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IRRIGATION WATER SALINITY AND IRRIGATION INTERVALS EFFECTS ON GROWTH, YIELD AND QUALITY OF THE SUGAR BEET, IN SALINE SOIL, AT MIDDLE NORTH NILE DELTA.

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ABSTRACT

Large area, about 200,000 feddan, of salt affected soil at north Nile Delta has been put under cultivation since 1970.This area suffers from water supplying for irrigation because, these area lie at the end of the canals. Filed experiment was conducted by using drainage water (EC=3.8 dSm^{-1}, SAR=3.69), to irrigate sugar beet crop grown on a clay saline soil (ECe=10.1dSm^{-1}). The aim of the study was, to investigate effects of water irrigation salinity and the irrigation intervals on growth, yield and quality of sugar beet crop, cultivated on saline clay soil at El-Hamoul, Kafer El-Sheikh governorate. The experiment comprised planting sugar beet with three irrigation intervals as main plot, namely; two weeks (I_1), three weeks (I_2) and four weeks (I_3). Three irrigation water salinities as sub plot; S_1 fresh water (0.5dSm^{-1}), S_2 mixed water (1.8dSm^{-1}) and S_3 drainage water (3.8dSm^{-1}). Sugar beet (*Beta vulgaris* L) seeds were planted by hand and irrigated with fresh water (0.5 dSm^{-1}) until sugar beet plants had 6- 8 leaves. Then the plots received different irrigation water with different intervals according to treatments.

Results showed that irrigation every 2 weeks with fresh water (treatment I_1 S_1) produced the highest sugar beet yield and the highest sugar percent, 27.03 ton/fed. and 18.2%, respectively. While irrigation every 4 weeks with drainage water (I_3 S_3) produced the lowest yield,18.4 ton/fed., and the lowest sugar percent, 13.1 %. Irrigation with drainage water (S_3) significantly reduced the beet root yield by about 21% relative to irrigation with fresh water (S_1). Also water salinity 3.8dSm^{-1} significantly reduced beet root yield quality. The lowest beet root quality was obtained with the drainage water. Increasing irrigation intervals from 2weeks up to 4 weeks, significantly decreased the root yield of sugar beet .The sugar percent of sugar beet, also, slightly decreased but not significantly, with increasing the irrigation interval .It could be concluded that irrigation at short intervals could compensate, partially, the hazard effect of the water salinity on the crop yield. Under the condition of the present study , irrigation every 2 weeks with water salinity up to 3.8 dSm^{-1},had an acceptable sugar beet root yield (22.1 ton roots/fed) of satisfactory quality(2.89 ton sugar/fed). The productivity of irrigation water (PIW) for both of root and sugar yields decreased with increasing salinity of irrigation water, but this decrease was lower for sugar yield than root yield. Increasing the irrigation intervals from 2 weeks to 4 weaks increased the (PIW) of root yield from 7, 28 to 8.8 kg/m^{-3}, and that of the sugar yield from 1.12 to 1.51 kg/m^{-3}.

On the light of this study, it could be recommend the possibility of irrigating sugar beet with drainage water (S_3), at 2 or 3 weeks intervals, to obtain economical yield with satisfactory quality.

Keywords: Sugar beet, irrigation interval; salinity of irrigation water.

INTRODUCTION

Egypt is one of the countries facing water shortage because of population growth, limited availability of fresh water and degradation of water supplies. The growing demand on existing waters alerts us to the need for reusing drainage and mixed water.

In Egypt, the drainage water is now officially reused through blending which estimated to be around 7 billion m^3/year. Farmers at the terminates of the irrigation canals unofficially reuse about 2.8 – 4.0 billion m^3/year of drainage water, directly for irrigation, whenever they suffer from limited canal water supply (FAO, 2005).The better quality canal water is used at all other times, depending on its availability. In other words, the tail end framers unofficially adopt the cycling strategy, but they can not limit saline water use to the salt-tolerant crops or growth stages as recommended by (Rhoodes *et al*., 1992). The high salinity of irrigation water can decrease crop yield, or even cause failure of crop establishment due to specific ion effect, or total salt build up in the root zone and or inadequate maintenance of soil physical properties, (Rhoades *et al*., 1992). The saline water resources can effectively be utilized by adopting new crop water management strategies .For agricultural crop production, various strategies has been advocated for substitution of saline irrigation water for fresh water. Oster (1994) suggested three changes from the standard irrigation practices for the use of saline irrigation water: 1- Selection of appropriately salt-tolerant crop 2- Improvement in water management 3- Maintenance of soil physical properties to, assure soil tilth and adequate soil permeability.

At north Nile Delta, there is a large area of salt affected soils (about 200,000 feddan) has been put under cultivation since 1970. This area suffers from water supply for irrigation, because these area lie at the end of the irrigation canals .Therefore, reliance on saline waters generated by irrigated agricultural or pumped from aquifers seems inevitable for irrigation

Sugar beet (*Beta vulgaris* L.) is considered the second crop for sugar production in Egypt after sugar cane. Recently, sugar beet crop becomes is an important position in Egyptian crop rotation as a winter crop, not only in fertile soils, but also in poor, saline, alkaline and calcareous soils. Sugar beet is one of the most salt tolerant crops, but is reported to be less tolerant of salinity during germination, emergence, and in the seedling stage (Maas, 1986). In Egypt, studies have focused on the analysis of results of agricultural activities under saline irrigation conditions for different crops. The studies included different treatments to reduce the negative effects of salinity, breeding for salt tolerance and application of different irrigation systems and water management to improve crop productivity under saline water conditions (Abou-Hadid, 1998). El-Etreiby (2000) indicated that water quality and nutrients are the major limiting factors for sugar beet production in most of soils. Sugar beet plants grown under salinity stress showed imbalanced nutrient contents in their tissues. The effect of salt stress on the nutrient concentration in the plant varies among elements. Khalil *et al*., (2001) found that sucrose, total soluble solids and purity of sugar beet juice decreased with salinity stress. Al-Shaher (2003) found that drainage water of up to 6 dSm^{-1} can be used for irrigation of

sugar beet in the Lower Euphrates basin provided that fresh water of about 2 - 3 dSm^{-1} is used during initial growth stages. Almodares and Sharif (2003) studied the effect of four irrigation water salinities (2, 5, 8 and 11 dSm^{-1}) on two sugar crops, sugar beet and sweet sorghum. The results showed that as the quality of irrigation water decreased the soil salinity and exchangeable sodium percentage increased which caused yield reduction for both plants.
The aim of the present work is to investigate the effects of water irrigation salinity and intervals of irrigation water on growth, yield and quality of sugar beet crop, grown on a clay saline soil, at El-Hamoul Kafer-Elshikh governorate

MATERIALS AND METHODS

Site:

Two field experiments were conducted during the two growing seasons 2006/2007 and 2007/2008 at El- Hamoul, Kafr El-sheikh Governorate. The experimental site is located near an open drain and was served by tile drainage. The soil profile of the experimental field is uniform without distinct change in texture. In general, the soil is saline and clayey in texture. some physical and chemical properties of the experimental soil were determined according to Kim (1996) and presented in Table (1).The climate of the studied area is classified as arid with hot dry summer and cold winter. Some meteorological data, during the two growing seasons of sugar beet crop are presented in Table (2)

Table (1): Average values of some physical and chemical properties of soil under consideration.

Soil depth	Particle size distribution %			Texture	FC %	PWP %	AW%	Bd kgm^{-3}	pH	EC dSm^{-1}	SAR	$CaCO_3$ %
	Sand	Silt	Clay									
0-60	29.63	19.47	51.90	clay	41.3	21.8	19.5	1.19	8.2	10.1	8.12	2.74

Experimental layout:

Three irrigation water salinities S_1 fresh water (0.5dSm^{-1}), S_2 mixed water (1.8dSm^{-1}) and S_3 drainage water (3.8 dSm^{-1}), and three irrigation intervals namely two weeks (I_1), three weeks (I_2) and four weeks (I_3) were assessed in a split plot design with four replicates. The irrigation intervals were assigned to main plots and the irrigation water salinities to sub plots. Mean composition of the irrigation waters are given in Table (3) The plot area was $84m^2$, 1.5 meter apart to prevent side effects.

Seeds of sugar beet (*Beta vulgaris* L.) were planted in hills 20 cm between at November 3rd, 5th in two successive seasons 2006/2007 and 2007/2008, and harvested after 190 days .All agricultural practices were done as recommended by the Egyptian Ministry of Agricultural and Land Reclamation, except the two factors of study i.e. irrigation intervals and salinity of irrigation water .

Sugar beet (*Beta vulgaris* L.) were planted by hand and irrigated with fresh water from an irrigation canal, with salinity of 0.5 dSm^{-1} until sugar beet plants had 6- 8 leaves. Then the plots received irrigation water with different irrigation qualities, at different intervals according to the treatments. The water with 3.8 dSm^{-1} was obtained from an open drain located near the experimental site. To prepare 1.8 dSm^{-1}, the water from the irrigation canal (0.5dSm^{-1}) and the drainage water (3.8dSm^{-1}) were mixed to get the desired salinity.

Table (2): Mean of some meteorological data for Kafr El-sheikh area during the two growing seasons of sugar beet crop

MONTH	Season2006/2007								Season 2007/2008							
	Air Temp.C°		Relative humidity,%		wind speed , km/ day	Solar radiation, MJ /m^2	Ep, Mm/day	rain, mm	Air Temp. C°		Relative humidity, %		wind speed , km/ day	Solarradiation, MJ /m^2	Ep, mm/day	rain, mm
	maxi.	min.	max	min					max	min	max	min				
Nov.	23.17	8.85	77.9	58.5	62.6	12.9	2.89	0.00	26.0	8.0	78.0	52.7	53.0	2.73	2.73	8.4
Dec.	19.7	4.5	82.9	62.6	58.2	9.8	1.97	9.6	21.0	3.7	79.0	55.5	60.0	1.92	1.92	13.8
Jan.	18.7	4.1	87.0	58.5	57.2	9.2	1.90	36.0	18.0	1.4	74.0	58.0	58.0	1.63	1.63	36.0
Feb.	21.6	5.6	95.4	67.6	60.0	14.0	2.30	48.0	20.4	3.00	79.0	63.3	81.0	3.18	3.18	39.0
Mar-	22.0	5.8	79.2	51.7	75.0	14.3	3.50	0.00	25.0	5.80	77.0	53.0	72.0	3.84	3.84	0.00
Apr-	25.3	7.5	80.5	49.5	100.0	18.6	5.30	0.00	27.8	8.3	70.0	46.0	98.5	6.15	6.15	0.00
May-	30.0	12.0	76.3	45.0	111.0	22.0	6.50	0.00	29.0	10.0	70.5	42.5	110.0	6.91	6.91	0.00

*** Source: meteorological station at Sakha 31-07' N Latitude, 30-57'E Longitude, N.elevation 6 m.**

Table (3): Chemical composition of the water used for irrigation

Water used for irrigation	pH	ECe dSm^{-1}	SAR	Cations and Anions (mmhos/cm)							
				Na^+	Ca^{++}	Mg^{++}	K^+	Cl^-	CO_3^-	HCO_3^-	$So_4^=$
S_1 (fresh water)	8.36	0.52	3.60	3.5	0.8	1.1	0.1	2.5	0.0	2.5	0.5
S_2 (mixed water)	7.75	1.8	6.60	12.2	2.9	4.0	0.2	8.6	0.0	5.5	5.2
S_3 (drainage water)	7.88	3.8	3.69	21.4	4.9	6.7	0.3	14.7	0.0	5.04	13.56

Water management:

Furrow irrigation was used and the amount of the delivered water to each plot was estimated using a submerged orifice according to Hansen *et al*., (1980).

The rate of water application was estimated by checking the time required to fill a container of known volume. The amount of water in each application was added until reaching the end of run length .Water applied (Wa) was calculated as, Giriapa (1983):

$$Wa = Iw + Re + S$$

Where:

Iw = irrigation water applied, Re = effective rainfall, S = amount of soil moisture contributing to consumptive use either from stored moisture in root zone and / or that from shallow water table.

Value of S was neglected because of the ground water table remained at a depth of a about 2 m below the surface according to observation wells installed in the field , so the upward flow into the soil profile was negligible.

Productivity of irrigation water (PIW)

Was calculated according to (Ali *et al.,* 2007)

$$PIW= GY/I$$

Where, I is irrigation water applied (m^3/fed.) and Gy is root yield (kg/fed.)

Crop parameters:

Root length and diameter.

At harvest time, (190 days from sowing) random sample of ten plants, were chosen from each plot to determine some plant parameters of sugar beet growth (i.e. root diameter and root length (cm), as well as, root weight (Kg). Also, some characters of sugar beet roots quality have been measured and calculated such as, Sucrose % and the purity %, were measured at Delta sugar Company Limited Laboratories at Kafr El-Schiekh.

Yield (ton/fed)

The yield of the two central furrows was weighed and computed as:

(a) Root yield (ton/fed.). (b) Sugar yield (ton/fed.) obtained by multiplying root yield by sucrose percentage.

The obtained data were statistically analyzed by analysis of variance. The data of the two seasons showed nearly the same trend, Thus, combined analysis was done according to Gomez and Gomez (1984). Means of the treatment were compared by the least significant difference (LSD) at 5% level of significance which developed by Waller and Duncan (1969)

RESULTS AND DISCUSSION

Root length and root diameter (cm)

Mean root length and root diameter as affected by irrigation intervals and water salinity are given in Table (4). The obtained results show that by increasing the irrigation intervals ,root length significantly increased but root diameter decreased. The longest irrigation intervals (I_3) had the longest root of sugar beet, 38.889 cm., and the smallest diameter, 13.250 cm. while the shortest root length 35.661 cm. and largest root diameter cm. were recorded under treatment (I_1) .this means that by extending the irrigation intervals from 2 to 4 weeks, increased the root length by about 9.05 %and decreased root diameter by 16.93 % under the condition of the study. This finding could be explained by under the long irrigation intervals of 4 weeks; more water was depleted from the lower depths due to the lack of the available water in the upper layer. So roots tracing behind soil water within the sub soil layer. These results are in general agreement with those obtained by Ibrahim *et al*., (2002) who found that root grow longer under moisture stress. Also, Emara (1990) mentioned that the highest root length was obtained by irrigation every 28 days, while the lowest root length was every 14 days.

Also, water salinity had highly significant effects on length and diameter of sugar beet roots, Table (4). Both root length and root diameter were reduced by high salinity level (3.8 dSm^{-1}), S_3 treatment, in comparison with low salinity (0.5 dSm^{-1}), S_1 treatment. As shown in Table (4), increasing water salinity from 0.5 dSm^{-1} up to 3.8 dSm^{-1} reduced slightly root length from 37.81 cm to 36.58 cm and root diameter from 14.67 cm to 13.85 cm. i.e. length and diameter of root reduced by 3.2% and 5.5 %, respectively, under the condition of the study .In this concern, Neumann (1995), revealed that salinity can rapidly inhibit root growth and hence capacity of water uptake and essential mineral nutrition from soil. The abovementioned results, also, indicate that the studied parameters of sugar beet growth (root length and root diameter) were less influenced by salinity stress than the drought stress resulting from the extend of irrigation intervals. i.e the decrease percentage of both root length and root diameter due to drought stress were greater than that of root diameter and that increase percentage of root length induced from extending irrigation intervals.

Table (4): Effect of irrigation water salinity and irrigation intervals on some plant parameter of sugar beet growth.(Root length (cm) and Root diameter (cm) , in combined analysis of the two growing seasons.

Treatments	Root length (cm)				Root diameter (cm)			
	S_1	S_2	S_3	mean	S_1	S_2	S_3	mean
I_1 (2 weeks)	36.517 c	35.550 c	34.917 c	35.661	16.150 a	15.550 a	14.783 a	15,944
I_2 (3 weeks)	37.533 b	36.800 b	36,467 b	36.933	14.350 b	14.117 b	13.733 b	14.067
I_3 (4 weeks)	39.383 a	38.917 a	38.367 a	38,889	13.517 c	13.200 c	13.033 c	13.250
	37.811	37.089	36.583	37.161	14.672	14.289	13.850	

Means designated by the same letter at each cell are not significant at the 5% level according to Duncan's multiple range test.

Comparison	LSD (5%)	LSD (1%)	LSD (5%)	L SD (1%)
In row	0.201	0.280	0.198	0.270
In column	0.152	0.205	0.207	0.279

Roots and sugar yield:

As shown in Table (5), irrigation intervals and water salinity affects clearly sugar beet production. The obtained results indicate that roots and sugar yield decreased significantly with increasing irrigation intervals and water salinity. The main effect of the irrigation intervals showed that, the highest average values of roots and sugar yield 25.1 and 3.88 ton/fed, respectively, were obtained under treatment (I_1),while the lowest average values 20.46 and 3.45 ton/fed, respectively, for the same two parameters, were obtained under treatment (I_3) .this mean that increasing irrigation intervals from two weeks (I_1) to four weeks (I_3) decreased roots and sugar yield by about 18.5% and 11.1% , respectively.

Also the main effect of the water salinity, showed that irrigation with fresh water (0.5 dS/m), S_1 treatment, gave the highest yield 25.5 ton/fed and 4.7 ton/fed for roots and sugar yield, respectively, while irrigation with drainage water (3.8dSm^{-1}) ,S_3 treatment, produced the lowest mean values 20.2 and 2.7 ton/fed for roots and sugar yield ,respectively. This means that irrigating sugar beet crop with drainage water (3.8dSm^{-1}) reduced roots and sugar yield by about 21% and 42% relative to irrigation with fresh water (0.5 dSm^{-1}), these results indicate that sugar yield is more adversely affectedly by the increment of irrigation intervals and water salinity than the roots yield ,and the harm effect, induced from increment water salinity, on sugar beet production is greater than that induced by increasing irrigation intervals, under the conditions of the present study. In other words, salt stress reduced the yield of sugar beet more than the water stress resulted from the great irrigation intervals. The greatest roots yield 27.03 ton/fed was obtained under treatmentI_1S_1 and that of sugar yield,4,9 ton/fed., was obtained under treatment I_2S_1 . While the lowest yield of both roots and sugar, 18.3 and 2.5 ton/fed ,respectively were obtained under treatment I_3S_3. i.e., irrigation every 2-3 weeks with fresh water (0.5ds/m) had the maximum sugar beet yield ,and irrigation with drainage water every 4 weeks had the lowest yield .irrigation with drainage water every 2 weeks ,treatment I_1S_3 had an acceptable yield of about 22.1 and 2.9 ton/fed for roots and sugar yield ,respectively .This indicate that irrigation at short intervals could compensate partially the harm effect of the water salinity on the crop yield. The obtained yield by treatments I_1S_3 is about 80% and 59% for roots and sugar yield , respectively ,relative to the yield obtained by the treatment I_1S_1. Similar results were obtained by Ibrahim *et al*., (1995), who showed that the Maximum yield of roots and sugar yield 25.1 and 3.99 ton/fed, respectively were obtained from treatment had 6 cm every two weeks in shallow water table in the same area of the current study .also ,these results are in harmony with those Published by several authors concerning the effect of salinity on sugar beet yield ,(El-Etreiby,2000). According to the above illustrated results and discussion, drainage water (3.8ds/m) can be used to irrigate sugar beet at two weeks interval , under the condition of the current study, to obtain an acceptable yield . Sugar beet grew well in response to high soil salinity and relatively higher water salinity levels experience in this trial . It is likely to tolerate higher levels of salinity than these observed in this trial, particularly if irrigation practiced at short intervals.

Table (5): Effect of irrigation water salinity and irrigation intervals on root yield (kg/fed) and sugar yield (kg/fed) of sugar beet, in combined analysis of the two growing seasons.

Treatments	Root yield (kg/fed)				Sugar yield (kg/fed)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
I_1 (2 weeks)	27033.3 a	25383.3 a	22116.7 a	25111.1	4936.2 a	3807.4 a	2897.2 a	3880.2 a
I_2 (3 weeks)	26183.3 b	21983.3 b	20150.0 b	22772.2	4990.5 a	3517.2 b	2821.0 a	3776.2 b
I_3 (4 weeks)	22600.0 c	20416.7 c	18366.7 c	20461.5	4361.8 b	3429.9 b	2571.2 b	3454.3 c
Mean	25538.9	22594.4	20211.1		4762.8	3584.8	2763.1	

Means designated by the same letter at each cell are not significant at the 5% level according to Duncan's multiple range test

Comparison	LSD(5%)	LSD(1%)	LSD(5%)	L SD(1%)
In row	444.2	609.6	112.9	154.8
In column	434.8	585.5	108.5	149.2

Yield Quality:

Table (6) represents the obtained results for effects of irrigation water salinities and irrigation intervals on the quality of sugar beet roots, which indicated by the sucrose content and juice purity. The results indicate significant differences among the quality measurements as result of variations in irrigation intervals and irrigation water salinity. Sucrose percentage and juice purity were significantly decreased with increasing water salinity. The highest average sucrose percentage for the two seasons (18.8 7 %) and juice purity percentage (78.6%) were obtained under the lowest water salinity (EC = 0.5 dSm^{-1}), while the lowest values (13.72 %) and (75.9 %), respectively, were obtained by irrigation with the water salinity of 3.8 dSm^{-1}.

Regarding main effects of irrigation intervals, the results indicated that increasing irrigation intervals from 2 to 4 weeks significantly increased sucrose percentage and juice purity, however the increase caused by treatment I_3 relative to I_2 was not significant.

The highest sugar % (19.3) and juice purity (80.2 %) was obtained by irrigation every 4 weeks with fresh water (s_1). This could be attributed to high water stress induced from the long irrigation intervals. These obtained results are in agreement with these of Ibrahim *et al* (2002). Carter *et al*., (1980) found that several weeks water stress before harvest increased sucrose and juice purity percentage due to the dehydration of sugar beet tops and roots.

Table (6): Effect of irrigation water salinity and irrigation intervals on some characters of sugar beet root quality, (Sugar% and Purity%) in combined analysis of the two growing seasons.

Treatments	Sugar%				Purity%)			
	S_1	S_2	S_3	mean	S_1	S_2	S_3	mean
I_1 (2 weeks)	18.267 b	15.067 c	13.150 b	15.494	77.4 c	74.2 c	2.3 c	74.6
I_2 (3 weeks)	19.067 a	16.333 b	14.000 a	16.467	80.2 a	79.0 a	76.0 a	78.4
I_3 (4 weeks)	19.300 a	16.800 a	14.033 a	16.711	78.2 b	78.2 b	74,3 b	76.9
	18.878	16.067	13.727	16.224	78.6	77.1	75.9	

Means designated by the same letter at each cell are not significant at the 5% level according to Duncan's multiple range test.

Comparison	LSD (5%)	LSD (1%	LSD (5%)	LSD (1%)
row	0.305	0.417	1.515	2.07
column	0.318	0.428	1.55	2.11

Seasonal Water applied (Wa):

As shown in Table (7), average seasonal water applied were 2450.0, 2120.0 and 2077.0 m^3/fed. For treatments I_1, I_2, and I_3. respectively. i.e irrigation each 4 weeks (I_3) had the lowest amount of irrigation water applied and irrigation each 2 weeks had the highest one . This due to number of irrigation events during the growing season, which they were 10, 6 and 5 irrigation events for I_1 , I_2 ,and I_3 respectively. The average amount of the effective rain fall was 398.7m^3 for the growing season .Since water duty represent the least amount of water that produces the maximum yield , hence treatment I_1 , i.e, irrigation amount of 2450.0 m^3/fed (irrigation every 2 weeks) with water salinity 0.5 dSm^{-1} resulted in the highest beet yield .Therefore, the water needs of sugar beet under the condition of treatment I_1 is considered as the water duty of beet in the north middle Nile Delta region and equaled 2450.0 m^3/fed. This figure consist of 2052.0 m^3 irrigation water (IW) and 398.79 m^3 rain fall .About the same conclusion was reached by Ibrahim *et al*., (1995) and Ibrahim and Emara (2010)

Table (7): Average of irrigation water applied (Wa) in m^3 as related to irrigation treatment in both sugar beet growing seasons of 2006/2007 and 2007/2008

Treatments	S_1	S_2	S_3	MEAN
I_1(2weeks)	3461.29	3451.29	3438.79	3450.45
I_2(3weeks	2713.79	2718.79	2716.29	2716.29
I_3(4weeks	2261.29	2283.79	2279.79	2274.95
Mean	2812.1	2817.9	2811.6	

Wa =amount of applied of irrigation water +effective rain fall. The average effective rain fall = 398.79 m^3/fed.

Productivity of irrigation water (PIW):

Results in Table (8) clear that with increasing the irrigation intervals, both PIW of root and sugar yield increased. The highest average values of PIW, 8.86 and 1.51 kg/m^3, for root and sugar yield, respectively, were obtained under treatment I_3 , while the lowest ones, 7.26 and 1.12 kg/m^3, respectively were obtained under treatment I_1. These results indicates that increasing irrigation intervals from 2 weeks (I_1) up to 4 weeks (I_3) increased the PIW of root and sugar yield by about 22% and 35%, respectively. This means that the effect of irrigation intervals is more pronounced on yield of sugar than that on the roots of beet. The higher values of PIW of (I_3) than that of (I_1) is obviously due to the less amount of the applied water (Wa) under treatment (I_3), as shown in Table (7). Average values of the Wa under (I_3) is less than that of (I_1) by about 34%. The less amount Wa induced less amount of root and sugar yield by about 18.5% and 11%, respectively. Thus, the reduction of the Wa, due to the irrigation regime of (I_3) ,is much lower than of the yield. Therefore values of PIW were higher under (I_3) than (I_1) treatment. These finding is in harmony with those obtained by Ibrahim and Emara (2010) and Emara *et al*., (2000), who reported that an adverse effect was found between amount of Wa and PIW for both root and sugar yield .

Table (8): Effect of irrigation water salinity and irrigation intervals on productivity of the irrigation water, in combined analysis of the two growing seasons.

Treatment	PIW of root yield (kgm^{-3})				PIW of root yield ($kgm^{=3}$)			
	S1	S2	S3	Mean	S1	S2	S3	Mean
I_1 (2 weeks)	7.8 c	7.5 c	6.5 c	7.26 b	1.43 b	1.10 b	0.84 b	1.12 b
I_2 (3 weeks)	9.3 b	8.0 b	7.5 b	8.26 ab	1.50 b	1.40 a	1.35 a	1.39 a
I_3 (4 weeks	9.8 a	8.8 a	8.0 a	8.86 a	1.92 a	1.50 a	1.13 a	1.51 a
	8.9	8.1	7.3		1.61	1.33	1.11	

Means designated by the same letter at each cell are not significant at the 5% level according to Duncan's multiple range test

LSD 5%	**In raw**	**0.168**	**0.0324**
	In column	**1.470**	**0.1964**

Concerning the effect of water salinity on the PIW, as shown in Table (8) results reveal that increasing irrigation water salinity decreased PIW values of root and sugar yield. This is due to the decreased of roots and sugar yield with increasing water salinity. The highest average values of PIW, 8.9 and 1.61 kg/m^3, for root and sugar yield, respectively, were obtained under treatment (S_1). Whereas the lowest ones, 7.3 and 1.11 kg/m^3, respectively, were obtained under treatment (S_3).This means that irrigation with drainage water (3.8 dSm^{-1}) reduced PIW of roots and sugar yield by about 18% and 31% respectively relative to irrigation with fresh water (0.5 dSm^{-1}). This indicate that PIW of sugar yield is more influenced, by water salinity hazard than PIW of roots yield.

CONCLUSION

It could be concluded that irrigation at short intervals could compensate partially the hazard effect of the water salinity on the crop yield. Under the condition of the present study, irrigation every two weeks with water salinity up to 3.8 dSm^{-1} produced acceptable sugar beet root yield (22.1 ton roots/fed) of satisfactory quality (2.89 ton sugar/fed). The productivity of irrigation water (WIP) for both of root and sugar yield decreased with increasing salinity of irrigation water, but this decrease was lower for sugar yield than root yield. Increasing the irrigation intervals from 2 weeks to 4 weeks increased the (PIW) of root yield from 7.28 to 8.8 kg/m^{-3}, and that of the sugar yield from 1.12 to 1.51 kg/m^{-3}.

On the light of this study, it could be recommend the possibility of irrigating sugar beet with drainage water (S_3) at 2 or 3 weeks intervals to obtain economical yield with satisfactory quality.

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تاثير ملوحة وفترات مياه الرى على النمو والانتاج وجودة انتاج بنجر السكر فى ارض ملحية بوسط شمال دلتا النيل

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فى وسط شمال دلتا النيل بمنطقة الحامول محافظة كفر الشيخ توجد مساحة كبيرة حوالى 200000 مائتى الف فدان اراضى متاثرة بالاملاح وضعت تحت الاستصلاح منذ عام 1970هذه المساحة تعانى من الامداد بمياه الرى العذبه نظرا لانها تقع فى نهاية الترع.

وقد اجريت تجارب حقلية باستخدام مياه صرف ملوحتها (3.8 dSm^{-1}) واخرى مخلوطة ملوحتها (1.8 dSm^{-1}) ومياه عذبة ملوحتها (0.5 dSm^{-1}) على فترات رى مختلفة لرى محصول بنجر السكر فى ارض طينية ملوحتها .(ECe=10.1 dSm^{-1}) وذلك بغرض توضيح كيفية استخدام مياة الصرف الملحية فى زراعة بنجر السكر ودراسة تاثير ملوحة المياه وفترات الرى على نمو وجودة انتاج بنجر السكر فى الاراضى الملحية.

اظهرت النتائج ان الرى كل اسبوعين باستخدام مياه عذبة ملوحتها (0.5 dSm^{-1}) اعطى اعلى انتاج من محصول الجذور 27.03 طن للفدان ونسبة سكر 18.2% بينما الرى كل اربع اسابيع باستخدام مياه صرق ملوحتها (3.8 dSm^{-1}) اعطى اقل انتاج من جذور البنجر(18.4 ton/fed) , وبلغ الانخفاض فى انتاج الجذور باستخدام مياه الصرق المالحة (S_3) حوالى 21% بالنسبه للرى باستخدام مياه الرى العذبة (S_1) وايضا تاثرت جودة الانتاج معنويا بملوحة مياه الرى حيث كانت اقل قيم جودة الانتاج تحت الرى بمياه الصرف.

وادت زيادة فترات الرى من اسبوعين الى اربع اسابيع الى انخفاض انتاج جودة الجذور معنويا وانخفاض غير معنوى فى نسبة السكر ومن ذلك امكن استنتاج ان :

الرى على فترات قصيرة يمكن ان يعوض جزئيا التاثير الضار لملوحة مياه الرى وتحت ظروف منطقة الدراسة اعطى الرى بمياة الصرف على فترات كل اسبوعين انتاج مقبول من جذور بنجر السكر(22.1) طن للقدان وذات درجة جودة مرضية من بنجر السكر (2897.2) طن سكر للفدان.

وقد انخفضت انتاجية مياة الرى (PIW) لانتاج كل من الجذور والسكر بزيادة ملوحة المياه وفترة الرى وكان هذا الانخفاض اقل بالنسبه لانتاج السكر عنه بالنسبه لانتاج الجذور ادى زبادة فترة الرى من اسبوعين الى اربع اسابيع لزيادة انتاجية مياه الرى من 7,28 الى 8.8 كجم للمتر المكعب و انتاج السكر من 1.12 الى 1.51 كجم سكر للمتر المكعب.

وتوصى الدراسة بامكانية الرى على فترات من 2 الى 3 اسابيع باستخدام مياه الصرف لانتاج بنجر السكر والحصول على انتاج اقتصادى مقبول ذات درجة جوده مرضية تحت ظروف منطقة الدراسه (ارض ملحية ومياه صرف).

قام بتحكيم البحث

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