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Effect of the distance between the drippers of border drip irrigation system and soil conditioners on some soil properties and the productivity of corn plants (Zea mays L.)

2- Saturated hydraulic conductivity (Ks) and plant productivity

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Abstract

The field experiment was conducted in the Agricultural College Research Station /University of Basra/Karmat Ali in the spring season of 2023-2024. The soil was classified as afine clay mixed, calcareous, hyperthermic typic torrifluvent. To determine the effect of the emitter distance and soil conditioners by using border drip irrigation on Ks and plant productivity. The study included a factor of three emitter distances of 20cm , 30cm and 40cm , and soil conditioner factor of three treatments include 3% crushed corn cobs, 3% crushed corn cobs, mixture of crushed corn cobs at a rate of 3% with used fuel oil at a rate of 0.3% and the third treatment issue fuel oil used at a rate of 0.3% in addition to the control treatment. The conditioners were added to basis dry soil weight. Soil samples were taken from the depths of 0-15 and 15-30. The factorial treatments were applied by using a with Randomized

Complete Block Design (RCBD).Measurements were taken in the middle and end of the growing season. The results showed an increase in Ks and plant productivity with a decreasing in the emitters distance, as treatment X_1 recorded the highest values of 0.776 m day^{-1}, 0.929 m day^{-1} and it differed significantly from two treatments X2 (0.731 m day^{-1}, 0.893 m day^{-1}) and X3 (0.690 m day^{-1}, 0.854 mm). As for soil conditioners, the mixture treatment (Co+O) gave the highest values (0.899 m day^{-1}, 1.117 m day^{-1}), followed by the treatment of Co (0.752 m day^{-1}, 0.885 m day^{-1}), followed by the oil treatment O (0.705 m day-1, 0.839 m day^{-1}) and with significant differences compared to the control treatment **(**C) (0.572 m day^{-1}, 0.727 m day^{-1}). The results also showed that the surface depth significantly difference with the highest values of (0.807 m day^{-1}, 0.960 m day^{-1}) compared to the subsurface depth of (0.657 m day^{-1}, 0.824 m day^{-1}), of mid and end growing season respectively. Also the study factors affected on plant productivity was increased with decreasing emitter distance. The values were (10.54 tons ha^{-1}, 10.17 tans ha^{-1}, 9.82 tons ha^{-1}) for distances of 20, 30 and 40 cm respectively, and when the conditioners were added, the treatment Co+O was superior with the highest values of (11.61 t ha^{-1}) followed by treatment Co of (10.45 t ha^{-1}) and oil treatment O of (9.56 t ha^{-1}) compared to the control treatment C of (9.08 t ha^{-1}).

Keywords: Border drip irrigation system. The distance between emitter, Soil conditioner, Saturated hydraulic conductivity **(**Ks**)**, Corn plant productivity.

Research extracted from the master's thesis of the first researcher.

Introduction

Saturated hydraulic conductivity of the soil is an important hydraulic property of soil, which is affected by factors such as dripper discharge, emitters distance, pipe length, and soil properties.

A study was conducted by (Al-Yasiri et al; 2019) in Dhi-Qar Governorate during the spring season of 2018 on soil with mixture it clay using the effect of emitters distance and the of the field pipe length in, they found a highly significant effect among all treatments at the beginning of the season, the 25 cm of emitter distance treatment led to a significant increase in Ks values by 11.92% and 32.98% compared to 30 cm and 40 cm treatments, respectively, is given as 25 cm the greatest value (0.629 m day-1).At the end of the season, the values reached 0.769, 0.669 and 0.539 m. day^{-1} for the 20, 30 and 40 cm treatments, respectively. This indicates that Ks It decreases with increasing the emitter distance, due to the decrease in soil moisture, the increase in soil salinity, and the decrease in MWD, increased soil bulk density, decreased porosity. Many studies have confirmed the role of organic matter in improving the physical properties of soil and increasing Ks where it is an important physical property in studying the soil's hydrological properties and evaluating water flow in it. It is a measure of the soil's ability to pass or transport water through its pores (Johnson et al., 2005). Al-Hadith et al; (2008) concluded that organic matter binding soil particles together and thus improves structure and increases values Ks. Al-Naimi (2012) when adding fuel oil in Ks for soil as the values increased for all addition levels when compared to the treatment control and reached 0.053, 0.08, 0.15, 0.20 and 0.08 cm min^{-1} for addition levels 0, 0.25, 0.5, 1 and 1.5% respectively. The conditioners reduce the deterioration of soil aggregates due to the air pressure trapped during wetting which is positively reflected on Ks. Regarding how the emitters distance affects and soil conditioners on plant growth and productivity, it has been study was conducted by Lamm and Aiken (2005) in America, explained that the emitters distance depends on the soil properties and the distance between plants, and they found that the best emitters distance for producing corn plant in loamy soil under a drip irrigation system is 0.3 meters and which gave the highest production compared to the distances of 0.4 and 1 meter which gave the lowest production respectively. A study was conducted in Basra by Salman and Nedawi (2017) on clay soil, they found that the emitters distance of 15 cm gave the highest grain weight (6.33 ton ha^{-1}), while the larger the emitter distances (25, 35, and 45 cm) gave lower grain weights (5.65 , 4.48, and 3.16 ton ha^{-1}) respectively. They attributed the reason to the difference in soil moisture content as a result of the difference in the emitter distance, which contributed to high area and volume of the wet soil, which led to increased root spread and vegetative growth, and thus increased plant productivity at a distance of 15 cm compared to other distances. Aati et al; (2007) reported that adding crushed corn cobs to soils of different textures led to an increase corn's productivity and growth were attributed to the high content of moisture soil and increase in viscosity of fulvic acid with time after addition. Consequently, there was an increase in soil. accumulations as a result of bonding of particles by adhesives such as organic matter the decomposed. As Found (Shabib et al;2017) adding 0.3% emulsified fuel oil has a high effect in increasing to rise plants corn and its productivity.

This experiment aims to study effect of the emitter distance and soil conditioners on the valuesof Ks and productivity of corn plant.

Materials and methods

The experiment was carried out in the Agricultural College Research Station University of Basra/Karmat Ali site, located between latitude 50-30 north and longitude74-47 east on the side of the Karmat Ali river during the spring season 2023-2024 and on a total area of 720 m^2. Soil texture was silt- clay and it classified as a Fine clay mixed, calcareous, hyperthermic, typic torrifluvent (Al-Atab, 2008).

Experimental Factors

1- The emitters distance factor. This factor including three treatments of (X_1=20 cm, X2= 30 cm and X3=40 cm).

2- Soil conditioners factor. This factor including four treatments.

A- 3% of crushed corn cobs were mixed with the soil based on their dry weight before agriculture (Co).

B- Amixture of crushed corn cobs at the rate of 3% with used fuel oil emulsifier at the rate of 0.3 % (Co+O), added based on the dry weight of the soil to a depth of 15 cm.

C- Adding used fuel oil as an emulsifier at a rate of 0.3% (O), added based on the dry soil weight to a depth of 15 cm.

D- The control treatment (C).

The treatments were done with three replicates number of experimental units were (3*4*3=36) and the distance between the field tubes was 40 cm.

Soil preparation

The soil was prepared in the area of (720 m^2) by moldboard ploughing of 30 cm depth. The field was divided into three equal blocks, with 2 meters' distance between each blocks. Each block was divided into 12 equal experimental units. The factorial treatments were applied by using RCBD. The soil samples were taken from depths of (0-15), (15-30) and (30-45) cm. The soil physical and chemical properties ware showed in the table (1). The soil physical properties were estimated according to the methods described in (Black et al.,1965).The soil chemical properties were estimated according to the methods described in Jackson ,1958, Richards, 1954 and Page et al., 1982.

Irrigation of experimental unit.

In the first, irrigation water times was added to the field capacity limits and to a depth of 15 cm, according to Kovda *et al.*, (1973). While for subsequent irrigations, the depth of water to be added is estimated based on the values of the American Evaporation pan according to the equation (Allen *et al.*, 1998).

Saturated hydraulic conductivity (KS) measurement

The saturated hydraulic conductivity of soil (KS) was calculated with a cylindrical soil sample using the constant head parameter method proposed by Klute which was mentioned by Black et al. (1965). The values of ks were calculated by Darcy's equation:

$$K_s = \frac{V}{At} \times \frac{L}{\Delta H} \dots\dots\dots (1)$$

Ks = saturated hydraulic conductivity of soil (cm min-1) L = length of soil column (cm).

t= time of measuring(min) v= water volume through the soil column (cm^3).

A= surface area of the soil column section (cm^2). ΔH = length of soil column(L + height of water column above soil column h (cm).

Plant productivity

It was taken seven plants were randomly selected from each experimental unit, the yield was collected, and the ears of those plants were weighed without wrapping, and the production of each experimental unit was calculated in ton ha^{-1}

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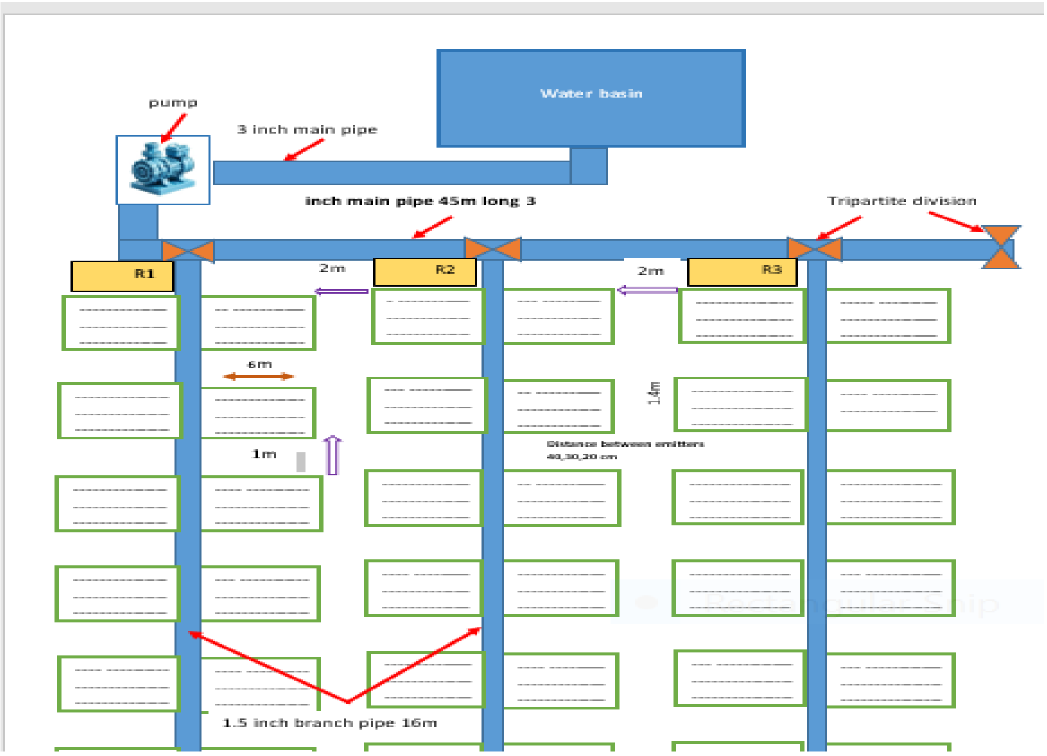

Table (1)Physical and chemical properties of the study soil

Soil depth (cm)			Features		
40 –30	30–15	15 – 0			
29.50	30.00	40.00	soil gm.kg $^{-1}$	Sand	
37.10	36.40	20.40		Silent	
33.40	33.60	39.60		Clay	
clay mix	clay mix	clay mix		Soil texture class	
0.98	0.105	0.120	Weighted diameter(mm		
1.35	1.34	1.28	Bulk density (mcg.m $^{-3}$)		
2.65			True density (Mg.m $^{-3}$)		
49.06	49.43	51.69	% Porosity		
32.86	33.55	33.88	Moisture content at field capacity %		
12.24	12.9	14.2	Moisture content at permanent wilting % point		
0.512	0.577	0.622	(Saturated water conductivity (m day $^{-1}$		
325.0	325.0	325.0	Total carbonate g.kg $^{-1}$		
2.91	4.16	5.60	Organic matter g.kg $^{-1}$		
7.27	7.31	7.50	EC (decisiemens m^{-1})		
7.64	7.71	7.83	PH		
12.31	12.29	12.20	millimoles.liter^{-1}	Ca^{++}	dissolved ions
8.5	7.7	8.7		Mg^{++}	
35,34	35,38	35.56		Yes $^{+}$	
1.95	2.03	2.71		K^{+}	
1.47	1.49	1.55		$HCO3^{-1}$	
6.91	7.04	8.43		SO_4^{-2}	
57.31	57.37	58.40		Cl^{-}	
---	---	---		CO_3^{-2}	
2.8			EC decisiemens m^{-1}	Irrigation water	
7.3			PH		

Results and discussion

1- Saturated Hydraulic Conductivity (Ks)

Table 2 showed the highly significant of emitter distance factor in border drip irrigation system of soil Ks valuesin the middle and end season. When comparing the treatments, it is showing there are significant differences between all treatments. Tables (3 and 4), showed it is generally that the values Ks increases with decreasing the emitter distance and was highest in the 20 cm treatment and decreased successively in the 30 cm and 40 cm treatments. The treatment was recorded as X_1 (20 cm) highest values 0.776 m day^{-1}, recorded a significant superiority of the growing season of Ks values increased by 6.16% and 12.46% compared to the 30 cm and 40 cm treatments, which had Ks values of 0.731 m day^{-1} and 0.960 m day^{-1} respectively, while at the end of the season the values were 0.929, 0.893 and 0.854 m day^{-1}for treatments 20, 30 and 40 cm where the increase rate of treatment 20 cm compared to the two treatments 30 cm and 40 cm 4.03% and 8.8% respectively, the reason for the increasing in Ks values with the increasing moisture content and thus reducing the salt concentration in the soil profile,, which preserved soil aggregates from deterioration, decreased apparent bluk density and increased total porosity, which was positively reflected in the pore size distribution for soil, leading to increasing values of Ks m day^{-1} (Chen et al., 2015). The findings show that Ks levels are higher near the conclusion of the growth season than they are in the middle, with an increase of 19.72%, 22.16% and 23.76% for the treatments 20, 30 and 40 cm, respectively.This is due to the increased effectiveness and activity of microorganisms, which contribute to the growth and dissemination of the plant's root system as well as the breakdown of

Table (2) Test F for Saturated Hydraulic Conductivity (Ks)values (m day-1) at the middle and end of the growing season

Source	df	Saturated Hydraulic Conductivity (Ks)		Plant productivity
		Mid of season	End of season	End of season
A	2	104.07**	79.63**	54.03**
B	3	773.87**	1125.15**	387.39**
D	1	954.53**	773.66**	
AB	6	6.83**	0.46*	3.9*
BD	2	2.72*	10.93**	
AD	3	3.79*	0.38*	
ABD	6	3.29*	2.09*	
A= distance between emitter, B=conditioners , D = depth				

organic matter and the binding of soil particles in aggregates, which increases the pore spaces occupied by root hairs, which in turn effect to increase Ks values (Sarhan, 2009). Results in the tables (2,3 and 4) showed the conditioners have a highly significant impact on values Ks is the middle and end of the growing season, where it is generally observed that the Ks valuesincrease with the use of conditioners. The highest of values Ks were in the treatment Co+O (0.899 and 1.117 m day^{-1}) followed by Co (0.752 and 0.885 m day^{-1}) and O (0.705 and 0.839 m day-1) compared with the control C (0.572 and 0.727 m day-1) in the middle and end of the growing season respectively. The increase value for the Co+O , Co and O treatments compared with the control treatment in the middle of the growing season was 57.17% , 31.47% and 23.25% , and at the end of the growing season the increase more was 53.65%, 21.73% and 15.41% respectively, these results are agreement with Atee (2009) who showed an increase in Ks values when adding crushed corn, of this improves soil structure and increases its porosity. As a result of the formation of the aggregates, this leads to an increase in the large pores that are important in the process of soil water movement. On the other hand, mixing corn crushed with fuel oil led to an increase in the valuesof Ks, this is due to the increase in the stability of soil aggregates by covering them with a water-repellent material and protecting them from deterioration, and thus stabilizing the condition of soil pores, conditioners some of their properties, increasing MWD values, and decreasing the apparent bluk density of the soil, thus increasing its ability to increase Ks (Shirani et al., 2002). Results showed Ks levels are higher near the conclusion of the growth season than they are in the middle because of the effect of adding conditioners of 24.25% , 17.68% , 19.01% and 09.27%for each at the Co+O , Co and O treatments and the control treatment respectively.This increase is due to a general improvement in the physical properties of the soil at the end of the growing season due to the role of conditioners and their decomposition and the formation of organic materials binding between the aggregates, in addition to the increase in root density and its role in improving the size of the soil pores through their secretions and increasing the effectiveness of soil microorganisms, which contributes to increasing MWD, which leads to increasing the porse and increasing the value of KS (Sarhan, 2009). The tables (2,3 and 4) a highly significant effect on the KS values with soil depth in the middle and end of the growing season. The surface depth (D1) exceeded the Ks there were significant differences in the subsurface depth in the Ks values in the middle and end of the growing season, with values decreasing with increasing the depth. The Ks values were 0.807 and 0.657 m $days^{-1}$ in the middle of the growing season and 0.960 and 0.824 m $days^{-1}$ at the end of the growing season for the depths D1and D2 respectively. This decrease in Ks values is attributed to the increase in soil bulk density and the decrease in soil total porosity with increasing depth as well as the increase in the percentage of clay and silt in the subsurface depths (Table 1) in addition to the growth and reproduction of roots within the subsurface depth. These results are in agreement with Mahdi (2010), who found a decrease in the values of Ks with depth, this is due to the lack of organic matter and the increase in apparent soil density at the subsurface depths of the soil. The results also showed that the valuesof Ks for surface and subsurface depths at the end of the growing season compared to the middle of the growing season, and this result is agreement with (Walpola and Arunakumara, 2010). The effect of the interaction between the factors of emitter distance and soil conditioners on Ks values was highly significant in the middle of the growing season and significantly in its end (Table 2). It is clear from (Table 3) that there are significantly differences between the interaction treatments, as the emitter distance and all their levels and their interaction with the conditioners had a positive effect on increasing the Ks valuescompared to the control treatment, with significant differences, especially at the emitter distance of 20 cm, and their interaction with the Co + O treatment as it gave the highest values, which were 0.920 and 1.154 m day^{-1}, followed by the Co and O treatment in the middle and end of the growing season. These values generally decrease with increasing emitter distance, but with significant differences between them and with the control treatment, for example values of Ks was 0.920 m day^{-1}, 0.804 m day^{-1} and 0.778 m day^{-1} for Co+O , Co, O treatments and for the emitter distance of 20 cm, respectively, compared with the control treatment (0.601 m day^{-1}) in the middle of the growing season. The values of Kswere higher at the end of the growing season and for the interaction treatments 1.154 m day^{-1}, 0.920 m day^{-1} and 0.881 m day^{-1} compared with the control treatment (0.763 m day^{-1}) at the end of the growing season and for the interaction treatments mentioned, respectively. The results also showed that in general, the Ks values at the end of the growing season more highest than in the middle of the growing season, the reason for the highest values of Ks for the small the emitter distance by interaction with the mixture treatment to the nature of the distribution of soil moisture content as it is balanced and helps in the decomposition of organic matter and improving the aerial and moisture properties of the soil suitable for the growth of microorganisms that decompose organic carbon, which effect to reorganize the soil particles and increase the size of soil pores, in addition to the role of the oil mixed with the coating the soil particles, which leads to reducing its ability to absorb water and reducing the action of the air trapped inside the clusters that causes their explosion and deterioration (Al-Dabbagh et al; 2010), in addition to the decreasing soil salinity as a result of leaching away the salts and improving the properties of the soil (Al-Muhammad et al;2014). The results in Table 2 show that there is an effect significant interaction between the factors of the emitter distance and soil depth in the values of Ks in the middle and end of the growing season (tables 3 and 4), as the significantly difference in values becomes clear Ks between the emitter distance treatments according to the soil depth variation. The highest significant variation is observed between the emitter distance at the surface depth (D1), while the lowest variation is observed at the subsurface depth (D2). In generally, highest values are observed in the soil depth interaction D1 for the distance of 20 cm compared to other corresponding distances at the mentioned depth. The highest values were recorded of 0.841 m day^{-1} , 0.994 m day^{-1} and 0.809 , 0.963 m day^{-1} , 0.771 m day^{-1} and 0.923 m day^{-1} for the emitter distance treatments 20, 30, 40 cm respectively for depth D1 in the middle and end of the growing season. It is also showed that the valuesdecreased at the depth D2 compared to depth D1 and these values were 0.710 m day^{-1}, 0.864 m day^{-1} and 0.653 m day^{-1} , 0.823 m day^{-1} and 0.609 m day^{-1}, 0.785m day^{-1} for the emitter distance treatments 20, 30, 40 cm respectively. The reason for the decrease in values is due to ks When the depth increases, the soil bluk density of the soil increases, the total porosity of the soil decreases, and the percentage of clay and silt in the subsurface depths was increasing. These results are agreement with Hassan, (2018) who found a decrease in Ks values with increasing soil depth. The results also showed an increase in Ks for all treatments at the end of the growing season compared to the middle season. This is due to the increased growth of the root system of the plant and the opening of pores within the soil profile, which helps the movement and penetration of water through the soil (Al-Halfi 2016, and Fuentes et al; 2004).

The results (in table 2) showed an effect significantly for the interaction between soil conditioners and soil depth in values of Ks at mid growing season and highest significantly in its end, and when comparing the interaction treatment in the middle and end of the growing season, it was found that there were significant differences. The table (3 and 4) as it gave depth D1 had the highest values of 0.980, 0.835, 0.773 and 0.640 m day-1 for the Co+O, Co, O and control treatments respectively, with significant differences compared to depth D2, which recorded the lowest values of 0.818 m day^{-1}, 0.670 m day^{-1} and 0.638 m day^{-1}, 0.504 m day^{-1} in the middle growing season, while the values of ks increased at the end of the growing season at both depths D1 and D2 compared to the middle season and were 1.206 m day^{-1} , 0.944 m day^{-1}, 0.910 m day^{-1} and 0.780 m day-1 for depth D1 and 1.027 m day^{-1}, 0.827, 0.769 and 0.673 for depth D2, as a result of the interaction with the mentioned conditioners and the treatment of control respectively. The reason for the high values of the Ks at the surface depth and its interaction with all the conditioners under this study led to an increase in organic matter that acts as a bonding material for soil particles and improves soil structure, in addition to the spread of the root system and an increasing the MWD which is reflected positively in the increase Ks (Fuentes et al;2004).

The results are shown in Table (2) for the interaction between the emitter distance factor and the conditioners with different soil depths in the values of Ks was significant effect at mid and end of growing season the(tables3 and 4) .The variation the effect of the emitter distance factor in Ks varies according to the conditioners added and the soil depths at this study, with significant differences, as the valuesdecrease with increasing soil depth for all the emitter distance treatments and with the addition of all conditioners, The treatments Co+O D1 X1 excelled on all other treatments, it gave 0.994 m day^{-1} and 1.249 m day^{-1} in the middle and end of the growing season, respectively. This is due to the role of the positive interaction effect of the 20 cm distance and the conditioner treatment Co+O in improving the soil structure, reducing soil bluk density and increasing total soil porosity, as well as being in the surface depth of the soil (D1), which is positively reflected in raising the values of Ks (Levy et al., 2005), while the lowest values were reached in the control treatment at a distance of 40 cm and a depth of the subsurface soil C D2 X3 were 0.437 m day^{-1} and 0.638 m day^{-1} at the middle and end of the growing season, respectively. The results of the test analysis (t) in the (table 5) there is a highly significant effect of growing season periods on the valuesof the Ks, it increases at the end of the season by 0.893 m day^{-1}, compared to the middle of the growing season, which reached 0.723 m day^{-1}, and the percentage of increase was 23.5%, the reason for this increase is due to the spread of plant roots, which increases the pore spaces occupied by the roots, especially after their death with the progress of the growing season and the decomposition of organic matter and the increase in the activity of microbial soil life, which contributes to binding soil particles and improving its structure and increasing its stability, which in turn is reflected in an increase Ks in addition to the decrease in the soil bluk density and the increase in its porosity at the end of the growing season.

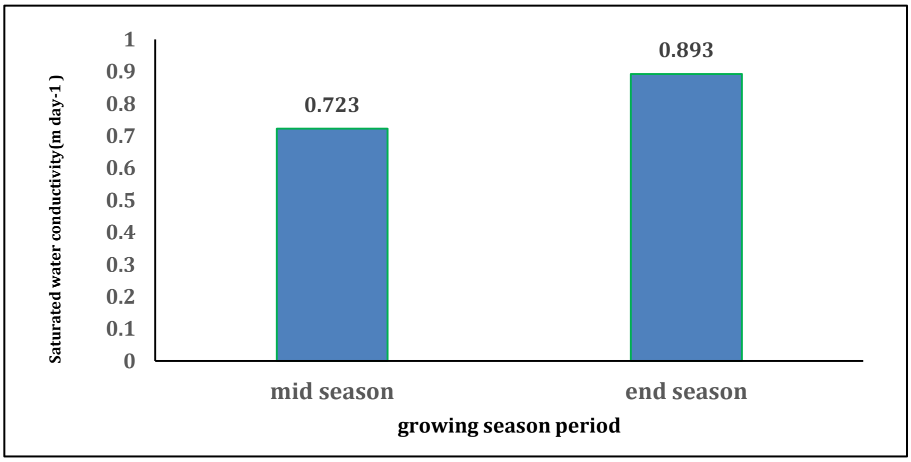

Figure (2) Effect of growing saturated water conductivity (m day-1) values mid and end of the season.

Table (3) Effect of experimental treatments under study on KS (m day-1) before subsequent irrigation in the middle of the season.

RLSD$_{0.05=}$0.01691 (mean) X*D		RLSD$_{0.05=}$ 0.02391 X (mean)* Cond.				RLSD$_{0.05=}$ 0.01196 (mean) X	Conditioners(cond.)								X (cm)
							O		Co		Co+O		Control		
D2	D1	O	Co	Co+O	Control		D		D		D		D		
							D2	D1	D2	D1	D2	D1	D2	D1	
0.710	0.841	0.778	0.804	0.920	0.601	0.776	0.718	0.837	0.730	0.878	0.846	0.994	0.546	0.656	20
0.653	0.809	0.687	0.751	0.899	0.588	0.731	0.623	0.750	0.645	0.857	0.815	0.983	0.528	0.647	30
0.609	0.771	0.652	0.702	0.878	0.528	0.690	0.572	0.732	0.635	0.769	0.792	0.965	0.437	0.618	40
							RLSD$_{0.05=}$0.03382 X* Cond.* D Interaction								
							0.638	0.773	0.670	0.835	0.818	0.980	0.504	0.640	RLSD$_{0.05=}$0.01952 Cond.* D (mean)
D= depth of soil(cm)		X= distance between emitter(cm).					0.705		0.752		0.899		0.572		RLSD$_{0.05=}$ 0.01381 (mean) Cond.
0.657	0.807	RLSD$_{0.05=}$0.00976 (mean) D													

Table (4) Effect of the experimental treatments under study on kS (m day-1) before the subsequent irrigation at the end of the season.

RLSD$_{0.05}$=0.01704 (mean) X*D		RLSD$_{0.05}$= 0.02410 (mean) X* Cond.				RLSD$_{0.05}$ = 0.01205 X(mean)	Conditioners(cond.)								X (cm)
							O		Co		Co+O		Control		
							D		D		D		D		
D2	D1	O	Co	Co+O	Control		D2	D1	D2	D1	D2	D1	D2	D1	
0.864	0.994	0.881	0.920	1.154	0.763	0.929	0.827	0.934	0.853	0.986	1.059	1.249	0.718	0.808	20
0.823	0.963	0.840	0.889	1.122	0.721	0.893	0.771	0.909	0.828	0.950	1.029	1.215	0.664	0.777	30
0.785	0.923	0.797	0.848	1.074	0.696	0.854	0.709	0.885	0.799	0.897	0.993	1.155	0.638	0.754	40
															RLSD$_{0.05}$= 0.03409 X* Cond.* D Interaction
							0.769	0.910	0.827	0.944	1.027	1.206	0.673	0.780	RLSD$_{0.05}$=0.01968 Cond.* D (mean)
D =depth of soil (cm). X=distance between emitter(cm).							0.839		0.885		1.117		0.727		RLSD$_{0.05}$= 0.01392 (mean) Cond.
0.824	0.960														RLSD$_{0.05}$=0.00984 (mean) D

2-Plant productivity.

Table 2 showed a very important consequence of the emitter distance factor in the border drip irrigation system on weight the corn yield, There were notable variations among all treatments when comparing them. (Figure 6). The 20 cm treatment was recorded the highest values of 10.54 ton ha^{-1}, followed by the 30 cm treatment, which gave 10.17 ton ha^{-1} while the lowest valueswere at the 40 cm treatment, at 9.82 ton ha^{-1}, and in proportions increase of 3.63% and 7.33% compared to treatments 30, 40 cm. The reason for the increase in the weight of the corn yield when the emitters distances are close is caused by the way water is distributed under the border drip irrigation system, which is uniform in its spread throughout the soil. at a distance of 20 cm increases as a result of the speed of the meeting of the wetting fronts, which leads to washing downward the salts and displacing them at the borders of the wetting front, especially to the bottom of the root zone, and thus improving the properties of the soil such as increasing MWD, soil porosity and moisture content, which in turn provides the ideal environment for the crop to perform its vital activities, thus increasing the efficiency of photosynthesis and transporting water and nutrients from the source to the corn cops formation sites, which works to increase crop productivity, in addition to increasing the volume of wet soil, which has a positive effect in increasing vegetative growth as well as increasing the spread of the root system

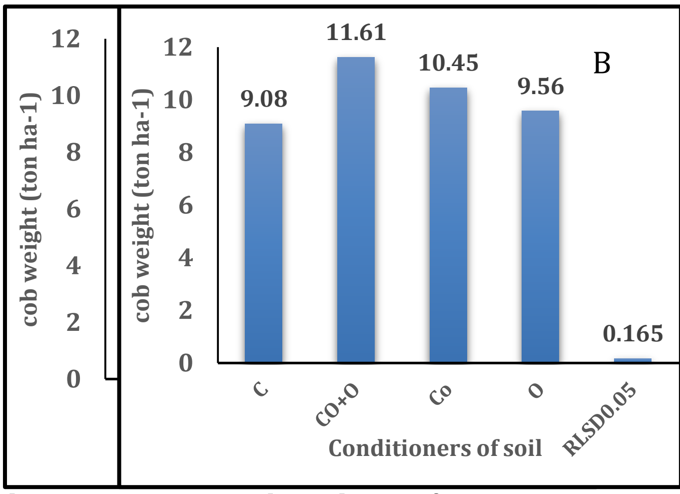

Figure (6) effect of the emitter distance factor in the border drip irrigation system (A) and soil conditioner(B) on weight the corn yield (ton ha^{-1})

and thus increasing the weight of The cob weight plants (Zhou et al., 2018). The results are shown in the figure (6) and the results of statistical analysis to test F table (2) there was a highly significant effect of improvers on the grain yield values of corn, as adding improvers for soil generally it led to a significant increase in grain yield values. The (Co+O) was recorded highest values of (11.61 ton ha^{-1})followed by the treatment of the corn (Co) and fuel oil(O) where the values were 10.45 and 9.56 ton ha^{-1} respectively, while the comparison treatment gave the lowest values, which were 9.08 ton ha^{-1} and with an increase of 27.86% and 15.09% 5.29% for treatments Co+O , Co , O compared to comparison with control treatment(C) and respectively with note the differences were significant between the different treatments of the improvers reason for increase grain yield by adding conditioners generally to the ability of conditioners to create suitable conditions for plant growth by improving the physical properties of the soil such as increasing the total porosity soil , low density the virtual with the increase in the soil's ability to retain moisture, and the increase in available water. In addition to the ability of organic waste to provide the plant with the necessary nutrients, and as a result, the activity of photosynthesis and other physiological processes increases, which increases the storage of carbohydrates in the grains and thus increases production (Hadith and Abdul Hamza, 2010).The results of the statistical analysis of the test are shown F tables (2 and 7) show a significant effect of the interaction between the factors of the emitter distance of the border drip irrigation system and the addition of soil conditioners on the values of the yield corn crop when comparing the treatments, the differences were significant, especially between the conditioners factor and comparison treatment at all levels of the emitter distance factor. The highest values were recorded at 12.14 ton ha^{-1} when treating the interaction between the emitter distance of 20 cm and the treatment of Co+O, and the lowest was 8.74 tons ha^{-1} in the comparison treatment (C)And its interaction with the spaced distance (40cm), as is generally the results that the treatment Co+O it recorded the highest values for the yield plant, followed by the treatment Co and O respectively, compared with the control treatment at both levels of emitter distance. The superiority of the distance between close emitter and its interaction with the conditioners treatments, especially the treatment Co+O the role of these two factors and their impact on improving the physical properties of the soil and increasing the soil's ability to retain moisture, as the determining factor is the availability of soil moisture and its readiness for the plant, which is positively reflected in increasing the growth and productivity of the plant (Bhowmik et al;2018).

Table (6): The effect of the interaction between the emitter distance and the soil conditioner in Weight of the cob weight (ton ha^{-1})

Distance between emitter			Conditioners
40cm	30cm	20cm	
8.74	9.13	9.38	C
11.12	11.56	12.14	Co+O
10.09	10.39	10.88	Co
9.34	9.59	9.76	O
0.286			RLSD0.05

Table (8) test (t) mid and its end season growth.

Source	df	t
Ks	**2**	**10,782**

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