

EVALUATION OF THE TILLAGE SYSTEMS ON THE SOIL MOISTURE CONTENT DISTRIBUTION UNDER DRIP IRRIGATION

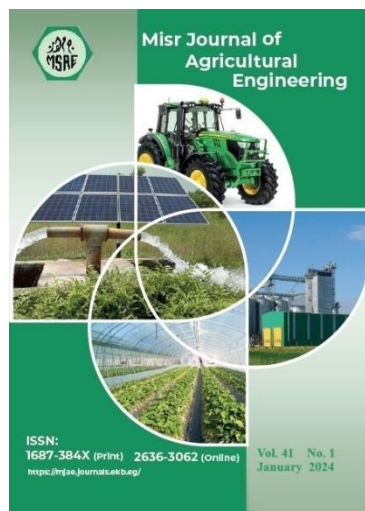
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ABSTRACT

Egypt's farmers would face a constant lack of water, so the main objective of this study is to choose the best tillage system to result in the soil retaining the suitable amount of water using a drip irrigation system with reducing irrigation to save water and ensure that plants receive water and produce superior crops. Two tillage treatments were used, with a chisel plow in the horizontal direction and a rotary plow in the perpendicular it (Ch+R), and plowed with the chisel system in both horizontal and vertical directions with a chisel plow using the wooden blade (2Ch+W). Two irrigation systems were traditional surface irrigation (basin) and surface drip irrigation; four treatments were 100%, 80%, and 60% traditional. The 2Ch+W treatment recorded a higher yield than the Ch+R treatment. The main results were obtained with a 100% applied irrigated rate, and the lowest values were recorded with a 60% irrigation usage rate. When comparing the drip irrigation system with 100% treatment to the basin system, the crop production of snake cucumber was decreased by 17.6% and 18.27% for the 2Ch+W and Ch+R treatments, respectively, for surface irrigation. Effect of tillage and irrigation treatments on Water use efficiency (WUE) in all treatments of irrigation (100%, 80%, and 60%) compared with basin treatment recorded 74.12%, 85.16%, and 94.75%, respectively for 2Ch+W treatment but 66.58%, 75.64%, and 79.58% respectively for Ch+R treatment.

INTRODUCTION

The lack of water is the most serious issue in many agricultural areas as a result of Ethiopia's construction of the Grand Ethiopian Renaissance Dam (GERD). As a result, in Egypt, the efforts apply different methods to solve the lack of water and achieve successful water management. One of these methods is to use a drip irrigation system as a function based on soil moisture. The design of a fine drip irrigation system depends on knowledge of perpendicular to the form and size of moist soil obtained from various tillage treatments. Increasing moisture in the soil level and reducing bulk density of soil was necessary impact of tillage processes on soil physical properties. Tillage and mulch had an

impact on the physical properties of the soil as well as maize growth by Khurshid et al. (2006). The chisel-plowed plots had lower soil bulk density in the tilled layer than the disk-plowed and moldboard-plowed plots. It also increased when the axle load in the tillage zone increased by Abu-Hamdeh (2004).

It has been reported Ordoñez-Morales et al. (2019) that there was a modest decrease in bulk density and an increase in pore space for conventional tillage and no-tillage, but essentially no change in these variables for vertical tillage. Different tillage methods influenced bulk density (ρ), particle density (P_d), porosity, field capacity, and permanent wilting limits, after four years, tillage techniques resulted in a decrease in bulk density. With conventional tillage, the increase in field capacity from the first year value was the smallest. The various tillage strategies had effects on the permanent wilting point (PWP) and tillage treatments produced a minor but permanent positive effect on porosity. Tillage methods increased soil porosity after four years as compared to the first year, according to Alam et al. (2014).

Khurshid et al. (2006) reported deep tillage had the lowest bulk density (1.38 Mg m^{-3}), while conventional tillage had the highest soil moisture content (18.51 percent). Abu-Hamdeh (2004) reported that it has been emphasized that the type of tillage treatments applied has an effect on soil retention and water holding capacity. The tillage system has had an important effect on the retention of water at each suction and the soil's plant accessible water capacity. Finer soil particles were created by chisel plowing, which improved soil pore space and, as a result, the amount of water retained by the soil. In addition, as pore space increases, so does the amount of water given to the plants. The increases in plant accessible water capacity of the soil for different tillage treatments started to decrease as compaction increased. Because compaction breaks down larger soil particles aggregated into smaller ones, water draining out of soils becomes more difficult due to the increased force of resistance between micropores and soil water. Increased axle load on dirt has the result of reducing total porosity and increasing the percentage of smaller pores for the same tillage treatment because compact has broken down some of the originally bigger holes into smaller ones. Mohammadi et al. (2009) reported that in terms of yield, chisel plows beat other plowing methods. Chisel ploughs improve the soil's physical and moisture properties. Yaghi et al. (2013) reported that Because of significant differences in soil moisture in the rooting zone, surface furrow irrigation reduces the irrigation rate from one irrigation every few days as a drip system to one every week, resulting in a 17% drop in cucumber output when compared to drip irrigation (DI) treatment and cucumber efficient root spreading zones have been found in 0.30 m increments up to 0.90 m deep following irrigation with each treatment. Sahin et al., (2015) reported that according to the study's findings, cucumber plants are sensitive to the amount of water they receive. As a result, drip water treatments using Class Pan Evaporation (100%) in semi-arid areas with cool climates would be optimal for increasing fruit harvests. A second finding is that water applications should be equal to 75% of Class Pan Evaporation to maximize fruit quality and irrigation water use efficiency has been emphasized. Nada and Abd El-Hady (2019) reported that lowering irrigation levels gradually reduced cucumber overall production (ton fed⁻¹) over two seasons. The highest values were achieved with the highest applied irrigated rate (1200 m³ fed⁻¹) and the lowest values were usage irrigation amount of 600 m³ fed⁻¹.

The main objective of this research is to select the optimal tillage strategy that results in the soil retaining the most required water while employing a drip irrigation system with reduced irrigation to save water.

MATERIALS AND METHODS

The study site was at El-Gemiza, Research Station, El-Gharbia Governorate, Egypt. Field location with latitude of 30.8° & 31.12° longitude, and 11.0° altitude. On the clayey soil, the experiments were conducted on the snake cucumber (*Cucumis melo* var local variety). The soil mechanical properties and some of the soil physical analysis are tabulated in Table 1.

Table 1. Soil mechanical and some physical analysis:

Depth, cm	Percentages soil particles %					Soil physical properties			
	Sand	Silt	Clay	Textural class	CaCo3	ρ (g cm ⁻³)	F.C, %.	W.P, %.	A.W, %.
0 – 15	15.21	41.02	43.76	Clayey	2.85	1.127	42.81	22.38	20.43
15 – 30	12.14	37.87	49.99	Clayey	4.37	1.135	39.33	21.76	17.57
30 – 45	10.71	40.32	48.97	Clayey	4.3	1.171	37.21	20.40	16.81
45 -60	10.49	39.65	49.86	Clayey	4	1.168	35.05	19.87	15.18

ρ : Soil bulk density, F.C: Field capacity, W.P: Welt point, A.W: Available water

The *Cucumis melo* var (snake cucumber) seeds were planted at 60 cm between plants, and 100 cm between rows. Per hill two seeds were planted beneath the soil surface. The soil was divided into two sections of 20 x 25 m each. At a depth of 20 cm, horizontally all of the plots were plowed with a chisel plow (4 rows with an operating width of 240 cm). Half of the plots were plowed with vertically using a rotary plow (Ch+R). The other was plowed in vertical directions using a chisel plow (2Ch+W).

In the field experiments, the SDI system was used with a lateral inner diameter of 12 mm. The emitter flow rate was 4 l/h for each with 30 cm spacing and 1m between lateral lines. The irrigation treatment in the study was determined to be 100% (M1), 80% (M2), and 60% (M3) from ETo. The experimental area was divided into two blocks for two different tillage treatments, and each block was then divided into four strips (2.5 x 20 m). Snake cucumbers were drip irrigated for 128 days in three stages as follows: 25 days for initial (IP), 86 days for middle (MP), and 17 days for end (EP)., According to **Allen et al. (1998)**.

Surface basin irrigation was used as the control with a plot area of 6m x 20m with a total area of 880 m². Also, the tract was irrigated in three stages IP (16 days), MP (86 days), and EP (12 days) for a total stage of 114 days. MP took 86 days, and EP took 12 days, In accordance with the **Allen et al. (1998)**.

The experiment was carried out in a split-plot layout, with the tillage system in the main plots and water treatment in the sub-plots.

The raw data of the average soil moisture content for the two seed bed preparation treatments with applied water by surface irrigation treatments and applied water by drip irrigation

treatments were collected. Soil samples taking at various depths (0-5cm, 5-10cm, 10-20cm, 20-30cm, 30-40cm, and 40-45 cm) to compare the moisture content of the soil before irrigation (B1), and after irrigation. (A48h).

Soil samples were collected from each treatment plot at six previous separate soil layers ahead of irrigation. There were collected using a soil core. The soil cores had a diameter of 3 cm and a height of 10 cm. Weighted soil samples were placed in jars and there were dried for 24 hours at 105°C in an electrical oven. Following that, all of the jars were weighed.

The bulk density of the soil was determined using Equation 1:

$$\rho = \frac{M}{V} \quad (1)$$

Where: ρ = Bulk density (g cm^{-3}), M = The mass of the dry soil sample (g), V = The sample volume (cm^3)

The pore volume (P) is obtained from the soil bulk density with the aid the equation (2) (Ordoñez-Morales et al. 2019)

$$SP = (1 - (\rho / Pd)) \times 100 \quad (2)$$

Where

$$SP = \text{Pore space (\%)}, \rho = \text{Bulk density (\text{g cm}^{-3})}$$

and

$$Pd = \text{Particle density (\text{g cm}^{-3})}.$$

Soil samples were collected from each replication plot before irrigation at six soils from locations 0, 15, 30 cm distant from the emitter along laterals and same distance between laterals. It also collected after 48 hours of irrigation. The amount of moisture in the soil was calculated using Equation (3) (Israelson and Hansen 1963).

$$M_d = \frac{(\text{wt of wet soil}) - (\text{wt of dry soil})}{(\text{wt of dry soil})} \quad (3)$$

According to Allen et al. (1998), the Penman-Montieth equation was utilized to determine ETo . CLIMWAT and CROPWAT model are being used. And crop k_c was acquired from FAO. Water applied to the basin irrigation plots was calculated according to Michael (1978). The orifice discharge was calculated using the following equation (4).

$$Q = CA\sqrt{2gh} \quad (4)$$

Where

Q = Discharge through a tube, $0.01 \text{ m}^3\text{sec}^{-1}$ (10 L sec^{-1}).

C = Coefficient of discharge 0.6 (0.6 up to 0.8).

A = Cross-sectional area of the tube (78.5 cm^2).

G = Acceleration of gravity (9.81 m sec^{-2}).

H = Head of water causing discharge through the tube (0.1 m).

Crop evapotranspiration is calculated from the following Equations.

$$Etc = Eto \times Kc = \quad (5)$$

The soil moisture content differences (SMCD) were determined using the following Equation.

$$SMCD = SMC \text{ A48 h} - SMC \text{ B1} \quad (6)$$

Where:

$SMC \text{ A48 h}$ = Soil moisture content after 48 h from irrigation

SMC B1= Soil moisture content before irrigation

Then the curves were drawn to the differences in the moisture content by the application (SURFER 10).

Water use efficiency (WUE) was determined by (Viets, 1962) and (Yaghi et al., 2013) as

$$WUE = \frac{\text{Crop yield}}{\text{Water used to produce the yield}} \quad (7)$$

Where the crop yield is used in kg m^{-2} (kg fed^{-1}) and the water used to produce the yield used in ($\text{m}^3 \text{ fed}^{-1}$) then WUE (kg m^{-3}) is identified.

There was a total of 18 moisture data points in the soil profile. From these 18 sites, the application (SURFER 10) was used to build moisture content lines, and contour maps for SMCD with depth were created.

RESULTS AND DISCUSSION

Soil specification for basin irrigation system

Before planting, the data in Table (2) showed the average soil bulk density (ρ , g/cm^3), porosity (SP, %) and soil moisture content (γ , %) for basin irrigation before tillage (BT), after tillage (AT) and after 48h from basin irrigation (A-48h) under 2Ch+W and Ch+R treatments at 0-5cm, 5-10cm, and 10-30 cm depths. In general, the average soil bulk density increased with depth. The rate of increase in bulk density ranged from 0.18 to 0.8 % for different treatments. The soil porosity (SP,%) was reduced with depths down after tillage and the rate of reduction in soil porosity ranged from 0.03 to 0.6 % for different treatments

The average change of the soil moisture content distribution was decreased in depths down to (Table 2), with ranged from 3.83 to 8.2 % for 2Ch+W and Ch+R treatments. Meanwhile, the soil moisture content at A-48h for the first irrigation increased in percentage when compared to “AT” treatments at 0-5cm, 5-10cm, and 10-30cm depths, respectively. The range of soil moisture content increased from 47.42% to 57.87%, for the Ch+R and 2Ch+W treatments. In addition, the difference in moisture content between the two treatments (2Ch+W and Ch+R) was noticeable, with the 2Ch+W treatment decreasing at depths 0-5cm and 5-10cm by 2.7% and 2.44%, respectively, when compared to the Ch+R. While the Ch+R reduces depth by 10-30cm by 2.1% more than the 2Ch+W treatment.

Table (2): The soil bulk density g/cm^3 , soil porosity%, and soil moisture content % with the basin irrigation system (Traditional treatment)

Tillage treatment	Depths, cm	Before tillage (BT)			After tillage (AT)			A-48h		
		ρ g cm^{-3}	SP %	γ %	ρ g cm^{-3}	SP %	γ %	ρ g cm^{-3}	SP %	γ %
2Ch+W	0-5	1.127	57.46	20.10	1.120	57.73	18.83	1.124	57.58	43.09
	5-10	1.127	57.49	20.49	1.121	57.71	19.02	1.126	57.49	42.91
	10-30	1.135	57.18	21.65	1.128	57.42	20.71	1.130	57.27	40.16
	30-45	1.167	55.96	23.22	1.168	55.91	22.68	1.167	55.96	37.69
Ch+R	0-5	1.127	57.46	20.10	1.118	57.80	18.56	1.123	57.62	44.05
	5-10	1.127	57.49	20.49	1.118	57.80	18.81	1.125	57.54	43.81
	10-30	1.135	57.18	21.65	1.133	57.25	20.82	1.132	57.27	39.60
	30-45	1.167	55.96	23.22	1.167	55.96	22.88	1.167	55.96	37.50

ρ : Soil bulk density, g cm^{-3} SP: Soil porosity, % γ : Soil moisture content, %

Soil specification for drip irrigation treatments

Before planting, the data in Table (3) showed the average soil bulk density for drip irrigation treatments under different tillage treatments. In general, soil bulk density and soil moisture content increased with depth, Meanwhile, soil porosity decreased with depth. The rate of increase in bulk density ranged from 0.2 to 0.7 % for different treatments. The rate of reduction in soil porosity ranged from 0.14 to 0.49 % for different treatments. The rate of increase in soil moisture content ranged from 4.8 to 56.36 % for different treatments.

Table (3): The soil bulk density g/cm^3 , soil porosity%, and soil moisture content for the drip irrigation system 100 % applied water

Tillage Treatments	Depths, Cm	Before tillage			After tillage			After 48 h. from 100% drip irrigation		
		ρ g cm^{-3}	SP %	γ %	ρ g cm^{-3}	SP %	γ %	ρ g cm^{-3}	SP %	γ %
2Ch+W	0-5	1.127	57.46	20.10	1.121	57.70	18.75	1.124	57.58	42.97
	5-10	1.127	57.49	20.49	1.122	57.68	18.93	1.125	57.56	42.77
	10-30	1.135	57.18	21.65	1.127	57.46	20.62	1.130	57.35	39.91
	30-45	1.167	55.96	23.22	1.167	55.96	22.62	1.167	55.96	37.51
Ch+R	0-5	1.127	57.46	20.10	1.119	57.78	18.44	1.122	57.66	43.34
	5-10	1.127	57.49	20.49	1.119	57.77	18.74	1.124	57.60	42.98
	10-30	1.135	57.18	21.65	1.132	57.26	20.73	1.132	57.27	39.37
	30-45	1.167	55.96	23.22	1.168	55.91	22.76	1.167	55.96	37.27

The irrigation timetable for basin irrigation

The amount of water applied is shown in Fig. 1 as the average of the Initial Period (IP), Mid Period (MP), and End Period (EP) of the planting duration under two soil treatments (2Ch+W & Ch+R). At the IP of planting, the amount of water provided was 435.40 and 415.80 $\text{m}^3\text{fed}^{-1}$ for the 2Ch+W and Ch+R, respectively. Also, during 2Ch+W and Ch+R soil treatments; there were 3087.35 & 2928.10 $\text{m}^3\text{fed}^{-1}$ and 574.70 & 547.40 $\text{m}^3\text{fed}^{-1}$ at MP and EP of planting duration, respectively. For the 2Ch+W and Ch+R soil treatments, the total amount of applied water was 4097.45 and 3891.30 $\text{m}^3\text{fed}^{-1}$, respectively. In general, the 2Ch+W treatment used around 206.15 $\text{m}^3\text{fed}^{-1}$ (5.03%) more applied water than the Ch+R treatment.

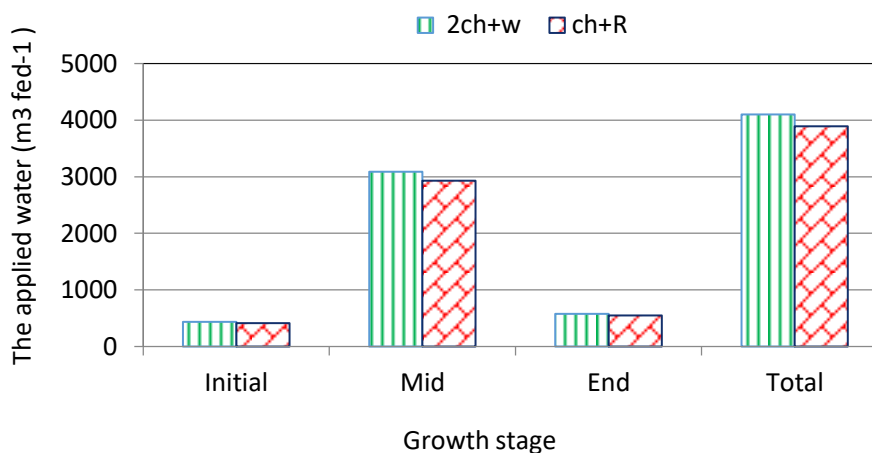


Fig (1): The applied water ($\text{m}^3 \text{fed}^{-1}$) Via IP, MP and EP.

The experiments indicated about 117.17 m³ and 111.19 m³ of water used to irrigate a 120 m² of farm area for Ch+R and 2Ch+W treatments, respectively per using basin irrigation technique. Then one feddan requires 4100.95m³ or 3891.72 m³for Ch+R and 2Ch+W treatments respectively.

The irrigation timetable for drip irrigation

At IP of the planting period, the applied water was 205.80, 163.80, and 122.85 m³fed⁻¹ for 100%, 80%, and 60% drip irrigation treatments, respectively. Whereas, at MP and EP of planting period were 2240.70, 1789.62, and 1338.33 m³fed⁻¹ and 412.44, 329.95, and 246.96 m³fed⁻¹ during 100%, 80%, and 60% drip irrigation treatments, respectively. As shown in Fig. (2), the total periods of applied water were 2858.94, 2283.37, and 1708.14 m³fed⁻¹ for 100%, 80%, and 60% drip irrigation treatments, respectively.

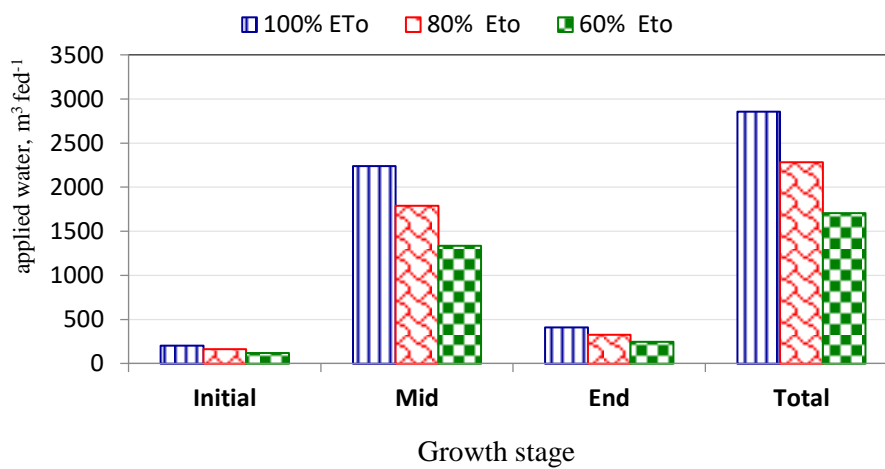


Fig (2): The drip applied water Via IP, MP and EP.

The SMCD for basin irrigation

Figures (3),(4) and (5) show the average of soil moisture content differences distribution after 48 hours of basin irrigation for 2Ch+W and C+R treatments at different depths for the first (IP), middle (MP), and end irrigations (EP), respectively.

In general, average soil moisture content increased in depths down to 48 hours following basin irrigation. Figure (3) shows that the moisture content of the Ch+R treatment increased more than the moisture content of the 2Ch+W treatment at depths 0-5cm. While the increase of moisture content of 2Ch+W treatment was greater than Ch+R at depths 20-30cm, 30-40cm, and 40-45cm by 6.33%, 7.34%, and 22.05% respectively as shown in Fig (3) and 0.78% and 1.13% respectively as shown in Fig (4), the increase of moisture content of both treatments was equal at depth 40-45cm. The rise in moisture content of both treatments was equal at all depths, as shown in Fig (5). Balance in the rate of addition, moisture, and depth of additional moisture in both types of tillage, as well as the recovery of natural soil qualities to pre-till. This balancing achieves the same ground moisture percentages and addition rate as mid-season irrigation. There is a balance in the distribution of granules in both types of tillage at the middle irrigation, but when the frequency of irrigation increases, the rate of water addition reduces because ground moisture increases with irrigation in surface irrigation. Because of the long period between irrigations, the moisture before may reach 80% of the field capacity of

each layer in (2Ch+W) treatment at 20cm depth and 85% of the field capacity in (Ch+R) treatment up to 10cm deep and 80% of the field capacity up to 10-20cm deep and 85% up to 20cm and the layers below that and up to a depth of 40cm in (2Ch+W) moisture but 85% of the field capacity of these layers in (Ch+R). In both tillage cases, the rate of addition is balanced, and the amounts of irrigation water added are equal. In both types of tillage, the moisture is parallel in each layer. The depth of moisture provided and accumulated from previous irrigations for mid-season irrigations raises the depth of moisture in the tillage of (Ch+R) treatment to the layer of (30-45cm) and is lower than the moisture ratios of (2Ch+W).

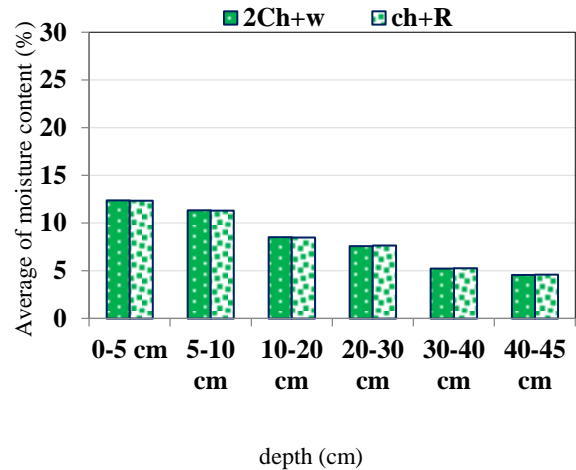
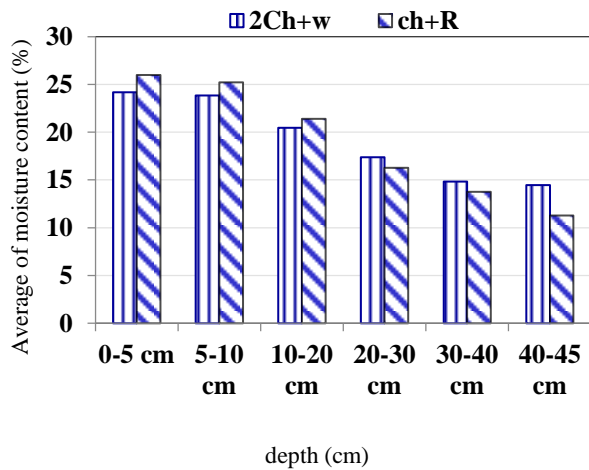


Fig (3): The average SMCD after 48 h from surface irrigation for IP

Fig (4): The average SMCD after 48 h from surface irrigation for MP

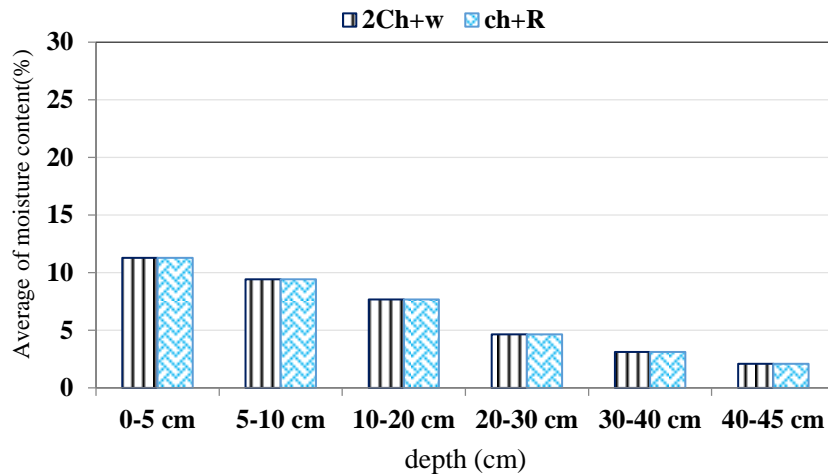


Fig (5): The average SMCD % after 48 h from surface irrigation for EP
The SMCD for drip irrigation 100%

The data in Figures (6) to (8) showed the contour curves for the soil moisture content differences distributed along lateral and between lateral after 48h from drip irrigation (100%) at IP, MP, and EP of planting stages. The data were collected for 2Ch+W and

Ch+R treatments at the emitter center, 15-30cm, and 30-45cm from the emitter under depths of 0-5cm, 5-10cm, 10-20cm, 20-30cm, 30-40cm, and 40-45 cm. In general, average soil moisture content at IP decreased in depths down along the lateral and reached the field

capacity at a depth of 30cm along the lateral and close to the field capacity at a depth 10cm between laterals at 15 cm from the emitter. The soil moisture content for the roots spreading zone at MP and EP and at 30cm from the soil surface was 18.85% and 17.4% along lateral and around 11.2% and 0.6% between lateral for 2Ch+W and Chr+R, respectively.

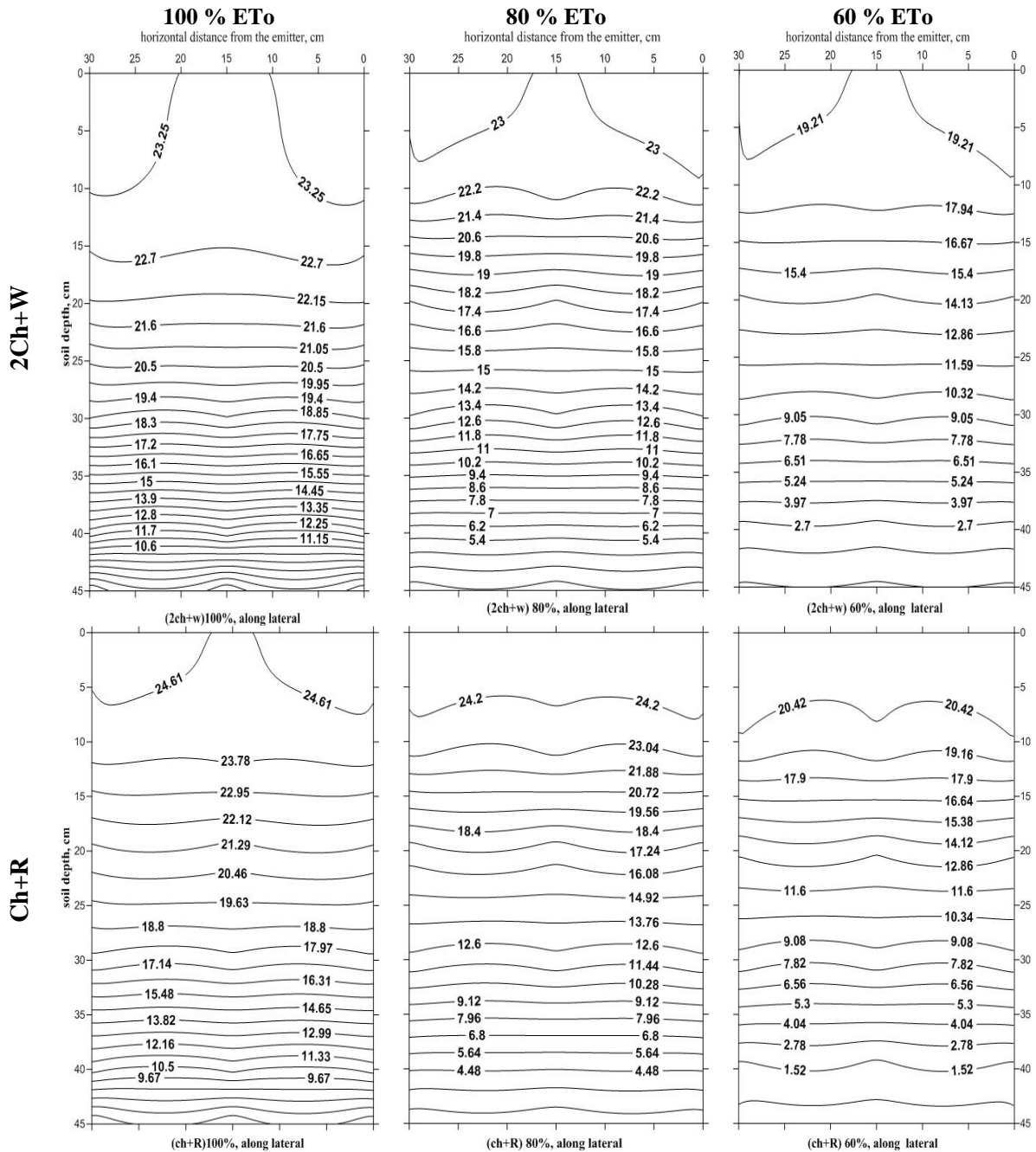


Fig. (6): The contour curves of the SMCD at the initial stage

At the distance of 30 cm from the emitter close to the field capacity at the depth 5cm. The moisture before irrigation is 2.5-5% lower in (2ch+w) than field capacity in the tillage layers from 0-20cm, while it is 2-3% lower in (Ch+R) in the 0-10cm layer and 5% lower in the 10-20cm layer, and the moisture depth in (Ch+R) increases by 5cm while it is fixed in (2Ch+W) at the middle irrigation. But, before irrigation is 5% lower than the field capacity in both types

of tillage. The regularity of moisture with drip irrigation greater since moisture in surface irrigation before irrigation is 18-20% higher than after irrigation than the layer's field capacity. Regular germination and growth throughout the season are more consistent than surface irrigation and are more consistent than field capacity. Drip irrigation saves more water than surface irrigation.

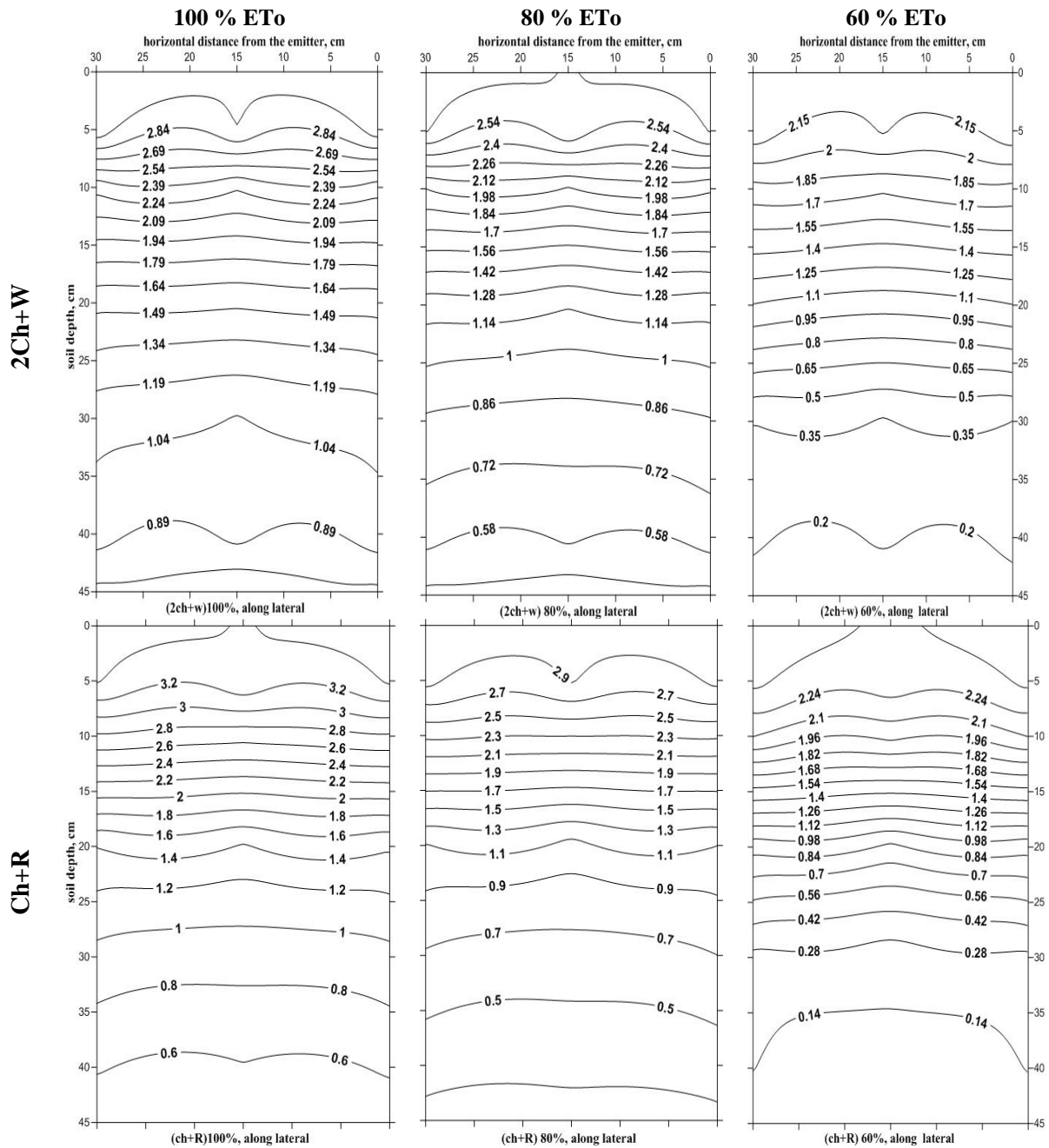


Fig. (7): The contour curves of the SMCD at the mid-stage.

The SMCD for drip irrigation 80

In general, the rate of additional water is one in both tillage procedures. Because of the inherent soil qualities following tillage, the ground moisture of the (2Ch+W) treatment is lower than that of the (Ch+R) treatment. The depth of moisture in (2Ch+W) is larger than in (Ch+R). Since the 80% water, the average ground moisture of the (Ch+R) treatment is higher

in the surface layer 0-10cm than that of the (2Ch+w) treatment. While the moisture depth is less than 100%, it is more in the (2Ch+w) treatment and reaches a depth of 40cm, while it is less in the (Ch+R) treatment.

The SMCD for drip irrigation 60%

The average soil moisture content changed by 60% compared to 100% after 48 hours from surface drip irrigation at the emitter center, 15-30cm from the emitter, and 30-45cm from the emitter at depths 0-5cm, 5-10cm, 10-20cm, 20-30cm, 30-40cm, and 40-45 cm for 2ch+w and Ch+R treatments, as shown in figures (6), (7), and (8). The moisture content changed of the soil after 48 hours of irrigation directly under the emitter, 15-30cm from the emitter, and 30-45cm from the emitter along the lateral reached the field capacity at a depth of 30cm along the lateral, but not at any depth between laterals between 15cm and 30cm from the emitter.

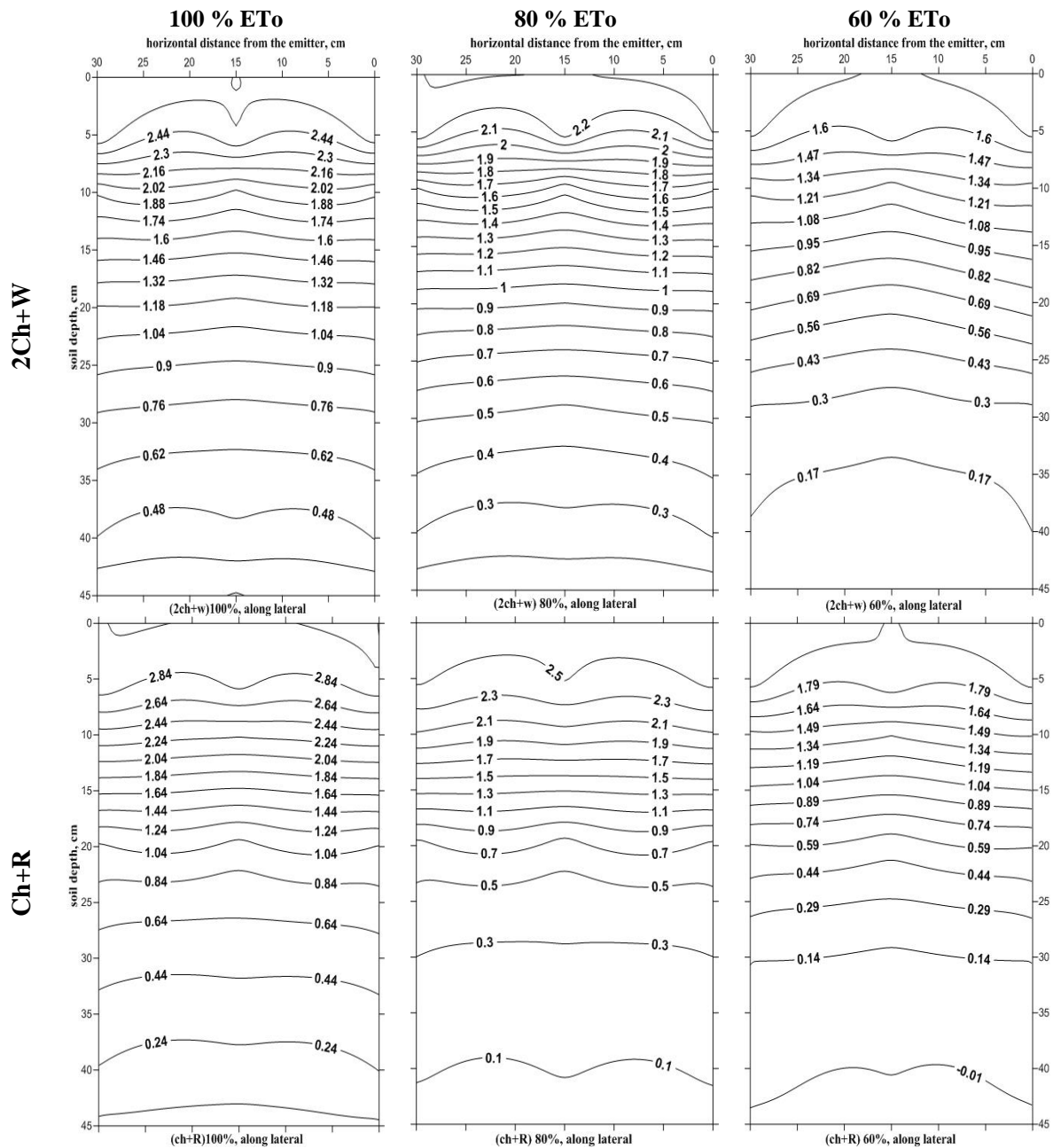


Fig. (8): The contour curves of the SMCD at the end-stage.

Generally, average soil moisture content increased in depths to 48 hours following surface drip watering. In general, the water addition rate is constant at 60% of Eto providing only minimal plant needs. The moisture before irrigation in (2Ch+w) is lower than the field capacity in the tillage layers from 0-20cm, and the depth of moisture below the emitter increases by 2.5cm in Ch+R treatment while it is fixed in 2Ch+W), that is, the moisture depth is up to 27.5cm in Ch+R.

In both cases, the moisture before irrigation is lower at the end of the season than the field capacity types of tillage due to the return of the soil to its natural qualities before the season with the stability of the depth of moisture. Because the water addition rate is 40% lower than 100% for the season, the average ground moisture in the surface layer 0-10cm of the Ch+R treatment is greater than that of the 2Cch+W treatment. The moisture depth is less than 100% treatment; the moisture depth in the 2Ch+W treatment is bigger and reaches a depth of 30cm, while it is less in Ch+R treatment and reaches a depth of 27.5cm

Crop yield

The results were shown in Fig (9) that for all irrigation treatments, the 2Ch+w treatment yielded more than the ch+R treatment. The results obtained were consistent with those published by **Mohammadi et al. (2009)**. Cucumber harvest yield for irrigation treatment 100% (5500 and 5200) kg fed⁻¹ was the top output; these results are consistent with (**Abed 2018**), who demonstrated the yield of traditional snake cucumber populations. The results showed that drip irrigation was effective for both tillage treatments.

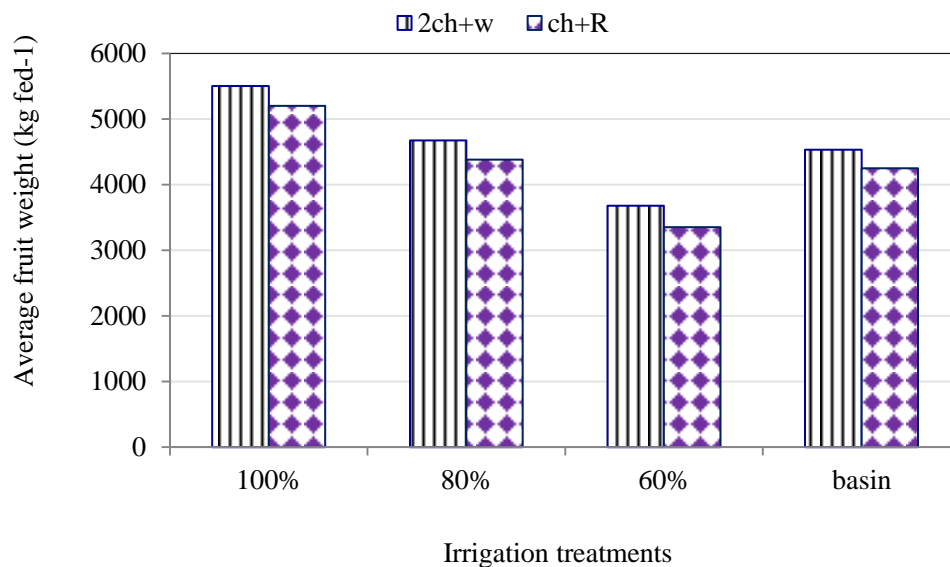


Fig (9): The total yield for irrigation treatments (100%, 80%, 60% ETo and basin irrigation)

The overall yield (ton fed⁻¹) of snake cucumbers cultivated under all drip irrigation for both tillage treatments was found to have reduced as a result of reducing irrigation levels throughout the season. The highest results were obtained when a 100% ETo treatment was

used, while the lowest values were obtained when a 60% ETo irrigation usage rate was used. The acquired results agreed with those published by **Nada and Abd El-Hady (2019)**. When the drip irrigation system with 100% ETo treatment was compared to the surface irrigation system, the output of snake cucumber was reduced by 17.6% and 18.27%, respectively, for the 2ch+w and ch+R treatments for surface irrigation. The irrigated rate was reduced from daily with drip system to weekly with basin irrigation, resulting in substantial changes in soil moisture levels in the rooting zone. The findings were consistent with those reported by **Yaghi et al. (2013)**, as shown in Fig. (9).

Water use efficiency (WUE)

Figure (10) represents the WUE results; the percentages of increases in all irrigation treatments (100%, 80%, and 60%) compared to the traditional treatment were 74.12%, 85.16%, and 94.75% for the 2Ch+W treatment, but 66.58%, 75.64%, and 79.58% for the Ch+R treatment.

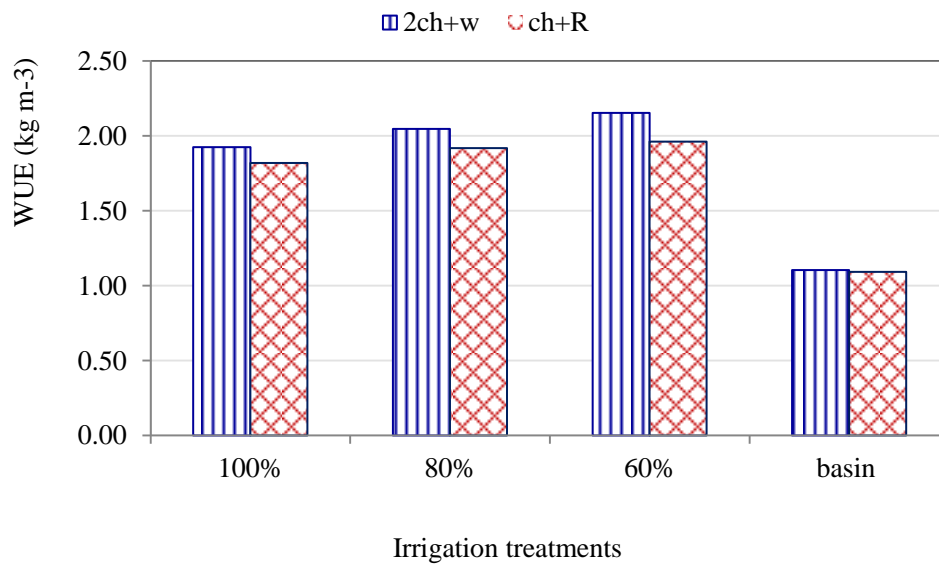


Fig (10): The WUE for 100%, 80%, 60% ETo and basin irrigation

CONCLUSION

The soil moisture contents were more evenly distributed between drippers on the lateral line and depths down with Ch+R treatment (using the a chisel plow in the horizontal direction and a rotary plow in the perpendicular it) than the 2Ch+W treatment (using in both horizontal and vertical directions with a chisel plow using the wooden blade) at depths 0-5cm and 5-10cm, but decreased at depths 10-30cm. Drip irrigation saves more water than basin irrigation. At treatment 100% ETo, the regularity of moisture is greater than that of treatment 80% ETo. The moisture is more in the (2Ch+W) treatment and reaches a depth of 40cm, while it is less in the (Ch+R) at 60% ETo, the moisture depth in the (2Ch+W) treatment is bigger and reaches a depth of 30cm, while it is less in the (Ch+R) treatment and reaches a depth of 27.5cm. The crop production of snake cucumber at the surface irrigation system was reduced compared to the 100% ETo treatment for

the 2Ch+W and Ch+R treatments. The water use efficiency (WUE) during the snake cucumber season increases in all irrigation treatments (100%, 80%, and 60%) ETo compared to the traditional treatment.

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دراسة عن تقييم أنظمة الحرق على توزيع محتوى رطوبة التربة تحت الري بالتنقيط

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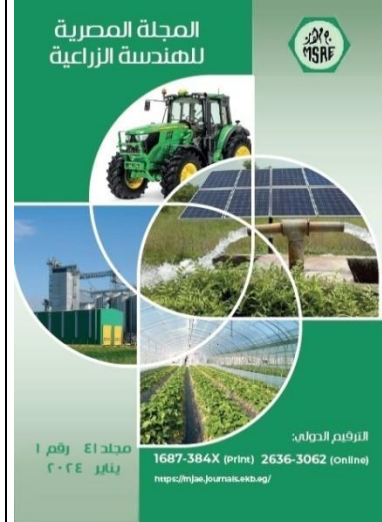
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الملخص العربي

يواجه المزارعون في مصر نقصاً مستمراً في المياه. لذلك، فإن الهدف الرئيسي لهذه الدراسة هو اختيار أفضل نظام حرق يؤدي إلى احتفاظ التربة بأكثر كمية من المياه باستخدام نظام الري بالتنقيط لتوفير المياه وضمان حصول النباتات على مياه فعالة وإنتاج محاصيل فائقة. تم استخدام معاملتين للحراثة، مع محراث الحفار في الاتجاه الأفقي ومحراث دوراني في الاتجاه العمودي (Ch+R) والحرق بنظام الحفار في الاتجاهين الأفقي والعمودي مع محراث الحفار ثم استخدم الزحافة الخشبية (2Ch+W). وهناك نظامان للري هما الري السطحي التقليدي بالأحواض والري بالتنقيط السطحي؛ أربعة معاملات كانت 100٪ و 80٪ و 60٪ من معدلات البخر نتح ETo والري بالأحواض. سجلت معامل 2Ch+W إنتاجاً أعلى من معامل Ch+R. تم الحصول على أعلى النتائج بمعدل ري مطبق بنسبة 100٪ من معدل البخر نتح، وشهدت أدنى القيم بمعدل استخدام ري بنسبة 60٪ من معدل البخر نتح. عند مقارنة نظام الري بالتنقيط المعاملة 100٪ مع نظام الري السطحي بالأحواض، انخفض إنتاج القثاء بنسبة 17,6٪ و 18,27٪ لمعاملات 2Ch+W و Ch+R، على التوالي للري السطحي التقليدي. تأثير الحراثة ومعاملات الري على كفاءة استخدام المياه (WUE) في جميع معاملات الري (100٪ و 80٪ و 60٪ من معدلات البخر نتح ETo) مقارنة بالري بالأحواض كانت 74,12٪ و 85,16٪ و 94,75٪ على التوالي للمعاملة 2Ch + W ولكن 66,58٪ و 75,64٪ و 79,58٪ على التوالي للمعاملة Ch+R.



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الكلمات المفتاحية:

الدوراني؛ الحفار؛ الري التقليدي؛ الري بالتنقيط؛ إنتاجية المحصول.