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The Effect of Soil Depth and its Management on the Stability of Soil Aggregates of Different Pedons in Basra Governorate

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The Effect of Soil Depth and its Management on the Stability of Soil Aggregates of Different Pedons in Basra Governorate

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Abstract. Four soils were selected by different departments of Basra Governorate, namely Abu Al-Khasib, Al-Tanuma, Al-Nashwa, and Al-Deir (i.e., cultivated and uncultivated) in the area confined between longitudes 30.980 and 47.460 N and latitudes 30.452 and 47.967 E for the study. Estimation of soil stability of eight cultivated and uncultivated Bedoons. In the province of Basra, in addition to studying some chemical properties such as organic matter and calcium carbonate, The results showed the effect of soil management on the average weighted diameter and the organic matter, where clear differences were found in the soil layers, especially in the cultivated areas compared to the uncultivated areas, especially in the surface layers of Abu al-Khasib and. Bedons al-Nashwa, while it decreases in the surface layers of Pedon l-Deir and Tanumah, and excludes among them the Bedons Abu al-Khasib. It is not cultivated as it decreases in the surface layer and increases with depth compared to other crops due to the presence of palm roots.

Keywords. Soil aggregate Stability, Mean weight diameter, Soil organic matter.

1. Introduction

The formation of soil aggregates and their stability are among the important issues in soil management, as they have an important effect on the soil ecosystem, such as bulk density and porosity [1]. Soil aggregates arise from a group of vital environmental activities and soil management processes, according to which the primary soil particles are linked to each other by natural forces through ions in the soil solution and materials that come from the activity of microorganisms, roots, or soil conditioners, and their stability varies. These aggregates differ in different activities and processes [2]. The stability of soil stability is affected by a variety of binding agents, including organic matter, iron and aluminum oxides, carbonates, and metal cations [3]. The physical characteristics of the soil are closely related to the quality of agricultural uses, starting from conducting soil management operations in terms of tillage, fertilization, irrigation, and hoeing, up to the provision of nutrients and the requirements for germination and growth of agricultural crops [4]. As the stability of soil agglomerations increases with the presence of vegetation cover, plant residue,s and the increase in organic matter [5]. The stability of soil aggregates is considered one of the measurements of soil construction and is defined as the arrangement of soil granules with each other in the form of aggregates or units by certain bonding factors, thus forming large voids between units to help roots penetrate and breathe, and small interstitial spaces within the soil aggregates for the movement of soil solution and plant nutrition [6], as it is considered an important physical indicator of soil quality due to its effect on changing water properties and storing organic carbon with time and reducing the susceptibility of soils to water and wind erosion [7]. The stability of soil agglomerations is one of the physical characteristics that reflect the quality of the soil [8]. The average weighted diameter (MWD) of the soil aggregations is used to measure the stability of soil agglomerations [9]. Soil permeability and stability are significantly related to the composition of soil particles, type of Lan,us,e and its root characteristics [10,11].

2. Materials and Methods

Soil samples were collected from different regions of Basra Governorate for agriculturally exploited and unexploited areas with the aim of studying the correlation between the weighted average diameter and some soil components and their management. Anatomical openings were made as shown in Figure (1).

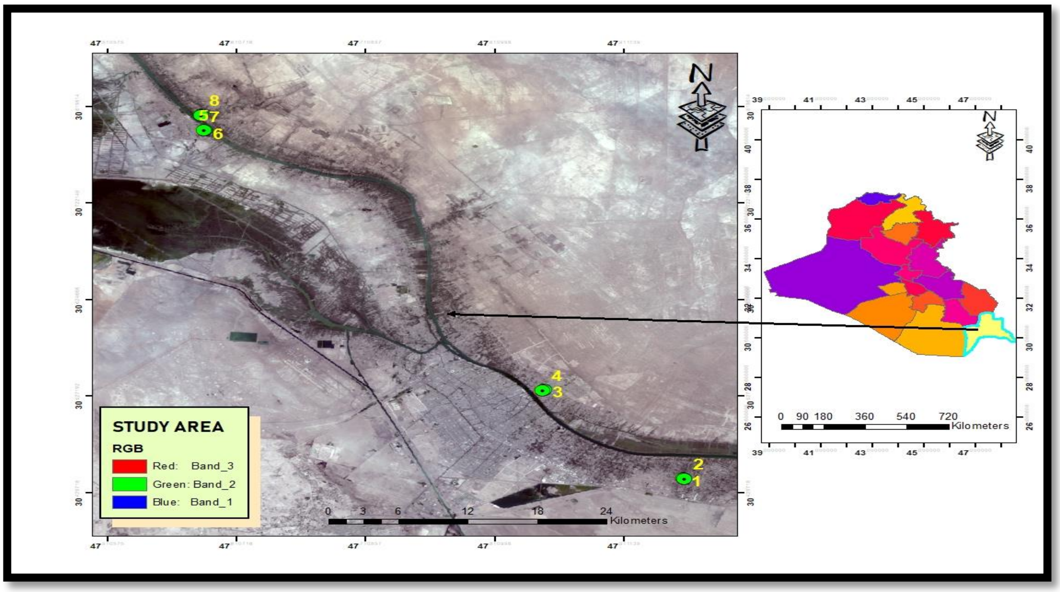

Figure 1. Shows the location of the study area in Basra Governorate.

Some chemical and physical properties of the soil of the study area were measured, where the dissolved ions were estimated by the soil solution in a 1:1 extract, where the calcium and magnesium ions were measured by titration with EDTA solution, and sodium ions by means of a flame photometer. As for the chlorides, they were estimated by the volumetric method by titration with Silver nitrate, and bicarbonate ions were determined by titration with hydrochloric acid as in Table 1 and 2 for cultivated and uncultivated soils, respectively.

Table 1. The positive and negative ions of the soil cultivated in the study area.

Analysis the site	Number of layers	Ca^{+2}	Mg^{+2}	Cl^{-1}	$SO4^{-2}$	$Caco_3$	HCO_{3-}	Na	K
AbuAl- Khasseb planted	A	10	40	7	5.089	0	3	46.309	1.369
	C1	36	124	17	2.864	0	4	25.038	0.834
	C2	76	178	77.5	2.686	0	2.8	25.038	1.551
	C3	10	30	7	1.350	0	1.3	19.286	1.150
Al Tannumah planted	A	30	100	7	2.977	0	1	37.238	1.638
	C1	20	20	9	2.463	0	3.2	19.095	0.707
	C2	2	20	57	4.422	0	1.2	14.559	0.549
Al Dayr planted planted	A	11	33	7	5.312	0	1.2	14.559	0.834
	C1	30	50	6	1.217	0	2	10.023	0.834
	C2	20	32	0	0.416	0	2	10.023	0.486
	C3	10	20	0	5.579	0	1	10.023	1.150
AlNashwa planted	A	10	40	7	5.712	0	1.2	13.936	0.865
	C1	20	38	7	1.706	0	4	13.936	0.707

Table 2. Positive and negative ions of uncultivated soil.

Analysis the site	Number of layers	Ca^{+2}	Mg^{+2}	Cl^{-1}	$SO4^{-2}$	$Caco_3$	HCO_{3-}	Na	K
AbuAl- Khasseb is not cultivated	A	20	70	17	0.727	0	3	55.381	1.435
	C1	10	41	7	4.422	0	2	37.240	1.290
	C2	10	30	9	0.772	0	2	26.262	0.960
	C3	7.6	32.2	7	5.223	0	1.3	19.095	1.467
Al Tannumah is not cultivated	A	10	130	7	11.187	0	2	37.238	6.385
	C1	21	39	17	5.087	0	9	19.095	1.530
	C2	10	60	17	0.460	0	1.2	14.559	1. 340
Al Dayr is uncultivated	A	1	79	7	11.543	0	9	10.023	11.290
	C1	1.566	34.953	7	4.422	0	1.6	13.936	7.018
	C2	2	18	7	1.217	0	1	10.023	1.372
	C3	10	30	7	0.416	0	2	19.095	1.337
AlNashwa is not cultivated	A	10	133	27	1.172	0	2	59.916	1.213
	C1	2	48	57	11.187	0	1.2	19.095	1.150

The electrical conductivity was measured to express the amount of total dissolved salts in the soil extract 1:1 using an EC-meter type Lovibond Con 200 at a temperature of 25 C as described by(12) And the degree of soil interaction was measured using a device (PH-meter) in the soil and water suspension at a ratio of 1: 1 using a device pH-meter type Lovibond pH 200 according to what was stated in [12]. As for carbonate minerals, calcium carbonate minerals were estimated according to the method presented in [13], by equating 1 molar of HCl with 1 moratorium of NaOH using the phenolphthalein index. As for the organic matter, the organic matter was estimated using the Walkley and Black method, as this method depends on the oxidation of organic carbon with potassium dichromate, and then the organic matter was estimated by multiplying the organic carbon by 1.724 [13]. As for the volume distribution of soil particles for the purpose of estimating the soil texture, the Pipette method mentioned [14], was used, as the sand was separated by wet sieving using a sieve with a diameter of 50 microns, and both clay and silt were separated on the basis of the difference in their fall velocity. Tables 3 and 4 for the cultivated and uncultivated soils of the study area. The size distribution of soil particles was also measured, as soil samples were taken, air-dried soil samples were passed through a sieve with a diameter of 8 mm and received on a sieve with a diameter of 4 mm. 25 g of soil sample was weighed and placed on a set of sieves with diameters (4, 2, 1, 0.5 and 0.25 mm) after wetting it with water by capillary method for 6 minutes, then the wet sieving process was carried out for 6 minutes as well. The contents of each sieve were transferred to a box. humidity, and dried in the oven at a temperature (of 105 °C). The soil weight was recorded on each sieve and then the Mean Weight Diameter (MWD) was calculated as stated by [15]. The bulk density was measured by the paraffin wax wrapping method described in (Black *et al*. 1965) and the real density was estimated using the Pycnometer as stated in the method presented in (Black 1965). As for the total soil porosity, it was calculated by applying the mathematical relationship between bulk density and The true density according to the method mentioned [14].

3. Results and Discussion

3.1. Soil Articulations

The results of Tables 3 and 4 show the size distribution of the soil classes of the soil pedons belonging to the study area, as it is noted that there is a difference in the distribution pattern of soil particles (sand, silt, and clay) generally within the same soil pod or between different soil pods, due to the subtle variation in the sedimentary environment. For each site and is often the result of the nature of the difference in the physiographic location of each pedon. In general, the results indicated that the sedimentary environment of the study soils is of calm to moderate type. This was reflected in the dominance of silt-separated soils in all soil pedons, with a significant increase in the content of fine particles in the subsurface horizons. It was also noted that the content of clay and silt was high in all soils compared to the amount of sand that was very small, as the content of clay ranged between

439.56-200 gm kg^{-1} and the content of silt ranged between 349.34-640 gm kg^{-1}. As for the sand content, it ranged between 0-267.46 gm^{-1} kg. The reason for the increase in silt percentages is high, because the sedimentation process in the middle of the sedimentary plain is linked to the sedimentation of the Tigris and Euphrates rivers, and their carrying capacity is medium, and thus the soft and medium materials moved, and then the medium-sized materials were deposited and the soft materials remained. In general, the results of the relative distribution of soil classes are consistent with the results of an increase in the concentration of clay and silt particles, and their dominance in a certain horizon in sedimentary soils and under certain conditions may in turn lead to the formation of soft-textured horizons that act as a solid layer in the body of the soil [16]. The results in Table 3 and Table 4 show that the horizons of the pedons of the study area ranged from clayey to clayey-alluvial mixtures and that the clay-silt mixtures dominated. The texture of the horizons of the study area pedons was characterized by the presence of stratification cases in the tissue. The pedons of the study area showed a clear variation in the tissue. This depends on the nature or influence of the geomorphological factor represented by the characteristics and speed of the conveyor, which affects the volume of particles transported during the layer deposition period. This was confirmed by [17]. She mentioned that the variation in the proportions of the soil classes (sand, silt, and clay) was generally high in variation, ad that the reason for their variation is attributed to the nature of sedimentation in the study area.

3.2. Soil Reaction (pH)

The results of the laboratory analysis of some chemical properties of the soil pedons of the study area in Tables 3 and 4 showed that the soil interaction values for the studied soil pedon horizons were distributed within the range of 7.250 - 7.695. It can be attributed to the presence of sodium bicarbonate ions, and soluble sodium contributes to a relative increase in pH values due to the precipitation of calcium and magnesium carbonates [18]. We also notice a decrease in soil interaction in some of its horizons, as in the salt-affected soil sites.

3.3. Electrical Conductivity (EC)

The values of the electrical conductivity of the horizons of the soil pedons of the study area, the horizons of the soil pedons showed a variation in the salinity content between the pedons of the study area, as the [19]. Soil classification was adopted related to the salt content of the soil. It is noted that the electrical conductivity values of the pedons of the study area are located between low-salinity to high-salinity soils and ranged between 33.9-2.70 dSm^{-1}. And the lowest electrical conductivity values appeared at the C3 horizon in pedons Al-Deir, as its EC was 2.70 dSm-1 for the cultivated soil, while the highest electrical conductivity appeared at the al-pedons Al Tannumah horizon, the A horizon, as it amounted to 33.9 dSm^{-1}, while it was for uncultivated soils between 40.700-3.13 decimals m^{-1} The lowest electrical conductivity values appeared at the C2 horizon in Pedons Al Dayr, as its EC reached 3.13 dSm^{-1} while the highest electrical conductivity appeared at the Pedons Al Tannumah horizon, A horizon, as it amounted to 40.700 dSm^{-1}. The reason for this variation can be attributed to the difference in the geomorphological location. Surface horizons are exposed to evaporation, leaving salts on the surface, and soil management has a major role in this [20].

3.4. Particle Density

The true density of soil minerals is an important characteristic, and it is a constant characteristic that is used to determine the total porosity of the soil [21]. As the results show in Tables 3 and 4 the values of the real soil density and its distribution with the depth of the horizons of the pedons of the study area. mgm-3 This is due to the effect of the organic content in the surface horizons in reducing the true density values. This reflects the effect of the value of the specific density of each of the soil components in the horizons of the study persons with respect to the cultivated soils, while the values of the real density ranged at the surface layer, as its values ranged from 2.626-2.508 µg m^{-3}, as the highest value was in the person of Altanoma A with a value of 2.626 µg m^{-3}, while The lowest values were 2.508 µgm-3 in the pedons of Al-Nashwah at horizon A. The reason for the difference in the real density values between the horizons of the buttons of the study area is the variation in the sand separation ratios.

3.5. Bulk Density

The results in Tables 3 and 4 show that there is a rise in the bulk density values of most soil pedons, and this is due to the fact that they are unexploited soils affected by salts and the low organic content in them, as the bulk density values of the surface horizons of the study soil ranged between 1.154-1.800 micrograms m-3, and they were Its highest value was in the Hannah peduncles, as it reached 1,800 µg m-3 each, respectively, despite the distinction of this soil with its alluvial admixture. The high values of bulk density could be due to the role of salts in the deterioration of soil properties, especially sodium ions, which work to break down soil aggregates and disperse their particles, leading to blockage of pore spaces, a decrease in their percentage and an increase in bulk density, and this is indicated by [22,23]. There is a discrepancy in the density values of the horizons of the graves, and this is due to the difference in the nature of the soil components that affect the porosity of the soil in addition to the binding materials and their role in influencing the bulk density [24].

3.6. Total Porosity

The results from Table 3 and Table 4 showed that the percentage of the total porosity f ranged for all the horizons of the study pedons for cultivated soils between -27.140 54.780, where the highest values of porosity appeared in the surface horizon of the pedons of euphoria A, as the highest values reached 54.780%, while in The subsurface horizons had the highest values in the C3 horizon of pedons AbuAl-Khasseb which amounted to 51.839%. The high values of porosity in the surface horizon were evident in the pedons of Al-Deir and Al-Nashwah as a result of the quality of the silty mixed texture of the soils of the sites that contain high proportions of silt and clay, as well as to the predominance of the influence of the vital factor of vegetation cover and organic content. Soil porosity depends mainly on the soil content of different particles, as fine particles cause soil compaction, which results in a decrease in soil porosity, which is one of the important characteristics that are affected by sedimentary layers [25]. As for the uncultivated soils, the percentage of the total porosity f ranged between -29.788 62.150, where the highest values of porosity appeared in the surface horizon 45.433 for pedons Tannumah, while in the subsurface horizons the subsurface horizon for pedons Al-Deir C3, as the highest values reached 62.150%.

3.7. Organic Matter (OM)

The results in Tables 3 and 4 show the distribution of soil content of organic matter to the horizons of the study area. There was a variation in the values of organic matter, as the organic content ranged between (1.500-2.690) g kg^{-1} with respect to cultivated soils. Most of the study horizons show that the highest values of the organic content are at the surface layer of the Tannumah pedons at the A horizon, while the lowest values are in the AbuAl- Khasseb pedon of the C2 horizon with a value of 2.690 g kg^{-1}. In general, it turns out that there are few differences in the distribution of organic matter between the pedons of the study area, and this may be due to the lack of vegetation cover as well as the prevailing conditions. As for the uncultivated soils, most of the horizons of the study show that the highest values of the organic content at the surface layer of the orgasm pedons are at horizon A with a value of 0.786 g kg^{-1}. While the lowest values are at pedons Al Dayr for the C2 horizon, with a value of 0.490 gm, kg^{-1}. Although all the studied pedons are located in agriculturally exploited lands and are grown with two crops, barley and wheat. Temperatures In the dry season, the high temperatures and the absence of rain, as well as the decrease in vegetation cover, made the soil vulnerable to sunlight, causing oxidation of organic matter, and this is co,nsistent with [26]. Ashe referred to the high temperatures that increase the oxidation of the organic matter and then accelerate its decomposition, as well as the decomposition of the organic matter is faster in the surface horizon of the soil, which is exposed to higher temperatures than the layers below it and the ventilation in it is better as the size of the pores is larger in the upper layers In addition to the low bulk density of the soil compared to the lower layers, which increases the activity of decomposing organisms and makes the organic matter faster [27], and the soil of the sedimentary plain is poor in its content of organic matter because it is located in arid and semi-arid regions [28].

Table 3. Primary characteristics of cultivated soil.

Site analys-is	number of layers	clay (gmkg^{-1})	Silt (gmkg^{-1})	sand (gmkg^{-1})	Soil Texture	ρ_b Mgm^{-3}	ρ_s Mgm^{-3}	PH	EC	F%	O.M %
AbuAl-Khasseb planted	A	295.67	591.34	96.09	Silty clay loam	1.285	2.413	7.695	10.160	46.746	0.408
	C1	275.9	551.82	149.9	Silty clay loam	1.392	2.668	7.25	6.120	47.900	0.349
	C2	275.9	551.81	149.6	Silty clay loam	1.500	2.545	7.500	9.90	41.060	0.269
	C3	256.13	512.27	202.77	Silty clay loam	1.27	2.637	7.541	7.67	51.839	0.422
Tannumah planted	A	200	640	132	Silty clay loam	1.800	2.558	7.448	33.9	29.632	1.500
	C1	267.55	624.31	94.76	Silty clay loam	1.772	2.584	7.412	7.94	31.424	0.845
	C2	577.13	355.16	75.47	Clay	1.636	2.683	7.490	4.87	39.023	0.466
Al Dayr planted	A	303.35	563.38	139.76	Silty clay loam	1.574	2.581	7.461	4.66	39.00	0.553
	C1	319.27	547.32	69.5	Silty clay loam	1.557	2.508	7.433	5.08	37.918	0.568
	C2	393.01	349.34	267.46	Silty clay loam	1.855	2.546	7.566	5.56	27.140	0.524
	C3	439.56	488.4	0	Silty clay loam	1.799	2.596	7.458	2.70	30.701	0.859
AlNashwa planted	A	376.56	585.78	50.2	Silty clay loam	1.154	2.552	7.478	6.90	54.780	0.786
	C1	334.12	525.06	119.33	Silty clay loam	1.731	2.672	7.602	8.93	35.217	0.728

Table 4. Primary soil characteristics of uncultivated soils.

Site analysis	number of layers	clay (gmkg^{-})	Silt (gmkg^{-})	sand (gmkg^{-})	Soil Texture	ρ_b Mgm^{-3}	ρ_s Mgm^{-3}	PH	EC	F%	O.M %
AbuAl-Khasseb is not cultivated	A	256.13	486.13	302.77	loam	1.647	2.59	7.324	16.33	36.409	0.408
	C1	228.11	581.79	196.03	Silty loam	1.337	2.588	7.25	6.52	48.338	0.529
	C2	247.42	536.08	193.8	Silty clay loam	1.307	2.583	7.390	9.66	49.399	0.364
	C3	180.79	723.16	91.52	Silty loam	1.583	2.587	7.468	11.57	38.809	0.816
Tannumah is not cultivated	A	258.06	214.55	537.05	Sand clay loam	1.398	2.562	7.882	40.7	45.433	0.466
	C1	120	800	70	Silty loam	1.337	2.626	7.768	16.22	49.086	0.539
	C2	151.1	768.8	87.62	Silty	1.80				32.12	

Site analysis	**number of layers**	**clay**	**Silt**	**sand**	**Soil Texture**	ρ_b **Mgm^{-3}**	ρ_s **Mgm^{-3}**	**PH**	**EC**	**F%**	**O.M %**
			gmkg^{-}								
		5	5		loam	0	2.562	7.738	12.43		0.378
Al Dayr is uncultivated	A	85.37	768.41	136.6	Silty loam	1.822	2.595	7.578	11.18	29.788	0.568
	C1	465.11	465.12	77.53	clay loam	1.257	2.584	7.62	7.515	51.354	0.364
	C2	280	560	159	Silty loam	1.048	2.630	7.661	3.13	60.152	0.51
	C3	894.56	42.6	34.07	clay	1.595	2.587	7.317	4.57	38.345	0.349
AlNashwa is not cultivated	A	181.2	634.2	100	Silty clay loam	1.484	2.508	7.743	23.00	40.829	0.786
	C1	366.97	570.84	62.18	Silty clay loam	1.636	2.626	7.780	12.97	37.699	0.670

3.8. Mean Weight Diameter

The results in Table 5 and Figure 2 show the values of the weighted average diameter with the depth of all the horizons of the pedons of the study area, as their values varied between the horizons and spatially between the pedons with the variation in the volume distribution of soil particles, their content of organic matter, their exploitation from the agricultural point of view, and the nature of the administrative operations that take place on them. The values of the average weighted diameter for the horizons of the study area ranged between 0.878 mm and 0.868 for the cultivated soils in pedons Abu al-Khasib horizon A and C1, which is the highest value recorded, followed by the site of the horizon C1, C2 and 0.684 and 0.785 mm. While the lowest value was 0.030 mm in pedons AlNashwa horizon C1, which is the lowest value recorded, followed by al-Deir horizon A by 0.046 mm. As for the subsurface horizons, they ranged from 0.265-0.382 mm. As for the uncultivated soil, from Table 5 and Figure 2 it is clear that The values of MWD in it have varied within the layers and at the spatial level, as the value of MWD reached as it was the highest value with respect to the surface horizon in the depth of growth at the horizon A by 0.571, then comes the depth of ecstasy at the horizon A by 0.216 mm, while it was the highest value with respect to the subsurface horizons at The value of Abu al-Khasib at the C3 and C2 horizons is 0.820 and 0.689 mm, while the lowest values were at the C2 horizon with a value of 0.077. This is due to soil organic matter content, soil salinity, and texture, as well as soil management and lime content. Where the values of the average weighted diameter of the surface horizon were 0.878, 0.478, 0.046, and 0.030 for the cultivated soils, and 0.046, 0.571, 0.107, and 0.216 mm for the uncultivated soils of the study pedons Abu al-Khasib, Tanumah, Al Dayr, and AlNashwa, respectively. It is clear from the results that the highest weighted average diameter appeared at the surface horizons. A for Abu al-Khasib in relation to the cultivated soils and horizon A for Bidun al-Tanuma in relation to the uncultivated soils, except for Pedons al-Tanuma in which the superiority of the C1 horizon was over the rest of the horizon. This is due to the outcome of the effect between the factors that increase the percentage of the vital factor and the organic content and their interaction with the opposite effect of the high concentration of salts, which have an opposite effect on the weighted diameter rate, where the concentration of salts is as high as possible in the surface layers, and this is consistent with what [29], concluded. The reason for this may be due to the high electrical conductivity values of the soil and the high sodium ion concentration in it, which leads to the dispersion of soil particles from each other and reduces the stability of soil aggregates [30]. In general, the values of the average weighted diameter in these pedons were very low due to the increase in the soil content of sand particles, which reduces the stability of the soil aggregates, in addition to its low content of organic matter.

Table 5. Weighted diameter average for cultivated and uncultivated soils.

Location	AbuAl- Khasseb				Tannumah			Al Dayr				AlNashwa	
number of layers	A	C1	C2	C3	A	C1	C2	A	C1	C2	C3	A	C1
Cultivated soil	0.878	0.868	0.265	0.308	0.478	0.785	0.684	0.046	0.382	0.27	0.382	0.335	0.030
Uncultivated soil	0.046	0.518	0.689	0.820	0.571	0.230	0.077	0.107	0.219	0.22	0.334	0.216	0.153

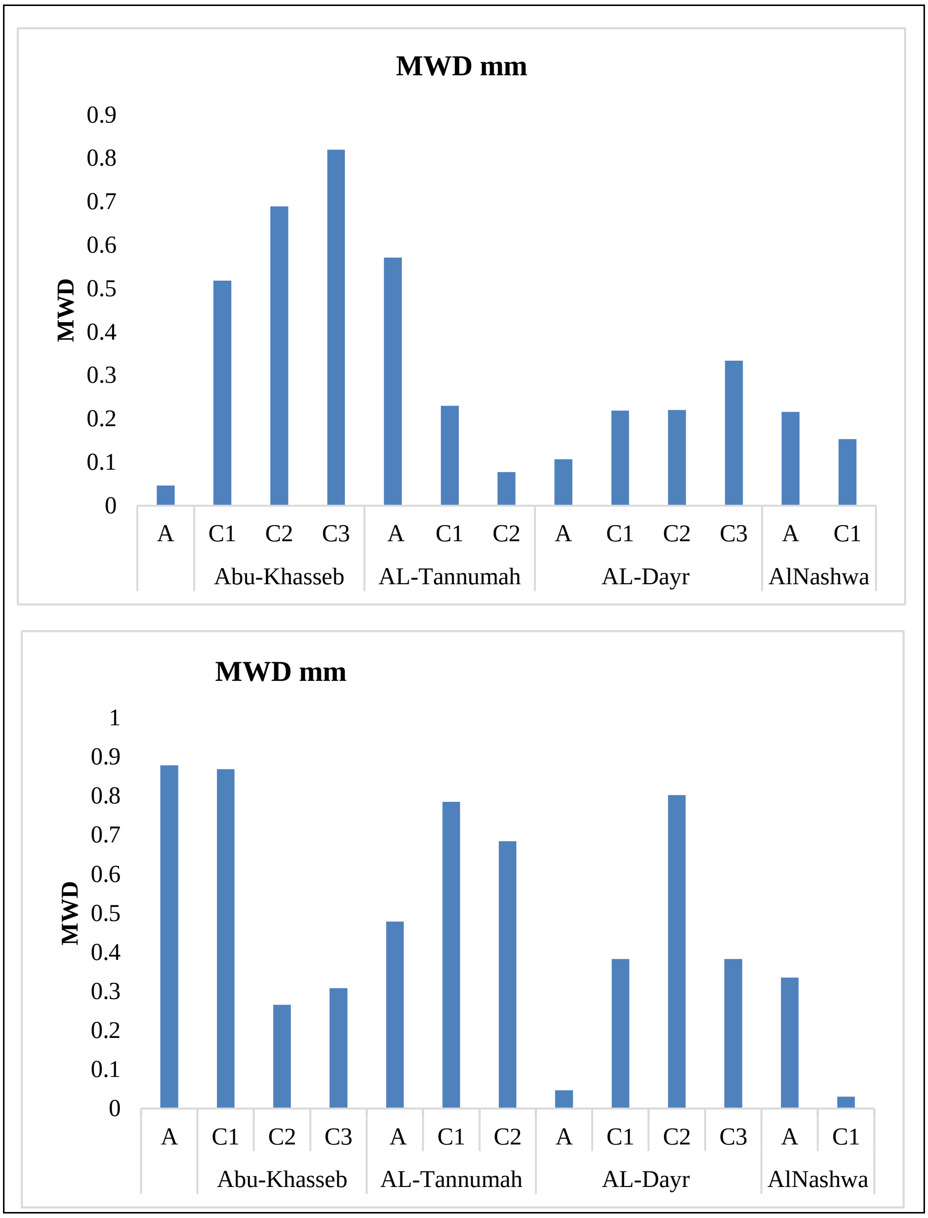

Figure 2. Average weighted diameter for cultivated and uncultivated soils.

Conclusion

- The research concluded that a large variation in the concentration values of the studied elements of the cultivated soils with the uncultivated soils, except for lead, did not show any effect in both soils and for all sites.
- Variation in the physical properties of the soil of the study area, where the analyzes showed a high rate of clay values and silt, for most of the samples, which made the studied soil mixed, silty, and silty, which is permeable. Low and low aeration reduces the self-decomposition of pollutants. As attested by other properties of b) density bulk density, true density, soil porosity, soil moisture, and spatial changes according to the difference in soil texture.

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