Effect of dripper types and irrigation water quality on some soil properties

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Abstract

A field experiment was conducted in Texture Clay soil to study the effect of some different types of drippers and the alternation method using saline water on some physical properties of soil. The experiment was designed globally - Split Plot Design and with three replications, using river water and well water with electrical conductivity of 0.7 and 4.38 ds. m^{-1}, respectively. Water was added by four methods (R 100% river water, W 66% well and R 34% river, W 100% well, R 66% river and W 34% well) and three drippers T-Tape, GR and Spiral were used. (Zea mays, L) is a local variety and the irrigation schedule has been scheduled for the purpose of conducting irrigation operations when 60% of the prepared water is drained. It was found that there was an increase in the values of bulk density and resistance to penetration and a decrease in the values of water conductivity and average diameter as shown by the results, and this was at the end of the corn crop growing season and for all treatments compared to their values before planting. It gave the highest values of bulk density 2.05 and 1.96 $Mg.m^{-1}$ for Spiral and GR type, compared to 1.84 $Mg.m^{-1}$ for T-Tape. The results also showed that the water quality had a significant effect in increasing the values of soil resistance to penetration and bulk density and decreasing the values of saturated water conductivity and the average weighted diameter, where the highest values of the average weighted diameter when adding river water reached 0.98, 0.75 and 0.50 mm compared to well water 0.47, 0.41 and 0.37 mm for T-Tape, GR, and Spiral, respectively. The addition of river water 66% and 34% of well water increased the values of saturated water conductivity and average weighted diameter and decreased the values of bulk density and soil resistance to penetration compared to the method of adding 66% of well water and 34% of river water. The saturated water conductivity values were 2.86, 2.69 and 2.36 cm. $Hour^{-1}$ when adding 66% river water and 34% well water compared to 2.5, 2.41 and 2.16 cm. $Hour^{-1}$ when adding 66% well water and 34% river water to the T-Tape, GR and Spiral drops, respectively.

Keywords: dripper types, irrigation water quality, soil properties

Introduction

Irrigation is one of the main pillars for raising agricultural production in various parts of the world, and its importance increases in semi-arid and arid regions where rains are few and insufficient for crops to grow and reach the stage of actual and economic production. As a result of the increased demand for water due to the multifaceted human activity, it was necessary to reconsider the programs for its exploitation, distribution and rationalization of its consumption in the most appropriate and optimal manner. good soil as well as providing suitable conditions for plant growth (Abou Kheira., 2005).

Therefore, it is more efficient to rely on modern irrigation technologies that ensure the use of saline types of water that are available in abundance, in a way that ensures reducing the risks of this water on the soil and plants, to ensure that this water is not wasted for the purpose of addressing the shortage in fresh water sources used in agriculture, and saline water has been used for some time. Not a few in arid and semi-arid areas with methods and methods that reduce its negative impact on the soil and various crops, and among these common methods of using saline water is alternating or scheduling it with fresh irrigation water, and using different irrigation methods according to the type of soil and the crop (Al-Busaid, 2007).

The emitters vary in the ways they dissipate the energy of the water running through them, and most often used in the design of the dots is the idea of friction in the lengthening of the water paths or the swirling movement and others.

Material and methods

The experiment was carried out in the north of Dhi Qar Governorate, at latitudes 31°17′55″N and length 46°14′30″E during the autumn season of 2020 in clay-textured soil for the period from 28/7 2020 to 13/12/2020. Samples were taken from the fresh and salty irrigation water used in the irrigation of the crop for the purpose of measuring the electrical conductivity of them. The transactions were distributed in a factorial experiment according to the split-plot design, with three replications. After installing the drip irrigation system, three types of drippers were used: T-Tape, GR and Spiral, with a water discharge of 8 liters.hour^{-1}, an operating pressure of 90 kPa, the distance between the dots was 25 cm, and the distance between one branch line and another was 1.25 m.

The experiment included the following transactions:

A - Three types of pips are (T-Tape, GR and Spiral).

B - Two types of water were used for irrigation:

1 - The water of the Garraf River has an electrical conductivity of 0.7 dm.m^{-1}.

2 - Well water with an electrical conductivity of 4.38 ds. m^{-1}.

Irrigation water was used in a percentage method as follows:-

A: 100% river water. B: 66% of well water and 34% of river water.

C: 100% well water. D: 66% river water and 34% well water.

The saturated water conductivity was calculated using the Constant Head Method mentioned by Klute, A. 1965. The bulk density of the soil was estimated using the Russell method mentioned by (Black et al., 1965) by taking unstimulated soil models using a metal cylinder (Core Sampler) and dried in an oven at 105° C until the weight is stable. Soil samples with a depth of 0-30 cm were taken and placed over a group of sieves according to the 1965 Kemper method, and the weighted diameter average values were calculated according to the equation proposed by (Youker., 1956).

$$MWD = \sum_{I=1}^{n} XiWi \ldots\ldots\ldots\ldots (1)$$

whereas :-

Xi: the average diameter for any volumetric range of separated assemblies (mm). Wi: The weight of the remaining aggregates within one volumetric range as a proportion to the total dry weight of the soil model. MWD: weighted diameter ratio (mm).

Table (1) Some of the primary characteristics of the soil used for the experiment and the irrigation water.

<table>
<tr><td colspan="2">Soil Depth (cm)</td><td colspan="3" rowspan="2">Properties</td></tr>
<tr><td>20 -40</td><td>0- 20</td></tr>
<tr><td>235</td><td>240</td><td rowspan="4">$g.kg^{-1}$ soil</td><td colspan="2">Sand</td></tr>
<tr><td>245</td><td>210</td><td colspan="2">Silt</td></tr>
<tr><td>520</td><td>550</td><td colspan="2">Clay</td></tr>
<tr><td colspan="2">clayey</td><td colspan="2">soil texture</td></tr>
<tr><td>0.105</td><td>0.125</td><td colspan="3">Weighted diameter (mm)</td></tr>
<tr><td>1.275</td><td>1.267</td><td colspan="3">Bulk Density ($Mg. m-^{3}$)</td></tr>
<tr><td>7.25</td><td>7.70</td><td colspan="3">pH</td></tr>
<tr><td>295.32</td><td>315.79</td><td colspan="3">Total Carbonate ($g. kg-^{1}$)</td></tr>
<tr><td>2.69</td><td>3.25</td><td colspan="3">Organic matter ($g. kg-^{1}$)</td></tr>
<tr><td>10.85</td><td>9.67</td><td colspan="3">Ec dSm-1</td></tr>
<tr><td colspan="2">2.50</td><td colspan="3">True Density ($Mg.m-^{3}$)</td></tr>
<tr><td>50</td><td>52</td><td colspan="3">porosity %</td></tr>
<tr><td>33.64</td><td>32.47</td><td colspan="3">field capacity %</td></tr>
<tr><td>14.88</td><td>13.46</td><td rowspan="8">$ds.l^{-1}$</td><td>Ca^{++}</td><td rowspan="8">dissolved ions</td></tr>
<tr><td>11.06</td><td>8.05</td><td>Mg^{++}</td></tr>
<tr><td>61.48</td><td>51.34</td><td>Na^{+}</td></tr>
<tr><td>2.89</td><td>1.89</td><td>K^{+}</td></tr>
<tr><td>3.01</td><td>3.44</td><td>HCO_3^{-1}</td></tr>
<tr><td>17.81</td><td>17.49</td><td>SO_4^{-2}</td></tr>
<tr><td>60.74</td><td>58.93</td><td>Cl^{-1}</td></tr>
<tr><td>---------</td><td>---------</td><td>CO_3^{-2}</td></tr>
</table>

7.40	**pH**	**Irrigation Water**

The values of soil resistance to penetration were calculated using a(Pocket Penetrometer) with a cylindrical stem and a flat end and a penetration depth of 1 cm from the soil surface, according to the method proposed by Donald, 1965.

Results and discussion

Table (2) Analysis of variance of the tabular F values for the values of the physical characteristics studied in the experiment.

source	df	bulk density	conductivity saturated water	Weighted diameter rate	Soil resistance to penetration
Em	**2**	**185.80****	**189.87****	**320.60****	**103.56****
Ro	**3**	**911.32****	**993.91****	**428.21****	**258.16****
Em.Ro	**6**	**13.34****	**5.50***	**56.88****	**3.52***
Alternating or adding style -: Ro			**Dripper type -: Em**		

It is clear from Figure (1) that there is a difference in the values of the bulk density according to the different used droppers, which gave the lowest values for them when using the T-Tape dropper compared to the GR and Spiral types and with the different types of irrigation water used, which gave the highest values for the bulk density of 2.05 and 1.96 Mg.m $^{-1}$ for Spiral and GR compared to 1.84 Mg.m^{-1} for T-Tape. The decrease in the values of Pb when using the T-Tape dripper is due to the high displacement of salts due to the increase in moisture content, which leads to the separation of soil colloids and thus the wide spread of the root system (Agassi, 1981). The results of Figure (1) show significant differences between the values of Pb according to the water quality, as the bulk density increases with the increase in the salinity of the irrigation water for all droplets. Its lowest values when irrigated with river water reached 100% and were 0.92, 1.21 and 1.37 Mg.m^{-1} for T-Tape, GR and Spiral dots, respectively. When irrigating with saline water, this led to the destruction of soil agglomerations and caused separation, dispersal and sedimentation of soil particles, thus clogging the pores and forming a semi-deaf layer with a low permeability and a high apparent density. (Emdad and Fardad ., 2006).

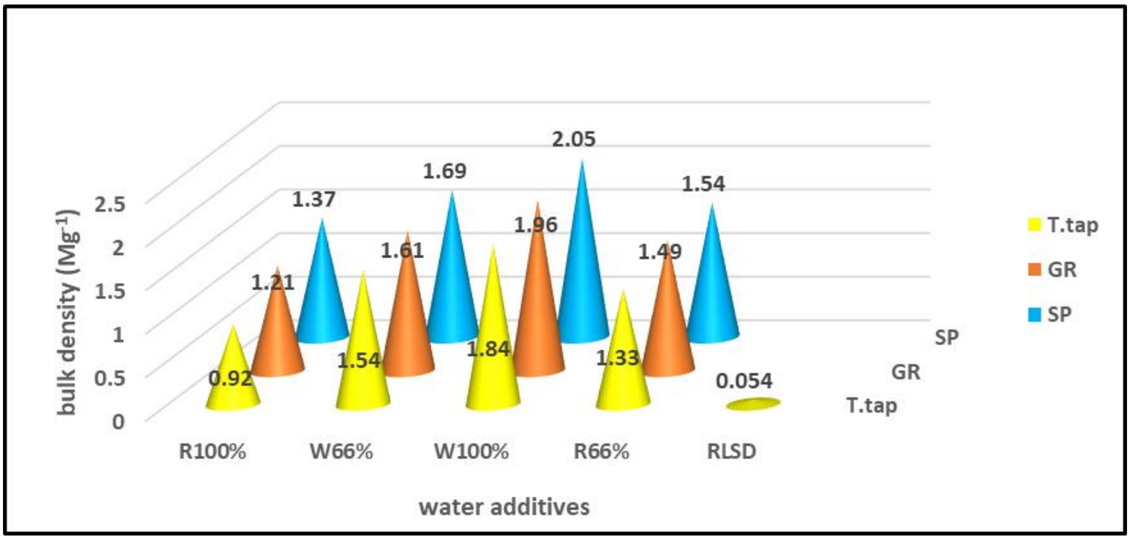

Figure (1) Effect of some types of drippers and rotations on water quality on the bulk density Mg-^{1} .

The results of Figure (2) showed significant differences between all saturated water conductivity values according to the quality of irrigation water, and for each dripper used in the experiment. Where it gave the highest values when using river water R100% and were 3.67, 3.35 and 3.05 cm. h^{-1} for T-Tape, GR, and Spiral, respectively. The low water conductivity values using shifts W 66% a well, R 34% a river, W 100% a well, is due to the deterioration of the soil structure, as the soil aggregates are crushed and the clay particles separate from each other, moving through the water movement paths, leading to the closure of the soil pores. Where the process of clay dispersal and swelling in the soil, especially when the sodium ion is present, and this process is the main cause in the breakdown of soil structure (Younan, 2008).

It is clear from the results in Figure (2) that the use of water quality R 66% in a river and W 34% in a well increased the saturated water conductivity values, reaching 2.86, 2.69 and 2.36 cm. Hour^{-1} compared to the quality of water added by rotation W 66% well and R 34% river, W 100% well, which gave (2.5, 2.41 and 2.16 cm. h^{-1}) and (2.1, 1.95 and 1.77 cm. h^{-1} and for drippers T -Tape, GR and Spiral, respectively. The addition of alternating water R 66% river and W 34% well led to a decrease in the salt concentration of the soil and this in turn helped to prevent the deterioration of soil aggregates and reduced their dispersal, which increased the saturated water conductivity values (Shabib, 2010).

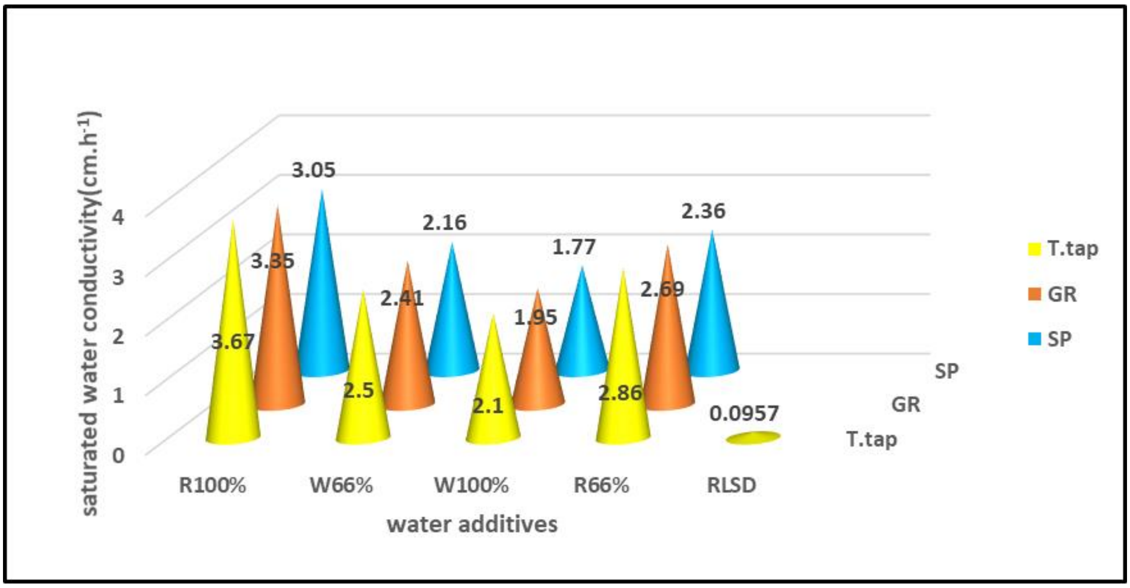

Figure (2) Effect of some types of drippers and rotations on water quality in saturated water conductivity (cm.h-^{1})

It is clear from the results in Figure (3) that the rotation method R 100% river water significantly increased the values of the average weighted diameter of the soil compared to the rotation method R 66% river and W 34% well, W 66% well and R 34% river, W 100% well. Its values at the rotation method R 100 were 0.98, 0.75 and 0.5 mm compared to the rotation method R 66% river and W 34% well 0.62, 0.53 and 0.49 mm, and rotation W 66% well and R 34% river which gave 0.54, 0.46 and 0.41 mm, alternating W 100% well 0.47, 0.41 and 0.37 mm for T-Tape, GR and Spiral drippers, respectively. The reason for this increase is attributed to the fact that the addition of river water led to a reduction in the EC and thus improved the physical properties of the soil. As for the decrease in the values of the average weighted diameter in the other shifts, it is due to the negative effect of the accumulation of salts in the soil sector, leading to the deterioration of the physical properties of the soil (Daniel I. 2008).

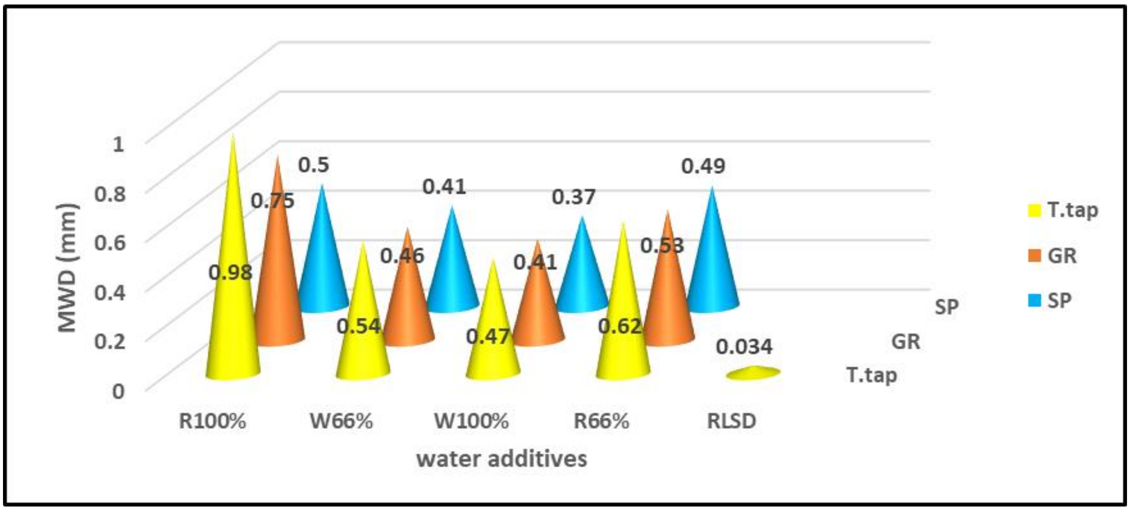

Figure (3) The effect of some types of drippers and rotations on water quality on the average weighted diameter mm.

Figure (4) shows the effect of the study coefficients on soil resistance to penetration, as it is noted that there is a difference in the values of soil resistance to penetration according to different types of dots used in the experiment. The highest value is 1.58 and 1.49 kg. cm^{-2} for Spiral and GR type compared to 1.36 kg. cm^{-2} for the type of T-Tape. The reason for the decrease in the values of soil resistance to penetration under the T-Tape is due to the increase in the moisture content of the soil, as the ability of the water envelopes surrounding the soil particles to reduce the strength of cohesion and the connection between these particles, which facilitates the penetration process (Al-Sheikhly, 2002).

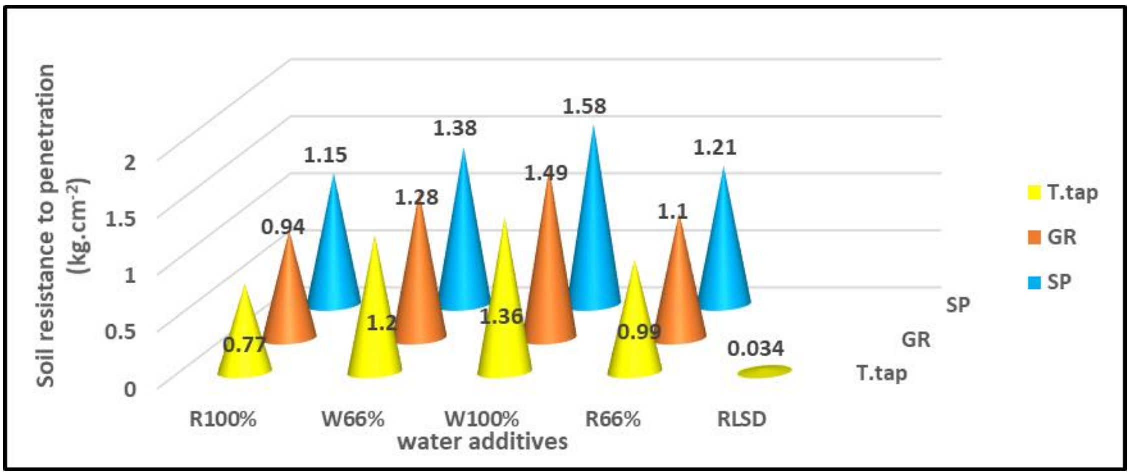

Figure (4) Effect of some types of drippers and rotations on water quality on Soil resistance to penetration kg. cm-1

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