103	0.86	229.1	651.4	119.5	Silt Loam
T_5	P_1	A_P	0-10	1.21	460.2	372.3	167.5	Loam
		C_1	10-30	1.46	173.1	656.9	170.0	Silt Loam
		C_2	30-53	1.22	198.4	584.7	216.9	Silt Loam
		C_3	+53	1.10	222.5	638.2	139.3	Silt Loam
	P_2	A_P	0-16	1.24	270.8	709.9	19.2	Silt Loam
		C_1	16-45	1.23	223.6	740.7	35.7	Silt Loam
		C_2	45-60	1.21	105.5	821.2	73.3	Silt
		C_3	+60	1.08	42.3	855.4	102.2	Silt
	P_3	A_P	0-12	1.24	243.7	357.9	398.4	Caly OR Caly Loam
		C_1	12-44	1.21	352.8	396.1	251.1	Loam
		C_2	44-63	1.16	197.4	747.4	55.2	Silt Loam
		C_3	+63	0.93	25.9	332.9	641.3	Caly

Bulk Density:

The results of Table (3) indicate that the values of the bulk density of the horizons of the study area with depth. It showed a clear variation in both horizontal and vertical directions. The values of bulk density for all five transects ranged (1.05 - 1.47) mcg m^{-3}, (0.92-1.36) mcg m^{-3}, (0.91-1.49) mcg m^{-3}, (0.76- 1.37) Mg m^{-3}, (0.93-1.46) Mg m^{-3} respectively, and the reason for this variation is attributed to the correlation of the values of the bulk density and its relationship with the surface or subsurface horizons of fine or coarse-textured soils, that is, it depends on the soil separations, in addition to the content of Soil organic matter compared to mineral soils, type of crop and soil compaction (soil compaction with depth)

Table (3) Some physical characteristics of the pedons of the study area

Transect	Pedon	Horizon	Depth (cm)	B. D	Sand	Silt	Clay	Texture class
				Mg m^{-3}	g kg^{-1}	g kg^{-1}	g kg^{-1}	
T1	P1	AP	0-27	1.47	383.3	565.3	51.4	Silt Loam
		C1	27-53	1.38	620.1	328.7	51.2	Sandy Loam
		C2	53-85	1.41	642.7	307.7	49.2	Sandy Loam
		C3	+85	1.45	454.5	495.8	49.6	Sandy Loam
	P2	AP	0-14	1.39	639.0	290.1	70.5	Sandy Loam
		C1	14-30	1.31	702.7	206.5	90.8	Sandy Loam
		C2	30-50	1.09	388.9	585.8	25.0	Silt Loam
		C3	50-67	1.18	120.7	649.1	230.1	Silt Loam
		C4	+67	1.05	88.6	888.7	22.6	Silt
	P3	AP	0-17	1.43	144.7	530.3	324.8	Silty Clay Loam
		C1	17-30	1.62	186.8	516.0	297.2	Silty Clay Loam
		C2	30-43	1.21	68.6	924.1	7.3	Silt
		C3	43-65	1.22	93.5	897.5	8.3	Silt
		C4	+65	1.15	53.1	935.5	11.2	Silt
T2	P1	AP	0-10	1.21	358.5	595.7	45.8	Silt Loam
		C1	10-27	1.25	509.5	490.5	49.6	Sandy Loam
		C2	27-36	1.19	351.8	440.7	207.5	Loam
		C3	36-83	0.97	155.9	712.8	131.3	Silt Loam
		C4	+83	0.92	138.8	678.2	183.0	Silt Loam
	P2	AP	0-11	1.13	380.9	494.4	124.7	Loam
		C1	11-31	1.06	311.9	331.7	356.4	Clay Loam
		C2	31-51	1.36	205.5	449.5	345.0	Clay Loam
		C3	51-74	1.07	470.6	487.3	42.2	Sandy Loam
		C4	+74	1.25	215.2	566.1	218.7	Silty Loam
	P3	AP	0-10	1.07	158.69	314.7	526.7	Caly
		C1	10-23	1.13	109.8	389.4	500.7	Caly
		C2	23-51	1.08	78.9	887.4	33.7	Silt
		C3	+51	1.15	102.0	875.7	22.3	Silt

T3	P1	AP	0-10	0.91	224.5	639.0	136.4	Silt Loam
		C1	10-40	1.06	305.7	485.9	208.4	Loam
		C2	+40	1.11	187.3	455.4	357.3	Silty Clay Loam
	P2	AP	0-24	0.99	122.2	674.9	202.9	Silt Loam
		C1	24-45	1.15	81.9	750.1	168.1	Silt Loam
		C2	45-69	1.22	35.7	515.7	448.6	Silty Caly
		C3	+69	1.16	67.3	494.4	438.3	Silty Caly
	P3	AP	0-40	1.40	906.6	24.6	68.8	Sand
		C1	40-83	1.49	959.6	11.9	28.5	Sand
		C2	83-96	1.48	690.8	259.2	50.0	Sandy Loam
		C3	96-106	1.25	452.7	364.6	182.7	Loam
		C4	+106	1.30	320.7	401.0	278.3	Caly Loam
T4	P1	AP	0-18	1.27	307.6	414.2	278.2	Caly Loam
		C1	18-43	0.76	303.4	350.1	346.4	Caly Loam
		C2	43-70	0.92	254.8	394.3	350.9	Caly Loam
		C3	+70	1.17	92.2	521.6	386.3	Silty Caly Loam
	P2	AP	0-28	0.97	100.5	386.2	513.3	Caly
		C1	28-49	1.36	155.8	803.8	40.3	Silt OR Silty Loam
		C2	49-61	0.99	182.6	562.4	255.0	Silt Loam
		C3	+61	1.01	226.1	498.4	275.5	Caly Loam OR Silt Loam OR Lo
	P3	AP	0-44	1.37	945.8	8.50	45.7	Sand
		C1	44-62	1.31	912.4	41.0	46.7	Sand
		C2	62-87	0.90	208.4	492.2	299.4	Caly Loam
		C3	87-103	0.82	163.0	529.4	307.6	Silt Caly Loam
		C4	+103	0.86	229.1	651.4	119.5	Silt Loam
T5	P1	AP	0-10	1.21	460.2	372.3	167.5	Loam
		C1	10-30	1.46	173.1	656.9	170.0	Silt Loam
		C2	30-53	1.22	198.4	584.7	216.9	Silt Loam
		C3	+53	1.10	222.5	638.2	139.3	Silt Loam
	P2	AP	0-16	1.24	270.8	709.9	19.2	Silt Loam
		C1	16-45	1.23	223.6	740.7	35.7	Silt Loam
		C2	45-60	1.21	105.5	821.2	73.3	Silt
		C3	+60	1.08	42.3	855.4	102.2	Silt
	P3	AP	0-12	1.24	243.7	357.9	398.4	Caly OR Caly Lo
		C1	12-44	1.21	352.8	396.1	251.1	Loam
		C2	44-63	1.16	197.4	747.4	55.2	Silt Loam
		C3	+63	0.93	25.9	332.9	641.3	Caly

Chemical properties:

The results of table (4) showed the chemical analyzes of the horizons of the soil pedons, and that there were variations in some soil characteristics in the vertical direction of one pedon with the depth. Such as pH, dissolved salts and soil organic matter (Ali, 2015).

2-2-1 Soil Reactivity (pH):

The values of the degree of soil reaction (pH), as shown by its results in Table (4), range between (7.04-8.19) between neutral to moderately basic according to the classification (Ellis and Mellor, 1995), and the reason is due to the fact that the Iraqi limestone soils are between neutral to moderately basic. This was confirmed by (Jdoua, 2020) by studying and revealing the physical and chemical properties of the governorate's soils and their spatial variation in the light of the results obtained from the results of the analyzes.

Ec:

The electrical conductivity is one of the most important chemical characteristics, especially in the conditions of dry and semi-arid areas, which are characterized by low rainfall and high temperatures, which in turn lead to the accumulation of salts in the upper horizons, especially irrigated soils (Ali, 2015).

Table (4) of some chemical properties of pedeons in the study area

Transect	Pedon	Horizon	Depth (cm)	pH	Ec	CEC	K^+	Na^+	Ca^{+2}	Mg^{+2}	SAR	OM	$CaCO_3$
				1:1	Ds m^{-1}	Cmol kg^{-1}	M Mol L^{-1}				$meql^{-1}$	gm kg^{-1}	g Kg^{-1}
T1	P1	AP	0-27	7.43	6.60	12.84	2.29	16.31	11.76	10.04	6.98	39.10	139.1
		C1	27-53	7.40	6.08	11.24	1.75	14.16	11.76	10.64	5.98	31.30	91.3
		C2	53-85	7.35	4.81	10.17	1.22	10.80	11.12	7.68	4.98	10.52	82.6
		C3	+85	7.25	4.15	12.31	0.95	8.51	12.72	5.36	4.00	11.97	87.0
	P2	AP	0-14	7.54	0.80	13.38	0.27	2.48	2.16	0.50	3.04	27.56	134.8
		C1	14-30	7.49	0.82	12.84	0.22	2.57	2.48	0.40	3.03	23.44	104.3
		C2	30-50	7.44	3.27	11.93	0.53	4.30	10.16	3.28	2.35	23.72	100.0
		C3	50-67	7.75	4.72	17.12	0.70	10.57	7.28	3.36	6.48	23.66	100.0
		C4	+67	7.76	6.24	13.38	0.50	17.39	10.48	9.14	7.79	19.52	191.3
	P3	AP	0-17	6.85	4.00	14.45	0.41	9.62	13.92	2.40	4.76	33.26	178.3
		C1	17-30	6.88	4.27	17.12	0.30	11.04	11.36	3.36	5.80	30.10	130.4
		C2	30-43	7.76	2.62	17.71	0.23	10.27	4.88	1.36	8.22	23.35	187.0
		C3	43-65	7.79	2.29	17.66	0.19	8.40	4.80	1.28	6.81	21.05	108.7
		C4	+65	7.78	1.63	18.78	0.17	7.06	2.10	0.18	9.35	26.37	160.9
T2	P1	AP	0-10	7.52	7.90	13.38	1.72	28.81	12.72	6.80	13.04	22.77	121.7
		C1	10-27	7.62	4.18	13.38	1.20	18.40	10.24	3.04	10.10	16.77	143.5
		C2	27-36	7.65	5.46	13.91	1.39	22.27	10.24	4.96	11.42	19.05	156.5
		C3	36-83	7.74	5.00	14.98	0.82	27.93	0.68	1.24	40.31	17.47	134.8
		C4	+83	8.01	2.69	15.52	0.15	18.37	0.92	0.50	30.84	14.34	191.3
	P2	AP	0-11	7.67	1.66	13.91	1.65	5.41	6.64	1.68	3.75	47.76	147.8
		C1	11-31	7.88	1.08	21.45	0.50	4.61	1.40	0.28	7.12	23.57	160.9
		C2	31-51	7.91	1.39	19.26	0.34	5.03	3.36	1.20	4.71	16.66	195.7
		C3	51-74	7.95	1.10	19.37	0.31	4.34	3.20	0.48	4.52	11.55	178.3
		C4	+74	8.00	0.73	19.47	0.25	2.86	2.40	0.24	3.52	11.10	191.3
		AP	0-10	7.92	1.20	19.80	0.25	3.41	2.50	0.58	3.88	34.36	165.2

	P3	C1	10-23	8.02	1.23	20.87	0.24	3.94	2.10	1.18	4.35	33.75	204.3
		C2	23-51	7.84	1.41	20.33	0.54	11.10	7.22	4.34	6.53	24.46	208.7
		C3	+51	7.86	6.45	20.33	0.47	17.19	10.88	8.24	7.86	17.51	173.9
T3	P1	AP	0-10	7.81	1.29	12.84	0.51	3.54	3.52	1.44	3.18	39.21	169.6
		C1	10-40	7.84	2.76	13.91	0.24	7.81	7.28	2.72	4.94	17.68	147.8
		C2	+40	7.86	2.96	11.24	0.22	7.39	11.12	5.92	3.58	21.81	165.2
	P2	AP	0-24	7.80	3.87	21.40	0.27	7.37	13.12	6.56	3.32	22.48	152.2
		C1	24-45	7.96	1.75	19.26	0.23	5.27	5.28	2.08	3.88	21.92	178.3
		C2	45-69	7.24	1.97	21.40	0.22	5.86	5.58	0.04	4.98	24.89	195.7
		C3	+69	7.96	1.60	22.47	0.24	4.50	3.30	1.96	3.92	19.63	191.3
	P3	AP	0-40	8.12	0.68	10.70	0.09	3.01	1.92	0.16	4.17	9.56	82.6
		C1	40-83	8.19	1.09	12.04	0.15	8.64	1.28	0.48	13.02	6.76	73.9
		C2	83-96	7.04	2.85	10.17	0.39	14.65	4.72	2.16	11.17	11.71	78.3
		C3	96-106	7.88	3.41	17.66	0.35	14.09	5.68	2.64	9.77	15.25	73.9
		C4	+106	7.89	3.28	18.73	0.27	13.21	4.88	2.48	9.74	15.98	73.9
T4	P1	AP	0-18	7.51	4.56	12.84	0.92	9.12	12.34	7.74	4.04	27.03	147.8
		C1	18-43	7.63	3.64	11.82	2.20	8.74	7.04	0.06	6.56	28.33	117.4
		C2	43-70	7.68	4.70	13.64	4.64	10.89	8.18	1.28	7.08	22.58	126.1
		C3	+70	7.78	2.88	19.26	0.70	9.41	6.40	0.30	7.27	18.72	95.7
	P2	AP	0-28	7.81	2.03	10.17	0.45	6.12	5.92	2.08	4.33	32.88	173.9
		C1	28-49	7.82	4.98	12.04	0.63	15.39	10.88	11.68	6.48	39.69	134.8
		C2	49-61	7.82	4.61	12.84	0.66	14.36	10.32	8.88	6.55	12.85	160.9
		C3	+61	7.84	3.24	11.77	0.37	9.26	10.64	5.92	4.55	19.82	130.4
	P3	AP	0-44	8.02	0.65	10.70	0.45	2.69	1.52	0.16	4.15	7.54	108.7
		C1	44-62	7.67	0.48	10.70	0.37	2.52	1.12	0.16	4.46	7.55	65.2
		C2	62-87	7.94	2.31	14.98	0.50	11.70	3.92	1.36	10.19	14.94	73.9
		C3	87-103	7.87	2.77	17.12	0.56	13.03	4.24	1.04	11.34	15.25	113.0
		C4	+103	7.79	3.56	17.12	0.64	13.17	8.64	2.24	7.99	11.84	160.9
T5	P1	AP	0-10	7.36	3.47	12.31	0.75	9.25	11.04	6.16	4.46	24.92	87.0
		C1	10-30	7.48	3.17	10.7	0.86	9.97	7.20	5.60	5.57	15.84	87.0
		C2	30-53	7.61	2.96	12.31	0.54	11.65	4.80	3.36	8.16	12.12	160.9
		C3	+53	7.66	3.00	10.43	0.35	11.73	4.08	4.00	8.25	9.62	143.5
	P2	AP	0-16	6.94	25.5	10.70	1.69	46.91	23.68	38.16	11.93	54.07	130.4
		C1	16-45	7.05	32.1	10.43	1.26	58.26	16.4	55.52	13.74	55.89	143.5
		C2	45-60	7.05	35.2	12.31	1.04	60.04	19.44	112.16	10.47	31.53	143.5
		C3	+60	7.10	36.3	10.17	1.03	62.96	16.26	45.42	16.03	32.90	134.8
	P3	AP	0-12	7.51	4.84	17.12	1.07	10.90	13.6	4.64	5.10	29.90	152.2
		C1	12-44	7.76	2.74	10.70	0.66	8.46	8.80	4.40	4.66	22.52	156.5
		C2	44-63	7.68	6.07	12.31	0.51	14.97	10.32	8.32	6.94	20.35	156.5
		C3	+63	7.68	5.09	13.38	0.65	16.06	2.86	6.58	10.45	27.27	173.9

The electrical conductivity values of the soil samples ranged between (0.48-7.90) dsi m^{-1}, as the soils are located between low to medium salinity, except for the second pedon of the fifth transect, and the conductivity was very high (25.5-36.3) dsi m^{-1} It was distinguished within highly salinized soils, and this pedon was characterized by a sudden rise compared to the rest of the pedons of the same transect and other transect pedons. It is possible that the reason is due to the activity of the capillary property, which leads to the accumulation of salts in the horizons, in addition to the fact that this soil is not planted and surrounded by cultivated lands or its proximity and its impact on the neighboring drainages.

cation exchange capacity CEC

The exchange capacity of the positive ions shown in Table (4) indicates the soil's ability to retain nutrients, in addition to the possibility of their replacement and ability to prepare them for plants, as their value ranged between (10.17-22.47) centimole charge kg^{-1}, and we note in general that these values are low and vary with depth and from one site to another for all transects of the studied sites, and this decrease of the cationic exchange capacity in some soil horizons, although it is directly related to the soil content of organic matter and the degree of its decomposition and the content of clay particles in the soil And the quality of the prevailing clay minerals, or it may be related to the intensity of weathering of the parent material, may be affected by the soil content or the percentage of total calcium carbonate minerals (Rasheed, 1986).

Sodium adsorption ratio SAR

This indicator is used to predict the irrigation water used in the management of soil affected by sodium, and to indicate the suitability of irrigation water for agricultural use. The values ranged between the horizons of one pedon with depth and from one site to another (2.35-16.03) mEq l^{-1}, meaning the values ranged between low sodium (S1) to medium sodium (S2) according to the classification of water into four sections (Al-Hadithi et al., 2010). Except for the last two horizons C3 and C4 of the first pedon within the second transect, the percentage of very high sodium (S4) waters exceeded, their values were 40.31 and 30.84, respectively.

O.M organic matter

Table (4) shows the values of organic matter for the horizons of the studied pedon soils, and there is a discrepancy in their content between the horizons of one pedon and from one site to another, which may be due to the repetition of different and alternating sedimentation processes that work to bury organic materials in the form of successive layers (Al-Rawi, 2003), in addition to the processes of The immersion of the shoulders of rivers, which leads to the transfer and movement of soil colloids and humic materials as a result of the leashing process (Al Dhahi, 2009 and Al Jubouri, 2010)

The values of the organic matter ranged between (6.76-39.69) g kg-1. Except for the AP horizon (tillage horizon) of the second transect of the second bed, which has a value of 47.76 g kg-1, and the AP and C1 horizons of the second transect of the fifth, whose value is 54.07 and 55.89 g kg-1, respectively.

The matter that led to an increase in the values of organic matter may be affected by the river load that contributes to repeated additions to the suspended materials it carries (Al-Rawi, 2003) or it may be due to its impact on the prevailing vegetation cover, which differs in the density and depth of the root system in relation to the depth (Rasse et al., 2005).

As well as from the most important reasons for the variation in the values of organic matter for the studied sites, it was characterized by the growth of vegetation cover in a dense and varied way, and better than the rest of the other sites, in which the characteristic prevails by its low content of organic matter, as well as the variation of the agricultural service received by the soil after adding fertilizers, which has a positive effect in raising the ratio. And the organic matter is the result of the interaction between soil, vegetation cover and climate, and the difference in its content of organic matter is due to the different intensity of these three factors (Ibrahim, 2005; Dregene, 1976).

Total Calcium Carbonate CaCO3

Calcium carbonate minerals are found in Iraqi soils, which were transported with the tributaries of river waters (Tigris and Euphrates) from the north towards the sedimentary plain in the form of fine particles, then they were deposited and collected with soil particles (Buringh, 1960; Delver, 1962). It is clear from Table (4) that there is a spatial discrepancy in the transects of the study area and with the depth, the values of calcium carbonate (lime) in all the transects of the study area, as their values ranged between (6.52-22.17%) and the reasons for this discrepancy are due to the discrepancy in the sediment separations (sand, silt and clay) as a result of the variation in the sedimentation energy and the origin of the parent material. The difference in sedimentation conditions between the past and the present contributed to the discrepancy in the proportion of calcium carbonate minerals with depth, and this is consistent with (Al-Atab, 2008) showing that the decrease in the proportion of carbonate minerals is due to the difference in sedimentation conditions, and the amount of transported quantity for each time period or sedimentation cycle.

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