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IRRIGATION REQUIREMENTS OF SWEET PEPPER (*Capsicum annuum* L.) GROWN IN PLASTIC GREENHOUSES UNDER EL-ARISH CONDITIONS: Π: SALT DISTRIBUTION PATTERN IN THE SOIL.

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ABSTRACT

Two green house experiments were carried out at The Experimental Farm of the Faculty of Environmental Agriculture Sciences, in El-Arish, Suez Canal University, during 1999-2000 and 2000-2001 early summer seasons. Sweet pepper (*Capsicum annuum L.*) plants *cv.* Sonar were grown in plastic greenhouse (9 x 60 m.) under drip irrigation system. The main object of this research was to study the effect of some irrigation treatments on sweet pepper growth and yield. Also, it included the effect of these treatments on soil salt distribution. Five irrigation treatments were carried out as follow:

Treatment A: one irrigation per day, treatment B: two irrigations with the same quantity (half in the morning and half at evening) per day , treatment C: one irrigation per 2 days, treatment D: two irrigations with the same quantity (half in the morning and half at evening) per 2 days, and treatment E: one irrigation per 3 days.

Every treatment was irrigated with the same quantity of irrigation water (based on water requirements for one day), which gradually increased from December to June. A complete block design in three replicates was used. The area of the plot was 18 m^2 (10 m long x 1.8 m wide). The distance between plants along the lateral irrigation line was 50-cm. Transplanting was carried out at December 25th and harvest began after (121) days from transplanting and extended for (67) days in both seasons. Before irrigation treatment, soil salinity increased in the 0-5 and 5-15 cm from the emitters. It was also noticed that soil salinity for the 15-25 cm distance from the emitter before irrigation was lower than after irrigation during January and February, then somewhat became higher after than before irrigation during latter months. The highest values were found for (E) treatment followed by (C), (D), (B) and (A) treatments, respectively. It is not recommended to use the systems of treatments (C, D or E) because it is expected that the soil can be salinized in the future.

Keywords: Irrigation requirements - Salt distribution - Drip irrigation - Sweet pepper plants.

INTRODUCTION

Salt accumulation under trickle irrigation depends on the rate of evaporation from the soil surface, water uptake by roots, location of the wetting front, total quantity of applied water and spacing between lines. Generally, high evaporation and transpiration rates cause high accumulations of salts at the soil surface (Yaron *et al.*, 1973). Singh *et al* (1985) stated that, the concentration of salts under trickle irrigation increased in downward direction along with the movement of moisture. Salts are also transported towards the surface due to evaporation.

Judah (1985) studied salt accumulation under various drip irrigation treatments. Tomato plants were irrigated every 2,4 and 7 days with three application rates; 2,4 and 6 letters per hour. The amount of water added at each irrigation was equal to that consumed by plants. He found that, the lateral distances from the emitters which exhibited the highest salinity at 10-cm depth, for the 2,4 and 7 days irrigation frequencies were 45,25 and 25cm, respectively. Also, the highest salinity at the same depth for all irrigation rates was at 25 cm from the drippers.

Papadopoulos (1988) studied field salinity profile under drip irrigation with high sulfate water. Amounts of applied water were 50 and 60 $l.plant^{-1}$ per week in the first and second irrigation seasons respectively. The soil was a pellic vertisol that contained no gypsum. Soil salinity by time, vertical depth and lateral distance from emitter was affected by moisture distribution during the irrigation season and leaching by winter rains. He found high accumulation of soluble salts during the irrigation season, particularly in the soil surface at a lateral distance of 20 to 40 cm from the emitter. Also, he found that, soil salinity decreased from its initial values after leaching by winter rains. Finally, he reported that, the distribution of salts at various depths and several distances from the emitter was affected by the extent of wetted soil front during the irrigation season and the leaching effect of winter rains.

Nightingale *et al* (1991) studied trickle irrigation rates and soil salinity distribution in an almond (*prunus amygdalus*) orchard. They determined the relationships among the volumes of applied water through trickle irrigation system (50,100 and 150% of the crop evapotranspiration), the amount and the distribution of soil salinity in clay loam soil. They found that, the greatest accumulation of soil salinity, 5.7 dSm^{-1}, was beneath the trickle line for the 50% of ETc treatment. Soil salinity decreased with distance from the trickle line. Increasing the water volume to 100 and 150% of ETc moved the zone of salt accumulation farther from the trickle line.

Abd El-Razek *et al* (1992) found before and after irrigation that salt content in the soil profile generally increased with depth and distance from the emitters as well as from the laterals. Under drip irrigation system, the 70-cm emitters spacing treatment resulted in a relative reduction in salt content after irrigation with 5.5 and 10.5% across and along the laterals, respectively. The maximum salinity was found near the soil surface at the mid-points between emitters and laterals as well as at deeper depths.

Tayel and El-Sebsy (1996) studied the effect of drip irrigation frequencies; daily; every two and three days as well as main line pressures; 0.5,1.0 and 1.5 $kg.cm^{-2}$, on salt distribution and emission uniformity. They noticed that, soil salinity was low under the emitter. It increased with both depth and distance from the emitter up to 15cm. A drop in soil salinity is quite evident at 30cm from the emitter. Also, increasing the depth of wetting gave gravity an opportunity to pull down irrigation water. The location of salt accumulation with respect to emitters varied according to irrigation regimes. It was located at 45,30-45 and 30 cm for the various irrigation frequencies, respectively. Finally, the lateral movement of water and salts towards the wetting front, and the absence of the overlapped wetting zones are the main

reasons for such salt accumulation.

El-Sebsy (1999) stated before and after irrigation that, soil salt content increased as soil depth increased and the distance from lines and emitter increased. The increase of soil salt content before irrigation was slight in the surface 10 cm at 22.8 cm across the lateral and 6.3 cm along the lateral. After irrigation, the same trend of salt distribution occured, but a marked decrease in soil salt content appeared throughout the soil profile. The decrease reached 5.5 and 10.5% from the original value before irrigation across and along the laterals, respectively. The highest levels of salinity were found at the mid-points between lines and emitters and also at the deeper soil depths.

Mostafa *et al* (2001) found that, under drip irrigation system, the soluble salts moved vertically and horizontally from the dripper and increased towards the fringes of the wet front , thus low salinity existed just beneath the dripper. At harvest, treatments of applied irrigation water at 125, 100, 75 and 50 % of the soil F.C. showed EC values of 0.61, 0.72, 0.89 and 4.27 dSm^{-1}, respectively, at a distance of 20 cm from the dripper orifice within the top 0-5 cm layer. These values are higher than those obtained just beneath the dripper, 0.46, 0.54, 0.59 and 0.66 dSm^{-1}, respectively. Thus, salinity at 20 cm away from the dripper compared with salinity just beneath the dripper increased by one-third for the applied irrigation water at 100 or 125 % of the soil F.C. treatment, one-half for the applied irrigation water at 75 % of the soil F.C. treatment and as much as nine-times for the applied irrigation water at 50 % of the soil F.C.

The aim of this work to study soil salt distribution pattern under drip irrigation system on sweet pepper plants.

MATERIALS AND METHODS

Two greenhouse experiments were carried out at the Experimental Farm of the Faculty of Environmental Agricultural Sciences at El-Arish, Suez Canal University, during 1999-2000 and 2000-2001 early summer seasons. Sweet pepper (*Capsicum annuum L.*) plants were grown in plastic greenhouse (9 x 60 m.). Before planting in both seasons, collected soil samples from the greenhouse were subjected to mechanical and chemical analysis according to Richards, 1954 (Table 1a). Chemical analysis of irrigation water is given in (Table 1b). Initial soil moisture contents were determined for both seasons (Table 1c).

Soil parameters were investigated before conducting the experiments as follow:

1- Particles size distribution was determined using the international A.C.A. pipette method (Piper, 1950).
2- Bulk density was determined using J.R.H. Coutts cylinder (Piper, 1950).
3- Calcium carbonate was determined as $CaCO_3$ % by means of Collin's calcimeter (Jackson, 1967).
4- Soil pH value was determined in (1:2.5) soil water suspension.
5- Water holding capacity, field capacity and wilting point were determined by the weighing method using the pressure membrane method (Richards, 1954).

6- The soil water extract for the (1:5) soil water suspension was chemically analyzed for:

a)-Electrical conductivity (E.C), conductimetrically using Radiometer compenhagen N.V. type CDM 2d (Jackson,1967).

b)-Carbonate and bicarbonate, titremetrically using $KHSO_4$ and phenophthalein and bromocresol green as indicators.

c)-Chloride following Mohr's method, (Richards,1954).

d)-Soluble sulfate was taken by the difference between the summation of soluble cations and anions.

e)-Soluble potassium and sodium, by the flame photometer.

f)-Calcium and magnesium, by the versenate method using ammonium purpurate as an indicator for Ca^{++} and Eriochrome black T for Ca^{++} plus Mg^{++} (Jackson,1967).

Sweet pepper (***cv***. Sonar) seeds were planted at November 10th on sterophome seedling trays, 209 holes. Nursing period lasted 45 days. Seedlings were transplanted to 18 m^2 plots, 10 m x 1.8 m at December 25th 1999 and 2000 at the age of four trues leaves. Each plot had 2 rows of seedlings spaced 90 cm from each other, the distance between seedlings on each row was 50 cm. The number of seedlings per plot was 40, therefore, planting density was 2.22 plants m^{-2}. During the nursing period, the seedlings were irrigated daily by constant volume. In-line drippers, G.R. polyethylene pipes 16-mm. in diameter having 4 liters discharge per hour were used for drip irrigation after transplanting.

Table (1a): Initial soil mechanical and chemical analysis.

Soil properties	Seasons							
	1999-2000				2000-2001			
	Depth(cm.)							
	0-15	15-30	30-45	45-60	0-15	15-30	30-45	45-60
Mechanical analysis								
Coarse sand %	68.00	65.60	64.50	65.70	67.99	65.64	64.54	65.73
Fine sand %	20.60	22.90	25.20	25.20	20.55	22.88	25.15	25.17
Silt %	3.50	3.80	3.20	1.80	3.52	3.83	3.18	1.84
Clay %	7.90	7.70	7.10	7.30	7.94	7.65	7.13	7.26
Soil texture	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy
Bulk density (g.cm^{-3})	1.53	1.52	1.56	1.53	1.53	1.52	1.56	1.53
Particle density (g.cm^{-3})	2.49	2.49	2.66	2.66	2.49	2.49	2.66	2.66
Chemical analysis [soluble ions in (1:5) extract]								
Ca^{++} (meq.l^{-1})	3.03	3.03	3.03	2.01	2.10	2.30	2.00	1.90
Mg^{++} (meq.l^{-1})	2.11	2.57	2.02	1.38	2.2	2.4	1.95	1.42
Na^{+} (meq.l^{-1})	1.18	1.14	0.75	0.86	4.49	3.56	3.49	2.07
K^{+} (meq.l^{-1})	0.48	0.36	0.30	0.34	0.31	0.24	0.26	0.21
CO_3^{-} (meq.l^{-1})	-	-	-	-	-	-	-	-
HCO_3^{-} (meq.l^{-1})	2.00	2.30	2.50	2.60	2.40	2.60	2.90	2.50
Cl^{-} (meq.l^{-1})	1.02	1.70	1.65	1.61	2.30	2.40	2.10	1.70
SO_4^{-} (meq.l^{-1})	3.78	3.10	1.95	0.38	4.40	3.50	2.70	1.40
EC(dS m^{-1}) in (1:5) extract	0.68	0.72	0.61	0.46	0.91	0.85	0.77	0.56
pH in (1:2.5) extract	8.10	8.30	8.50	8.70	8.20	8.40	8.30	8.50
Organic matter %	0.16	0.14	0.12	0.10	0.21	0.195	0.16	0.12
$CaCO_3$ %	3.95	4.67	4.15	4.03	3.95	4.65	4.16	4.21

Table (1b): Chemical analysis of irrigation water.

pH	EC		Soluble ions ($meq.l^{-1}$)							
			Cations				Anions			
	dSm^{-1}	Ppm	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	CO_3^{--}	SO_4^{--}
6.7	5.65	3616	18.12	20.20	17.72	0.25	38.40	6.25	-	11.64

Table (1c): Soil moisture constants for the chosen soil site.

Depth (cm.)	Saturation percentage		Field capacity		Wilting point		Available water	
	% $g.g^{-1}$	Soil moisture (mm/15cm)	% $g.g^{-1}$	Soil moisture (mm/15cm)	% gg^{-1}	Soil moisture (mm/15cm)	% $g.g^{-1}$	Soil moisture (mm/15cm)
0-15	28.92	66.37	7.50	17.21	3.21	7.37	4.29	9.85
15-30	28.29	64.50	7.71	17.58	3.13	7.14	4.58	10.44
30-45	30.04	70.29	7.32	17.13	3.14	7.35	4.18	9.78
45-60	26.16	60.04	7.43	17.05	3.10	7.11	4.33	9.94

Irrigation treatments started on December 25th and continued to June 30th. The number of treatments were 5 as follows:

-Treatment A: one irrigation per day.

-Treatment B: two irrigations with the same quantity of water (half in the morning and half at evening) per day.

-Treatment C: one irrigation per 2 days.

-Treatment D: two irrigations with the same quantity of water (half in the morning and half at evening) per 2 days.

-Treatment E: one irrigation per 3 days.

All treatments were irrigated with the same quantity of water (based on water requirements for one day), which gradually increased from December 25th till the end of June. The rates of applied irrigation water, according to Khalil (1998) were 0.97, 1.18, 1.64, 2.25, 2.89, 3.50 and 3.65 liters per plant each irrigation during December, January, February, March, April, May and June, respectively. The quantity of water chosen to be applied daily as in treatment A was divided into 2 halfs for treatments B and D. One half was applied daily in the morning for treatment B or every 2 days for treatment D. Similarly, the second half was applied in the evening. The quantity of water chosen to be applied daily in treatment A was applied every 2 days in treatment C or applied every 3 days in treatment E.

Chemical fertigation was done through the drip irrigation system according to the common recommendation. A complete block design in three replicates was used. The harvest began on April 25th after 121 days from transplanting and extended for 67 days till the end of June.

Data recorded:

Soil salinity determined at three depths; 10,20 and 30 cm. and at three distances from plants; 5,15 and 25 cm.

RESULTS AND DISCUSSION

Results in Tables (2 to 7) show that, soil salinity is generally higher than the initial level probably due to the effect of irrigation water during

seedling emergence. After the application of irrigation water treatments, it increased with increasing soil depth and distance from the emitters. The reason for this response is definitely related to the high salinity level of irrigation water, 5.56 dSm^{-1}. Before irrigation treatment, soil salinity increased in the 0-5 and 5-15 cm from the emitters. It was also noticed that soil salinity for the 15-25 cm distance from the emitter before irrigation was lower than after irrigation during January and February, then somewhat became higher after than before irrigation during latter months. Moreover, before irrigation, it generally decreased with increasing the soil depth. On the other hand, soil salinity gradually increased from the beginning of the establishment growth period until the end of the season in both seasons. This effect may be due to the increase in air temperature, which is reflected on increasing evaporation.

Concerning the effect of irrigation water treatments on soil salinity, it is noticed that its highest level was found for treatment (E) followed by (C), (D), (B) and (A) treatments, respectively. This trend is completely opposite to that obtained for soil moisture distribution.

The compiled data representing weighed averages for soil salinity contents, table (8) indicate that, the highest soil salinity after irrigation was found for treatment (E), although the soil in this treatment received the lowest water quantity of irrigation water, however evapotranspiration was high. On the other hand, treatments (A and B) received the highest quantity of irrigation water, therefore may leach out some desolved salts to depths more than 30 cm. Apparently, soil salinity for treatment (B) after irrigation is slightly better than for treatment (A). Generally, the sequence of soil salinity were E > C > D > B > A. These results agree with Yaron *et al*, 1973; Judah, 1985; Singh *et al*, 1985; Nightingale *et al*, 1991; Abd El-Razek *et al*, 1992; Tayel and El-Sebsy, 1996 and El-Sebsy, 1999.

It should be brought into attention that intensive use of irrigation water will lead to an equilibrium between soil salinity and salinity of irrigation water which is considered high in this study relative to salinity of River Nile water. In the meantime, it is well known that, growing plants consume some, but little, of the dissolved salts in irrigation water. At the end of the experiment, average soil salinity for treatment (A) became 2.26 and 2.38 times that of soil salinity at January for both of after and before irrigation, respectively. The corresponding values for treatment (B) are 2.3 and 2.53 times that of soil salinity at January, respectively.

Moreover, economizing the use of irrigation water by means of decreasing its applied volumes and or widening irrigation intervals led to increasing soil salinity from January to June before or after irrigation, table (8), for treatments (E, C and D) in this order. Average soil salinity at the end of experiment for treatment (C) became 2.50 and 2.57times their levels at January after and before irrigation, respectively. Furthermore, the corresponding values for treatment (D) became 2.61 and 2.78 times the values at January, respectively. Moreover, the values obtained for treatment (E) became 2.73 and 2.91 times the values at January, respectively. Hence, if the amount of irrigation water is limited, it is not recommended to use such treatments of irrigation because it is expected that the soil will be saline in the future.

Table (2): Soil salts distribution, dSm^{-1}, as affected by drip irrigation frequency during January.

Irrigation treatments	Soil depth (cm.)	1999-2000						2000-2001					
		After irrigation			Before irrigation			After irrigation			Before irrigation		
		Distance from emitter (cm.)											
		0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25
A	0-10	0.63	0.84	0.94	0.88	0.92	0.82	0.76	0.94	0.97	0.96	0.98	0.91
	10-20	0.78	0.91	0.95	0.86	0.86	0.84	0.92	0.95	0.98	0.98	1.00	0.94
	20-30	0.73	0.92	0.97	0.87	0.85	0.82	0.83	1.05	1.10	0.91	0.92	0.89
B	0-10	0.65	0.79	0.87	0.84	0.86	0.78	0.76	0.87	0.91	0.93	0.96	0.90
	10-20	0.73	0.86	0.90	0.89	0.92	0.86	0.80	0.85	0.98	0.96	0.95	0.92
	20-30	0.80	0.81	0.96	0.91	0.96	0.83	0.91	0.96	0.99	0.93	0.89	0.87
C	0-10	0.87	0.94	1.02	0.96	1.23	0.72	0.93	0.97	0.98	0.97	1.24	0.93
	10-20	0.86	0.93	0.98	0.94	0.98	0.87	0.92	0.99	1.04	1.12	1.01	0.98
	20-30	0.92	0.96	0.98	0.99	1.04	0.89	0.94	0.97	0.99	1.09	0.99	0.97
D	0-10	0.83	0.91	0.97	0.89	0.96	0.81	0.87	0.90	0.92	0.94	0.98	0.91
	10-20	0.86	0.89	0.92	0.92	0.94	0.82	0.84	0.93	0.95	0.91	0.93	0.89
	20-30	0.84	0.93	1.00	0.87	0.97	0.79	0.89	0.96	0.99	1.01	0.91	0.89
E	0-10	0.96	0.98	1.06	1.01	1.06	0.93	0.92	0.98	0.97	1.12	1.31	1.02
	10-20	0.95	1.09	1.20	0.98	1.32	0.91	0.88	0.97	1.01	0.95	0.91	0.87
	20-30	0.97	1.02	0.98	1.16	1.23	0.96	0.98	1.04	1.21	1.13	0.98	0.96

A = one irrigation per day.
B = two irrigations with the same quantity per day (half in the morning and half at evening).
C = one irrigation per 2 days.
D = two irrigations with the same quantity per 2 days (half in the morning and half at evening).
E = one irrigation per 3 days.

Table (3): Soil salts distribution, dSm^{-1}, as affected by drip irrigation frequency during February.

Irrigation treatments	Soil depth (cm.)	1999-2000						2000-2001					
		After irrigation			Before irrigation			After irrigation			Before irrigation		
		Distance from emitter (cm.)											
		0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25
A	0-10	0.66	0.88	0.99	1.02	0.99	0.95	1.09	1.24	1.37	1.30	1.45	1.21
	10-20	0.81	0.95	1.00	1.02	1.21	0.99	1.24	1.26	1.31	1.31	1.41	1.26
	20-30	0.76	0.96	1.02	1.23	1.15	1.14	1.23	1.26	1.28	1.25	1.30	1.13
B	0-10	0.68	0.82	0.90	1.25	1.36	1.18	1.19	1.20	1.23	1.35	1.36	1.22
	10-20	0.77	0.90	0.94	1.12	1.22	1.09	1.2	1.23	1.35	1.31	1.29	1.20
	20-30	0.85	0.86	1.01	1.41	1.46	1.33	1.25	1.32	1.38	1.28	1.54	1.17
C	0-10	0.90	0.97	1.03	1.56	1.83	1.52	1.12	1.23	1.48	1.41	1.51	1.36
	10-20	0.89	1.00	1.04	1.38	1.34	1.2	1.28	1.32	1.44	1.35	1.49	1.18
	20-30	0.95	0.95	1.02	1.37	1.39	1.26	1.31	1.37	1.49	1.40	1.48	1.27
D	0-10	0.87	0.96	0.99	1.39	1.36	1.21	1.21	1.29	1.32	1.39	1.35	1.26
	10-20	0.89	0.93	0.97	1.22	1.24	1.12	1.23	1.26	1.38	1.36	1.31	1.28
	20-30	0.87	0.96	1.33	1.50	1.37	1.33	1.29	1.36	1.46	1.37	1.46	1.39
E	0-10	1.01	1.02	1.13	1.61	1.66	1.53	1.31	1.35	1.47	1.43	1.56	1.41
	10-20	1.00	1.12	1.60	1.48	1.82	1.41	1.26	1.37	1.43	1.42	1.46	1.38
	20-30	1.06	1.07	0.99	1.56	1.63	1.36	1.40	1.44	1.49	1.50	1.45	1.43

A = one irrigation per day.
B = two irrigations with the same quantity per day (half in the morning and half at evening).
C = one irrigation per 2 days.
D = two irrigations with the same quantity per 2 days (half in the morning and half at evening).
E = one irrigation per 3 days.

Table (4): Soil salts distribution, dSm^{-1}, as affected by drip irrigation frequency during March.

Irrigation treatments	Soil depth (cm.)	1999-2000						2000-2001					
		After irrigation			Before irrigation			After irrigation			Before irrigation		
		Distance from emitter (cm.)											
		0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25
A	0-10	0.88	1.09	1.20	1.23	1.30	1.06	1.10	1.25	1.40	1.38	1.40	1.36
	10-20	0.92	1.16	1.31	1.52	1.50	1.47	1.36	1.38	1.41	1.36	1.39	1.34
	20-30	0.87	1.17	1.33	1.42	1.46	1.25	1.24	1.38	1.40	1.33	1.33	1.31
B	0-10	0.79	1.03	1.21	1.46	1.37	1.29	1.21	1.37	1.34	1.38	1.39	1.35
	10-20	0.88	1.11	1.25	1.54	1.53	1.37	1.32	1.33	1.36	1.35	1.37	1.32
	20-30	0.96	1.07	1.32	1.62	1.77	1.35	1.35	1.37	1.39	1.33	1.41	1.37
C	0-10	1.01	1.18	1.34	1.77	1.96	1.56	1.24	1.33	1.49	1.45	1.46	1.37
	10-20	1.00	1.21	1.35	1.59	1.65	1.39	1.26	1.38	1.45	1.37	1.46	1.33
	20-30	1.06	1.16	1.33	1.58	1.68	1.55	1.33	1.36	1.46	1.42	1.44	1.38
D	0-10	0.98	1.17	1.30	1.60	1.67	1.32	1.26	1.31	1.41	1.41	1.43	1.35
	10-20	1.00	1.14	1.28	1.53	1.55	1.30	1.34	1.37	1.42	1.46	1.34	1.30
	20-30	0.98	1.08	1.63	1.71	1.68	1.56	1.31	1.37	1.45	1.41	1.38	1.42
E	0-10	1.12	1.23	1.44	1.82	1.96	1.64	1.38	1.42	1.48	1.44	1.52	1.41
	10-20	1.11	1.33	1.91	1.69	1.95	1.52	1.39	1.42	1.45	1.44	1.52	1.42
	20-30	1.17	1.28	1.20	1.77	1.94	1.50	1.39	1.44	1.52	1.43	1.50	1.39

A = one irrigation per day.
B = two irrigations with the same quantity per day (half in the morning and half at evening).
C = one irrigation per 2 days.
D = two irrigations with the same quantity per 2 days (half in the morning and half at evening).
E = one irrigation per 3 days.

Table (5): Soil salts distribution, dSm^{-1}, as affected by drip irrigation frequency during April.

Irrigation treatments	Soil depth (cm.)	1999-2000						2000-2001					
		After irrigation			Before irrigation			After irrigation			Before irrigation		
		Distance from emitter (cm.)											
		0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25
A	0-10	1.38	1.59	1.70	1.73	1.80	1.56	1.61	1.75	1.91	1.89	1.98	1.86
	10-20	1.32	1.56	1.81	1.88	1.84	1.80	1.72	1.78	1.81	1.77	1.76	1.72
	20-30	1.17	1.47	1.63	1.80	1.78	1.55	1.54	1.76	1.79	1.70	1.72	1.69
B	0-10	1.29	1.53	1.72	1.97	1.87	1.79	1.89	1.88	1.91	1.88	1.89	1.86
	10-20	1.28	1.52	1.65	1.73	1.93	1.71	1.70	1.73	1.77	1.75	1.77	1.73
	20-30	1.26	1.37	1.62	1.92	2.07	1.65	1.63	1.67	1.70	1.72	1.75	1.68
C	0-10	1.52	1.68	1.84	2.27	2.46	2.06	1.89	1.90	1.92	1.88	2.04	1.87
	10-20	1.41	1.61	1.75	1.99	2.05	1.78	1.76	1.82	1.85	1.90	1.93	1.87
	20-30	1.36	1.46	1.63	1.88	1.98	1.85	1.76	1.78	1.82	1.76	1.81	1.73
D	0-10	1.46	1.67	1.91	2.10	2.17	1.82	1.80	1.89	1.93	1.90	1.95	1.78
	10-20	1.40	1.44	1.68	1.93	1.96	1.71	1.75	1.80	1.89	1.84	1.85	1.76
	20-30	1.28	1.38	1.94	1.84	1.88	1.76	1.62	1.65	1.78	1.79	1.77	1.72
E	0-10	1.62	1.74	1.94	2.32	2.46	2.14	1.89	1.92	1.98	2.12	2.03	1.99
	10-20	1.43	1.72	2.31	2.09	2.36	1.92	1.79	1.82	1.85	1.99	1.97	1.83
	20-30	1.47	1.78	1.70	2.01	2.20	1.90	1.79	1.95	2.01	1.80	1.83	1.76

A = one irrigation per day.
B = two irrigations with the same quantity per day (half in the morning and half at evening).
C = one irrigation per 2 days.
D = two irrigations with the same quantity per 2 days (half in the morning and half at evening).
E = one irrigation per 3 days.

Table (6): Soil salts distribution, dSm^{-1}, as affected by drip irrigation frequency during May.

Irrigation treatments	Soil depth (cm.)	1999-2000						2000-2001					
		After irrigation			Before irrigation			After irrigation			Before irrigation		
		Distance from emitter (cm.)											
		0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25
A	0-10	1.49	1.69	1.81	1.84	1.92	1.67	1.71	1.86	1.96	1.98	2.08	1.96
	10-20	1.53	1.76	2.01	2.20	2.18	2.09	1.80	1.90	1.92	1.95	1.97	1.90
	20-30	1.47	1.78	1.93	1.92	2.09	1.85	1.86	1.90	1.93	2.11	2.15	1.99
B	0-10	1.40	1.64	1.82	2.07	1.97	1.86	1.96	1.97	1.95	1.99	2.06	1.96
	10-20	1.48	1.72	1.85	2.10	2.03	1.98	1.92	1.94	1.97	1.96	1.95	1.91
	20-30	1.57	1.67	1.93	2.22	2.37	1.95	1.89	1.97	1.98	2.10	2.17	2.06
C	0-10	1.82	1.98	2.14	2.57	2.76	2.36	2.15	2.26	2.29	2.18	2.34	2.12
	10-20	1.81	2.01	2.15	2.39	2.45	2.18	2.06	2.13	2.35	2.32	2.34	2.12
	20-30	1.87	1.96	2.13	2.38	2.48	2.35	1.98	2.03	2.32	2.23	2.32	2.18
D	0-10	1.81	1.84	2.08	2.41	2.47	2.13	2.06	2.13	2.23	2.28	2.29	2.09
	10-20	1.81	1.84	2.08	2.33	2.36	2.11	2.03	2.18	2.39	2.36	2.21	2.16
	20-30	1.78	1.89	2.44	2.52	2.38	2.26	2.13	2.23	2.28	2.29	2.28	2.21
E	0-10	2.12	2.24	2.45	2.82	2.96	2.64	2.32	2.36	2.48	2.45	2.53	2.32
	10-20	2.03	2.34	2.64	2.69	2.96	2.72	2.27	2.42	2.46	2.51	2.57	2.46
	20-30	2.13	2.42	2.45	2.87	2.84	2.73	2.49	2.65	2.71	2.42	2.53	2.40

A = one irrigation per day.
B = two irrigations with the same quantity per day (half in the morning and half at evening).
C = one irrigation per 2 days.
D = two irrigations with the same quantity per 2 days (half in the morning and half at evening).
E = one irrigation per 3 days.

Table (7): Soil salts distribution, dSm^{-1}, as affected by drip irrigation frequency during June.

Irrigation treatments	Soil depth (cm.)	1999-2000						2000-2001					
		After irrigation			Before irrigation			After irrigation			Before irrigation		
		Distance from emitter (cm.)											
		0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25	0-5	5-15	15-25
A	0-10	1.70	1.90	2.02	2.05	2.13	1.88	1.92	2.07	2.17	2.32	2.29	2.18
	10-20	1.74	1.97	2.23	2.50	2.39	2.35	2.32	2.26	2.35	2.24	2.18	2.16
	20-30	1.68	2.01	2.14	2.05	2.30	2.06	2.07	2.13	2.14	2.23	2.25	2.20
B	0-10	1.61	1.85	1.93	2.28	2.18	2.07	1.99	2.01	2.16	2.29	2.27	2.17
	10-20	1.69	1.93	2.06	2.34	2.24	2.19	2.01	2.15	2.18	2.25	2.26	2.18
	20-30	1.78	1.88	2.14	2.43	2.58	2.16	2.04	2.08	2.14	2.32	2.38	2.27
C	0-10	2.13	2.29	2.45	2.88	3.07	2.67	2.36	2.45	2.61	2.49	2.65	2.38
	10-20	2.12	2.34	2.46	2.71	2.66	2.49	2.36	2.44	2.66	2.48	2.65	2.43
	20-30	2.18	2.27	2.44	2.69	2.79	2.67	2.38	2.44	2.63	2.54	2.63	2.49
D	0-10	2.07	2.28	2.52	2.72	2.78	2.44	2.47	2.54	2.64	2.59	2.62	2.45
	10-20	2.13	2.15	2.39	2.64	2.61	2.42	2.31	2.37	2.45	2.47	2.52	2.42
	20-30	2.09	2.31	2.75	2.83	2.69	2.57	2.44	2.46	2.49	2.61	2.59	2.52
E	0-10	2.53	2.65	2.86	3.23	3.37	3.05	2.71	2.77	2.89	2.86	2.94	2.73
	10-20	2.44	2.75	3.05	3.32	3.21	3.13	2.68	2.83	2.87	2.95	2.98	2.92
	20-30	2.54	2.83	2.82	3.28	3.25	3.14	2.77	2.82	2.87	2.92	2.94	2.88

A = one irrigation per day.
B = two irrigations with the same quantity per day (half in the morning and half at evening).
C = one irrigation per 2 days.
D = two irrigations with the same quantity per 2 days (half in the morning and half at evening).
E = one irrigation per 3 days.

Table (8): Weighed averages for soil salinity (dSm^{-1}) at 12.5 cm distance from emitter and at 15 cm soil depth.

Month	Treatments	1999-2000		2000-2001	
		After irrigation	Before irrigation	After irrigation	Before irrigation
January	A	0.88	0.85	0.96	1.02
	B	0.84	0.87	0.90	0.92
	C	0.95	1.02	0.98	1.03
	D	0.92	0.93	0.93	0.92
	E	1.04	1.08	1.01	1.02
February	A	0.92	1.07	1.27	1.29
	B	0.88	1.27	1.27	1.34
	C	0.98	1.42	1.36	1.38
	D	0.99	1.29	1.33	1.35
	E	1.13	1.57	1.40	1.45
March	A	1.14	1.35	1.34	1.35
	B	1.11	1.44	1.34	1.37
	C	1.21	1.63	1.38	1.41
	D	1.21	1.54	1.37	1.38
	E	1.35	1.75	1.44	1.45
April	A	1.56	1.72	1.77	1.79
	B	1.51	1.84	1.77	1.78
	C	1.62	2.03	1.84	1.87
	D	1.61	1.89	1.80	1.81
	E	1.80	2.16	1.90	1.92
May	A	1.76	1.97	1.88	2.01
	B	1.71	2.05	1.96	2.03
	C	2.02	2.43	2.20	2.24
	D	1.98	2.31	2.16	2.23
	E	2.36	2.80	2.48	2.47
June	A	1.98	2.19	2.17	2.22
	B	1.91	2.26	2.10	2.26
	C	2.33	2.73	2.50	2.53
	D	2.34	2.61	2.48	2.52
	E	2.77	3.21	2.82	2.90

A = one irrigation per day.
B = two irrigations with the same quantity per day (half in the morning and half at evening).
C = one irrigation per 2 days.
D = two irrigations with the same quantity per 2 days (half in the morning and half at evening).
E = one irrigation per 3 days.

The results are summarized, as soil salinity became higher than its initial value probably due to the effect of irrigation water during seedling emergence. As for, the effect of irrigation treatments, it increased with increasing soil depth and distance from the emitters. Before irrigation it

increased in the 0-15 cm from the emitter and was lower than after irrigation. Moreover, concerning salinity, it decreased with increasing the soil depth. Soil salinity increased gradually from the beginning of the establishment growth period until the end of the season. The highest values are found for (E) treatment followed by (C), (D), (B) and (A) treatments, respectively. It is not recommended to use the systems of treatments (C, D or E) because it is expected that the soil can be salinized in the future.

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الإحتياجات المائية للفلفل الحلو النامي في الصوب البلاستكية تحت ظروف منطقة العريش:
٢-نمط توزيع الأملاح في التربة.

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تناول موضوع البحث دراسة تأثير بعض معاملات الري على توزيع والأملاح في التربة تحت نظام الري بالتنقيط.

أجريت التجربة بالمزرعة التجريبية لكلية العلوم الزراعية البيئية بالعريش جامعة قناة السويس خلال الموسم الصيفي المبكر لموسمي ١٩٩٩/٢٠٠٠ - ٢٠٠٠/٢٠٠١ م . حيث زرعت نباتات الفلفل الحلو صنف سونار بالصوب البلاستيكية (٩ × ٦٠م).

تم استخدام خمس معاملات للري كالأتي:

-المعاملة (أ): الرى مرة واحدة يومياً.

-المعاملة (ب): الرى مرتين بنفس الكمية يومياً (نصف الكمية صباحاً ونصف الكمية مساءً).

- المعاملة (ج): الرى مرة واحدة كل يومين.

- المعاملة (د): الرى مرتين بنفس الكمية كل يومين (نصف الكمية صباحاً ونصف الكمية مساءً).

- المعاملة (هـ): الرى مرة واحدة كل ثلاثة أيام.

وقد رويت كل معاملة من المعاملات السابقة بكمية مياه واحدة لكل منها في كل ريه والتي تزايدت تدريجياً من شهر ديسمبر حتى شهر يونيو.

نفذت التجارب باستخدام تصميم القطاعات كاملة العشوائية في ثلاث مكررات وكانت مساحة الوحدة التجريبية ١٨ م^2 (١٠م طول × ١,٨ م عرض). وكانت المسافة بين النباتات في نفس الخط ٥٠ سم. وزرعت النباتات في ٢٥ ديسمبر وبدأ الحصاد بعد (١٢١) يوم من زراعة الشتلة واستمر موسم الجمع لمدة (٦٧) يوم في كل من الموسمين.

وتتلخص النتائج المتحصل عليها في الأتي:-

تزايدت ملوحة التربة عن قيمتها قبل بداية التجربة و يرجع ذلك إلى تأثير مياه الري خلال فترة نمو البادرات وكذلك تأثير معاملات الري حيث إزدادت بعد الري بزيادة عمق التربة والمسافة من النقاطات. وتزايدت قبل الري في مسافة صفر-٥سم من النقاط وكانت أقل منها بعد الري، وعلاوة على ذلك فقد تناقصت مع زيادة عمق التربة. وتزايدت ملوحة التربة تدريجياً من بداية مرحلة النمو حتى نهاية الموسم وقد وجدت أعلى قيم للملوحة في المعاملة (هـ) تتبعها المعاملة (ج) ، (د) ، (ب) ، (أ) على التوالي.

وبالتالي فإنه لا ينصح بإستخدام نظم المعاملات (ج) ، (د) ، (هـ) لأنه يتوقع أن تسبب تمليح للتربة في المستقبل تحت تلك الظروف.