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EFFECT OF IRRIGATION FREQUENCY WITH DIFFERENT SALINE WATER LEVELS ON POTATO PLANTS . 1- GROWTH AND YIELD.

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ABSTRACT: *The present investigation was performed to evaluate the response of potato plants to different levels of saline irrigation water i.e. 0.4, 1.5, 3.0, 4.5 dS m-¹. Irrigation water was applied either once or twice a day every 2 days in pots filled with sandy soil during fall 1998, 1999 and summer seasons of 1999, 2000. Diamant cultivar was used. Salinity reduced the stem length by increasing water salinity. The average leaf area (cm^2) in the high salinity EC 4.5 dS m-¹ decreased by 34.75, 35.82 and 34.82, 36.88 % less than E.C.0.4 dS m-¹ during fall of 1998, 1999 and summer seasons of 1999 and 2000 respectively.*

Twice irrigation treatment showed higher FW. and DW. of stems, leaves and roots, also, showed more number of stems, and number of tubers, than once irrigation. Both numbers of stems and leaves were reduced by increasing water salinity. Higher salinity i.e. 3.0 or 4.5 dS m^{-1} caused a significant reduction in FW and DW for stems, leaves and roots in both fall and summer seasons. Tuber weight decreased as salinity of water increased from 0.4 to 4.5 dS m^{-1} by 17.81, 21.39 and 25.16, 33.85 % in both fall of 1998, 1999 and summer of 1999, 2000 respectively.

Key words: *Salinity, Irrigation frequency, Diamant cultivar, leaf area .*

INTRODUCTION.

Potato is considered one of the main important vegetable crops for both local consumption and export . It occupies the first rank as export crop among the different vegetable crops in Egypt. About 200 thousand feddan are cultivated in three seasons in the year. The total production of potato in Egypt about two million tons yearly from which about 250 thousand tons are exported to different markets such as England, West European countries and some Arab countries. To face the increase in population in Egypt, there is a great increase in the reclaimed land in the desert area, which have high concentrations of salts in the soil. Although the river Nile is the main source of irrigation in Egypt, nowadays water is not sufficient for irrigating the cultivated area required for food production. Thus, it becomes important to

look for another source of water that could be used for irrigation without harmful effect on both soil and field crops. It has been suggested that beside the Nile water, other sources such as ground water, drainage waters and the mixture between them can be used.

Therefor, it is necessary to study the effect of different concentrations of saline water on vegetative growth, yield and quality of potato plants.

MATERIALS AND METHODS.

The present investigation was carried out at the experimental farm of Vegetable Research Department of the Horticulture Research Institute, Agriculture Research Center, Ministry of Agriculture at Dokki, Giza governorate.

The experiments started on October 25 and 20 for both fall seasons of 1998 and 1999 respectively and on February 17 and 15 for both summer seasons of 1999 and 2000 respectively. Diamant cultivar was used. The sand culture technique (Hewitt 1952) was used in this investigation. The crude sand was sieved through a 20-mesh sieve and then the sieved sand was soaked for 3 days in 5 % hydrochloric acid. A current of tap waters was subsequently used for washing the sand for 3 days to get rid of any soluble salts; the sand was dried by air. Plastic pots of 40 centimeters in diameter and 50 centimeters in depth were used; each pot was filled with 20-Kg .of washed sand up to 5 centimeters from its upper edge. The field capacity of the experimental soil was determined by the pressure cooker method at 1/3 atm. It was found to be 2.9 % on dry weight basis. The wilting point of this soil was found to be 1.56 % as determined by the pressure membrane apparatus at 15 atm. according to Israelson and Hanson (1980) Plants irrigated with tap water till complete germination; (35 days after planting) hence forward plants were irrigated with Hoagland nutrient solution (Hoagland and Arnon 1950). Molar stock solutions of pure salts were prepared separately using distilled water and kept for the preparation of feeding solutions. Feeding nutrient solution was prepared just before application to the pots by dilution with tap water.

four levels of salinity, E.C 0.4 as a control, 1.5 , 3.0 and 4.5 dS m^{-1} were used. Plants in each treatment were irrigated with one of the four mentioned salinity levels either once or twice a day every two days, using the same quantity of irrigation water. The amount of irrigation water was added to refill the profile to the field capacity again. The saline water was prepared by dissolving NaCl and CaCl2 salts in a ratio of 1: 1 Na: Ca.

At 75 days after planting (DAP), four plants from each treatment were taken to determine plant height, leaf area, number of main stem, number of leaves, length of roots, fresh and dry weight of stems. Leaves, and roots.

Harvesting was conducted on February 8, and 6 for the fall seasons of 1998 and 1999 respectively. and June 6 and 5 for the summer seasons of 1999 and 2000 respectively, thereafter, yield (as number and weight of tubers

per plant) was determined on four plants from each replicate i.e. 32 plants from each treatment.

Complete randomized blocks in factorial design were used with four replicates; each experimental unit contained 8 pots. Data was statistically analyzed using the analysis of variance according to Snedicor and Cochran (1981). Least significant difference (LSD) test at 5 % level was used to verify differences between treatments mean data.

RESULTS AND DISCUSSION.

1-Plant height.

Regarding the effect of salinity on plant height results were shown in Table (1).

It could be observed that the difference between the irrigation frequencies was significant in both fall seasons, while that in both summer seasons was not significant.

The presented data clearly indicate that the average plant height with 0.4 dS m^{-1} level significantly surpassed that with 4.5 dS m^{-1} by 20.85, and 21.55 % in both fall seasons of 1998 and 1999 respectively. Similar results were shown in summer seasons, the average plant height with 0.4 dS m^{-1} significantly surpassed that of the 4.5 dS m^{-1} by 33.92 and 34.14% in both summer seasons of 1999 and 2000 respectively.

The interaction between salinity levels and irrigation frequency had no statistical significant effect on the plant height in both fall and summer seasons.

The depression effect of salinity on plant height could be attributed to the reduction in cell number, cell enlargement and cell size of the intercellular space per unit area (Strogonov 1962). These results were in agreement with those reported by Bruns and Caesar (1990) who found that irrigation potato plants with saline water decreased plant height. Also, similar finding was obtained by Levy (1992), Mangal et al (1993) Heuer and Nadler (1995), Barakat (1996), EL-Khattib (1996) and Evers et al (1999) who reported that salinity decreased plant height.

The observed reduction in growth under high salinity levels may be due to the inhibition of both merestimatic activity and elongation of cell, Niemen (1965). It can be also added that the reduction in plant height might be due to the disturbance in metabolic activities, which might be affected by the decrease in water absorption and disturbance of mineral balance or absorption and utilization together, EL-Nimr (1986).

2- Leaf area .

Regarding the effect of irrigation frequency on leaf area, twice irrigation increased this character significantly through the1998 and 1999 fall seasons and 1999 summer season only (Table 2).

The different concentrations of saline water, which were used for irrigating potato plants, had a negative significant effect on leaf area in both fall and summer seasons.

The average leaf area with highest salinity 4.5 dS m^{-1} were 34.75 and 35.82% less than that shown in the 0.4 dS m^{-1}(Control) in both two-fall seasons 1998 and 1999 respectively (Table 2). The same results were obtained in both summer seasons; the data showed that the depressive effect on leaf area was 34.82 and 36.88% in the high salinity 4.5 dS m^{-1} less than that shown in the 0.4 dS m^{-1} in both summer seasons 1999 and 2000 respectively.

The depressing effect of salinity on leaf area or leaf size might be attributed to the reduction in cell enlargement and the size of the intercellular space per unit area (Strogonov 1962). In this respect Bilski et al (1988), Levy et al (1988), Heuer and Nadler (1995) and Karam et al (1998) observed that leaf area of potato plants was reduced by increasing salinity level.

The interaction effect of irrigation frequencies and saline concentration was significant in both fall seasons, whereas it did not reach to a significant level in both summer seasons.

Table 1: Stem length (plant height cm) as affected by irrigation frequency and salinity concentrations at 75 days after planting during fall of 1998 and 1999 and summer seasons of 1999 and 2000.

Seasons		Fall		Summer	
Years		1998	1999	1999	2000
Irrigation frequency					
Once		48.56	46.44	41.25	39.05
Twice		50.63	48.44	42.69	40.28
Salinity concentration .					
E.C. dS m^{-1}	0.4	52.38	50.25	45.00	43.54
	1.5	54.88	52.88	46.88	43.53
	3.0	47.75	45.50	40.50	37.15
	4.5	43.38	41.13	35.50	34.45
Interaction					
Irrigation once					
E.C. dS m^{-1}	0.4	51.75	49.50	44.50	42.20
	1.5	54.00	52.00	46.00	44.00
	3.0	46.00	44.00	39.50	36.40
	4.5	42.50	40.25	35.00	33.60
Irrigation twice					
E.C. dS m^{-1}	0.4	53.00	51.00	45.50	44.88
	1.5	55.75	53.75	47.75	43.05
	3.0	49.50	47.00	41.50	37.90
	4.5	44.25	42.00	36.00	35.30

L.S.D. 5 %

	Fall		Summer	
	1998	1999	1999	2000
Irrigation frequency	0.87	0.83	N. S.	N. S.
Salinity concentration	1.23	1.1	2.23	2.30
Irrigation x salinity	N. S.	N. S.	N. S.	N. S.

Table 2: Leaf area (cm^2./ plant) as affected by irrigation frequency and salinity concentrations at 75 days after planting during fall of 1998 and 1999 and summer seasons of 1999 and 2000.

Seasons		Fall		Summer	
Years		1998	1999	1999	2000
Irrigation frequency					
Once		924.98	905.43	895.58	870.55
Twice		980.28	957.79	915.21	883.69
Salinity concentration					
E.C. dS m^{-1}	0.4	1065.90	1051.35	1001.73	990.70
	1.5	1107.65	1094.60	1070.18	995.30
	3.0	941.51	905.80	896.80	863.25
	4.5	695.45	674.68	652.88	625.24
Interaction					
Irrigation once					
E.C. dS m^{-1}	0.4	1001.70	1000.50	995.90	985.90
	1.5	1080.10	1070.00	1050.60	990.50
	3.0	932.71	901.10	891.30	860.50
	4.5	685.41	650.10	644.51	645.30
Irrigation twice					
E. C. dS m^{-1}	0.4	1130.10	1102.20	1007.55	995.50
	1.5	1135.20	1119.20	1089.75	1000.10
	3.0	950.30	910.50	902.30	866.00
	4.5	705.50	699.25	661.25	673.18

L.S.D. 5%

	Fall		Summer	
	1998	1999	1999	2000
Irrigation frequency	9.92	21.14	16.18	N. S.
Salinity	14.03	29.88	22.88	18.94
Irrigation x salinity	19.84	42.26	N. S.	N. S.

3 - Number of main stems.

The irrigation frequencies had no significant effect on number of main stems in both fall and summer seasons.

Concerning the effect of salinity concentrations, the data indicated a significant reduction effect on number of main stems per plant in both fall seasons, whereas it did not reach a significant level in both two-summer seasons. Thus, these results of fall seasons are in agreement of those of Salisikala and Prasad (1994), Heuer and Nadler (1995) and EL-Kattib (1996) indicated that salinity reduced the number of main stems per potato plant. On the contrary Levy (1992), Mangal et al (1993) and Nadler and Heuer (1995) reported that average number of stems per plant was not affected by salinity.. E.C 0.4 dS m^{-1} produced 20.7, 25.0, 15.7 and 14.2% more number of stems as compared to those of 4.5 dS m^{-1} during 1998, 1999, 1999 and 2000 years, respectively (Table3).The interaction effect between irrigation frequencies and different saline water levels did not reach to a significant level in both fall and summer seasons.

Table 3: Effect of irrigation frequency and concentration of saline water on number of stems, number of leaves, and roots length of potato plants at 75 days after planting during fall of 1998 and 1999 and summer of 1999 and 2000.

		Once irrigation				Twice Irrigation				Average				Average	
		E.C. dS.m^{-1}.													
Seasons	Years	0.4	1.5	3.0	4.5	0.4	1.5	3.0	4.5	0.4	1.5	3.0	4.5	Once	Twice
		Number of main stems.													
Fall	1998	5.00	5.00	4.25	4.25	5.25	5.25	4.25	4.25	5.13	5.13	4.25	4.25	4.63	4.75
	1999	5.00	5.00	4.00	4.00	5.00	5.00	4.00	4.00	5.00	5.00	4.00	4.00	4.50	4.50
Summer	1999	4.25	4.25	4.00	4.00	5.00	5.00	4.00	4.00	4.63	4.63	4.00	4.00	4.13	4.50
	2000	4.00	4.00	3.50	3.50	4.00	4.00	3.50	3.50	4.00	4.00	3.50	3.50	3.75	3.75
		Number of leaves.													
Fall	1998	40.00	41.75	38.00	33.50	41.00	42.50	39.00	35.00	40.50.	40.13	38.50	34.25	38.31	39.38
	1999	38.00	40.00	35.75	31.00	38.50	41.25	36.75	32.50	38.25	40.63	36.25	31.75	36.19	37.25
Summer	1999	33.00	34.50	29.50	24.50	35.50	36.00	30.50	25.75	34.25	35.25	30.00	25.13	30.38	31.94
	2000	32.25	33.00	28.50	26.50	33.00	34.25	29.00	25.00	32.63	33.63	28.75	25.75	30.06	30.31
		Roots length.													
Fall	1998	46.68	47.35	41.15	34.90	46.93	47.58	41.43	35.38	46.80	47.46	41.29	35.14	42.52	42.83
	1999	44.85	46.58	39.48	32.78	45.20	45.20	39.70	33.68	45.03	46.04	39.59	33.23	40.92	41.02
Summer	1999	37.65	40.80	34.60	29.50	41.80	42.60	35.20	29.90	37.73	41.70	34.90	29.70	35.64	37.38
	2000	37.10	37.90	32.10	28.00	38.00	38.30	33.40	28.90	37.55	38.10	32.75	28.45	33.78	34.65

L.S.D. 5 %

	Number of main stems.				Number of leaves.				Roots length.			
	Fall		Summer		Fall		Summer		Fall		Summer	
	1998	1999	1999	2000	1998	1999	1999	2000	1998	1999	1999	2000
Salinity.	0.60	0.78	N.S.	N.S.	1.92	1.55	1.48	1.86	1.99	1.92	2.25	0.93
Irrigation frequency.	N.S.	N.S.	N.S.	N.S.	N.S.	1.10	1.05	N.S.	N.S.	N.S.	1.59	0.66
Salinity x Irrigation frequency.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

4-Number of leaves per plant.

Using twice irrigation per day resulting in increasing average leaf number significantly in 1999 of both fall and summer seasons. In other words, applying twice irrigations a day was more useful on number of leaves than irrigation once a day.

It is clear that the high salinity level was significantly lower in leaf number in comparison with those in the other salinity treatments.

The average leaf number in the high salinity E.C 4.5 dS m^{-1} Was 11.03 and 12.41% less than that shown in the E.C 3.0 dS m^{-1} and the latter was 4.06 and 10.78% less than that in the E.C 1.5 dS m^{-1} in both fall seasons 1998 and 1999 respectively. The same results obtained in both two-summer seasons, the average leaf number in the high salinity E.C 4.5 dS m^{-1} was 16.20 and 10.43% less than shown in E.C 3.0 ds m^{-1} and the latter was 14.89 and 14.51% less than that in the E.C 1.5 ds m^{-1} in both two seasons 1999, and 2000 respectively.

The interaction effect between irrigation frequencies and salinity concentrations did not reach to a significant level through both two falls and summer seasons. These results were in agreement with those obtained by several investigators such as Bliski *et al* (1988), Levy *et al* (1988) and Mangal *et al* (1993).

5- Length of roots.

It is clear that the irrigation frequency had significant effect on root length in both two fall seasons, whereas in summer season the effect was not significant. Results cleared that twice irrigation frequency produced the highest value of root length through the fall and summer seasons.

Concerning the effect of different saline water concentrations on potato root length, the data indicated a significant reduction with increasing of salinity concentrations in both fall and summer seasons.

The average length of root in the high salinity level i.e. 4.5 dS m^{-1} was significantly depressed than that in the E.C 0.4 dS m^{-1} (Control) by 24.91 and 26.20% in both fall seasons 1998 and 1999 respectively. The same results obtained in both two-summer seasons, the average root length in the high salinity E.C 4.5 dS m^{-1} was 21.28 and 24.23% less than the E.C 0.4 dS m^{-1} in both summer seasons 1999 and 2000, respectively.

From the previous results, it could be concluded that root length in summer was more sensitive to salinity hazard than fall seasons. E.C 4.5 dS m^{-1} was the most harmful concentration on root length whereas E.C 1.5 dS m^{-1} was the most beneficial concentration on root length in both fall and summer seasons. The decrease in root length with increasing salinity may be due to the increase in osmotic pressure of soil solution with corresponding decrease in available water in addition to the toxic effect of sodium ion.

The interaction effect between irrigation frequencies and salinity levels was not significant in both fall and summer seasons. These results were in agreement with those obtained by AL-Hagdow (1999) who indicated that increasing salinity decreased the root length .

6 – Fresh and dry weight of stems.

It is evident that irrigation twice a day produced higher fresh and dry weight of stems as compared to irrigation once a day in both fall and summer seasons, (Tables 4 & 5).

On the other hand, the highest concentration of saline water significantly decreased fresh and dry weight of stems whereas the lowest salinity concentration E.C 1.5 dS m^{-1} had a significant increasing effect on fresh and dry weight of stems in both fall and summer seasons.

The interaction effect between irrigation frequencies and salinity concentration had significant effect on dry weight of stem in both fall and summer seasons.

7- Fresh and dry weight of leaves.

Twice irrigation a day increased leaves fresh and dry weight over once irrigation a day in both fall and summer seasons.

High salinity E.C 4.5 dS m^{-1} had a negative effect on the leaves fresh and dry weight, also E.C 3.0 dS m^{-1} of salinity caused a significant reduction in leaf fresh and dry weight in both fall and summer seasons (Tables 4 & 5). In this regard Bilski *et al* (1988), Heuer and Nadler (1995) and EL-Khattib (1996) indicated that increasing salinity caused a significant decrease in leaves fresh and dry weight of potato plants.

The interaction between irrigation frequencies and salinity level was not significant in both fall and summer seasons.

8 – Fresh and dry weight of roots.

Concerning the effect of irrigation frequencies and salinity levels on fresh and dry weight of roots, results presented in Tables (4 & 5) show that twice irrigation frequency resulted in significantly higher fresh and dry weight of roots comparing to once irrigation in both fall and summer seasons.

High salinity E.C 4.5 dS m^{-1} significantly decreased fresh and dry weight of roots as compared to low salinity concentration E. C 1.5 dS m^{-1} in both fall and summer seasons.

The interaction effect between irrigation frequencies and salinity levels was significant in both two fall seasons and in summer of 1999 only. In this respect the previous studies indicated that salinity reduced roots fresh weight (Morpurgo and Silva 1987) roots dry weight (Salsikala and Prasad 1994) and both root fresh and dry weight (Barakat 1996, Kalifa 1997, and Alhagdow *et al* 1999).

Table 4: Effect of irrigation frequency and concentration of saline water on fresh weight of stems, leaves, and roots of potato plants at 75 days after planting during fall of 1998 and 1999 and summer of 1999 and 2000.

		Once Irrigation				Twice Irrigation				Average				Average	
		E.C.dS m^{-1}													
Seasons	Years	0.4	1.5	3.0	4.5	0.4	1.5	3.0	4.5	0.4	1.5	3.0	4.5	Once	Twice
		Fresh weight of Stems.													
Fall	1998	39.28	39.90	28.35	25.50	38.25	41.40	31.05	28.30	38.77	40.65	29.70	26.90	33.26	34.75
	1999	35.40	38.80	27.22	24.38	34.00	40.29	29.80	26.80	34.70	39.55	28.51	25.59	31.45	32.72
Summer	1999	33.33	37.65	26.10	23.25	34.53	39.14	28.58	25.58	33.93	38.39	27.34	24.42	30.08	31.96
	2000	33.10	37.12	25.10	22.10	36.20	38.10	26.60	24.20	34.65	37.61	25.85	23.15	29.36	31.28
		Fresh weight of leaves.													
Fall	1998	54.91	57.26	44.59	33.32	57.45	58.67	47.32	36.19	56.18	57.97	45.96	34.76	47.52	49.91
	1999	53.09	56.37	43.65	30.80	55.77	57.61	46.30	35.32	54.43	56.99	44.98	33.06	45.98	48.75
Summer	1999	51.27	55.47	42.80	31.25	53.99	56.56	45.44	34.40	52.63	56.02	44.12	32.83	45.20	47.60
	2000	50.95	52.11	41.20	29.61	52.20	53.20	43.31	33.90	51.58	52.66	42.26	31.76	43.47	45.65
		Fresh weight of roots.													
Fall	1998	46.59	48.93	40.99	39.34	49.88	51.66	44.73	41.06	48.24	50.30	42.86	40.20	43.96	46.83
	1999	43.23	45.10	38.10	37.05	46.60	48.10	41.05	35.07	44.23	45.10	39.58	36.38	40.87	42.86
Summer	1999	39.17	41.70	35.53	34.58	43.55	44.59	38.39	35.59	41.36	43.15	36.96	35.09	37.75	40.53
	2000	40.16	41.10	35.10	33.12	43.26	44.00	38.12	34.13	41.71	42.55	36.61	33.63	37.37	39.88

L.S.D. 5%

	Fresh weight of stems.				Fresh weight of leaves.				Fresh weight of roots.			
	Fall		Summer		Fall		Summer		Fall		Summer	
	1998	1999	1999	2000	1998	1999	1999	2000	1998	1999	1999	2000
Salinity	0.68	2.33	1.22	0.74	0.94	1.48	1.51	1.52	1.59	2.25	1.72	1.92
Irrigation frequency	0.48	0.65	0.86	0.53	0.66	1.05	1.07	1.07	1.12	1.59	1.22	1.36
Salinity x Irrigation frequency.	0.96	N.S.	N.S.	1.05	N.S	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table 5: Effect of irrigation frequency and concentration of saline water on dry weight of stems, leaves, and roots of potato plants at 75 days after planting during fall of 1998 and 1999 and summer of 1999 and 2000.

		Once Irrigation				Twice Irrigation				Average.				Average.	
		E.C. dSm-¹													
Seasons	Years	0.4	1.5	3.0	4.5	0.4	1.5	3.0	4.5	0.4	1.5	3.0	4.5	Once	Twice
		Dry weight of stems.													
Fall	1998	4.70	4.91	3.49	3.14	4.83	5.04	3.82	3.45	4.77	5.00	3.66	3.30	4.06	4.29
	1999	4.35	4.77	3.35	3.00	4.49	4.96	3.67	3.30	4.42	4.87	3.51	3.15	3.87	4.11
Summer	1999	3.97	4.25	3.21	2.86	4.64	4.82	3.52	3.15	4.30	4.54	3.37	3.01	3.57	4.03
	2000	4.00	4.23	3.72	2.99	4.60	4.76	3.53	3.20	4.30	4.50	3.62	3.10	3.74	4.02
		Dry weight of leaves.													
Fall	1998	8.79	9.16	7.13	5.33	9.20	9.39	7.57	5.79	9.00	9.28	7.35	5.56	7.60	7.99
	1999	8.49	9.02	6.98	5.13	8.92	9.22	7.41	6.65	8.71	9.12	7.20	5.89	7.40	8.05
Summer	1999	8.21	8.88	6.85	5.15	8.64	9.05	7.77	5.54	8.43	8.97	7.31	5.35	7.27	7.75
	2000	8.43	8.55	6.72	5.00	8.61	8.80	7.17	5.50	8.52	8.68	6.95	5.25	7.18	7.52
		Dry weight of roots.													
Fall	1998	14.44	15.17	12.71	12.20	15.46	16.01	13.87	12.73	14.95	15.59	13.29	12.47	13.63	14.52
	1999	13.39	13.98	11.81	11.49	14.45	14.91	12.80	11.85	13.92	14.45	12.31	11.67	12.67	13.50
Summer	1999	12.14	12.93	11.01	10.72	13.50	13.85	11.90	11.03	12.82	13.39	11.46	10.88	11.70	12.57
	2000	12.05	12.38	11.00	10.52	13.10	13.42	11.30	10.51	12.58	12.90	11.15	10.51	11.49	12.08

L.S.D. 5%

	Dry weight of stems.				Dry weight of leaves.				Dry weight of roots.			
	Fall		Summer		Fall		Summer		Fall		Summer	
	1998	1999	1999	2000	1998	1999	1999	2000	1998	1999	1999	2000
Salinity.	0.07	0.05	0.06	0.24	0.16	0.48	0.43	0.07	0.10	0.10	0.60	0.47
Irrigation frequency.	0.05	0.03	0.04	0.17	0.11.	0.34	0.31.	0.05	0.07	0.07	0.42	0.33.
Salinity x Irrigation frequency.	0.11	0.07	0.08	0.34	N.S.	0.67	N.S.	0.11	0.14	0.14	0.84	N.S.

9 - Number of tubers.

Irrigation of potato plants with high saline water E.C4.5 ds m^{-1} caused a dramatic reduction in the number of tubers per plant in both fall and summer seasons (Table 6 and Fig. 1) .In this concern Yadav and Paliwal (1990), Mangal *et al* (1993) and Barakat (1996) reported that salinity reduced the tuber number per plant.

The interaction between irrigation frequency and salinity levels did not show a significant effect on the number of tubers per plant in both fall and summer seasons.

10 - Fresh weight of tubers.

Twice irrigation frequencies produced significantly a higher tubers fresh weight per plant comparing with once irrigation in both fall and summer seasons (Table 6 and Fig. 2)

The effect of salinity concentration on tuber fresh weight shows a reverse relationship between salinity concentrations and tuber fresh weight per plant. This means that the highest salinity concentration produced the lowest tuber yield. E.C 4. 5 dS m^{-1} was the most harmful concentration to tuber fresh weight. This reduction may be due to the depression in average tuber weight and number of tubers per plant (Barakat 1996).

The average tuber fresh weight per plant in the high salinity E.C 4.5 dS m^{-1} was 17.81, 21.39, 25.16 and 33.85% less than that shown in the E.C 0.4 dS m^{-1} in both fall and summer seasons respectively. E.C 1.5 dS m^{-1} produced 28.37, 30.96, 35.62 and 53.39% more tuber fresh weight as compared to those of E.C 4.5 dS m^{-1} during 1998, 1999, 1999 and 2000 years, respectively. These results are similar to those stated by Levy *et al* (1988), Abdullah and Ahmad (1990), Bruns and Caesar (1990), Chauhan *et al* (1990), Yadav and Paliwal (1990), Chauhan *et al* (1992), Levy *et al* (1992), Hoorn et al (1993), Mangal et al (1993), Nadler and Heuer (1995), Barakat (1996), EL-Khattib (1996), and Karam etal (1997 and 1998),) who indicated that salinity reduced the potato tuber yield.

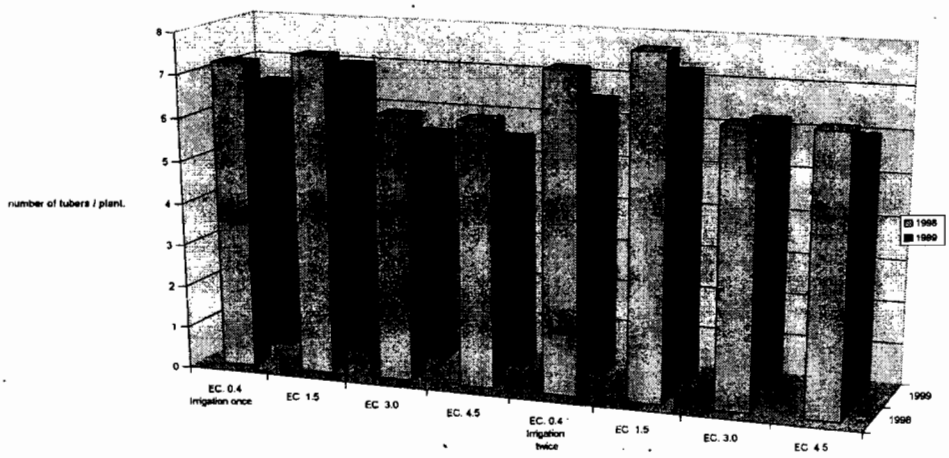
Table 6: Effect of irrigation frequency and concentration of saline water on number of tubers per plant and tuber fresh weight of potato plants during fall of 1998 and 1999 and summer of 1999 and 2000.

		Once Irrigation				Twice Irrigation				Average				Average	
		E.C. dSm-1													
Seasons	Years	0.4	1.5	3.0	4.5	0.4	1.5	3.0	4.5	0.4	1.5	3.0	4.5	Once	Twice
		Number of tubers per plant.													
Fall	1998	7.25	7.50	6.25	6.25	7.50	8.00	6.50	6.50	7.38	7.75	6.38	6.38	6.81	7.13
	1999	6.50	7.00	5.50	5.50	6.50	7.25	6.25	6.00	6.50	7.13	5.88	5.75	6.13	6.50
Summer	1999	6.50	6.50	5.50	5.00	6.50	6.50	5.50	5.00	6.50	6.50	5.50	5.00	5.88	5.88
	2000	6.00	6.00	5.50	5.00	6.00	6.25	5.50	5.00	6.00	6.13	5.50	5.00	5.63	5.69
		Tuber fresh weight per plant.													
Fall	1998	229.10	243.03	214.95	183.50	237.25	249.05	219.20	199.80	233.18	246.04	217.08	191.65	217.65	226.33
	1999	217.60	226.70	201.25	167.15	235.04	239.25	209.25	188.65	226.32	232.98	205.25	177.90	203.18	218.05
Summer	1999	206.35	208.94	179.53	143.36	210.84	214.84	198.79	168.86	208.60	211.72	189.16	156.11	184.55	198.25
	2000	203.11	205.10	178.50	142.48	206.11	210.10	196.90	128.20	204.61	207.60	187.70	135.34	182.30	185.33

L.S.D. 5 %

	Number of tubers per plant.				Tuber fresh weight per plant.			
	Fall		Summer		Fall		Summer	
	1998	1999	1999	2000	1998	1999	1999	2000
Salinity.	0.82	0.75	0.65	0.85	2.54	3.72	3.96	2.35
Irrigation frequency.	N.S.	N.S.	N.S.	N.S.	1.80	2.63	2.80	1.66
Salinity x Irrigation	N.S.	N.S.	N.S.	N.S.	3.59	5.26	5.60	3.33

A



B

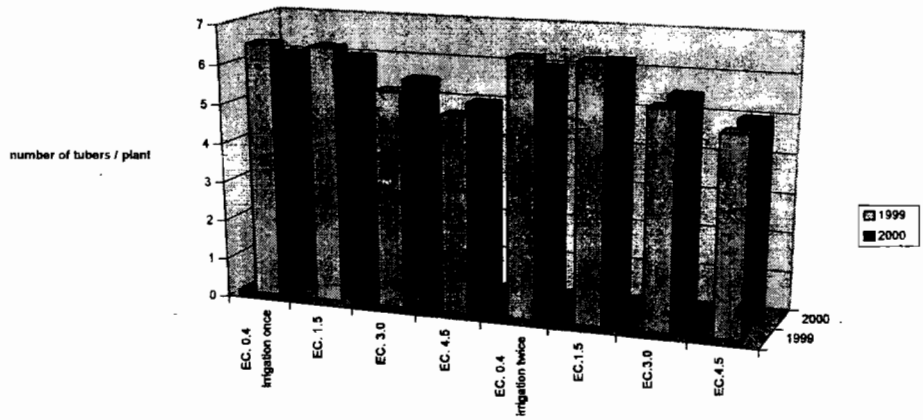


Fig. (1). Effect of irrigation frequency with different concentrations of saline water on number of tuber per plant during fall 1998 and 1999 (A) and summer 1999 and 2000 (B) seasons.

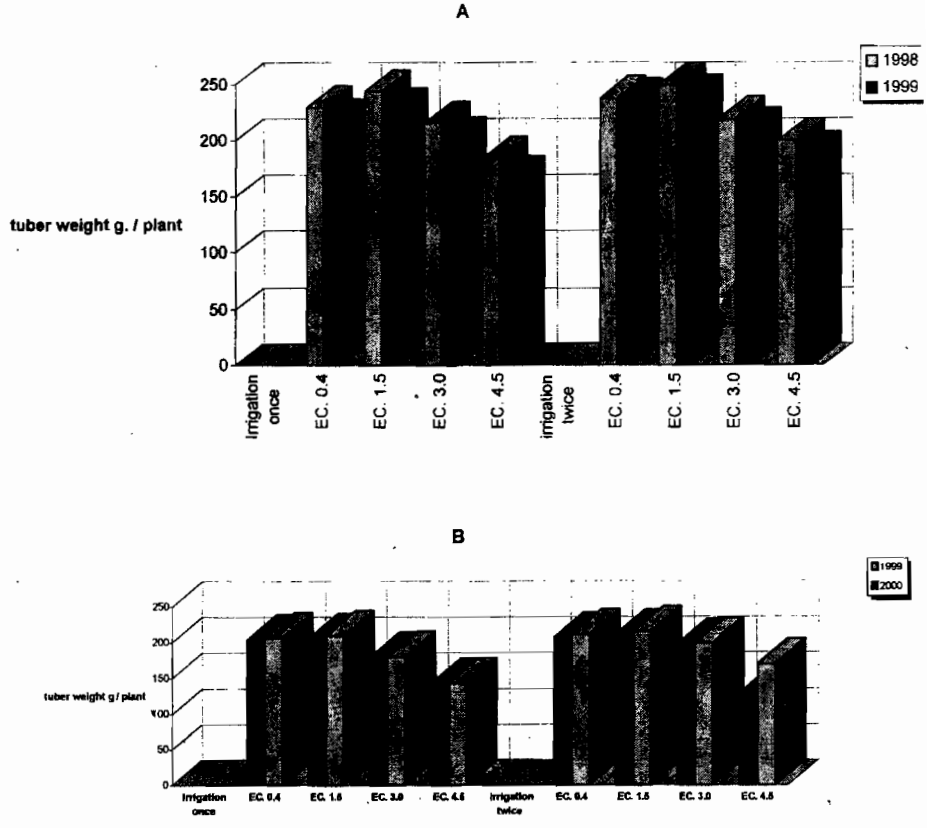


Fig. (2). Effect of irrigation frequency with different concentrations of saline water on tuber fresh weight gm./ plant during fall 1998 and 1999 (A) and summer 1999 and 2000 (B) seasons.

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تأثير الري المتكرر بمستويات مختلفة من الماء المالح على نبات البطاطس.
١-النمو والمحصول .

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الملخص العربي

أجري هذا البحث خلال موسمي الخريف ١٩٩٨ ، ١٩٩٩ وموسمي الصيف ١٩٩٩ ، ٢٠٠٠ لتقييم إنتاجية واستجابة نبات البطاطس صنف الديامونت للري مرة واحدة أو مرتين في اليوم باستخدام تركيزات مختلفة من الملوحة٠,٤، ١,٥، ٣,٠، ٤,٥ دسم في أصص مملوءة بتربة رملية .

انخفضت أطوال السيقان بزيادة الملوحة في ماء الري وكان معدل مساحة الأوراق في التركيزات المرتفعة للملوحة ٤،٥ دسم منخفضا بحوالي٣٤,٧٥، ٣٥,٨٢، ٣٤,٨٢، ٣٦,٨٨% عن التركيز الأقل في الملوحة ٠,٤ دسم خلال موسمي الخريف ١٩٩٨، ١٩٩٩ وموسمي الصيف ١٩٩٩، ٢٠٠٠ على الترتيب

أدى الري مرتين في اليوم إلى زيادة كل من الوزن الطازج والوزن الجاف لكل من السيقان والأوراق والجذور كما أدى إلى زيادة في عدد السيقان وعدد الدرنات بالمقارنة بالري مرة واحدة. بينما لوحظ انخفاض عدد السيقان والأوراق بزيادة تركيز الأملاح في ماء الري.

انخفض الوزن الطازج والجاف للسيقان والأوراق والجذور انخفاضا معنويا بزيادة مستوى الملوحة (٣,٠ أو ٤,٥ دسم) وذلك في كلا الموسمين الخريفي والصيفي. انخفض وزن الدرنات بزيادة تركيز الملوحة من ٣,٠ ألي ٤,٥ دسم بنسبة ١٧,٨١ ، ٢١,٣٩ ، ٢٥,١٦ ، ٣٣,٨٥% بالنسبة للموسم الخريفي ١٩٩٨ ، ١٩٩٩ والموسم الصيفي ١٩٩٩ ، ٢٠٠٠ على الترتيب.