ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 44(1): 265- 277, (2006).

EFFECT OF IRRIGATION WITH SALINE WATER ON GROWTH AND YIELD OF SWEET FENNEL

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ABSTRACT

This investigation was carried out on the variety Florence of sweet fennel to throw light on the growth and yield of growing plants to efficiency to tolerate different salinity levels in irrigation water.

This experiment was designed to irrigate plants with three concentrations of saline drainage water, which were 1000, 2000 and 3000 ppm. in addition to the control one which received only tap water. Data were recorded on the physical and chemical characteristics of 5 plants ages representing 30, 60, 90, 120 and 150 days from seed sowing. The great significant tallest plants, number of leaves per plant, plant fresh weight, bulb fresh weight, bulb size and bulb perimeter during the various development stages were obtained from irrigation with saline water at the concentration of 2000 ppm. While the least number was exerted from the highest concentration of 3000 pp. Bulb acidity, phosphorus, potassium, oil and dry matter contents were not significantly affected by the increase of different salinity levels in all the tested ages. Bulb carotenaids content significantly increased with the increase in salinity concentrations from 1000 to 3000 ppm. in all the examined ages from 90 to 150 days.

INTRODUCTION

Most attempts on the estimation of plant height in some vegetable crops showed a characteristic contious depression with the increase in salinity levels. In parsley, studies of the growing behavior under saline conditions (0, 1500, 3000 and 6000 ppm. NaCL and Ca CL_2) gave signs that the plants could tolerate the salinity levels up to 3000 ppm. during the first and second months of growth but generally irrigation with saline water significantly depressed plant height (Salem, 1974).

Regarding the effect of irrigation with saline water on the number of leaves, it was found that celery plants subjected to 300 mml Na CL desiccated and lost the older leaves which in turn led to a substantial reduction in the number of viable leaves at final harvest. (Loescher *et al.*, 1994).

In garlic, irrigation with water salinized with 1 Na CL: 1 Ca CL_2 (W/W) at EC 1.4 (control), 3.1, 5.8, 8.8, 12.0 and 14.8 ds/m reduced bulb size by 14.3% with each unit increase in soil salinity > 3.9 ds/m. (Francois, 1994).

There is evidence in the literature that T.S.S. increase in onion bulb with the increase in salinity levels in irrigation water. (Singh and Abrol, 1985).

On the other hand, it was found that nitrogen content in parsley plants decreased with every increase in salinity levels from zero to 6000 ppm in irrigation water (Salem, 1974). This was also noticed in another investigation as the increase in salt level from 2 to 10 ds/m. reduced the dry weight content in onion plants (Habib *et al*, 1987). Irrigation with saline water at 600 M^2/ ha. to depth of 40 to cm at class A pan. Evaporimeter readings of 40, 80 or 120 cm minimized the total oil content in sweet fennel with every increase in soil salinity (Lo-Cassio *et al*, 1988).

MATERIALS AND METHODS

The variety Florence of sweet fennel (*Foeniculum vulgare var. dulce Mill*) was used in this investigation. The experiment was done in a private farm at Abo-Zabal, Kalubia Governorate during the two successive winter seasons of 1995/1996 and 1996/1997, to elucidate the effect of saline irrigation water on the resulted plants and its quality characteristics. The soil type of this area was sandy-Loam. The design of the experiment was complete randomized blocks with four replicates. Surface irrigation by furrows was applied and other agriculture practices took place whenever it was necessary.

A pot experiment was conducted to investigate the effect of saline drainage water used in irrigation on the development of sweet fennel plants. Pots were arranged in four replicates. Every replicate consisted of 20 pots each one contained 4 plants. The used water was brought from Karoun lake at El-Fayoum Governorate then diluted to the required three concentrations. 1000, 2000 and 3000 ppm. The control irrigation water was tap water at 260 ppm. The chemical analysis of the saline drainage water is shown in Table (1). Ten seeds were sown per pot (No. 50) on September 15th in the two seasons of the experiment. The seedlings were thinned to 4 plants per pot after 10 days from planting. Data were recorded on 5 plant ages which were 30, 60, 90, 120 and 150 days after seed sowing on the following items:

A- **Physical characteristics:** Plant height, number of leaves/plant, fresh weight and bulb fresh weight, size and perimeter of bulb.

B- **Chemical constituents:** Bulb total soluble solids, ascorbic acid, acidity, total carotenoids, nitrogen, phosphorus, potassium, dry weight and total oil content.

Determination procedures:

1- Plant height was estimated in cm.
2- Number of leaves/plant was counted.
3- Fresh weight of the whole plant and bulb only were weighed in g.

4- Bulb size was determined in cm^3 by dipping the bulb in a container flied with water and the displaced water was measured by a graduated cylinder.
5- Bulb perimeter was estimated in cm.
6- Total soluble solids were determined by abbe refractometer (A.O.A.C. 1980).
7- Ascorbic acid was determined as mg/ 100 g fresh weight using dye 2,6-dichioro phenolindophenol (A.O.A.C., 1980).
8- Dry matter percentage was determined by drying a hundred g of fresh plants or bulbs and 70 ^{o}C till constant weight was reached. The results were calculated as g /100 g fresh weight.
9- Total acidity of the blended flesh was determined by titration with NaOH 0.01 N using phenolphethaline indicator (A.O.A.C., 1980). The results were calculated as mg. citric acid per 100 g. fresh weight.
10- Total carotenoids were determined colorimetrically as mg/100 g fresh weight (A.O.A.C., 1980).
11- Total nitrogen was determined according to the micro-Kjeldahl method (A.O.A.C., 1980).
12- Phosphorus was determined colorimetrically using the ascorbic acid method (Mattk, 1970).
13- Potassium was determined photometrically by using the flame photometer method (Richard, 1954).
14- Total oil was determined in g /100 g dry weight by using soxelit method (A.O.A.C., 1980).

Statistical Analysis:

The physical and chemical characteristics of both the whole plants and the bulb with the saline irrigation water were subjected to the analysis of variance method. (Snedecor, 1956).

Table (1): Chemical analysis of diluted saline drainage water used in irrigation (meq./1).

Treatments	EC (dS/m)	HCO_3^-	Cl^-	SO_4^-	Ca^{++}	Mg^{++}	Na^+	K^+	SAR*
260 ppm	0.4	3.1	1.5	0.1	1.9	1.5	1.1	0.2	0.8
1000 ppm	1.4	3.1	10.5	0.2	2.5	3.3	7.7	0.3	4.5
2000 pmm	3.0	310	24.1	0.5	2.9	6.6	17.5	0.4	8.1
3000 pmm	4.5	310	35.3	0.8	3.5	10.0	25.0	0.7	9.7

(SAR) = Sodium adsorption ratio.

RESULTS AND DISCUSSION

A- Plant Growth:

1- Plant height:

The changes in plant height due to irrigation with the various levels of saline water are presented in Table (2). The general view in all the examined ages from 30 to 150 days reflected that both the medium (2000 ppm) and low (1000 ppm) concentrations resulted in the tallest plants, and the medium concentration (2000 ppm) was the most obvious. The highest salinity concentration (3000 ppm)

induced the shortest ones. However, this picture was clear in the last examined age (150 days) as the tallest plants were obtained from irrigation with the medium level (2000 ppm) of saline water followed by those of the low one (1000 ppm) while the shortest plants came from using the highest level (3000 ppm). All the differences are significant except that between the highest concentration (3000 ppm) and the control in the first season.

Numbers of leaves plants:

The data presented in Table (2) show the effect of irrigation with the various concentrations of saline water on the number of leaves per plant in the two seasons of study. The data in both seasons exhibit that significant differences in this character started to be shown at the age of 60 days till the last examining age of 150 days due to the irrigation with the different concentrations of saline water. However, the results in both seasons show that using 2000 ppm saline water gave the highest significant rise in this number during the various developmental ages after 60 days age while the least number resulted from the highest concentration (3000 ppm).

Plant fresh weight:

The results for the effect of irrigation with saline water on plant fresh weight in the two seasons of growth are shown in Table (2). The result in both seasons exhibit that this weight gained increment with the increase in saline concentrations up to 2000 ppm then a serious reduction occurred due to the irrigation with the highest concentration (3000 ppm).

B- Yield:

Bulb characteristics:

a- Physical Characters:

Fresh Weight

The results in Table (3) summarize the effect of irrigation with the various concentrations of saline water on the average bulb fresh weight in the two seasons of 1995/1996 and 1996/1997. The values in both seasons exhibit that there was a simultaneous increase in average weight of bulb with the increase in salinity concentration till 2000 ppm then a sharp reduction occurred at the highest concentration (3000 ppm). On the other hand, it is 'clear that the lowest weight was obtained from plants irrigated with the highest concentration (3000 ppm) but significant differences existed in the last examined age (150 days) only.

Size:

The results in Table (3) clear the effect of irrigation with the various concentrations of saline water on bulb size in the two seasons of the experiment. The data show that this character increased with the increase of saline concentration till 2000 ppm then a severe drop occurred when the concentration reached 3000 ppm. However, the results showed in both seasons that using both the concentrations of 1000 and 2000 ppm gave the largest significant size over the control ones with the superiority of 2000 ppm.

Table (2): Effect of irrigation with saline water on plant physical characteristics at various ages in 1995/1996 and 1996/1997 seasons.

(1995/1996 season)															
Plant age (days) / Salinity (ppm)	Plant height (cm)					Number of leaves / Plant					Plant fresh Weight (g)				
	30	60	90	120	150	30	60	90	120	150	30	60	90	120	150
260 control	9.36	15.31	31.33	69.80	73.70	3.53	6.61	10.53	13.04	15.18	27.24	108.59	216.92	311.25	366.65
1000	12.66	24.45	45.55	86.90	89.35	3.64	6.64	11.50	15.18	17.26	44.28	151.53	295.28	413.23	488.04
2000	12.49	29.38	50.05	99.15	104.87	3.88	9.19	16.50	21.02	24.51	79.50	184.28	366.63	616.77	745.91
3000	7.83	15.14	27.86	59.04	63.67	2.64	4.96	8.88	10.04	11.28	14.88	67.83	191.70	252.82	294.17
L.S.D at 5%	3.52	6.88	7.70	8.66	12.95	N.S	2.57	3.47	3.66	3.68	16.92	47.42	78.70	105.20	111.01
(1996/1997 Season)															
260 control	10.96	17.43	32.92	73.08	80.29	3.36	7.15	11.30	14.10	15.01	24.12	96.64	256.73	370.57	422.68
1000	11.77	22.31	43.46	79.86	93.08	3.94	7.73	11.96	14.71	17.03	28.93	98.52	267.00	403.19	493.90
2000	12.37	23.18	44.70	85.18	110.79	3.53	8.79	15.63	22.47	27.29	38.03	125.04	329.07	552.35	688.95
3000	8.72	12.64	22.87	59.15	66.04	2.93	5.73	8.50	11.94	13.27	17.48	69.07	17.34	230.36	326.76
L.S.D at 5%	2.14	4.54	5.67	7.09	12.83	N.S	1.49	3.03	4.90	4.91	12.08	21.04	63.81	104.02	115.87

Table (3): Effect of irrigation with saline water on bulb physical characteristics at various ages in 1995/1996 and 1996/1997 seasons.

(1995/1996 season)															
Plant age (days) / Salinity (ppm)	Bulb fresh Weight (g)					Bulb Size (cm^3)					Bulb Perimeter (cm)				
	30	60	90	120	150	30	60	90	120	150	30	60	90	120	150
260 control	8.85	19.44	70.75	146.83	233.44	17.42	40.50	129.40	242.37	377.04	3.38	8.23	19.53	24.20	26.78
1000	12.49	50.80	107.74	178.25	290.49	21.98	51.43	169.89	299.88	426.92	4.78	10.58	20.60	28.20	30.98
2000	14.74	40.12	120.62	220.37	301.36	22.19	60.99	182.98	359.97	508.44	5.68	11.83	23.33	35.33	37.18
3000	6.03	16.81	58.41	96.62	152.99	15.09	35.36	98.18	135.28	188.11	1.60	5.73	11.70	21.95	23.58
L.S.D at 5%	3.29	15.02	35.84	63.84	55.11	3.35	11.49	34.78	50.29	41.45	0.67	1.01	0.66	2.06	3.10
(1996/1997 Season)															
260 control	11.10	24.72	87.29	130.03	227.22	15.47	58.13	169.77	274.44	431.46	3.78	8.68	18.65	25.93	27.38
1000	16.65	41.48	109.10	158.39	296.01	18.81	73.83	198.72	374.78	856.20	5.05	11.35	21.98	28.38	30.65
2000	17.59	43.16	111.32	165.37	332.55	20.45	81.85	222.46	440.25	585.94	6.28	12.00	24.10	35.63	36.95
3000	9.30	16.81	69.77	99.52	150.25	15.39	51.80	119.59	155.51	184.45	1.88	6.28	11.95	22.60	23.38
L.S.D at 5%	2.96	16.28	20.80	27.24	58.89	3.32	14.21	28.03	42.92	47.61	0.75	0.90	1.20	2.19	2.23

Perimeter:

The changes in bulb perimeter due to the irrigation with various concentrations of saline water are presented in Table (3). The general view in all the examined ages from the ages of 30 to 150 days reflected that the medium salinity concentration (2000 ppm) induced significantly the longest bulb perimeter followed by the low one (1000 ppm) then the control. However, the bulbs resulted from using the high concentration (3000 ppm) showed the shortest significant perimeter.

b- Chemical constituents:

Total soluble solids:

The results in Table (4) show the effect of irrigation with the various concentrations of saline water on the bulb T.S.S. content in the two seasons of study. In this respect, increasing the salinity concentrations till 2000 ppm caused the increase of T.S.S content in all the examined ages from 30 to 150 days. So, the results showed in both seasons that using 2000 ppm saline water gave the highest content of T.S.S .

Ascorbic Acid:

The data presented in Table (4) show the effect of irrigation with the various concentrations of saline water on bulb ascorbic acid content in the two seasons of growth. The results in both seasons show that significant differences in this vitamin started to appear from the age of 60 days till the last examining age (150 days) due to the application of the different concentrations of saline water. The obtained values reflect that ascorbic acid content was increased with the increase in saline concentrations till 2000 ppm after which the high concentration (3000 ppm) reduced this content in both seasons.

Total acidity:

Changes in total acidity due to irrigation with the various concentrations of saline water in the two seasons of the experiment are shown in Table (5). It is evident from the results that there were no significant differences in the total acidity due to the application of the various concentrations of saline water during the different bulb developmental stages.

Carotenoides:

The results in Table (5) show the effect of irrigation with the various concentration of saline water on total carotenoids content in the two growth seasons of 1995/1996 and 1996/1997. The general scope extracted from the results of all the examined ages from 60 to 150 days indicate that increasing the salinity concentration from 1000 to 3000 ppm caused proportional increase in the total carotenoids content.

Total nitrogen:

The changes in total nitrogen content due to irrigation with the various concentrations of saline water in the two seasons of study are demonstrated in Table (6). The results of both seasons exhibit that this content was increased with the increase in saline concentrations till 2000 ppm

Table (4): Effect of irrigation with saline water on bulb T.S.S and ascorbic acid contents at various ages in 1995/1996 and 1996/1997 seasons.

Plant age (days) / Salinity (ppm)	T.S.S %					Ascorbic acid (mg/ 100 g FW)				
	30	60	90	120	150	30	60	90	120	150
(1995/1996 season)										
260 control	2.10	2.77	3.28	4.15	4.20	9.98	14.81	21.10	28.89	33.66
1000	2.19	2.83	3.48	4.43	4.48	9.95	16.09	24.70	33.80	37.37
2000	2.23	2.96	4.25	5.58	5.65	11.47	18.02	25.55	36.56	39.77
3000	2.22	2.91	4.10	5.50	5.62	8.81	14.30	18.29	21.39	23.85
L.S.D at 5%	N.S	N.S	0.58	0.93	0.92	N.S	1.56	1.86	2.47	1.98
(1996/1997 Season)										
260 control	2.18	2.62	3.12	4.16	4.25	10.22	14.70	21.34	30.93	34.10
1000	2.34	2.97	3.55	4.92	4.98	10.34	16.38	25.44	34.22	37.94
2000	2.56	3.36	4.54	6.10	6.15	12.15	17.63	26.00	35.68	41.75
3000	2.41	3.23	4.57	5.48	5.59	9.57	14.68	18.74	23.06	25.98
L.S.D at 5%	N.S	N.S	0.69	0.99	0.98	N.S	1.03	2.04	2.55	2.45

Table (5): Effect of irrigation with saline water on bulb total acidity and total carotenoids at various ages in 1995/1996 and 1996/1997 seasons.

Plant age (days) / Salinity (ppm)	Total acidity (mg/ 100 g FW)					Total carotenoids (mg/ 100 g FW)				
	30	60	90	120	150	30	60	90	120	150
(1995/1996 season)										
260 control	90.15	110.23	160.44	193.50	270.61	46.26	87.83	155.18	244.07	264.69
1000	90.34	115.00	163.15	199.01	268.24	44.57	59.90	165.19	253.78	293.92
2000	92.11	109.25	161.26	196.54	273.70	45.42	91.15	183.21	272.48	315.03
3000	89.60	112.06	162.43	197.22	271.65	47.24	94.79	190.00	284.23	251.16
L.S.D at 5%	N.S	N.S	N.S	N.S	N.S	N.S	N.S	24.64	35.05	37.41
(1996/1997 Season)										
260 control	88.24	153.34	188.21	245.62	298.37	45.69	88.55	154.86	233.59	252.90
1000	91.14	151.20	183.46	250.33	287.19	45.53	90.14	167.02	265.83	283.08
2000	90.16	159.26	186.34	247.65	292.70	43.20	93.62	190.01	280.97	299.69
3000	93.37	154.18	183.17	251.64	295.68	46.13	89.98	191.57	306.70	386.32
L.S.D at 5%	N.S	N.S	N.S	N.S	N.S	N.S	N.S	30.10	33.73	34.91

(FW) = Fresh weight.

Phosphorus:

The data in Table (6) exhibit the results of the effect of irrigation with the various concentrations of saline water on the phosphorus content in the two seasons of growth. The results of both seasons clear that the irrigation with the different concentrations of saline water did not show any significant effect on the contents of this element.

Potassium:

The changes in potassium content due to the effect of irrigation with the various concentrations of saline water in the two seasons of the experiment are demonstrated in Table(6). The results clear that this content was not significantly affected by the increase of the different salinity levels.

Dry matter percentage:

The data obtained on the dry matter percentage as affected by irrigation with the various concentrations of saline water in the two seasons of growth are presented in Table (7). The results clear that the irrigation with the different concentrations of saline water had no significant effect on the bulb dry matter percentage in all the tested ages in the two seasons.

Oil content:

The effect of irrigation with saline water on bulb total oil content in 1995/1996 and 1996/1997 seasons is shown in Table (7). The results in both seasons were clear in indicating that there was no significant differences existed in this content due to the application of the various salinity levels at all the examined ages.

Quantitative data of sweet fennel placed this crop among the moderately sensitive ones while what was reported by Gabriels (1972) indicated that fennel was a moderately tolerant crop , though no definite information's are is available regarding its salt tolerance (Pascale and Barbieri 1995). Some scattered reports done before on fennel point that plant height, number of leaves per plant, plant and bulb fresh weight and size were decreased rapidly under high salinity levels (Singh *et al* 1986; Lo-cascio *et al*., 1988). Thus, this research work was conducted to answer the question, to what extent of salinity levels can fennel be economically productive?

The results obtained from using the three salinity levels 1000, 2000 and 3000 ppm in irrigation water reflected clearly that fennel plant height , weight and number of leaves per plant beside bulb fresh weight, perimeter and size were increased significantly up to the level of 2000 ppm after which all these characters were significantly decreased when the concentration reached 3000 ppm except values number of leaves per plant and plant fresh weight which did not reach the significance level. Thus, two main trends were noted from the obtained results The first cleared a positive increase effect on the studied plant physical characteristics due to the irrigation with saline water within 2000 ppm. The second one showed a negative drop in these characteristics with the increase in salinity level up to 3000 ppm.

Table (6): Effect of irrigation with saline water on bulb total nitrogen, phosphorus and potassium at various ages in 1995/1996 and 1996/1997 seasons.

(1995/1996 season)															
Plant age (days) / Salinity (ppm)	Total nitrogen (g/ 100 g DW)					Phosphorus (g/ 100 g DW)					Potassium (g/ 100 g DW)				
	30	60	90	120	150	30	60	90	120	150	30	60	90	120	150
260control	0.35	0.80	1.48	2.41	2.97	0.20	0.34	0.46	0.50	0.52	1.39	1.45	2.32	3.23	3.67
1000	0.41	0.84	1.94	2.94	3.27	0.21	0.36	0.42	0.52	0.55	1.43	1.62	2.47	3.36	3.72
2000	0.49	1.11	2.34	3.68	3.95	0.23	0.36	0.47	0.55	0.56	1.38	1.83	2.56	3.60	3.89
3000	0.33	0.77	1.56	2.13	2.29	0.21	0.33	0.33	0.51	0.54	1.38	1.55	2.44	3.25	3.60
L.S.D at 5%	0.09	0.05	0.46	0.52	0.74	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
(1996/1997 Season)															
260 control	0.26	0.82	1.58	2.60	2.79	0.19	0.30	0.46	0.60	0.61	1.37	1.78	2.14	3.68	3.81
1000	0.34	1.07	1.81	2.93	3.21	0.20	0.31	0.47	0.64	0.66	1.54	1.82	2.18	3.72	3.88
2000	0.44	1.30	2.72	3.66	3.95	0.20	0.31	0.50	0.65	0.67	1.39	1.77	2.31	3.77	3.91
3000	0.24	0.76	1.14	2.01	2.22	0.17	0.28	0.45	0.59	0.62	1.36	1.73	2.26	3.64	3.79
L.S.D at 5%	0.10	0.23	0.63	0.57	0.76	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Table (7): Effect of irrigation with saline water on bulb total oil content and bulb dry weight al at various ages in 1995/1996 and 1996/1997 seasons.

(1995/1996 season)										
Plant age (days) / Salinity (ppm)	Total oil (g/ 100 g D W)					Dry matter percentage				
	30	60	90	120	150	30	60	90	120	150
260 control	0.10	0.16	0.42	0.98	1.65	1.40	2.63	5.72	8.05	10.12
1000	0.13	0.19	0.47	0.95	1.60	1.48	2.59	5.48	8.38	10.35
2000	0.12	0.18	0.45	0.97	1.60	1.54	2.47	5.13	7.95	9.97
3000	0.10	0.17	0.41	0.94	1.70	1.66	2.58	5.32	8.24	9.92
L.S.D at 5%	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
(1996/1997 Season)										
260 control	0.14	0.18	0.46	0.96	1.83	1.57	2.66	5.12	8.02	9.92
1000	0.15	0.19	0.44	0.91	1.88	1.59	2.49	5.15	7.84	9.83
2000	0.13	0.19	0.45	0.94	1.87	1.60	2.49	4.59	7.91	9.65
3000	0.14	0.18	0.43	0.97	1.82	1.65	2.47	4.87	8.11	9.99
L.S.D at 5%	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

(DW) = Fresh weight. (FW) = Fresh weight.

Regarding the increase in the physical characteristics of fennel plant due to the irrigation with saline water up to 2000 ppm, it is well known that the salt tolerance of any crop may be appraised according to three criteria: (1) The ability of the crop to survive on saline medium, (2) the resulted yield of the crop developed on this medium, and (3) the relative yield of the crop grown on the used saline medium as compared with its yield on a nonsaline one under similar growing conditions (Ayers 1952). However, in our experiment the maximum amount of salts under which sweet fennel grow safely and gave the highest significant yield was the 2000 ppm. with the nominated different kinds of salts shown in Table (1). In this concern, it was reported that many halophytes have a special and distinguishing feature enable their growth to be improved by low levels of salt but beyond a certain level growth was reduced (Ruskin *et al.*, 1990). This view was observed in a series of investigations which, pointed that there are many plants require some amounts of salts in their growth medium or in other words need moderate salinity conditions. These salts positively promote plant growth, enhance productivity and improves quality than salt free conditions (Pasternak 1987 and Gupta 1990). For example, moderate salinity induced increases in the obtained yield of cotton (Pasternak *et al.*, 1979) and the fruit yield of tomato (Lo-cascio *et al.*, 1988). Physiologically speaking, sodium chloride which is the main salt in saline water plays an important role through ionic Na that is absorbed by plants in this form. Thus, the informations summarizing the results of studies carried out in the United Kingdom with sugar beet, the claim is made that sodium is essential for this crop. More recently, sodium was shown by Australian workers to be an essential element for a group of plants exhibiting the so-Called hatch-slack pathway of carbohydrate metabolism. These studies threw light on crops is stimulated by applications of sodium. In some cases this benefit has been observed when there was a deficiency of potassium and in other cases when the supply was adequate. So, crops responding largely to sodium fertilization in the presence of adequate potassium were for example, celery, sugar beet, sweiss shard, table beet and turnip while those responding in absence of potassium were lettuce, onion, barsley, potato ,soy bean, spinach, squash and strawberry (Tisdale and Nelson 1975).

The harmful effects of irrigation with saline water at 3000 ppm. on fennel physical characteristics may be related to the decrease in osmotic potential or in other words the increase in osmotic pressure of saline root media (Mass and Hoffman 1977), and-or the in curious effect of specific ions such as NaCl, $CaCl_2$ and Na_2SO_4 which inhibited the production of chlorophyll and carotene in leaves, high sodium concentration that induced calcium and magnesium nutritional deficiencies and influenced the respiratory pathways in roots (Abel and Mackenzie 1964). However, long term exposure of roots to high salt concentration make the plants suffer from drought (Bernstein 1975), reduced water and nutrient availability, make direct toxic effect of different ions because of imbalances of mineral nutrition (Bower 1976), minimized photosynthesis due to reduction in stomata conductance and increasing stomata limitations to CO_2 up take (Pascale and Barbieri 1995) and changed the enzymatic activities in the plant.

Apart from the obtained results of plant growth which are generally the most important consideration it is also very important to check if the quality of the obtained product under saline conditions is impaired or not. However, the results of the last examined age showed that the bulb T.S.S and total carotenoids were significantly increased with the increase in salinity level up to 3000 ppm. Meawhile ascorbic acid and N contents were also increased but up to 2000 ppm only then a drop accured however, all the other studied chemical constituents were not significantly changed. In this regard, it was shown in many reports that the chemical constituents of different plant or in the part used as food were influenced or not by saline water irrigation. Hence, in some research work the increase in salinity levels in the irrigated water decreased the chemical contents in some plants as oil in India rape (Deo and Ruhal 1971). Total carotenoid in parsley, radish and cabbage (Shimose and Hayashi 1983). On the other hand, in other research work the increase in salinity levels in the irrigation water did not affect the chemical contents in some plants as potassium in potatoes (Bernstein *et al.*, 1951).

The previous results covered some of the experiences and opportunities in the agricultural use of saline water to the development fennel crop with good production. This creates greater awareness about fennel as a moderately salt tolerant plant. Hence, fennel can be used successfully in lands irrigated with 2000 ppm saline water and up to 3000 ppm. with reasonable reduction in production. However, the latest available information support our results and assured that the irrigation with moderately saline water up to certain degree is not necessarily harmful but higher yields may be obtained and some times oven quality of the product may be (Gupta 1990). So, this experiment succeeded in providing evidence that fennel which is an important vegetable crop in the field of exportation to foreign countries can grow well under the previous levels of salinity.

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تأثير الري بمياه ملحية على نمو ومحصول الفينوكيا

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أجريت هذه الدراسة على محصول الفينوكيا صنف فلورانس لإلقاء الضوء على مدى تحمل هذا المحصول للري بالمياه الملحية وقد تم إجراء التجارب خلال الموسم الشتوي لعامي ١٩٩٥-١٩٩٦، ١٩٩٦-١٩٩٧ بجهة أبو زعبل بمحافظة القليوبية، تضمنت هذه التجربة الري بثلاثة تركيزات مختلفة من مياه الصرف الزراعي الملحية وهي ١٠٠٠، ٢٠٠٠، ٣٠٠٠ جزء في المليون ومقارنتها بمياه الصنبور (٢٦٠ جزء في المليون) وأخذت القياسات الطبيعية والكيماوية للنباتات عند خمسة أعمار وهي ٣٠، ٦٠، ٩٠، ١٢٠، ١٥٠ يوماً بعد الزراعة. ويمكن تخليص أهم النتائج المتحصل عليها في الآتي:

أدى ري النبات بمياه ملحية بتركيز ٢٠٠٠ جزء في المليون إلى زيادة معنوية لكل من طول النبات، وعدد الأوراق على النبات، والوزن الطازج للنبات، والوزن الطارج للبصلة، وحجم الأبصال، ومحيط البصلة عند العمر ١٥٠ يوماً في حين حدث عكس هذه الزيادة عند استخدام ٣٠٠٠ جزء في المليون.

زادت نسبة المواد الصلبة الذائبة الكلية للأبصال معنوياً بزيادة ملوحة مياه الري حتى ٣٠٠٠ جزء في المليون، أيضاً زاد محتوى الأبصال من حمض الأسكوربيك بزيادة ملوحة ماء الري حتى ٢٠٠٠ جزء في المليون، لم يتأثر محتوى الأبصال من الحموضة والفسفور والبوتاسيوم والوزن الجاف والزيت الكلي تأثيراً معنوياً بأي من تركيزات الملوحة المختلفة في كل الأعمار.

زاد محتوى الأبصال من الكاروتينات الكلية زيادة معنوية بدءً من عمر ٩٠ يوماً حتى عمر ١٥٠ يوماً مع زيادة الملوحة من ١٠٠٠ حتى ٣٠٠٠ جزء في المليون، زاد محتوى الأبصال من النيتروجين الكلي زيادة معنوية مع زيادة الملوحة حتى ٢٠٠٠ جزء في المليون ثم حدث نقص معنوي بعد ذلك باستخدام ٣٠٠٠ جزء في المليون.