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A STUDY OF THE EFFECT OF SITE ROTATION OF IRRIGATION LEVELS AND THE DISTANCE BETWEEN DRIPPERS ON SOME PHYSICAL SOIL PROPERTIES AND THE GROWTH OF MAIZE

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Abstract:
A field experiment was conducted at the site of Karma Ali / located between latitude 30-500N and longitude 47-740E in sedimentary soil of fine clay mixed, calcareous, hyberthermic typic torrifluvent (Al-Atab, 2008) during the spring agricultural season 2021-2022. With the aim of the effect of on-site rotation of irrigation levels using double field drip lines, the distance between the drippers and the degree of soil smoothing on some physical properties of the soil and the growth of maize (Zea mays L.).

It included the site rotation factor for the irrigation level with four rotations: 0-100%, 33-100-100%, 100-66%, and 100-100% calculated on the basis of the American evapotranspiration basin class A. The second factor is the factor of the distance between the drippers 25, 30 and 35 cm distributed alternately on two parallel field pipes for each experimental unit of 12 meters. as a fixed length of the field tube in the experimental unit, and the experiment coefficients were distributed with three replicates, Sectoral design was used complete randomness (R.C.B.D), The experimental units were cultivated with a crop of yellow corn in a valley on both sides of the drippers, as drip irrigation is carried out according to the alternations, in addition to the washing requirements of 20%. Soil samples were taken at two depths of 0-20 and 20-40 cm and at three horizontal distances of 0, 15 and 30 cm from the drip source at the beginning and end of the season for the purpose of studying some of the chemical and physical properties of the soil. Plant characteristics were also measured, including plant height and wet and dry weight. The results obtained were summarized by my agencies:

1- The site rotation treatments 0-100%, 33-100%, and 66-100% contributed to the rationalization of irrigation water by 50%, 34%, and 17%, compared to the 100-100% rotation treatment.

2- The results showed that the saturated water conductivity values increased and the bulk density decreased significantly when the site rotation treatment of the irrigation level was 100-100% compared to the site rotation treatments of 0-100%, 100-33% and 100-66%.

Keywords:

INTRODUCTION

The availability of water is one of the important and determining factors for the development of agriculture in arid and semi-arid regions, so competition for water resources has become important due to the rapid growth of population and the development of industry and civilization. This in turn led to the inclusion of many countries within the water deficit gap (Al-Jawad et al. , 2020). Therefore, it is necessary to adopt different methods, including the use of modern irrigation methods, in order to rationalize water consumption by reducing the depths of wastewater and the appropriate moisture depletion rates, which do not cause stress to the plant in the event that it obtains easily available water (Al-Mohammadi et al., 2018).

One of the basic things that must be taken into consideration when designing a drip irrigation system is the distance between each of the drippers and branch pipes and their lengths. Determining the best distance between the drippers makes the root zone with higher moisture than if the drippers were spaced apart from each other in terms of its effect on the distribution of moisture in the soil sector. The distance between the drippers (Baiamonte, 2016).

MATERIALS AND METHODS

The study was carried out on agricultural lands belonging to the College of Agriculture - University of Basra, Karma Ali site / located between latitude 30-500 north and longitude 47-740 east during the fall agricultural season 2019-2020 on a total area of 2500 square meters, and its soil was clay and classified as Fine clay mixed , calcareous, hyberthermic typic torrifluvent (Al-Atbah, 2008).

Selected combinations of the following irrigation levels were used:

1-100 % of the evaporation value (Epan A% 100) + 20% washing requirements.
2- 66 % of the evaporation value (Epan A% 100) + 20% washing requirements.
3- 33% of the evaporation value (Epan A% 100) + 20% washing requirements.
4- 00 % of the evaporation value (Epan A% 100) + 20% washing requirements.

Where the experiment included the use of the site rotation method and the irrigation time (time rotation), and a double drip irrigation system was used for two field tubes (fixed) in which the drippers alternated depending on the distance between the drippers used in the experiment as one of the experiment parameters. The system for arranging the shifts was as follows:

1- Treatment (100% -0% of evaporation value) + 20% washing requirements. It is applied in an experimental unit that uses two field pipes, as the drippers installed on the first field pipe give 100% of the evaporation value + 20% washing requirements, while the second pipe adjacent to it gives 0% of the evaporation value, and this is done in the first irrigation, but in the second irrigation, the irrigation system is reversed, i.e. The first pipe discharge of water will be 0%, and the second pipe will be 100% of the evaporation value. In the third irrigation, the first irrigation method is applied, and in the fourth irrigation, the second irrigation method is applied, and so on.

2- Treatment (100% - 33% of evaporation value) + 20% washing requirements. It is applied in an experimental unit that uses two field pipes, as the drippers installed on the first field pipe give 100% of the evaporation value + 20% washing requirements, while the second pipe adjacent to it gives 33% of the evaporation value + 20% washing requirements. This is done in the first irrigation, but in the second irrigation So the irrigation system is reversed, that is, the first tube will discharge water 33%, and the second tube will be 100% of the evaporation value + 20% washing requirements, and in the third irrigation, the first irrigation method is applied, and in the fourth irrigation, the second irrigation method is applied, and so on.

3- Treatment (100% - 66% of the evaporation value) + 20% washing requirements. It is applied in an experimental unit that uses two field pipes, as the drippers installed on the first field pipe give 100% of the evaporation value + 20% washing requirements, while the second pipe adjacent to it gives 66% of the evaporation value + 20% washing requirements. This is done in the first irrigation, but in the second irrigation So the irrigation system is reversed, that is, the first tube will drain water 66%, and the second tube will be 100% of the evaporation value + 20% washing requirements, and in the third irrigation, the first irrigation method is applied, and in the fourth irrigation, the second irrigation method is applied, and so on.

4- Treatment (100% - 100% of the evaporation value) + 20% washing requirements. It is applied in an experimental unit that uses two field pipes, as the drippers installed on the first field pipe give 100% of the evaporation value + 20% washing requirements, while the second pipe adjacent to it gives 100% of the evaporation value + 20% washing requirements also. This is done in the first irrigation, but in the irrigation The second one repeats the same method and continues in this manner throughout the cultivation period. The quantities of irrigation water were determined based on the evaporation value measured directly from the American evaporation basin (Evap.pan class-A), which was installed at the study site. During the three-day period that follows, during which water is added depending on the crop's need for irrigation, and an additional amount of 20% water was added as a washing requirement.

As for the second factor, it is the distance between the drippers, and it was as follows: - 25 cm. 30 cm. 35 cm.

The bulk density of the soil was estimated using the Russell method mentioned by Black et al., (1965), by taking unexcited soil samples using a metal cylinder (Core Sampler) and dried in an oven at 105^0 degrees until the weight stabilized.

The saturated water conductivity of the soil was measured by taking a soil sample by following the static water column method proposed by Klute and described in Black et al., (1965) by fixing a column of water over the unexcited soil column taken from the field by Core Sampler, and then calculating the volume of The water passing through the column for specific periods of time until the values are fixed with time, and the saturated water conductivity values of the soil were calculated by applying the following Darcy's law:

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

Since:

Ks : saturated water conductivity of the soil (cm min-1).
V : the volume of water passing through the soil column (cm3).
L : the length of the soil column (cm).
A : cross-sectional area of the soil column (cm 2).
t : time (minutes).
ΔH : the length of the soil column (L) + the height of the water column above the soil column (h) (cm).

Discuss the results

1- Soil Bulk Density (Pb)

It is clear from the results that there is a significant effect at the beginning of the season of the interaction between the two factors of the locational rotation of the irrigation levels and the distance between the drippers on the values of ρb and is not significant at the end. It shows a significant decrease in the values of ρb at the beginning of the season by increasing the rotation factor for the irrigation level and reducing the distance between the drippers, and the lowest values were 1.324 µg m-3 ρb at the beginning of the season when the treatment was 100-100% and the distance between the drippers was 25 cm, while the treatment gave 0-100% The distance between the drippers was 35 cm. The highest values were 1.439 µg m-3 ρb at the beginning of the season. The reason for the decrease in the ρb values may be attributed to the speed of overlapping of the wetting fronts due to the increase in the movement of water vertically and horizontally in the soil depth as a result of the increase in the level of added moisture and the close distances between the drippers and the resulting displacement of salts away to the boundaries of the wetting front, which is positively reflected in the improvement of the physical properties of the soil. Among them is the reduction of ρb in the soil body (Barboush and Diab, 2015).

Table (1) the effect of the overlap between the locational rotation and the distance between the drippers on the bulk density values (µgm-3) at the beginning of the growing season.

positional rotation %	Distance between drippers (cm)		
	25	30	35
0-100	1.415	1.425	1.439
33-100	1.389	1.397	1.407
66-100	1.359	1.370	1.382
100-100	1.324	1.337	1.349
$RLSD_{0.05}$	0.0032		

2- Saturated Hydraulic Conductivity (Ks)

The results showed that the effect of the bilateral interaction between the factors of site rotation of irrigation level and the distance between drippers on the saturated water conductivity values was significant at the beginning and end of the season. It is evident from (Table 2) the significant variation in the Ks values of the rotation treatment 100-100% compared to the rest of the rotation parameters under study, which change with the variation of the distances between the points. The highest significant differences appeared between the site rotations of the irrigation level at the distance between the drippers 25 cm compared to the two treatments 30 and 35 cm. In general, the highest values for the 100-100% rotation treatment and the 25 cm distance between drippers treatment were 0.865 and 1.038 m on Day-1 at the beginning and end of the season, respectively, while the lowest values were 0.569 and 0.736 m on Day-1 when on-site rotation treatment. 0-100% and the distance between the drippers was 35 cm at the beginning and end of the growing season, respectively. The reason for the increase in the Ks values is attributed to the maintenance of moisture content within not far limits of the field capacity at the level of 100-100% throughout the growth period, which contributed positively to the improvement of Ks-related soil properties by improving construction, reducing the bulk density and increasing the total porosity of the soil. While the humidity level is 0-100% and the overlap with the distance between the drippers of 35 cm did not contribute to the improvement of these characteristics due to the low leaching efficiency due to the low added moisture content and the low rate of water movement due to the spacing of the distance between the drippers (Sarhan and Abdullah, 2009).

Table (2) The effect of the bilateral overlap between the site rotation of the irrigation level and the distance between the drippers on the saturated water conductivity values (m day-1) at the beginning of the growing season (A) and its end (B).

growing stages	Beginning of the growing season			End of the growing season		
Distance between drippers (cm) / Positional rotation level of irrigation	25	30	35	25	30	35
0-100	0.643	0.615	0.569	0.777	0.757	0.736
33-100	0.712	0.688	0.666	0.853	0.829	0.802
66-100	0.796	0.767	0.739	0.921	0.899	0.878

100-100	**0.865**	**0.840**	**0.820**	**1.038**	**0.998**	**0.960**
$RLSD_{0.05}$	**0.0118**			**0.0124**		

3- Plant height

The results show that there is a highly significant effect of the distance factor between drippers on plant height values at the end of the season. When comparing these treatments, significant differences appeared between all treatments (Fig. 1), as the 25 cm treatment recorded the highest values by 165.38 cm, while the values were 160.17 and 156.50 cm for the two treatments 30 and 35 cm, respectively. With a decrease of 3.15% and 5.36% compared to the 25 cm treatment. The height of the plant when the distance between the drippers is reduced is due to the availability of optimal moisture for plant growth, which leads to a decrease in the effort exerted to absorb water and nutrients, and thus an increase in the rate of photosynthesis and growth processes and an increase in cell division and elongation, which is positively reflected in the height of the plant. Through the convergence of the distance between the drippers, it contributes to reducing the salinity of the soil and increasing the stability of its aggregates, which increased the provision of appropriate conditions of moisture and ventilation to increase the growth and spread of the root system, and this was reflected in the plant height (Cakir, 2004).

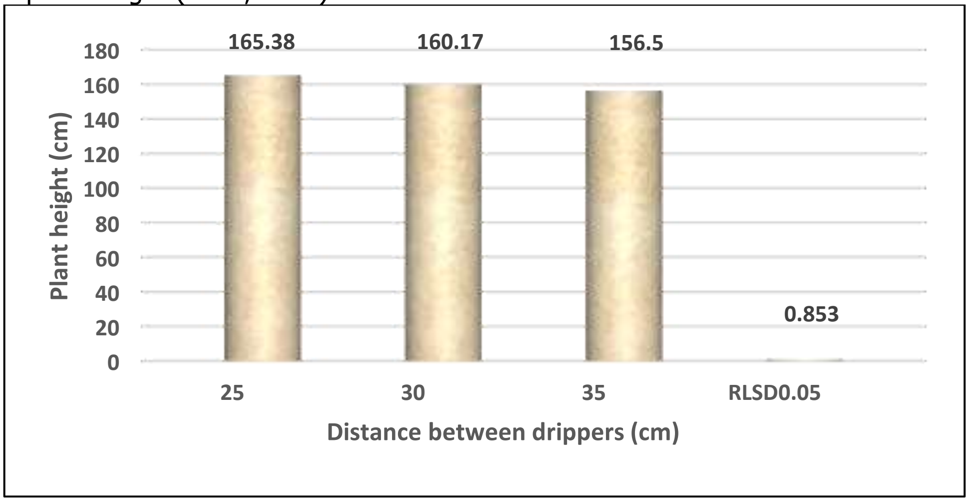

Figure (1) The effect of the distance between drippers (cm) on plant height values (cm) at the end of the season.

The results show that there is a highly significant effect of the site rotation factor of irrigation level on plant height values at the end of the season. When comparing the treatments, it turns out that there are significant differences between all the treatments in Figure 2, as the treatment 100-100% gave the highest values by 178.61 cm, while the treatments recorded 100-66%, 100-33%, 100-0% the lowest values by 166 and 155.17 and 142.94%, respectively, with decrease rates of 7.06%, 13.12%, and 19.97%, compared to the treatment of 100-100%. The reason for the increase in plant height values at high irrigation levels is due to the increase in the added moisture content, which contributes to raising the standard of homogeneity in the distribution of water and thus making the plant in a state of balance by obtaining its sufficient amount of irrigation water without being subjected to water stress, as well as increasing the availability of nutrients. of the plant, which is reflected in the height of the plant (Bouazzama ,et al. 2012).

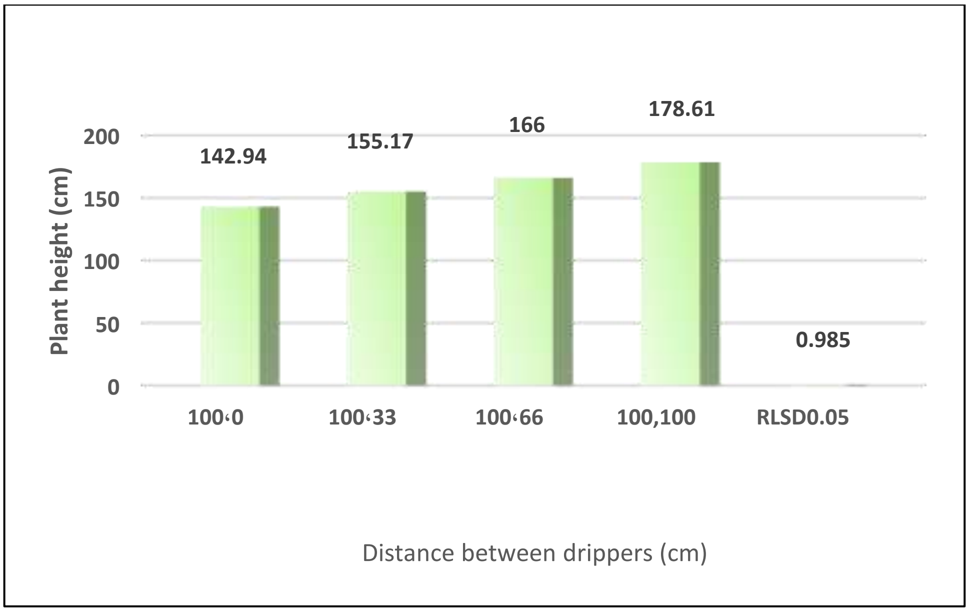

Figure (2) Effect of site rotation of irrigation levels on plant height values (cm) at the end of the season.

4- Dry and wet weight of the vegetative part of the plant

The results show that there is a significant effect of the distance factor between drippers on the dry and wet weight of the vegetative part at the end of the season. When comparing these treatments, there were significant differences (Fig. 3), as the 25 cm treatment recorded the highest values of 13.18, 20.48 tons ha-1 and it did not differ significantly from the 30 cm treatment, which recorded 13.07, 20.25 tons ha-1, but it differed significantly For the 35 cm treatment, which gave the lowest values of 12.19 and 18.96 tons hectare-1 for the dry and wet weight of the vegetative part, respectively. It is also noted from the results that the differences were significant between the treatments of 25 cm and 35 cm for dry and wet weight, respectively. The reason for the increase in the dry and wet weight values of the vegetative total is due to the provision of optimal moisture for plant growth and thus reducing the effort exerted to absorb water and nutrients by converging the distance between the drippers and the speed of convergence and overlapping of the moisture fronts. The root system spread area and reduce its osmotic effect, which leads to a decrease in the amount of water entering the plant and thus increases the effectiveness and activity of the photosynthesis process and its products, and in turn encourages the building of proteins and carbohydrates, which reflected positively on increasing the growth of the vegetative part of the plant (Arbat et al., 2010).

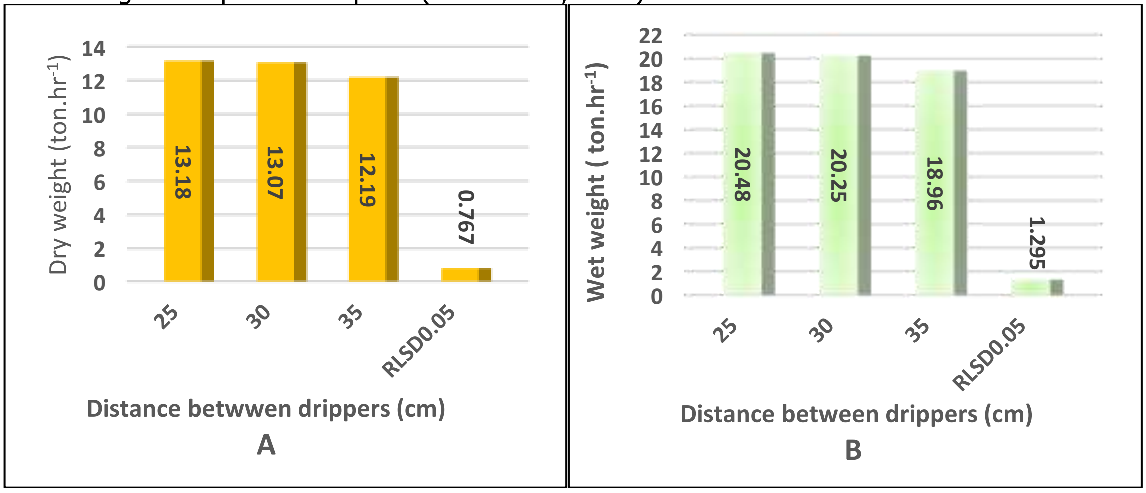

Figure (3) The effect of the distance between the drippers (cm) on the dry (A) and wet (B) weight values of the vegetative part (1 ton hectare) at the end of the season.

The results show that there is a highly significant effect of the rotation factor in the irrigation levels, which is represented by the amounts of water added by 50%, 66%, 83% and 100% for the shift treatments as an average for each two consecutive waterings of one dripper on the weight values of the dry and wet vegetative part of the plant at the end of the season. When comparing the treatments, there are significant differences in Figure 4, as the treatment 100-100% gave the highest values by 14.29, 22.75 tons hectare-1, while the treatment 0-100% recorded the lowest values by 11.31, 16.89 tons hectare-1. As for the treatments 100-33% and 100-66%, they recorded 12.30, 19.49 ton ha-1 and 13.35, 20.47 ton ha-1 for dry and wet weight, respectively. It is also clear from the results that the differences were significant between all treatments for the dry and wet weight of the vegetative part of the plant and non-significant between the treatments of 100-33% and 100-66% for the wet weight. It is noted from the results that there is an increase in the values of the dry and wet weights of the vegetative part of the plant with an increase in the level of irrigation, by 8.75, 18.03, and 26.34% for the dry weight, and 15.39, 21.19, and 34.69% for the wet weight, compared with the treatment of 0-100%, respectively. The reason may be attributed to the availability of optimal water quantities for plant growth, in addition to the aforementioned reasons related to the increase in the spread of roots and their overlapping role with soil organisms, which promotes the efficiency of salt leaching at a high irrigation level, which encourages an increase in the absorption of water and nutrients, and thus increases the rates of photosynthesis and what it produces in plants. Building proteins and carbohydrates, and then increasing the wet and dry weight of the vegetative part of the plant (Kazemeini et al.2009).

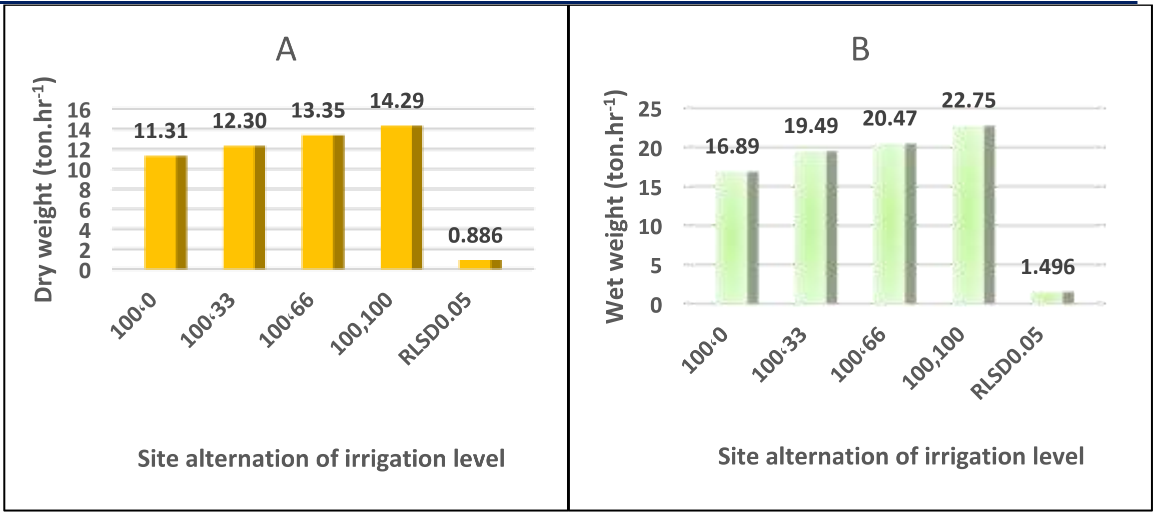

Figure (4) The effect of site rotation of irrigation levels on the dry (A) and wet (B) weight values of the vegetative part (ton. hectare^{-1}) at the end of the season.

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