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EFFECT OF COMPACTION AND ORGANIC MATTER ON SOME SOIL PHYSICAL PROPERTIES AT DIFFERENT DEPTHS

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Abstract

A field experiment was conducted in the field of the Department of Field Crops - College of Agriculture located behind the University of Babylon 32022'51.892" N 44023'46.00" E, which is 10 km from the center of Babylon province.The soil of the field was of clay, silty texture, and it was classified according to the modern American classification (2010 soil survy staff) within the rank torrifluvent typic. The aim of the study was to know the effect of compaction and organic matter on some physical properties of the soil under different depths. Bulk density, total porosity and stability of aggregates. A factorial experiment was carried out using a randomized complete block design (RCBD) according to the split-split-plot system, with three replicate. As the main factor was the organic fertilizer (compost) M, with three levels, namely the first level without adding M0, the second level adding 2% by weight M1, and the third level adding 4% by weight M2, and the secondary work represents compaction L and three levels,The first level is without passing L0, the second level is repeating the passage twice on the same track L1, and the third level is repeating the passage four times on the same track L2. The sub-secondary factor represents depth D with two levels, the first level D1 (0-15 cm) and the second level D2 (15-30 cm)Stacking levels were conducted by a 1990 Fiat agricultural tractor with two-wheel drive at the rear, with a total weight of 2046 kg .The results of the study showed that increasing the level of sedimentation led to a significant increase in the bulk density, and a significant decrease in the total porosity and stability of soil aggregates. Where the highest value of the bulk density was found to be 1.437 µg.m-3 at the L2 stacking level and the lowest to 1.316 µg.m-3 for control treatment. Also, the lowest value of the total porosity was found to be 47.61% at the L2 stacking level and the highest value to 53.96% for control treatment.Also, the lowest value of 43.65% was found for the stability of the clusters at the L2 stacking level, and the highest value of 51.88% was found for control treatment. The results of the study also showed that when increasing the level of organic matter addition, it led to a significant decrease in the bulk density values under the influence of the M2 level, and a significant increase in the values of total porosity and stability of the aggregates .It was found that the highest average bulk density was 1.421 Mg.m-3 in control treatment and the lowest average was 1.352 Mg.m-3 at the level of adding 4% organic matter. While it was found that the highest percentage of total porosity was 54.476% at the level of adding 4% organic matter, and the lowest percentage was 45.954% in control treatment. The highest value of the stability of the aggregates was 54.11% in the treatment with 4% organic material added, and the lowest value was 40.82% in control treatment.The results of the study also showed that increasing the depth level led to an increase in the bulk density value, as well as a decrease in the stability of the aggregates and the total porosity of the soil. Where the highest value of bulk density was found to be 1.416 µg.m-3 at depth D2, and the lowest value for aggregate stability was 42.71%, and for total porosity 49.624% at depth D2 .The results of the study showed when increasing the level of compaction with the stability of other factors led to a significant increase in the values of bulk density and a significant decrease in the total porosity and the stability of clusters, as the results of the study showed when increasing the level of organic matter led to a significant decrease in the values of bulk density and a significant increase in the values of total porosity and stability of soil aggregates .It appears from the results that with increasing the level of organic matter and the level of compaction, the soil response to compaction decreases. As it was noticed that the highest value was 1.51 µg.m-3 for the bulk density at the level of compaction L2 and depth D2 without the addition of organic matter, it decreased to 1.26 µg.m-3 at the level of compaction L0 and depth D1 and the level of addition of organic matter M2.The highest value of total porosity of 58.20% was observed in the M2L0D1 treatment and the lowest value of 41.30 under the influence of the M0L2D treatment. When comparing between the treatment M2L2D2 (50.30%) and the treatment M0L0D2 (48.85%), the effective role of the organic matter appears in reducing the negative compaction in the total porosity.It was also found that the highest value of the soil agglomeration constant was (65.27%) in the treatment M2L0D1 and the lowest value (34.71%) under the influence of the treatment M0L2D2. When comparing between the treatment M2L2D2 (43.78%) and the treatment M0L0D2 (40.18%), the effective role of organic matter appears in reducing the negative compaction in the stability of soil aggregates.This result shows the role of organic matter in improving soil properties, as it reduced the effect of depth and compaction on the interaction of soil properties under study.

Keywords: compaction, organic matter, soil depth

introduction :

Soil compaction is a global problem that targets the productive capacity of the soil, especially the mineral soil, and thus the inability to achieve food security for the growing population.In the middle of the last century, the world witnessed a wide renaissance in the manufacture and development of agricultural machinery and tractors that would increase the productivity of agricultural machinery, reduce the costs of agricultural operations, save effort and shorten time.Soil compaction can be defined as the process of soil degradation that is exposed to pressures that cause soil particles to come together, resulting in a decrease in total porosity, pore size ratio (MC Garry 22)and a deterioration in the physical properties of the soil through the increase in the apparent soil density and soil resistance to penetration Dexter (16) and the decrease in total porosity and stability of the agglomerations (Botta 13), which negatively affects agricultural production.Also, in compacted soils, the yield of the crop decreases to more than 50% as a result of poor aeration, increased penetration resistance of the roots, poor internal drainage and determination of plant nutrients readiness (Wisconsin countr Extension office 36).Agricultural soils in the world have been subjected to compaction, as it found about 68 million hectares of the Earth’s surface affected by compaction, and most of these lands are located in Europe (33) million hectares, Africa (16 million hectares, and Asia 100 million hectares), and some areas of North America and other continents are compaction-sensitive and physically degraded (Soane and Van ouwerkerk (32). As a result of the negative effects of compaction in reducing soil productivity, several methods were used to avoid compaction or mitigate its effects on soil characteristics by increasing the contact area between the soil and the ground contact devices of agricultural pullers by using wasteful pullers, or using double wheels (Sheridon 31).As well as reducing the inflation pressure of pneumatic tires within the permissible limits without damage to those tires, as well as controlled traffic. Recently, there has appeared a trend towards the use of organic matter in reducing, mitigating, or reducing the response of soil to compaction due to its characteristics, including its low density. its relative flexibility, Which makes it a means of reducing the effects of compaction on soil properties, in addition to the fact that the organic waste will decompose with time to produce different organic compounds that are positively affected by the physical properties of the soil, such as the apparent soil density, water conductivity, soil resistance, agglomeration stability and other traits, in addition to reducing Environmental pollution risks (Gupta et al. 18). When studying the changes in the bulk density of the soil with a mixed clay texture when the Fiat type agricultural puller with a capacity of 85 horsepower and a weight of 3460 kg passes on the same track. Mujdeci (24) found the bulk density value before passing 1.28 Mg.m-3, and after passing the same track (1, 3, and 5 times), it increased to 1.42 Mg.m-3, 1.44 Mg.m-3, and 1.48 megagrams. gr.m-3, respectively. Al-Janabi (1) also found the highest value for the bulk density of 1.38 mg.m-3 at the level of compaction of 1059 joules, while the lowest average bulk density was 1.30 mg.m-3 without compaction. Amir (2) found a significant effect of compaction factor levels on the mean values of stability of the clusters.The highest mean for the trait under study was 43.33% without compaction, while the lowest average was 37.88% at the compaction level of 1059 J. It appears through this result that with increasing compaction, the percentage of fixed clusters decreases. Akol (9) obtained the addition of organic matter in increasing the stability of soil aggregates. It used five levels of cow waste, without addition, 5, 10, 15, and 20 tons / ha, as the stability of the agglomerations increased from 46.90% to 59%, 65.20%, 68.10%, and 70.50%, respectively, in clay soil. Busse (15) found that the average total porosity in the surface soil (0-30) cm was 61 ± 2%, and after passing the harvester 21.7 times, the total porosity decreased to 56 ± 2% and 54 ± 2%, respectively, compared to the control treatment that remained without 61% change. The Iraqi soils are among the soils with a weakly built structure (7) as a result of their high silt content and low organic matter content due to the dry climatic conditions, especially in the center and south of the country, and the increase in their silt content makes them of soils that are sensitive to compaction, and this requires the exploitation of all available organic resources to improve soil structure and reduce the effects of environmental pollution.This study came to investigate the effect of organic matter added to the soil on soil compaction or reduce the soil response to compaction.

MATERIALS AND METHODS

The experiment was conducted on (1/6/2020) in a field of the Department of Field Crops _ College of Agriculture located behind the University of Babylon 32022'51.892" N 44023'46.00" E in clay-silty mixed soil and classified according to the modern American classification (2010 soil survy staff) within the rank torrifluvent typic .

Excited and unexcited samples were taken using a cylinder method with a diameter of 5 cm and a height of 5 cm in a random manner from the field at a depth of (0-30) cm. The samples were placed in plastic bags and the information was fixed on them and transferred to the laboratory. The stirred samples were air-dried and then ground with a ceramic mortar, and the samples were mixed homogeneously to obtain a representative sample of the field soil, and then the soil was sifted with a sieve of 2 mm.)The physical properties were estimated according to the work methods mentioned in Black (12), as the size distribution of soil particles was estimated by the sorbent method, while the bulk density of the soil was estimated using the core method, and the real density was estimated by using a vial and the organic matter was estimated by the method of wet digestion by Walkely and Black. The soil of the field was prepared by plowing it with Moldboard plows to a depth of 20 cm, after which it was smoothed, amended, and leveled. The field area, amounting to 2092.50 square meters, was divided into three replicates of equal dimensions, leaving a space between one replicate and another of 2 meters. The length of the sector is 25 meters, and the width of the sector is 27.9 meters.The length of the field was 25 meters, and the first 15 meters were left for the purpose of the tug gaining a constant speed of 4.5 km | hour, while the width of the field was 83.7 m.The total number of experimental units was 54 experimental units. The experiment was conducted according to the split-plot design_split using the RCBD. Use a 1990 Fiat tow truck with two-wheel drive, rear wheel, weighing 2046 kg.

The study included three factors

1 - The main factor organic matter (M) three levels:

The first level: without adding (Mo)

The second level: adding 2% (M1). The amount of organic matter added was 16.8 kg per experimental unit

The third level: adding 4% (M2). The amount of organic matter added was 33.6 kg per experimental unit The organic matter was added on the basis of the dry weight of the soil.

Table 1. Some physical and chemical properties of the soil before the study for a depth of 0-30 cm

values	**units**	traits
1.32	**Mg.g^{-3}**	bulk density
2.65		true density
180	**g.kg^{-1}**	the sand
464		silt
355		clay
Silty clay loamy		texture
10.50	**DS.m^{-1}**	electrical conductivity EC

7.18		pH
Dissolved positive and negative ions		
46.4		calcium
34		magnesium
25.88		Sodium
2.18		potassium
2.2		bicarbonate
Nil	**Meq.L^{-1}**	carbonate
109.13		chlorine
8.89	**g.kg^{-1}**	organic matter

2- The compact secondary factor (L) has three levels:
The first level: without passing (L0)
The second level: repeating the passage twice on the same track (L1).
The third level: repeating the pass four times on the same trail (L2)
3 - Sub-Secondary Depth (D): It includes two depths
The first depth (D1) ((15 __ 0 cm
The second depth (D2) ((30 __ 15 cm
The number of experimental treatments for factors and their levels = 3 organic matter levels x 3 soil compaction levels x 2 depth levels = 18 treatments in each sector
The number of experimental units = 3 x 18 = 54
statistical analysis :
The data for the different traits were statistically analyzed using the Gen stat statistical program to analyze the variance between the treatments, their differences and interaction, and using the F test and the value of the least significant difference (LSD) at a probability level of 0.05 for comparison between the means (16).

- Results and discussion

4 - 1. Effect of compaction, organic matter and depth on bulk density

The results of Table 2 showed that there were significant differences between the average values of bulk density under the influence of organic matter levels when other factors were constant. The highest value was found to be 1.421 micrograms. M-3 at the level of M0 addition and the lowest value of 1.352 µg. M-3 at the level of M2 addition. With the increase in the level of addition of organic matter, the decrease in the bulk density value increases as a result of its large size compared to its low mass.In addition to its role in reducing the mass of the metallic substance per unit mass. (Al-Amari) (5) This result came as confirmation of what happened williams ((37). The results of Table 2 showed a significant effect of soil depth on the average values of bulk density, regardless of other factors. successions.The reason is due to the weight of the upper soil layers on the layers that follow, which leads to an increase in the bulk density value. This result agreed with what was obtained by Mujdeci (23).It was noted from the results of Table (2) that there is a significant effect of the levels of compaction on the values of bulk density of soil with the stability of other factors in the study.Where the highest mean was found to be 1.437 micrograms. M-3 at the level of L2 stacking (4 times for the tow truck) and the lowest average is 1.316 megagrams. M-3 at L0 stacking level (without passage).It is clear from this result that with the increase in the level of compaction, the value of bulk density increases. The reason for this is that compaction destroys the large pores that can be compacted, causing a decrease in the pore size and an increase in the closeness between the soil particles, which leads to an increase in the bulk density. This result was similar to what was obtained (Busse 15). The results of the bi-interaction between the factors of organic matter and depth indicated that there were significant differences between the average values of bulk density. The highest mean was found to be 1.451 µg.m-3 in treatment M0D2 and the lowest value was 1.322 µg.m-3 in treatment M2D1.It appears from this result that with increasing the level of addition of organic matter and decreasing the depth, the value of bulk density decreases. The reason for this is due to the increase of organic matter in the surface soil layer within the depth of 0-10 cm.

Table 2. Effect of organic matter levels, compaction and depth on soil bulk density (Mgm-3)

averages M	M*D	levels			levels D	levels M
		L2	L1	L0		
1.421	1.390	1.442	1.405	1.325	D1	
	1.451	1.515	1.467	1.373	D2	M0
1.381	1.35	1.388	1.368	1.294	D1	M1
	1.413	1.475	1.426	1.339	D2	
1.352	1.322	1.356	1.345	1.267	D1	M2
	1.383	1.446	1.401	1.302	D2	
L.S.DM = 0.0061	L.S.D M×D=0.0086	LSD L × M ×D = 0.015			L.S.D 0.05	
M × L						
L.S.D M × L= 0.0106		L2	L1	L0		
		1.478	1.436	1.349	M0	
		1.431	1.397	1.316	M1	
		1.401	1.373	1.284	M2	

averages	interaction between L × D			levels D
	L2	L1	L0	
1.354	1.395	1.372	1.295	D1
1.416	1.478	1.431	1.338	D2
L.S.D D =0.0050	L.S.D L ×D=0.0086			L.S.D 0.05
L.S.D. L= 0.0061	1.437	1.402	1.316	levels L

The results of the bi-interaction between the factors of organic matter and compaction showed that there were significant differences between the average values of bulk density. The highest mean was found to be 1.478 µg.m-3 in treatment M0L2, and the lowest value was 1.284 µg.m-3 in treatment M2L0. It appears from this result that with the increase in the level of organic matter addition and the decrease in compaction, the value of bulk density decreases. The reason for this is due to the fact that the organic matter reduces or prevents the particles from coalescing with each other, in addition to what is characterized by its somewhat flexibility Mosaddeghi (23)The results showed in the aforementioned table a significant effect of the interaction between compaction levels L and depth D levels on the average values of soil bulk density. The highest value was 1.478 mcg.m-3 under the influence of treatment L2D2 and the lowest value1.259 µg M-3 under the influence of L0D1 treatment. From this we conclude that with the increase in the level of compaction and the level of depth, the value of bulk density increases. The reason for this is due to the destruction of most of the pores that can be compacted, in addition to the weight of the soil layers, one on top of the other. Kumar (20) and Obou (28).The results of the interaction of the study factors mentioned in Table 2 indicated that there were significant differences between the soil bulk density values. The lowest value for the trait under study was found to be 1.267 µg.m-3 for the treatment L0M2D1 without tamping and for a depth of 0-15 cm and at the level of adding 4% organic matter, and the highest value was 1.515 µg.m-3 for the treatment L2M0D2 (4) times of pulling and without adding the material Organic and at a depth of (15-30) cm. It appears through this result that with the increase in the level of compaction and soil depth and the decrease in the level of organic matter, the value of bulk density reaches its highest value in this study. This result was in agreement with Mosaddeghi (22).

2-4 Effect of compaction, organic matter, and depth on the stability of soil aggregates

The results of Table 3 showed the significant effect of the levels of addition of organic matter on the average values of stability of the communities. The highest average was found at 54.11% at the level of M2 (4) addition of organic matter, and the lowest average was 40.82% without the addition of organic matter. It is clear from this result that with the increase in the level of addition of organic matter, the percentage of stability of the aggregates to the soil increases. The reason is that the organic matter, when decomposed by microbial activity, forms binders and releases organic acids that help to collect soil particles according to a clear structural system that leads to an increase in the stability of the soil aggregates (Brady (14)). This result was consistent with Obalum (27).The results of Table (3) showed the significant effect of depth levels on the average values of stability of soil aggregates. The highest percentage of agglomeration stability was recorded at 52.89% at depth (0 - 15) D1 cm, and the lowest percentage was 42.71% at depth D2 (15 (30)). A bond binds the soil particles together, which increases the stability of the soil aggregates, and when the depth increases, the percentage of the stability of the aggregates decreases, and the reason for this is due to the decrease in the percentage of organic matter with the increase in the depth level, and this result was consistent with Murphy (25) The results shown in Table (3) indicated that there is a significant effect of compaction levels on the values of the average stability of soil aggregates. The highest value of the average stability of the aggregates was 51.88% without L0 compaction, while the lowest value was 43.65% at the level of L2 compaction (4 times for the puller). Increasing the level of compaction causes the destruction of the soil structure, which leads to an increase in the bulk density value, which causes a decrease in the stability of soil aggregates. This result was in agreement with Valicheski (33).

The results of Table 3 regarding the bi-interaction between the levels of organic matter and the levels of depth showed that there were significant differences between the stability values of the assemblages. Where the highest value of 60.43% was found in the treatment M2D1 and the lowest value of 37.38% under the influence of the treatment M0D2. It appears from this result that with the increase in the level of addition of organic matter and the decrease in soil depth, it increases assemblies stability.

Table (3): Effect of Compaction, Organic Matter and Depth on the Aggregate Stability of Soil (%)

averages M	M × D	levels L			levels D	levels M
		L2	L1	L_0	D	M
40.82	44.26	38.90	44.53	49.35	D1	M0
	37.38	34.71	37.24	40.18	D2	
48.46	53.97	50.02	54.85	57.04	D1	M1
	42.95	38.65	42.90	47.31	D2	
54.11	60.43	55.87	60.16	65.27	D1	M2
	47.79	43.78	47.43	52.16	D2	
L.S.D M=0894	L.S.D M×D=1.264	L.S..D M × L × D=2.189			L.S.D 0.05	
		L× M				
L.S.D M ×L=1.548		36.80	40.89	44.76	M0	
		44.34	48.87	52.17	M1	

	49.82	53.79	58.71	M2
averages D	Interaction L × D			levels D
52.89	48.26	53.18	57.22	D1
42.71	39.05	42.52	46.55	D2
L.S.D D=0.730	L.S.D L× D=1.264			L.S.D 0.05
L.S.D L=0.894	43.65	47.85	51.88	averages L

The reason for this is due to the fact that the organic matter is a bonding substance between particles and between the agglomerations, which increases the stability of the agglomerations, and the effect of depth appears through the fact that the organic matter content in the soil decreases with increasing depth, and the pressure on the underlying layers increases as a result of the weight of the layers above it, which leads to This result is in agreement with Al-Jubouri (2).It was noted from the results of Table 3 that the binary overlap between the levels of organic matter and the levels of compaction indicates that there are significant differences between the values of the stability of the agglomerations. Where the highest value of 58.71% was found in the M2L0 treatment and the lowest value of 36.80% under the influence of the M0L2 treatment. The reason for this is due to the role of organic matter that acts as a binder that binds soil particles together, which increases the stability of soil aggregates, which leads to a decrease in soil response to compaction.The results of the bi-interaction between compaction levels and soil depth listed in Table 3 indicated that there were significant differences between the mean values of the stability of soil aggregates.As it was observed that the highest percentage of the stability of the clusters was 57.22% under the influence of treatment L0D1 and the lowest percentage was 39.05% when treatment L2D2. It appears from this result that with the increase in the level of compaction and soil depth, the stability values of the aggregates decrease. This is due to the decrease in the percentage of organic matter with the increase in depth and the pressure of the surface soil layers on the subsurface soil layers, which caused a decrease in the percentage of fixed agglomeration The results of the interaction of the study factors mentioned in Table 3 indicated that there were significant differences in the values of the stability of the clusters. The highest value of 65.27% was found for the treatment L0M2D1 without compaction and at the level of organic matter addition of 4% and at a depth of (0-15) cm, and the lowest value of 34.71% was found for the treatment L2M0D2 at the level of compaction L2 and the level of organic matter M0 and at a depth (15-30). It appears through this result that when the compaction level and soil depth increase and the organic matter level decreases, the value of the stability of the agglomerations reaches its lowest value in this study. The reason for the decline is due to the role of compaction in breaking down soil aggregates.Likewise, when the level of depth increases, the soil aggregates are destroyed as a result of the weight of the upper layer over the lower one, and also when the level of organic matter decreases, the stability of the soil aggregates decreases, due to the role of organic matter in improving soil structure and increasing soil aggregates.

3-4 Effect of compaction, organic matter, and depth on total porosity (%)

The results of Table 4 indicated the significant effect of organic matter levels on the total porosity values of the soil. The highest value of total porosity6 was 54.47% at the level of organic matter M2 (4%), and the lowest value was 45.95% without the addition of organic matter (0%) M0. This result shows that the higher the level of organic matter, the higher the total porosity percentage, and the reason for the increase is due to the role of organic matter in improving soil structure and increasing porosity as a result of changes in the volume distribution of pores due to the decomposition of organic matter (Budair) (8) This result is consistent with Al-Janabi (8). 1). The results of Table 4 showed a significant effect of depth levels on the average values of total porosity. The highest percentage of total porosity was recorded at 51.827% at depth D1, and the lowest percentage at 49.624% at depth D2. This result shows that with increasing depth, the percentage of total porosity decreases.The reason for this is due to the pressure of the upper soil layers on the layer below it by the influence of its weight, which leads to a higher bulk density of the soil and a decrease in the total porosity. This result is consistent with Naveed et al. (26). It was clear from the results of Table 4 the significant effect of compaction levels on the values of total soil porosity when the other factors in the study remained constant. The highest value of total porosity was 53.96% without L0 compaction and the lowest value was 47.61% at the L2 compaction level (4 passes of the puller). This result shows that the higher the level of compaction, the lower the total porosity, because compaction leads to the destruction of large and medium pores (compactable pores), which leads to a decrease in the percentage of total pores. This result was in agreement with Watson (34) and Busse (15).The results of Table 4 of the bi-interaction between organic matter levels and depth levels indicate that there are significant differences between the total porosity values. Where the highest value of 55.489% was found in the treatment M2D1 and the lowest value of 44.882% under the influence of the treatment M0D2.It appears from this result that with the increase in the level of addition of organic matter and the decrease in the depth of the soil, the total porosity increases, and the reason for this is that with the increase in depth, the percentage of organic matter decreases, and the pressure on the substratum layers increases as a result of the weight of the layers above them, which leads to the destruction of the pores and the decrease in the total porosity.The results of Table 4 showed that the binary interaction between the levels of organic matter and the levels of compaction indicated that there were significant differences between the total porosity values. Where the highest value of 57.287% was found in the treatment M2L0 and the lowest value of 42.459% under the influence of the treatment M0L2. This result shows that with a decrease in the level of compaction and an increase in the level of addition

Table 4): Effect of compaction, organic matter and depth on total porosity (%)

averages M	M × D	levels L			levels D	levels M
		L2	L1	L_0		
45.954	47.026	43.281	46.721	51.076	D1	M0
	44.882	41.637	44.15	48.859	D2	
51.747	52.968	50.305	52.842	55.759	D1	M1
	50.527	47.571	50.498	53.512	D2	
54.476	55.489	52.572	55.692	58.204	D1	M2
	53.463	50.307	53.714	56.37	D2	
L.S.D M=0.0144	L.S.D M×D=0.0204	L.S..D M × L × D=0.0354			L.S.D 0.05	
		L× M				
L.S.D M ×L=0.0250		42.459	45.435	49.967	M0	
		48.938	51.67	54.635	M1	
		51.439	54.703	57.287	M2	
averages D		L × D			levelsD	
51.827		48.719	51.751	55.013	D1	
49.624		46.505	49.454	52.913	D2	
L.S.D D=0.0118		L.S.D L× D=0.0204			L.S.D 0.05	
L.S.D L=0.0144		47.612	50.602	53.961	averages L	

For organic matter, the total porosity of the soil increases. From this result, it appears that the addition of organic matter reduced the response of the soil to compaction, and this result was consistent with Gupta et al. (1987) (Rahim).For organic matter, the total porosity of the soil increases. From this result, it appears that the addition of organic matter reduced the response of the soil to compaction, and this result was consistent with Gupta et al. (1987) (Rahim).The results of the bi-interaction between compaction levels and soil depth listed in Table 4 indicated that there were significant differences between the total porosity values. The highest percentage of total porosity was 55.013% under the influence of treatment L0D1 and the lowest percentage was 46.505% when treatment L2D2. It appears from this result that with the increase of compaction level and soil depth, the total porosity values decrease. The reason is due to the deterioration of the physical properties of the soil as a result of compaction and the weight of the upper layers of the soil body leads to an increase in the value of bulk density and a lack of large and small pores, and thus a decrease in the total porosity Kut ((19). The results of Table 4 showed the presence of significant differences in the values of the total porosity. The highest value was found 58.20% in teatments L0M2D1 and the lowest value of 41.63% in teatments L2M0D2. It appears through this result that with the increase in the level of compaction and soil depth and the decrease in the level of organic matter, the value of total porosity reaches its lowest value in this study.This result shows the effective role of organic matter in reducing the effect of compaction and depth on the deterioration of total porosity. The organic matter works to improve the structure of the soil and reduce its density, which increases the total porosity of the soil, as well as reducing the response of the soil to compaction, as it acts as an elastic cushion and an insulating material that prevents the adhesion of side particles (1)) This result was in agreement with and Kuncoro (21).

5- Conclusions

From the results of this study, the following can be concluded:

1_ The addition of organic matter at the level (M2 4%) reduced the effect of compaction and depth on the physical properties of the soil (bulk density, agglomeration stability, total porosity).

2- The soil is poor in organic matter. The entry of the agricultural haul under the conditions of the study 4 times may raise the density.

3- The amount of decrease in soil compactness increases with the increase in the level of addition of organic matter and under any of the compaction levels.

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