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Evaluation state of degradation of tillage and non-tillage agricultural by adopting the stability indicator of dry aggregates in province of Baghdad – Iraq

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Abstract: *The study was conducted on the province of Baghdad \ Iraq. Soil sample were collected from the area of Jadiriya and Abu Ghraib. The aim of this study was to identify the extent of degradation in Non-tillage soil (abandoned), using the stability of dry aggregates as an indicator of degradation. Soil samples were brought from 0–10 cm depth from annually cultivated land (tillage soil) and neighboring uncultivated land (Non-tillage soil). Some physical and chemical properties were measured and the percentage of soil particle size and soil texture was estimated in both regions. The percentage of Non-Erodible fractions (NEF) was estimated according to method proposed by Chepil (1950), which their values were based on indicator of soil erodibility (I) by wind according to Skidmore, (1983). The results showed that there was significant effect ($P<0.05$) of tillage on dry Mean Weight-Diameter (MWD) were decreased in Jadriya -tillage by 40.51% comparing with non-tillage, also was a significant effect on Non Erodible Fraction (NEF) decreasing in Jadriya Loam- tillage by 40.47% ,increasing in finest Abu Ghraib silt loam-tillage by 3.36% comparing with non-tillage. In addition, there was a significant decrement in Jadriya and Abu Ghraib soils accumulative infiltration of 82.28 and 57.66%, respectively. Also water conductivity increased compared with non-tillage soils. The results showed a significant effect of tillage on the bulk density where decreased in the tillage soils of 24.68% compared with non-tillage. Indicator of soil erodibility by wind (I) values differed with the difference of soil roughness which increased by 5 times in Jadriya tillage soils while decreased in Abu Ghraib tillage soils of 18.77% compared with non-tillage, which can be attributed to increasing NEF in Abu Ghraib non-tillage soils and led to soil erosion resistance. The results showed a high correlation of 0.99 of I with the MWD and NEF, and negative correlation with the H.C and C.I, and positive correlation with the soil bulk density.*

***Keywords**: Accumulative infiltration, bulk density, means weight diameter, water conductivity, wind erosion*

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I. Introduction

Land degradation is defined as a long-term loss in the function and productivity of ecosystem resulting from disturbances so that the land cannot recover without assistance. Agricultural soil is deteriorating for many reasons, some of which overlap, and there is no clear correlation between land degradation and the nature of soil or terrain (Bai et al., 2008). The soil degradation problem ranges from surface soil erosion and pollution to over extraction and pollution of groundwater. The loss of soil fertility itself may lead to degradation of local agriculture productivity. Soil transferred by water or wind erosion may cause significant damage to water management systems by filling water reservoirs (Van den Born, 2000). Soil degradation through accelerated erosion is a dangerous problem and will continue to be so during the twenty-first century, especially in developing countries in the tropics and subtropical regions (Lal, 2001). The climate in Iraq is mainly of the continental, subtropical semi-arid type (Frenken, 2009), thus problem of wind erosion which led to dust storms, loss of soil surface, land degradation and desertification are more important aspects in this country, especially in central and southern Iraq. Increased wind speeds in areas which are naturally poor in vegetation have exacerbated this phenomenon in these areas due to their low resistance to wind erosion (Zachar, 1982). Soil resistance to wind erosion is determined by some soil properties such as soil texture, aggregation stability, organic matter content, calcium carbonate, moisture, salinity and sodium content (Mohamed, 1985). Aggregate with a diameter greater than 0.84 mm are not erodible and are used in soil as an indicator of soil erodible by wind. Aggregate less than 0.84 mm are erodible by wind (Chepil, 1958). Since then, the percentage of non-erodible fractions (NEF) identified by dry sieving has been used as an indicator of soil erodibility by wind (Chepil and Woodruff, 1959). Chepil (1960) also developed a model for estimating the relative of soil erodibility using indicator of aggregate size distribution, and based on the wind tunnel experiment and field data, aggregates whose diameter greater than 0.84 mm were not erodible by wind. Wind speed range used in the tests was considered. There are many methods used to reduce soil losses due to wind erosion. These methods allow tillage to Increase surface roughness and thus reduce wind speed. The cultivation of permanent vegetation is the key to control wind erosion (Eltaefet al., 1991). The aim of this study was to determine extent of degradation in non-tillage soil, using the stability of dry soil aggregates as an indicator of the degradation in some of abandoned soils previously cultivated in some Baghdad regions and its relationship with other physical and chemical properties.

II. Materials And Methods

The experiment was conducted for period 1/2/2016 to 1/4/2016 in the Jadriya center of Baghdad near Tigris River (33 ° 16 '16 0.81 "N, 44 ° 22 '38.58" E) and Abu Ghraib in Baghdad belt (33 ° 17 '57 .03 " N, 44 ° 4 '59.37 'E). Soil samples from annually cultivated land (tillage soil) and neighboring uncultivated land (Non-tillage soil, left for more than 5 years) were brought from 0–10 cm depth, by 3 replicates. Some physical and chemical properties were measured. The dry Mean Weight Diameter MWD (Youker and Gaines, 1956) and the percentage of Non-Erodible soil Fractions NEF were estimated according to the method proposed by Chepil (1950), whose values were based on Indicator of Soil Edibility (I) by wind (Skidmore, 1983). Spatial readings were taken on field using Mini-Disk Infiltrometer device according to method described by (Zhang, 1997) to obtainsome soil hydraulic properties (Cumulative Infiltration (C.I) and Hydraulic Conductivity (H.C)). Soil texture, reaction (pH), Electrical Conductivity (EC) and Soil Bulk Density (S.B.D) were measured according to methods described by (Black, 1965) and (Page et al., 1982). Experiment was designed using factorial in CRDwith three replicates.

III. Results And Discussion

Jadriya-Loam was more roughness and contained less organic matter than Abu Ghraib-Silt Loam (Table 1). The table shows the high soil salinity EC in Abu Ghraib, while pH values were neutral and calcium carbonate values were near in both sites (Table 1).

TABLE 1.Selected soil properties

Property	Jadriya	Abu Ghraib
PSDA gm.kg^{-1}		
Sand (2-0.05) mm	430	220
Silt (0.05-0.002) mm	350	670
Clay (<0.002) mm	220	110
Texture	Loam	Silt Loam
CaCO3 gm.kg^{-1}	220	225
O.M gm.kg^{-1}	14	30
pH	7.34	7.1
EC ds.m-1	3.87	5.86

(Table 2) showed that Mean Weight Diameter (MWD) of non-soil Jadriya-Loam was higher than Abu Ghraib Silt Loam-non tillage due to the relative increase in coarse particles compared with fine (Table 1). Tillage had a significant effect at ($p<0.05$) in MWD were decreased in Jadriya -tillage by 40.51% compared with Jadriya-non tillage, while very little increased in tillage- Abu Ghraib compared with non-tillage- Abu Ghraib. Tillage also had a significant effect on NEFpercentage. Table 2 showed decreasing NEF in more roughness Jadriya Loam- tillage (40.47%) compared with non-tillage. In contrast, NEF in more softness Abu Ghraib-Silt Loam tillage and highest organic matter (Table 1) increased at 3.36% compared with non-tillage. However, tillage decreased from macro aggregates and increases micro aggregates (Huang, 1995) but there was a positive relationship between tillage and aggregates with the presence of organic matter (Njeru, 2015) so tillage in this state caused increasing NEF.

TABLE 2. Dry Aggregate Stability Parameters

Property	Soil	Non-Tillage	Tillage	Deviation	Change%	Significant/LSD(0.05)
Dry MWD mm	Jadriya- Loam	3.11	1.85	1.26	40.51	S
	Abu Ghraib-Silt Loam	2.82	2.91	-0.09	-3.19	0.703
NEF %	Jadriya- Loam	71.9	42.8	29.1	40.47	S
	Abu Ghraib-Silt Loam	65.4	67.6	-2.2	-3.36	16.21

Accumulative Infiltration (CI) in 1 hour was highest in more roughnessJadriya-Loam (Table 3). Tillage had a significant effect in C.I increased by 82.28 and 57.66% in Jadriya and Abu Ghraib, respectively, compared with non-tillage. The same occurred in Hydraulic Conductivity H.C. Increasing concentration of salinity in Abu Ghraib-Silt Loam led to the dispersion and separation of soil aggregates causing release of fine particles (clay and silt) and then it deposited inside pores , which led to closure and clogging it, and thus decrease C.I and H.C, agreeing with (Russo and Bresler, 1977) and (Al-Rawi, 2014). The role of tillage in a hard layer Cracking and ventilation improving was reflected on the biological activity and increase organic matter and improve the of soil physical properties and thus increase C.I and H.C.

TABLE 3.Hydraulic Properties Parameters

Property	Soil	Non-Tillage	Tillage	Deviation	Change%	Significant/LSD(0.05)
Accumulative Infiltration cm 1 hour	Jadriya- Loam	5.9	33.3	-27.4	-82.28	S 10.51
	Abu Ghraib-Silt Loam	4.7	11.1	-6.4	-57.66	
H.C $cm.hur^{-1}$	Jadriya- Loam	0.44	3.22	-3.23	-100.12	S 0.2227
	Abu Ghraib-Silt Loam	0.28	0.94	-0.66	-70.35	

Results showed significant effect in tillage on Soil Bulk Density (table 4), more effect in Silt Loam Abu Ghraib, were S.B.D decreased by 24.68% comparing with non-tillage. This is due to fact that tillage makes soil in disassembled form, causing increased porosity. In this volume of weight unit, the virtual density value decreased (Mckyes and Maswanre, 1997). In addition, more softness Silt Loam Abu Ghraib had more developed structure (Al-Ani, 1980), larger size aggregate and a higher percentage of Macro-pores causing increased visible size, resulting decrease bulk density after tillage. EC values showed no significant differences, but showed higher in Silt Loam Abu Ghraib non-tillage and decreased slightly in tillage.

TABLE 4. Soil Bulk Density and Electrical Conductivity

Property	Soil	Non-Tillage	Tillage	Deviation	Change%	Significant/LSD(0.05)
Bulk Density $gm.cm^{-1}$	Jadriya- Loam	1.48	1.35	0.13	9.39	S 0.044
	Abu Ghraib-Silt Loam	1.30	1.04	0.26	24.68	
EC $ds.m^{-1}$	Jadriya- Loam	3.93	3.81	0.183	2.62	N.S 3.88
	Abu Ghraib-Silt Loam	6.68	5.04	1.64	32.54	

Table 5 showed a difference in the indicator of Soil Erodibility (I) according to soil roughness, with significant differences ($P <0.05$). I values increased in Jadriya-Loam tillage by 5 times compared with non-tillage, while decreased in Abu Ghraib -Silt Loam by 18.77% compared with non-tillage. This result due to increasing NEF in Abu Ghraib - tillage (Table 2), Causing increase inI.

TABLE 5. Indicator of SoilErodibility

Property	Soil	Non-Tillage	Tillage	Deviation	Change %	Significant/LSD (0.05)
Indicator of Soil Erodibility $Mgm.Hec.^{-1}$	Jadriya- Loam	20	114.3	-94.3	-471.5	S 36.31
	Abu Ghraib-Silt Loam	35.7	29	6.7	18.77	

About the correlation values of indicator of Soil Erodibility (I) with other soil properties (table 6), we found high correlation in a negative relationship of I with MWD and NEF. A low negative correlation inI with H.C and C.I, in addition low positive correlation with B.D. This result has a relationship with the positive NEF correlation with HC and C.I (Table 6) and might due to the accumulation of salts in the silt loam Abu Ghraib, which resulted in dispersion and separation of soil aggregates as shown in Table 3. High correlation of Iwith NEF Resulting from adopting of NEF values to calculate I values.

TABLE 6. Correlations among soil Properties and Indicator of SoilErodibility (I)

Proprieties	MWD mm	NEF %	H.C $Cm.hr^{-1}$	C.I cm	B.D $gm.cm^{-3}$	I mega gm.hec.
MWD mm	1					
NEF %	0.99	1				
H.C Cm.hr-1	0.09	0.09	1			
Infiltration	0.09	0.1	0.99	1		
B.D gm.cm-3	-0.31	-0.32	-0.003	-0.002	1	
I Mgm.hec.	-0.99	-0.99	-0.11	-0.12	0.35	1

IV. Conclusions

Moderate texture soil with a higher percent of colloids (clay and organic matter) are more resistant to soil degradation because of development of structure and contain a high percent of non - erodible aggregates (diameter >0.84 mm) and thus reduce soil losses due to erosion. Although apparent tillage effect in destruction of soil aggregates reducing of non-erodible friction (<0.84 mm), but this effect may be reduced if colloidal (clay and organic matter) increase in soil, and tillage may have a positive effect on increasing of non-erodible frictionbut not significant. The soil left without use or minimum tillage is characterized by poor hydraulic properties, with low hydraulic conductivity and cumulative infiltration, leading to runoff in rainy season, salt accumulation in the dry season, low water storage and increased soil exposure to pressure in the surface layer due to human actions such as passage of machinery and animals.

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