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EFFECT OF DIFFERENT SIZES OF AGGREGATES ON HYDRAULIC PROPERTIES OF SOIL

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Abstract

This study was conducted to evaluate the effect of different sizes of aggregates clay soil on soil water available, soil water conductivity, soil water diffusion and wet aggregate index. The results showed that the amount of water held by the aggregates decreases significantly with the increase in the volume of the aggregates at the low and high tension; the small aggregates made up them of fine pore space which increase soil ability to water holding; significant decrease in soil water diffusivity values with increase size of aggregates; more pronounced decrease in the values of saturated water conductivity with a decrease in the size of soil aggregates for the bloating of soil particles and a significant increase in the wet aggregate index with the increase in the size of the aggregates generally.

Key words : Available water of soil, Soil aggregate size, Soil water diffusivity, Soil water conductivity, Wet aggregates index.

Introduction

Soil aggregate composition and stability are important factors in soil management for their effect on the physical properties of soil, such as the density and porosity. The change in the stability of soil complexes causes changes in these properties rather than on the same properties (Brady and Well, 2002). The particles of clay are connected to each other to form aggregates less than 20 micrometers called pockets. These pockets are connected to each other to form aggregates small of 20-50 micrometers; also Small aggregates are connected to large groups of more than 250 micrometers (Gochin and Oades, 1998). The different sizes of the soil aggregates may have little stability as they are dispersed into smaller groups by plowing or irrigating crops, Another part of these sizes is fixed against external pressures (Ankeny and Allmras, 1994); The heavy rain water, the excessive use of machines in the field and the intensive grazing can cause the soil to be compacted. Explain (Reicosky *et al.,*1981)explained that the soil compaction change the geometric shape of the porous spaces between the soil aggregates; the sizes of the large aggregates are reduced to smaller sizes and the soil becomes of more density and physical solid, Subsequently a change in the movement and diffusivity of water in the soil, It is also noted (Shulan *et al.*, 2006) that the increase in the degree of soil grading by increasing its apparent density of 1.27 g/cm^3 by 10% led to a decrease in soil hydraulic conductivity of 56 mm / h by 28%, also they pointed out that the small pores in the-compacted and non-compacted soil at the high tensions are similar to the moisture content and therefore are similar in the wet tensile curves because non effect of the compaction on pores which small diameters within the aggregates of soils. The purpose of this paper was to study the importance of the volumetric distribution of soil pores resulting from the distribution of different sizes of soil aggregates as evidence of soil compaction and its effect on soil to water retention, conductivity and diffusivity of water in soil.

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Materials and Methods

Soil samples representing the depth of (0- 30 cm) were collected from field plowed located at Basrah University/Agriculture Research Station. Some physical and chemical properties of the soil are given in table 1. The collection of soil aggregates was obtained 0.75 (G1), 1.5 (G2), 2.5 (G3), 3.5 (G4), 5(G5) mm, by passing of soil samples to a group of sieves whose diameter ranged between 1-6 mm, the estimates for different size of aggregates are summarized in table 2.

Results and Discussions

The values of moisture content at tension of 15 Kpa and 1000 Kpa are shown Fig. 1-A, 1-Brespectively for the sizes of studied soil aggregates. It is clear that the amount of water held by the aggregates decreased significantly with the increase in the volume of the aggregates at the low and high tention. Small-diameter aggregates are composed of fine pores, which increases the soil ability to held water, thus the possibility of estimating soil water available (Fig. 1-C) by the difference between soil moisture at law tension and soil moisture at high tension (Fig. 1-A, 1-B) respectively.

Soil water available data in (Fig. 1-C) showed that the value of water available decreased with increase size of aggregates, the small aggregates made up of fine pore space which increased soil ability to water holding ; in this regard Saleh, *et al*., (2005) pointed out that the small aggregate have water in layer which contacted the walls of pores,making them holding more water even at law tension.

Significant decrease in soil water diffusivity values were observed in fig. 2 with increase size of aggregates, this variation is

Table 1: Particles distribution and organic matter content of used soil.

Properties			Procedure reference
$gm.kg^{-1}$	Sand	90	Pipet method according to Black,1965
	silt	410	
	clay	470	
Tex.		Clay	
$gm.kg^{-1}$	O.M	2.8	Walkly and Black according to Jackson,1958

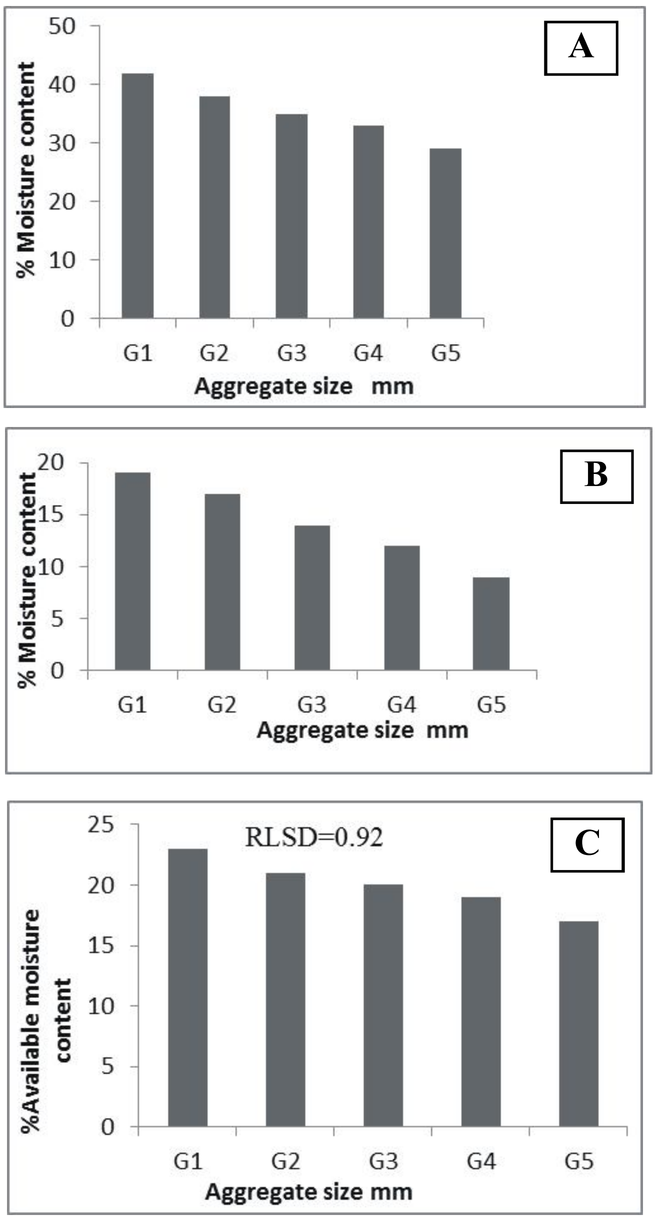

Fig. 1: Moisture content of soil size aggregates, (A) at 300 kpa (B) at 1000 kpa (C) available moisture = moisture content at 300 kpa - at 1000 kpa - moisture content at 1000 kpa.

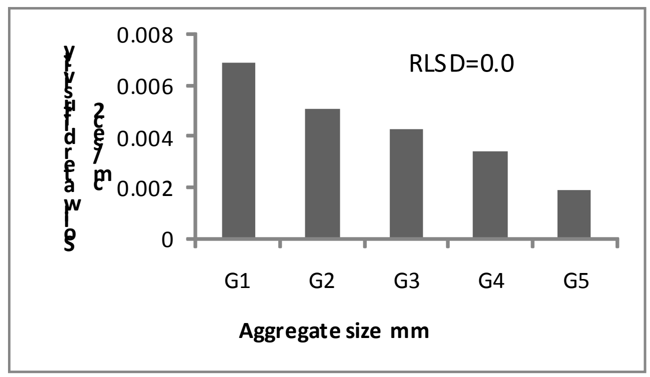

Fig. 2: Soil water diffusivity to aggregate size.

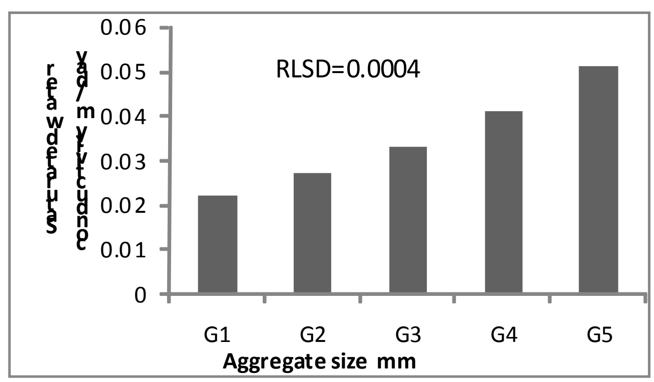

Fig. 3: Saturated water conductivity to aggregate size.

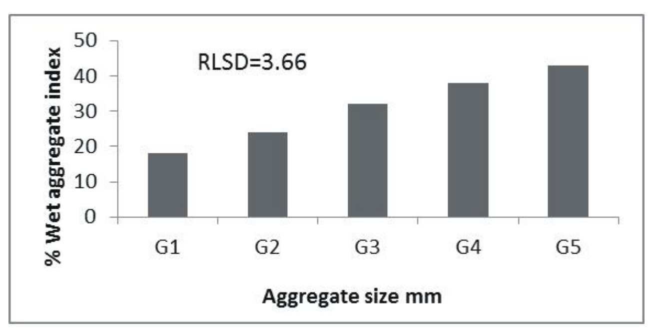

Fig. 4: Wet aggregate index to aggregate size.

Table 2: Methods and reference estimation of the studied aggregate.

Properties	**Procedure and reference**
Wet aggregate index	according to ADAS,1979
Soil-water characteristics curve	Pressure plate apparatus according to Black, 1965
Soil water diffusivity	Dry by Evaporating method, according to Arya,*etal,*1975
Soil hydraulic conductivity	Constant head method, according to Black,1965

consistent with variation with water content in aggregates, the difference in the value between small and large aggregates are due to the difference in the percentage of fine particles in aggregate due to differences in bulk density and difference in the loss of moisture to the columns of different sizes of the aggregates with different measurement time (Hassan, 1995)., Increasing the percentage of small volumes of soil aggregates has increased the radius of active pores, increasing the diffusivity of soil water (Hillel, 1982).

In fig. 3, a more pronounced decrease in the values of saturated water conductivity with a decrease in the size of soil aggregates for the bloating of soil particles, which caused a change in the relative distribution of soft pores when moisturizing the soil aggregates during the estimation of water conductivity and thus decrease theirt, ransportability and water movement (Bouma *et al.*, 1976), Adding to that the retention of small aggregates with water causes a decline in the tensile voltage during drying, pores clogging, and the loss of air bubbles in them, thus reducing their ability to conductivity water (Gollis-George *et al.*, 1979). In general, Figure 4 shows a decrease in the wet aggregate index values for all sizes of soil aggregates due to the low soil content of the organic matter (Table 1). The organic matter increases the bonding of the structural units of the aggregates and reduces the soil swell when wetting; In addition, there is a significant increase in the wet aggregate index with the increase in the size of the aggregates due to the decrease of air inside the building units of the small aggregates and the result of the water entering during the wetting with the capillary properties, causing irregular pressure on the structural units and their destruction.

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