Sumer Journal for Pure Science (ISSN: 2790-7031)
2nd International Scientific Conference on Pure and Medical Sciences/University of Sumer 2024

The Effect of Soil Depth and Adding Soil Conditioners on Aggregates Stability of Clay Soil by Using Drip and Surface Irrigation Systems

Yahya Ajib Oudah Al-Shami[1*] , Haider A. Al-Maamori[2] , Muntadher Al-Budeiri[3]

[1]*Soil sciences and water resources Dep. / College of Agriculture / University of Sumer / Thi Qar . Al-Refai / Iraq*
[2]*Department of Biology / College of Education for Pure Sciences / University of Wasit / Wasit / Iraq*
[3]*Agriculture Research Office, Ministry of Agriculture, Baghdad , Iraq.*
*Email : Yahya.alajeb@gmail.com

Abstract

A field experiment was conducted in one of the agricultural research fields in Basra Governorate on clay soil, for the purpose of studying the effect of soil depth and adding soil Conditioners that included bitumen emulsion (1%) and organic matter (3%) on the aggregate stability of the soil and by using drip and surface irrigation methods. The results showed that there were significant differences due to the effect of varying soil depth, as it was observed that the mean weight diameter (MWD) values of soil decreased with increasing depth, and the addition of soil conditioners led to a significant increase in the mean weight diameter values. The results also showed that the use of drip irrigation maintained soil structure as a result of a significant increase in the values of the mean weight diameter compared to surface irrigation.

Keywords: Soil conditioners ; aggregate stability ; drip irrigation ; surface irrigation

تأثير عمق التربة و إضافة محسنات التربة في ثباتية تجمعات التربة الطينية باستخدام طريقتي الري بالتنقيط والري السيحي

يحيى عاجب عوده الشامي[1] , حيدر عباس المعموري[2] ، منتظر حمادي منصور البديري[3]

[1]قسم علوم التربة و الموارد المائية ، كلية الزراعة ، جامعة سومر ، ذي قار ، العراق
[2] قسم علوم الحياة ، كلية التربية للعلوم الصرفة ، جامعة واسط ، ذي قار ، العراق
[3]قسم ابحاث الرز ، دائرة البحوث الزراعية، وزارة الزراعة ، بغداد ، العراق

الخلاصة

أجريت تجربة حقلية في احد حقول الابحاث الزراعية في محافظة البصرة على تربة ذات نسجة طينية ، لغرض دراسة تأثير عمق التربة و إضافة محسنات التربة التي شملت مستحلب البتيومين (1%) والمخلفات العضوية (3%) على ثباتية تجمعات التربة وباستخدام طريقتي الري بالتنقيط و السيحي. اظهرت النتائج وجود فروقات معنوية لتأثير اختلاف عمق التربة، إذ لوحظ انخفاض قيم معدل القطر الموزون للتربة مع زيادة العمق ، كما ان إضافة محسنات التربة ادت زيادة معنوية في قيم معدل القطر الموزون للتربة. كما أظهرت النتائج ان استخدام الري بالتنقيط حافظ على بناء التربة نتيجة الزيادة المعنوية في قيم معدل القطر الموزون مقارنة مع الري السيحي.

الكلمات المفتاحية: : محسنات التربة ، ثباتية التجمعات ، الري بالتنقيط و الري السيحي

1. Introduction

Most of the regions of central and southern Iraq, which fall within the arid and semi-arid regions, are characterized by poor construction due to the deterioration of the physical, chemical, biological and fertility properties of the soil as a result of its low organic matter content, due to high temperatures, lack of rainfall and lack of vegetation cover, in addition to poor use of land and Improper management of irrigation operations and its negative effects on crop productivity, What the past years have shown of severe water shortages in most regions of the world confirms the fact that water abundance is about to decline, which affects the availability of water for future generations [1]. In order to reduce these negatives, it is necessary to take appropriate preventive measures that are compatible with the environmental and economic conditions of the region by developing an integrated management system, including the use of soil conditioner sand determining the levels and method of irrigation appropriate for each soil depending on its texture and the salinity of the irrigation water used to irrigate the crops in it, which contributed effectively. In treating soil structure, growth and productivity of cultivated crops [2].

Soil Conditioners are added first to improve the physical properties and reduce soil losses, and second to improve the water properties of the soil by increasing the soil's retention of water and nutrients and reducing their loss. Bitumen emulsion, which is a petroleum derivative, has been used as one of the conditioners to improve the physical and water properties of the soil. Many researches have shown the extent of its effect on the physical properties of the soil, especially in soil construction, which in turn affects the water properties of the soil. One of the reasons that helped expand its use is its availability and cheap price in Iraq, which is one of the oil-rich countries. Organic matter also has a role in improving soil properties by binding soil particles from the decomposition of these wastes, which contain humic acids that work to encapsulate the soil particles, as well as binding the particles and causing the process of bridging between the soil particles. The addition of animal organic matter leads to the arrangement of the distribution of pores in the soil [3]. This study aims to know the effect of varying soil depth and effect of adding Conditioners on some physical properties and the possibility of improving irrigation efficiency using drip and surface irrigation systems in clay soils by adding Conditioners.

2.Materials and Methods

A field experiment was carried out in one of the research fields in Basra Governorate in a semi-arid area with a clay texture. Soil samples were taken from the study site, then air-dried and passed through a 2 mm sieve to estimate some primary physical and chemical properties, as shown in Table No. (1). The soil experiment was prepared by plowing Using traditional surface tillage and deep tillage by sub soiler, smoothing and levelling, and the soil was divided into marrows, and then a drip irrigation system was installed in the field on water tanks equipped with water, and the surface irrigation process was carried out by opening the main and secondary channels. Bitumen and organic matter were added based on the weight of dry soil. Irrigation was carried out according to the total water requirement of the plant based on the evaporation value measured directly from the American evaporation basin (Evap. pan class -A-) which was installed at the study site. Implemented the Factorial Experiment, The

treatments were distributed randomly according to the Randomized Complete Block Design (RCBD) with three replicates:-

1- **Soil Depth (cm)**
   - 0 - 15 cm
   - 15 - 30 cm
   - 30 - 60 cm
2- **Soil conditioners :-**
   - Bitumen (%1)
   - Organic matter (%3)
   - Control
3- **Irrigation system factor;-**
   - Drip irrigation (DI)
   -Surface irrigation (SI)

The aggregates stability was estimated using the wet vibrating sieving method. A Retsch AS 200 wet vibrating sieving device was used for this purpose, by taking soil samples and passing the air-dried soil samples through a sieve with a hole diameter of 8 mm, and they were received on a sieve with a hole diameter of 4 mm. After that, a weight of 25 grams was taken.

Table (1): Some chemical and physical characteristics of the study soil before planting

Properties		*value*	*Unit*	*Properties*		*value*	*unit*
pH (1:1)		**7.5**	**----**	*available*	**N**	**25.14**	**mg Kg^{-1}**
EC (1:1)		**5.4**	**dSm^{-1}**		**P**	**13.61**	
MWD		**0.25**	**mm**		**K**	**265.34**	
O.M		**5.8**	**gkg^{-1}**	*FC*		**31.78**	**%**
Soluble	**Ca^{++}**	**20.45**	**Meq L^{-1}**	*f'b*		**1.44**	**Mg m^{-3}**
	Mg^{++}	**12.90**		*Particles analysis*	**Sand**	**64.30**	**gkg^{-1}**
	K^{+}	**60.53**			**Silt**	**352.30**	
	Na^{+}	**2.14**			**Clay**	**583.40**	
	CO$_3^{-}$	**3.31**					
	HCO$_3^{-}$	**24.10**					
	SO$_4^{=}$	**97.10**		***Texture Class***		**Clay**	
	Cl^{-}	**20.45**					

From the soil sample, wet it using capillary action for six minutes, then transfer it to a set of sieves for the wet sieving device, the diameters of which range as follows: 4, 2, 1, 0.5 and 0.25 mm. After operating the device for six minutes, the sieves were separated and the contents of each sieve were dried in the oven at a temperature of 105°C. Then their dry weight was calculated. The results were expressed as the weighted diameter rate by applying the equation mentioned in [4] According to the following equation:

$$MWD = \sum_{i=1}^{n} XiWi$$

3. Results and discussion

The results shown in Figure (1) show that there are significant differences due to the effect of varying soil depth, as it is observed that MWD values decrease with increasing depth at the beginning and end of the growing season. The results indicate an increase in the MWD values at the beginning of the growing season when compared with the MWD values before planting. This is due to the role of tillage and soil preparation operations and the effective effect of added soil conditioners in raising the MWD values, as the depth of 0-15 cm gave the highest percentage increase in the values, amounting to 71.69% in While the percentage reached 38.87% and 20.38% for depths of 15-30 cm and 30-60 cm, respectively. The decrease in MWD values with depth may be due to the decrease in the proportion of improvers and their effect with depth. On the other hand, the reason for the superiority or high MWD at superficial depths is due to the effect of root growth and density and the nature of the distribution of the root system of the planted plant, which has superficial roots at these depths, especially at a depth of 0-15 cm, which allows for the growth and increase of microorganisms and their role in Increasing the stability of assemblies [5].

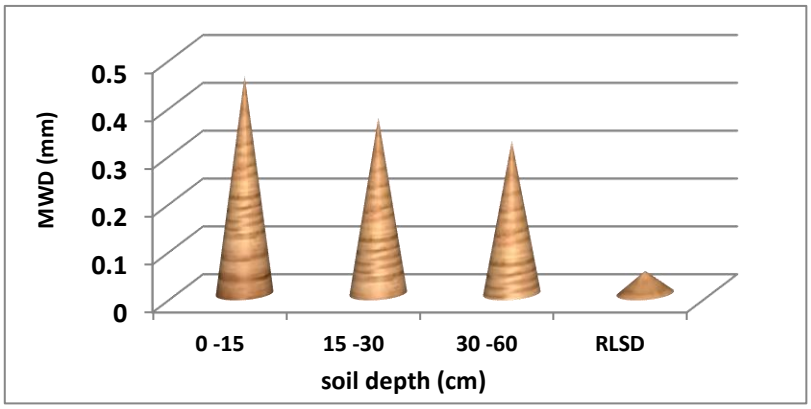

Figure -1 The relationship between the values of mean weight diameter (MWD) (mm) and soil depth.

The results shown in Figure (2) show that there are significant differences in the effect of the treatment of adding conditioners on the MWD values. it is noted that the MWD values increased when adding soil amendments, and the increase was higher compared to the initial values before planting. The bitumen addition treatment gave the highest values, with an increase percentage of 74.72% . while the organic waste addition treatment amounted to 44.91% and was approximately 21.13% for the comparison treatment. The reason for the increase in MWD values is due to the ability of the bitumen emulsion to coat soil particles and aggregates with the emulsion material, which increases the bond strength of the aggregates and gives them a hydrophobic character that reduces the ability of the soil to absorb water and thus reduces the chance of it breaking down during the movement of water [2]. organic residues added to the soil also create stable soil aggregates against water currents [2]. It was found [6] that the use of organic waste led to an increase in the stability of soil aggregates compared to the control treatment through increasing the activity of microorganisms that work to form a network of threads (hyphae) surrounding the soil particles and interspersing between the soil particles to bind them together, leading to an increase in bonding forces and cohesion between particles.

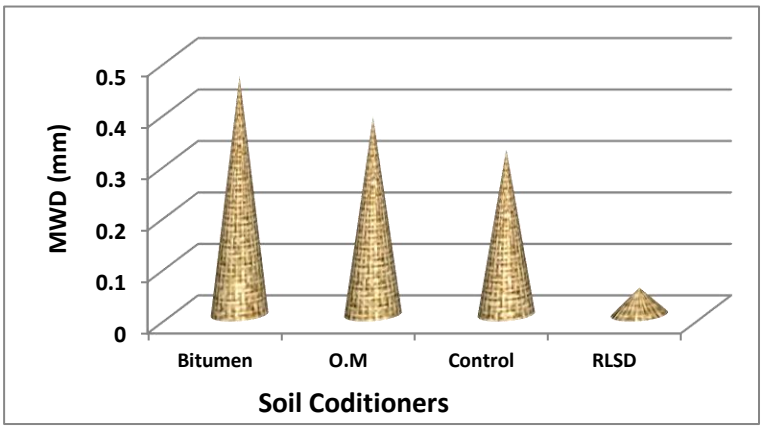

Figure -2 The relationship between the values of mean weight diameter (MWD) (mm) and soil conditioners.

As for the change in MWD values when using different irrigation methods, the results shown in Figure (3) show that there are significant differences for the two irrigation methods on MWD values at the beginning and end of the growing season. The values increased at the beginning of the growing season for the drip and stream irrigation methods, with an increase rate of 75.47% and 29.81%, respectively, compared to the initial values before planting. The reason for this is that flood irrigation leads to the destruction of some soil aggregates, which causes the soil particles to reorganize between the pore spaces, closing them together, and reducing the MWD value in them. Also, sudden submersion of the soil during flood irrigation causes the soil aggregates to be destroyed and the MWD values to be reduced compared to with slow wetting of drip irrigation [7].

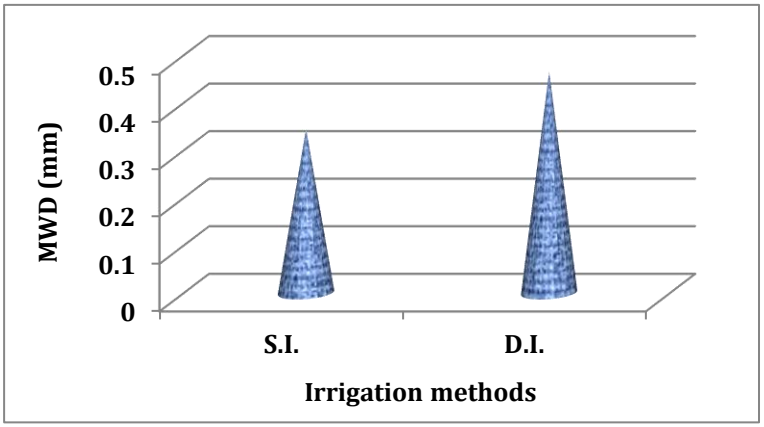

Figure -3 The relationship between the values of mean weight diameter (MWD) (mm) and Irrigation methods.

The results in Figure (4) show that there are significant differences in the effect of the two-way interaction between the two soil amendment treatments and the irrigation method on the MWD values at the beginning and end of the growing season. MWD values increased at the end of the growing season compared to the beginning of the season in the two irrigation methods. The percentage increase for the drip irrigation and for the bitumen and organic waste

treatments reached 5.46% and 5.22%, respectively, and an increase of 4.32% for the comparison treatment. While the percentage of increase in the irrigation method was 4.31% and 4.24% for the bitumen and organic waste treatments, respectively, and the percentage of increase was 3.72% for the comparison treatment.

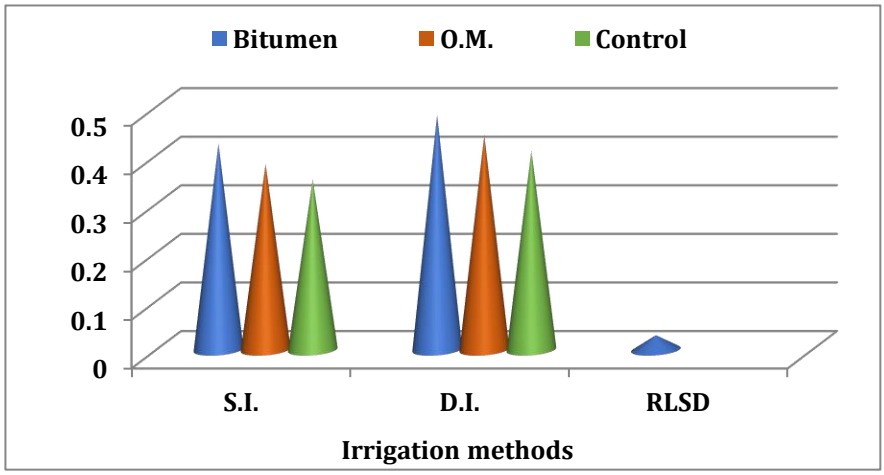

Figure -4 The effect of the interaction between soil conditioners and irrigation method on the mean weighted diameter of the soil(MWD).

The reason is that the drip irrigation method at the end of the season was greatly influenced by the effective role of the conditioners in binding the soil particles and preserving them from collapsing, thus increasing the stability of the soil aggregates compared to surface irrigation, as the conditioners are more effective in the slow wetting of drip irrigation to maintain the soil structure from Deterioration [8]. Drip irrigation keeps the soil aggregates from dispersing and collapsing against the irrigation water, compared to the rapid and sudden irrigation of surface irrigation, which breaks up the aggregates, deteriorates the structure of the soil, and creates air pressure inside the aggregates, leading to their destruction [9].

4. Conclusions and recommendations:

1) Adding Soil conditioners led to an improvement in most of the physical properties of the soil and increased soil stability as a result of increasing the diameter rate. Therefore, it is recommended to add bitumen emulsion at a rate of 0.5% or organic waste at a rate of 1% for the purpose of improving the physical and water properties of the soil.
2) The use of the drip irrigation system preserved the soil structure from deterioration, which improved the various physical properties of the soil. Therefore, it is recommended to use the drip irrigation system in clay soils, especially in dry and semi-arid areas that suffer from water scarcity and deterioration in its quality, while improving the soil structure by adding conditioners.

References

[1] A. Barrett, *Water Use Efficiency for Irrigated Turf and Landscape*, firest ed. sidny, Australian: National library of Australian, 2010.

[2] Ayman Abdel Latif Al-Qannas, "The effect of loosening and adding conditioners on the physical properties of the soil, water consumption, and growth of the barley crop, Hordeum Volgare L.," *Master thesis*, vol. College of Agriculture, no. University of Basra, 2001.

[3] G. P. Sodhi, V. R. Beri, and D. K. Benbi, "soil aggregation and distribution of carbon and nitrogen in different fractions under long-term application of compost in rice-wheat system," *Soil and Tillage Research*, vol. 1, no. 2, pp. 412-418, 2009.

[4] C. A. Black, D. D. Evans, L. L. White, and L. E. Ensminger and F. E. Clark, *Method of soil analysis*, 1st ed. Madison, USA: Am. Soc. of Ag., 1965.

[5] Salah Mahdi Sultan Al-Atab, "The effect of soil aggregate sizes on soil physical properties and water movement on maize plant growth," *Master thesis*, vol. collage of agriculture, no. university of Basra, 2001.

[6] M. N. Bipfubusa, D. A. Angres, A. N. Dayegamiye, and H. A. Antoun, "Soil Aggregation and Biochemical properties following theApplication of fresh and Composted Organic Amendments," *Soil Sci. Soc. Am. J.*, vol. 1, no. 1 and 2, pp. 160-166, 2008.

[7] E. F. Bolton, F. A. Driks, and M. M. Donnel, "Effects of depth and spring plowing at three depths on soil bulk density, porosity and moisture in Brookston clay," *Can. Agric. Eng.*, vol. 23, no. 2, pp. 71-76, 1982.

[8] Hussein Ali Shehab Al-Murad, "The effect of soil compaction on some physical and mechanical properties and its relationship to water consumption of barley plants," *Master thesis*, vol. college of agriculture, no. University of Basra, 1998.

[9] G. M. Darren, H. Y. Miched, and E. Donald, "A laboratory method for determining the unsaturated hydraulic properties of soil pods," *Soil Sci. Soc. Am. J.*, vol. 69, no. 3, pp. 807-815, 2005.