EFFECT OF SALINITY OF IRRIGATION WATER ON ELEMENTAL COMPOSITION OF SOME CULTIVARS OF POMEGRANATE SEEDLINGS

Ahmed Amin, K.I.[1]; H.M.A. Ragheb[2]; H.A. Abdel-Galil[1] and Y.S.Ali[1]

[1]Hort, [2]Soil and Water Sci. Dept., Fac. Agric., Assiut University.

Abstract: The present work was carried out during 1995-1998 growth seasons under a shade house at the Experimental orchard of the Faculty of Agriculture, Assiut University. The aim of this work was to study the effect of four levels of salinity in irrigation water (tab water as a control, 2000, 4000 and 6000 ppm soluble salts) on the chemical composition of leaves, and roots of four different cultivars of pomegranate (*Punica granatum*, L.) seedlings namely (Manfalouty, Nab El-Gamal, Montakhab, and Rosy) of one- and two-years old.

The saline irrigation water was prepared by dissolving a mixture of NaCl and $CaCl_2$ (1:1 on the base of equivalent weight) in tab water. At the end of each growth season the concentrations of N, P, K, Ca and Na in both leaves and roots were determined.

The obtained results could be summarized as follows:

1 - Salinity levels of irrigation water had no significant effects on N concentrations in leaves and roots the seedlings of Nab El-Gamal, Montakhab and Rosy, while N in leaves of Manfalouty pomegranate seedlings were reduced.

2 - Increasing the salt concentration in irrigation water up to 2000 ppm and significantly reduced the P concentration in leaves of the seedlings. P concentrations in roots of the studied cultivars were not affected.

3 - Pomegranate cultivars were differed in their ability of absorption, translocation and accumulation of K in seedlings. Increasing the salt concentration in irrigation water resulted in insignificant increases in K concentrations in leaves and roots. In the roots of the oldest seedlings, increasing the salt concentration in irrigation water up to 6000 ppm reduced the concentration of K. Rosy and Montakhab accumulated the lowest amount of K ions during the growth seasons of the study.

4 - Increasing the salt concentration in irrigation water up to 4000 ppm had no significant effects on Ca concentrations in leaves, but raising the salinity to 6000 ppm significantly increased the Ca concentrations in leaves. The differences in Ca concentrations in leaves between cultivars may be due to the differential response of pomegranate cultivars to salinity.

5 - Calcium concentrations in the roots of pomegranate seedlings were less affected by salinity of irrigation water. Increasing salinity levels of irrigation water up to 6000 ppm significantly increased Ca concentrations only in roots of 1-year old seedlings of Manfalouty and Rosy cultivars.

6 - The main effects of the irrigation water salinity on Na accumulation in leaves of pomegranate seedlings in both growth seasons were significant. Na concentrations were significantly increased with salinity levels up to 6000 ppm in the oldest seedlings. The main effects of cultivars were not significant in most cases.

7 - Na concentration in roots of pomegranate cultivars did not affected by increasing the salt concentration in irrigation water of the 1-year old seedlings. While, only in the second growth season, the main effect of raising the salinity levels of irrigation water on Na accumulation in roots were significant. The studied cultivars differed in their ability to absorpt, translocate and accumulate the sodium ion.

Introduction

Land reclamation projects in the Toshky, Sinai, Eastern and Western deserts, to increase the cultivated area, and to produce more food, occupy a very important sector in the programms of Agricultural development in Egypt. These projects depends on using the under ground water which usually contains high concentration of salts. Therefore, it is important to study the impacts of using such water on the plant growth and the elements concentration in crop plants.

Total minerals contents in plant and plant organs is a function of many factors that influence the absorption by roots and translocation of nutrients from roots to shoots. Salinity level in both soil solution and irrigation water is considered as a direct factor that affects absorption, translocation and accumulation of different ions in plant organs. In seedlings of two Redhaven peach cultivars a correlation between Na:K ratio and salt concentration in the growth media was detected by Biricolti and Pucci (1995). Results obtained by Bondok *et al.* (1995) showed that peach seedlings responded to salinity by increasing the concentration of Ca, Na and Cl and decreasing the concentration of both Mg and Zn ions in leaves.

In their studies on the differences among 15 pomegranate cultivars in leaf mineral contents, Yamdagni *et al.* (1988) found that P and Mg levels did not show significant differences among the studied

cultivars, while N content was significantly higher in 7 cultivars. The highest K content was found in Banipur selection (2.18%) and the lowest was found in Shirine Anar (1.15%). The highest level of Ca was in Bedana Seedana (2.71%) and the lowest level was in nabha (1.96%). Zarad *et al.* (1996) reported that K and Mg contents in leaves of Nabk seedlings decreased with the increase of salt concentration, while Na, Ca and Cl increased.

The impact of saline irrigation water may be reduced by using some growth regulators that control the uptake and accumulation of toxic ions in seedling. Abou El-Khashab *et al.* (1997) found that paclobutrazol (PBZ) reduced the hazard effects of accumulated Na^+ and Cl^- ions in peach seedlings. They reported that PBZ promoted salt stress avoidance in peach by reducing the uptake and accumulation of harmful Na^+ and Cl^- ions in plant tissues.

Stevens *et al.* (1996) found that leaf Na^+ and Cl^- concentrations were elevated by increasing the salt concentration in irrigation water used for sprinkler and surface irrigation. The increases of Na^+ and Cl^- in leaves of grapevines with saline sprinkler irrigation being 4 times those with saline root irrigation. Leaf K^+ concentration was reduced by saline foliar irrigation and increased by saline root irrigation. Saline foliar irrigation had no effect on root concentrations of Na^+, Cl^- and K^+ of grapes seedlings.

The objective of the present work was to study the effect of four levels of salinity in irrigation water on the elemental chemical composition in leaves, stems and roots of four different cultivars of pomegranate seedlings namely (Manfalouty, Nab El-Gamal, Montakhab, and Rosy) of different age (one- and two-years old).

Materials and Methods

The present work was carried out during the 1995-98 growth seasons under a shade house conditions at the Experimental orchard of the Faculty of Agriculture, Assiut University.

The aim of this work was to study the effect of four levels of salinity in irrigation water (tab water as a control, 2000, 4000 and 6000 ppm salt) on chemical composition and nutrient distributions in leaves and roots of four different cultivars of pomegranate (*Punica granatum* L.) seedlings namely (Manfalouty, Nab El-Gamal, Montakhab, and Rosy) of one- and tow-years old.

In November 1994 homogeneous stem cuttings were taken from 15-years old pomegranate trees grown in the experimental orchard of the Pomology Department, Assiut

University. Stem cuttings were buried in soil till March 1995 then after they were taken out and planted in polyethylene bags that contained 3-4 kg of clay soil mixed with 20% sand. Table (1) shows some physical and chemical properties of the soil used in the experiment. The planted stem cuts were irrigated using tab water and left to grow for three months. Seedlings were transplanted into black polyethylene bags of 30x40 cm in dimentions filled with 20 kg of the same clay soil mixed with 20% sand. Seedlings were irrigated with tab water and left to grow for one year.

Table (1):Some physical and chemieal properties of the soil used in the experiment.

Particle size distribute:	
Sand %	19.3
Silt %	31.00
Clay %	49.70
Texture	Clay
Field Capacity %	42.70
pH (1:1)	7.88
ECe (ds/m)	1.84
$CaCO_3$ %	3.13
Exch. K meq/100 gm	1.37
$NaHCO_3$ extractable P ppm	16.40
Soluble ions meq/100 gm	
Ca + Mg	0.58
Na	0.69
K	0.09
$CO_3 + HCO_3$	0.35
Cl	0.82
SO_4	0.12

At the beginning of 1996 growth season uniform and healthy one-year old seedlings of the four pomegranate cultivars were selected and seedlings of each cultivar were arranged in two patches each contained 36 seedlings. The first patch was exposed to salinity stress for one year (1996-1997) and the other was exposed to salinity stress for two consecutive years (1996-1997 and 1997-1998). The experiment consisted of 4 pomegranate cultivars x 4 levels of saline irrigation water. Three replicates each contained 3 seedlings were used and arranged in a complete randomized block design.

The saline irrigation was prepared by dissolving a mixture of NaCl and $CaCl_2$ at the rate of 1:1 on the base of equivalent weight in tab water. The amount of total soluble salts in tab water was measured (360 ppm) and sub tracted from the amount of salt mixture needed for preparing each level of saline irrigation water. At the beginning of March 1996, seedlings were exposed to salinity treatments using the saline irrigation water. Seedlings were irrigated each 4 days using a two and half litter of saline irrigation water so as to maintain the soil moisture content at 80-90% of field capacity. Irrigation using the saline irrigation water were continued to the end of the growth season. Seedlings received the basic N, P and K fertilization during the growth season with irrigation water.

By the end of the first growth season the first patch of seedlings was taken to running the chemical analysis. The second patch was continuously irrigated with tab water to flush out the accumulated salt and left to grow for the second growth season.

Seedlings were taken out of the polyethylene bags and shoots were separated immediately above the soil surface. Shoots were separated into leaves and stem, wiped free of dust with a damp cloth, fresh weighed, washed with tab water, rinsed twice with distilled water, air dried and dry weighed.

Roots were washed out of soil using a jet of tap water then washed with distilled water. Roots were plotted dry and fresh weighed. Two fresh root samples, each of one gram, were taken to measure the root length using the modified Newman's intersection method as described by Tennant (1975).

Plant materials were oven dried at 70°C, dry weighed, finely ground to pass through a 2 mm screen and

digested with H_2O_2-H_2SO_4 mixture as described by Parkinson and Allen (1995).

Total nitrogen was determined using a micro-kjeldahl technique as described by Bremner (1965). Phosphorus was determined colorimetrically using the chlorostannous-reduced phosphomolybdic acid method according to Jackson (1958). Sodium and potassium were measured in the digest by flamephotometer while calcium were determined by the versen volumetric method.

All treatment combinations were arranged in a factorial experiment in a complete randomized block design with three replicates according to Snedecor and Cochran (1979). The collected data were analyzed using the MSTAT computer program as described by Freed *et al.* (1986).

Results and Discussion

Effect of saline irrigation water on nutrients concentrations in pomegranate seedlings:

1. Nitrogen concentrations in leaves and roots:

Data presented in Table (2) showed the effects of increasing the salinity level in irrigation water on the concentration of N in leaves of pomegranate seedlings. Regardless of pomegranate cultivars, N concentration in leaves of the 1-year old seedlings was not significantly affect by inereasing the salt concentration in irrigation water up to 6000 ppm. However, N concentration in leaves of the 2-year old seedlings was significantly reduced from 2.85 to 2.63% with raising the salt concentration in irrigation water up to 6000 ppm.

Data presented in Table (2) also represented the effects of interaction between pomegranate cultivars and salinity levels of irrigation water on N contents in leaves of pomegranate seedlings grown for two successive seasons. Saline irrigation water had only an adverse effect on the N% in leaves of Manfalouty pomegranate seedlings of 1- and 2-year old. Raising the salt concentrations in irrigation water up to 2000 ppm and more and up to 4000 ppm and more significantly reduce the N concentrations in leaves of Manfalouty pomegranate seedlings of one- and two-year old, respectively. In both growth seasons N% in leaves of Manfalouty pomegranate significantly reduced from 3 to 2.5% with increasing the salinity levels up to and more than 2000 ppm. Salinity levels of irrigation water had no significant effects on N concentrations in the leaves of 1- and 2-year old pomegranate seedlings of Nab-El-Gamal, Montakhab and Rosy. These results are in agreement with those found by Yamdagni *et al.* (1988). Who found that N content in leave of

7 pomegranate cultivars was significantly higher than that of 8 other cultivar.

Salinity levels of irrigation water had no significant effects on the N concentrations in roots of the 1-year old seedlings of Manfalouty, Nab-El-Gamal and Montakhab pomegranate cultivars. However, raising the salt concentrations in irrigation water up to 2000 ppm and more pronouncedly and significantly reduced the N% in roots of 1-year old seedlings of Rosy pomegranate (Table 3) In general, nitrogen contents in stems and roots of 1- and 2-year old seedlings of Rosy pomegranate cultivar were more susceptible to the adverse effects of increasing the salinity levels of irrigation water.

Data of the response of N concentration in pomegranate seedlings to salinization of irrigation water emphasized that the oldest pomegranate seedlings of the all studied cultivars were more tolerant to high salt concentration of irrigation water than the youngest ones.

2- Phosphorus concentrations in leaves and roots:

Investigating the data presented in Table (4) showed that in both growth seasons the overall main effect of salinization of irrigation water on P concentration in leaves of pomegranate seedlings was significant, but the magnitude of this effect was more remarkable in the first growth season. Increasing the salt concentration in irrigation water up to 2000 ppm and more significantly reduced the P concentration in leaves of the youngest seedlings from 0.39% to 0.34%, while in the oldest one, the adverse effect of salinization of irrigation water appeared only with increasing the salt concentration in irrigation water up to 4000 ppm and more.

The effects of salinity levels of irrigation water on P concentration in leaves of pomegranate seedlings were differed with cultivars, Table (4). In the first growth season, P concentrations in leaves of all studied cultivars but Montakhab were significantly redueed with increasing the salt concentration in irrigation water up to 6000 ppm. In the second growth seasou, P concentration in leaves of both Nab El-Gamal and Montakhab cultivars was not affected by increasing the salinity levels of irrigation water. The results obtained by Yamdagni *et al.* (1988), showed that P levels in leaves did not show significant differences among the pomegranate cultivars.

Data summarized in Table (5) reflected that, in general, P concentrations in roots of pomegranate cultivars was not

affected by both salinization of irrigation water and salinization of irrigation water x pomegranate cultivars interaction effects. It is worthy to mentioned that P concentrations in roots of the 2-year old seedlings of Rosy cultivars were significantly reduced with increasing the salt concentration in irrigation water up to 6000 ppm.

Table (2): Effect of different levels of salinity in irrigation water on N concentration in leaves of four different cultivars of pomegranate seedlings.

Salinity treatment ppm	N concentration in leaves (%)									
	Manfalouty		Nab El-Gamal		Montakhab		Rosy		Mean	
	Season 1996/1997									
	12 months after salinity treatment									
Control	3.02	a	2.40	C	2.50	c	2.57	c	2.63	A
2000	2.61	bc	2.55	C	2.57	c	2.90	ab	2.66	A
4000	2.65	bc	2.46	C	2.63	b	2.59	bc	2 58	A
6000	2.50	c	2.53	c	2.65	bc	2.49	c	2.54	A
Mean	2.70	A	2.49	B	2.59	AB	2.64	AB		
	Season 1997/1998									
	24 months after salinity treatment									
Control	3.00	ab	2.87	a-e	2.63	efg	2.90	a-d	2.85	A
2000	2.80	a-f	2.74	a-g	2.75	a-g	3.00	a	2.82	A
4000	2.60	fg	2.97	abc	2.73	c-g	2.97	abc	2.81	A
6000	2.50	g	2.68	d-g	2.64	d-g	2.74	b-g	2.63	B
Mean	2.73	AB	2.8	AB	2.65	B	2.90	A		

Means followed by the same letter are not significantly different at 5% level.

Letters from (A-B) for comparing salinity levels.

Letters from (A-B) for comparing cultivars of pomegranate.

Letters from (a-g) for the interaction.

Table (3): Effect of different levels of salinity in irrigation water on N concentration in roots of four different cultivars of pomegranate seedlings.

Salinity treatment ppm	N concentration in roots (%)									
	Manfalouty		Nab El-Gamal		Montakhab		Rosy		Mean	
	Season 1996/1997									
	12 months after salinity treatment									
Control	1.69	bcd	1.43	cd	1.50	cd	2.21	a	1.71	A
2000	1.76	bc	1.47	cd	1.57	bcd	1.75	bc	1.64	A
4000	1.68	bcd	1.56	bcd	1.70	bcd	1.85	b	1.71	A
6000	1.71	bcd	1.40	d	1.65	bcd	1.50	bcd	1.56	A
Mean	1.71	AB	1.47	C	1.61	B	1.83	A		
	Season 1997/1998									
	24 months after salinity treatment									
Control	1.55	cde	1.59	cd	1.67	abc	1.78	a	1.65	A
2000	1.51	de	1.56	cde	1.67	abc	1.63	bcd	1.59	AB
4000	1.56	cde	1.43	e	1.75	ab	1.55	cde	1.57	AB
6000	1.43	e	1.56	cde	1.62	bcd	1.58	cde	1.55	B
Mean	1.15	B	1.54	B	1.68	AB	1.63	A		

Means followed by the same letter are not significantly different at 5% level.

Letters from (A-B) for comparing salinity levels.

Letters from (A-C) for comparing cultivars of pomegranate.

Letters from (a-e) for the interaction.

Table (4): Effect of different levels of salinity in irrigation water on P concentration in leaves of four different cultivars of pomegranate seedlings.

Salinity treatment ppm	P concentration in leaves (%)									
	Manfalouty		Nab El-Gamal		Montakhab		Rosy		Mean	
	Season 1996/1997									
	12 months after salinity treatment									
Control	0.39	ab	0.37	abc	0.38	abc	0.42	a	0.39	A
2000	0.34	bcd	0.36	bcd	0.37	abc	0.38	abc	0.36	B
4000	0.34	bcd	0.33	cd	0.37	abc	0.34	bcd	0.35	B
6000	0.33	cd	0.31	d	0.35	bcd	0.36	bcd	0.34	B
Mean	0.35	AB	0.34	B	0.37	A	0.37	A		
	Season 1997/1998									
	24 months after salinity treatment									
Control	0.31	b-c	0.23	f	0.26	def	0.43	a	0.31	A
2000	0.35	b	0.27	c-f	0.31	bcd	0.34	b	0.32	A
4000	0.26	ef	0.27	def	0.25	f	0.32	bc	0.28	B
6000	0.23	f	0.26	def	0.24	f	0.27	c-f	0.25	B
Mean	0.29	B	0.26	C	0.27	BC	0.34	A		

Means followed by the same letter are not significantly different at 5% level.

Letters from (A-B) for comparing salinity levels.

Letters from (A-C) for comparing cultivars of pomegranate.

Letters from (a-f) for the interaction.

Table (5): Effect of different levels of salinity in irrigation water on P concentration in roots of four different cultivars of pomegranate seedlings.

Salinity treatment ppm	P concentration in leaves (%)									
	Manfalouty		Nab El-Gamal		Montakhab		Rosy		Mean	
	Season 1996/1997									
	12 months after salinity treatment									
Control	0.30	b	0.32	ab	0.30	b	0.35	a	0.32	A
2000	0.31	ab	0.30	ab	0.32	ab	0.33	ab	0.32	A
4000	0.29	b	0.32	ab	0.30	ab	0.28	b	0.30	A
6000	0.29	b	0.29	b	0.33	ab	0.32	ab	0.31	A
Mean	0.30	A	0.31	A	0.31	A	0.32	A		
	Season 1997/1998									
	24 months after salinity treatment									
Control	0.23	b-e	0.23	b-e	0 24	a-d	0.28	a	0.25	A
2000	0.25	a-d	0.26	abc	0.24	a-d	0.26	abc	0 26	A
4000	0.24	a-d	0.26	ab	0.26	abc	0.25	a-d	0.24	A
6000	0.23	cde	0.21	e	0.22	de	0.24	b-e	0.22	B
Mean	0.24	A	0.24	A	0.24	A	0.25	A		

Means followed by the same letter are not significantly different at 5% level.

Letters from (A-B) for comparing salinity levels.

Letters A for comparing cultivars of pomegranate.

Letters from (a-e) for the interaction.

3. Potassium concentrations in leaves and roots:

The overall main effect of salinization of irrigation water significantly and adversely affected the K concentrations in leaves of the 1-year old pomegranate seedlings. The decrease of K concentration in leaves of the 1-year old pomegranate seedlings occured with the first

increment of increases the salinity levels in irrigation water (up to 2000 ppm) However, in the second growth season, irrespective of pomegranate cultivars, salinization of irrigation water did not affect the K concentrations in leaves of pomegranate seedlings. Data obtained by El-Hammady *et al.* (1995) revealed that, regardless of the rootstock of citrus seedlings, plants irrigated with water of 3000 ppm salt exhibit of lowest values of leaf K concentrations.

In both growth seasons, the differences between the overall means of K concentrations in leaves of pomegranate cultivars were significant. Nab El-Gamal seedlings accumulated the highest amount of K in their leaves. These data emphasized that pomegranate cultivars were differed in their ability of absorption, translocation and accumulation of K in their leaves.

In both growth seasons, K concentration in leaves was not significantly affected by the interaction between salinity of irrigation water and pomegranate cultivars. Salinity levels of irrigation water had no significant effects on the K concentrations in leaves of both 1- and 2-year old seedlings of all studied pomegranate cultivars except for Rosy cultivar. Increasing the salt concentration in irrigation water up to 6000 ppm significantly reduced the K concentration in leaves of the 1-year old Rosy pomegranate from 1.4 to 1.0%. Data obtained by Zarad *et al.* (1996) showed that K content in leaves of Nabk seedlings decreased with increased salt concentration in growth media. Using saline water for foliar irrigation of grapes seedlings resulted in reducing the leaves K concentration (Stevens *et al.*, 1996).

Data summarized in Table (7) showed that K concentrations in roots of the younger seedlings were less susceptible to the adverse effects of salinization of growth media. Irrespective to pomegranate cultivars, K concentrations in roots of 1-year old pomegranate seedlings were not affected by raising the salt concentration in irrigation water up to 6000 ppm. In the second growth season, however, the increases of salinity levels in irrigation water up to and more than 4000 ppm significantly reduced the K concentration in roots.

Table (6): Effect of different levels of salinity in irrigation water on K concentration in leaves of four different cultivars of pomegranate seedlings.

Salinity treatmcnt ppm	K concentration in leaves (%)									
	Manfalouty		Nab El-Gamal		Montakhab		Rosy		Mean	
	Season 1996/1997									
	12 months after salinity treatment									
Control	1.30	abc	1.40	ab	1.04	c-f	1.40	ab	1.26	A
2000	1.00	def	1.50	a	0.83	f	1.20	bcd	1.11	B
4000	1.23	a-d	1.20	bcd	0.90	ef	1.10	c-f	1.08	B
6000	1.01	def	1.30	abc	1.11	b-e	1.02	def	1.11	B
Mean	1.13	B	1.32	A	1.0	C	1.15	B		
	Season 1997/1998									
	24 months after salinity treatment									
Control	1.20	a-d	1.33	a	0.81	f	1.00	c-f	1.09	A
2000	1.14	a-d	1.20	a-d	0.90	f	0.90	ef	1.01	A
4000	1 13	a-d	1.22	abc	0.90	f	1.01	c-f	1 05	A
6000	1.00	c-f	1.30	ab	1.00	def	1.10	b-e	1.09	A
Mean	1.10	B	1.25	A	0.88	D	1.00	C		

Means followed by the same letter arc not significantly different at 5% level.

Letters from (A-B) for comparing salinity levels.

Letters from (A-D) for comparing cultivars of pomegranate.

Letters from (a-f) for the interaction.

Roots of pomegranate cultivars were significantly differed in their ability to absorb and accumulate K ions (Table 7). The overall main effects of pomegranate cultivars on K concentrations in roots showed that in the first growth season, seedling of Manfalouty and Montakhab accumulated the highest amount of K in their roots. In the second growth season, roots of Nab El-Gamal and Montakhab accumulated the highest amount of K ions.

Table (7): Effect of different levels of salinity in irrigation water on K concentration in roots of four different cultivars of pomegranate seedlings.

Salinity treatment ppm	K concentration in leaves (%)									
	Manfalouty		Nab El-Gamal		Montakhab		Rosy		Mean	
	Season 1996/1997									
	12 months after salinity treatment									
Control	0.49	a-d	0.55	abc	0.47	a-d	0.40	d	0.48	A
2000	0.48	b-d	0.40	d	0.50	a-d	0.53	a-d	0.48	A
4000	0.51	a-d	0.49	a	0.44	cd	0.46	a-d	0.50	A
6000	0.45	b-d	0.59	ab	0.47	a-d	0.52	a-d	0.50	A
Mean	0.48	A	0.53	A	0.47	A	0.48	A		
	Season 1997/1998									
	24 months after salinity treatment									
Control	0.55	bc	0.53	b-e	0.53	bcd	0.51	c-f	0.53	A
2000	0.61	a	0.57	ab	0.52	b-e	0.48	efg	0.54	A
4000	0.50	c-f	0.52	b-e	0.51	c-f	0.46	fg	0.50	B
6000	0.46	fg	0.45	g	0.49	d-g	0.46	fg	0.47	C
Mean	0.53	A	0.52	A	0.51	A	0.48	A		

Means followed by the same letter are not significantly different at 5% level.

Letters from (A-C) for comparing salinity levels.

Letters from (A-B) for comparing cultivars of pomegranate.

Letters from (a-g) for the interaction.

The salinity level x pomegranate cultivar interaction had no significant effects on K concentrations in roots of pomegranate seedlings of the 1-year old, but it was significant in the case of the 2-year old seedlings (Table 7). Increasing the salt concentration in irrigation water up to 6000 ppm reduced the concentration of K in roots of the 2-

year old seedling of Manfalouty and Nab El-Gamal only

Saline irrigation water has many type of injury effects on plants. Osmotic effects and specific ion effects are the most well known effects. Salinization of irrigation water may also damage the cell membrane and demolish its selectivity. Thus the salt affected cells may aecumulate higher amount of disolved ions as a final result of destroying the cell membranc. Therefore, in most cases salinization of irrigation water increased the concentration of ions in plant organs. In some cases, increases the salt concentration in growth media resulted in decreasing the ability of roots to absorb and translocate the dissolved ions as a result of the antagonistic effects between ions and thus the concentrations of ions in plant organs decreased with increasing the salt concentration in the growth media.

4- Calcium concentrations in leaves and roots:

Tables (8 and 9) showed the effects of salinity levels in irrigation water on Ca concentrations in leaves, and roots of 1- and 2-year old seedlings of pomegranate cultivars. Regardless of cultivars, in the case of 1-year old pomegranate seedlings, increasing the salt concentration in irrigation water up to 4000 ppm had no significant effects on Ca concentrations in leaves, but raising the salinity level in irrigation water up to 6000 ppm significantly increased the Ca concentrations in leaves (Table 8) Ca concentrations in leaves of the 2-year old pomegranate seedlings were significantly increased with increasing the salt concentrations in irrigation water up to 4000 ppm and higher. Leaves of Rosy seedlings aceumulate the highest amount of Ca while leaves of Nab El-Gamal seedlings contained the lowest concentration of Ca. The increase amounts of Ca in leaves may be due to the increases of Ca concentrations in the growth media that associated with salinization of the irrigation water. The differences in Ca concentration in leaves of different pomegranate cultivars may be due to the differences among cultivars in absorption, translocation and accumulation of Ca in leaves. These results are in line with Zarad *et al* (1996), they found that Ca concentration in leaves of Nabk seedlings increased with the increases of salt in growth media. Bondok *et al.* (1995) showed that peach seedlings responded to salinity by increasing the concentration of Ca in leaves.

The cultivar x salt concentration of irrigation water interaction markedly affected the Ca concentrations in leaves of 1- and 2-year old pomegranate seedlings. In

the first growth season, salinization of irrigation water up to 6000 ppm significantly increased the Ca concentrations in leaves of all studied pomegranate cultivars but Nab El-Gamal.

Table (8): Effect of different levels of salinity in irrigation water on Ca concentration in leaves of four different cultivars of pomegranate seedlings.

Salinity treatment ppm	Ca concentration in leaves (%)									
	Manfalouty		Nab El-Gamal		Montakhab		Rosy		Mean	
	Season 1996/1997									
	12 months after salinity treatment									
Control	1.57	d-g	1.45	fg	1.70	c-f	1.93	bc	1.68	B
2000	1.67	def	1.62	def	1.48	fg	1.80	cd	1.64	B
4000	1.77	cde	1.52	efg	1.66	def	2.08	b	1.76	B
6000	1.95	bc	1.50	g	1.95	bc	2.47	a	1.98	A
Mean	1.74	D	1.52	C	1.70	D	2.05	A		
	Season 1997/1998									
	24 months after salinity treatment									
Control	1.44	cde	1.35	de	1.50	cde	1.56	cd	1.50	B
2000	1.48	cde	1.52	cde	1.68	c	2.1	ab	1.68	B
4000	1.35	de	1.54	cde	2.16	a	1.93	b	1.75	A
6000	1.33	e	1.37	de	2.18	a	2.15	ab	1.78	A
Mean	1.43	B	1.42	B	1.88	A	1.95	A		

Means followed by the same letter are not significantly different at 5% level.

Letters from (A-B) for comparing salinity levels.

Letters from (A-D) for comparing cultivars of pomegranate.

Letters from (a-e) for the interaction.

Table (9): Effect of different levels of salinity in irrigation water on Ca concentration in roots of four different cultivars of pomegranate seedlings.

Salinity treatment ppm	Ca concentration in leaves (%)									
	Manfalouty		Nab El-Gamal		Montakhab		Rosy		Mean	
	Season 1996/1997									
	12 months after salinity treatment									
Control	1.13	def	1.07	def	1.33	cd	1.20	c-f	1.19	B
2000	1.13	def	1.00	f	1.13	def	1.28	cde	1.14	B
4000	1.23	c-f	1.03	ef	1.25	c-f	1.23	c-f	1.18	B
6000	1.77	b	1.03	ef	1.47	c	2.10	a	1.59	A
Mean	1.31	A	1.03	B	1.30	A	1.23	AB		
	Season 1997/1998									
	24 months after salinity treatment									
Control	0.87	ef	1.00	b-e	1.13	ab	0 98	c-f	1.00	A
2000	1.08	abc	1.16	a	0.97	c-f	1.05	a-d	1.07	A
4000	1.13	ab	1.10	abc	0.87	ef	1.02	bcd	1.03	A
6000	0.85	f	1.13	ab	0.92	def	1.03	a-d	0.98	A
Mean	0.98	A	1.10	A	0.97	A	1.02	A		

Means followed by the same letter are not significantly different at 5% level.

Letters from (A-B) for comparing salinity levels

Letters from (A-B) for comparing cultivars of pomegranate.

Letters from (a-e) for the interaction.

Calcium concentrations in leaves of 1-year seedling of Nab El-Gamal were less affected by raising the salt concentrations in irrigation water. Leaves of rosy cultivars had the highest concentrations of Ca which were more affected by raising the salt concentrations in irrigation water comparing to the other studied cultivars. In the second growth season, the trend was changed. Ca concentrations in leaves of the 2-year

old seedlings of both Manfalouty and Nab El-Gamal were not affected by salinization of irrigation water, while Ca concentrations in leaves of the 2-year old seedlings of both Montakhab and Rosy cultivars were significantly increased with increasing the salt concentrations in irrigation water up to 4000 ppm and higher. Increasing the Ca concentrations in the growth media that associated with raising the salinity levels of irrigation water may explain these results. The differences in Ca concentrations in leaves among cultivars may be due to the differential response of pomegranate cultivars to salinization of irrigation water. El-Hammady *et al.* (1995) found that citrus rootstock were significantly differed in their leaves Ca concentrations Bondok *et al.* (1995) reported that peach seedlings responded to salinity levels in irrigation water by increasing the concentration of Ca in leaves

The main effect of increasing salt concentration in irrigation water on Ca concentration in roots of the 1-year old pomegranate seedling was significant, while it was not significant for the 2-year old pomegranate seedlings (Table 9). Raising the salt concentration in irrigation water up to 6000 ppm significantly increased the Ca concentration in roots of the 1-year old pomegranate seedlings from 1.19 to 1.59%. The 2-year old pomegranate seedlings seemed to be more tolerance to salt injury, therefore increasing the salinity levels did not affect the Ca concentrations in their roots.

Data presented in Table (9) also showed that the differences in Ca concentrations in roots of the 1-year old pomegranate seedlings were significant, but the roots of the 2-year old seedlings accumulated almost the same amount of Ca in their roots.

The effect of interaction among cultivars and salinity levels of irrigation water on Ca concentrations in roots was highly significant (Table 9). This effect was more pronounced in the 1-year old seedlings compared to the 2-year old ones. Increasing salinity levels of irrigation water up to 6000 ppm significantly increased Ca concentrations only in roots of 1-year old seedlings of Manfalouty and Rosy cultivars.

5- Sodium concentrations in leaves and roots:

The main effects of the irrigation water salinity on Na accumulation in leaves of pomegranate seedlings in both growth seasons were significant (Table 10) Na concentrations in leaves of pomegranate seedlings significantly increased with raising the salinity levels of irrigation water up to 6000 ppm. The main effects of cultivars were not significant in most cases.

In both growth seasons the interaction effects of salinity levels x cultivars were significant. In both growth seasons and in all the studied pomegranate cultivars, salinization of irrigation water resulted in increasing the concentration of Na in leaves (Table 10). This may be a direct result of using NaCl salt in salinizing the irrigation water. Many investigators reported that, in many fruit trees, increasing the salt concentration in irrigation water was associated with accumulation of Na ions in leaves. These increases in Na accumulations in leaves may be responsible for reducing the weight and root length of pomegranate seedlings (Ahmed Amin *et al.*, 2002). This effect is the same as that reported by El-Hammady *et al.* (1995) in citrus rootstocks, Stevens *et al.* (1996) in grape and Zarad *et al.* (1996) in nabak.

As presented in Table (11) the main effects of the saline irrigation water on Na concentration in roots was only significant in the second growth season. Increasing the salinity level of irrigation water resulted in increasing the overall mean of Na concentration in roots of 2-year old pomegranate seedlings from 0.14 to 0.22%. As enumerated above, in leaves only in the first growth season significant differences existed in Na concentration in roots among the pomegranate cultivars. Nab El-Gamal and Montakhab cultivars had the highest Na concentration in their roots. The differences among the 1-year old pomegranate cultivars in Na concentration in roots confirmed that pomegranate seedlings tolerate the salinity stress by accumulate high amount of Na ions in their roots and the young cultivars differed in their ability of developing the exeluded mechanism of tolerate the salinity stress. The oldest seedling already developed this mechanism and all the pomegranate cultivars were equal in this respect.

It is worthy to mention that the interaction effects of salinity level x pomegranate cultivars on Na concentration in roots in both growth season were not significant. However, only in the second growth season, the effects of salinization on Na concentration in roots varies with pomegranate cultivars. Increasing the salinity levels of irrigation water from 2000 to 6000 ppm significantly increased the concentration of Na in roots of the 2-year old Manfalouty, Nab El-Gamal and Montakhab cultivars where 6000 ppm salinity level gave the highest concentration of Na in roots.

Table (10): Effect of different levels of salinity in irrigation water on Na concentration in leaves of four different cultivars of pomegranate seedlings.

Salinity treatment ppm	Na concentration in leaves (%)									
	Manfalouty		Nab El-Gamal		Montakhab		Rosy		Mean	
	Season 1996/1997									
	12 months after salinity treatment									
Control	0.17	c	0.18	c	0 34	abc	0.16	c	0.21	B
2000	0.46	ab	0.50	ab	0.46	ab	0.25	abc	0.42	A
4000	0.26	bc	0.30	abc	0.43	abc	0.54	a	0.39	A
6000	0.25	bc	0.34	abc	0.55	a	0.43	bc	0.39	A
Mean	0.29	B	0.33	B	0.44	A	0.35	AB		
	Season 1997/1998									
	24 months after salinity treatment									
Control	0.08	d	0.10	d	0.13	cd	0.10	cd	0.10	C
2000	0.23	bc	0.18	bcd	0.16	cd	0.14	cd	0.17	B
4000	0.14	cd	0.23	bc	0.21	bc	0.15	cd	0 18	B
6000	0.18	cd	0.40	a	0.31	ab	0.17	cd	0.27	A
Mean	0.16	A	0.22	A	0.20	A	0.15	A		

Means followed by the same letter are not significantly different at 5% level.

Letters from (A-C) for comparing salinity levels.

Letters from (A-B) for comparing cultivars of pomegranate.

Letters from (a-d) for the interaction.

Table (11): Effect of different levels of salinity in irrigation water on Na concentration in roots of four different cultivars of pomegranate seedlings.

Salinity treatment ppm	Na concentration in leaves (%)									
	Manfalouty		Nab El-Gamal		Montakhab		Rosy		Mean	
	Season 1996/1997									
	12 months after salinity treatment									
Control	0.24	cd	0.32	ab	0.25	a-d	0.29	a-d	0.27	A
2000	0.25	bcd	0.31	abc	0.31	abc	0.30	abc	0.29	A
4000	0.24	cd	0.29	a-d	0.32	ab	0.27	a-d	0.28	A
6000	0.30	abc	0.27	a-d	0.32	a	0.21	d	0.28	A
Mean	0.26	B	0.30	A	0 30	A	0.27	B		
	Season 1997/1998									
	24 months after salinity treatment									
Control	0.12	h	0.14	gh	0.15	e-h	0.15	fgh	0.14	C
2000	0.16	d-g	0.17	d-g	0.14	fgh	0.16	d-g	0.16	C
4000	0.19	bcd	0.21	bc	0.18	b-e	0.17	d-g	0.19	B
6000	0.21	b	0.27	a	0.22	b	0.17	c-f	0 22	A
Mean	0.17	A	0.19	A	0.17	A	0.16	A		

Means followed by the same letter are not significantly different at 5% level.

Letters from (A-C) for comparing salinity levels.

Letters from (A-B) for comparing cultivars of pomegranate.

Letters from (a-g) for the interaction.

References

Abou El-Khashab, A.M.; A.F. El-Samak; A.A. Elaidy; M.I. Salman and M. Rieger (1997) Paclobutrazol reduces some negative effects of salt stress in

peach. J. Amer. Soc. Hort. Sci. 122 (1): 43-46.

Ahmed Amin, K.I.; H.M.A. Ragheb; H.A. Abdel-Galil and Y.S. Ali (2002). Differential tolerance of seedlings of some pomegranate cultivars to salinity. Assiut J. of Agric. Sci. (In press).

Biricolti, S. and S. Pucci (1995). Effects of increasing NaCl rates on (*Redhaven*) peach and (*GF677*) rootstock cultured in vitro. Advances in Hort. Sci. 9 (2): 75-78

Bondok. A., H. Tawfic; A. Shaltout and N. Abdel-Hamid (1995). Effect of salt stress on growth and chemical constituents of three peach rootstocks. Assiut J. of Agric. Sci. 26 (1): 173-194.

Bremner, J.M. (1965). Inorganic forms of nitrogen. p. 1179-1237. In C A. Black et al. (ed.) Methods of Soil Analysis. Part 2. Agron. Monogr. 9 ASA, Madison, WI.

El-Azab, E.M., M.W. Taha and M.N. Al-Rawi (1978). Effect of stratification and salinity on seed germination, vegetative growth and leaf mineral content of apricot and peach seedlings. Alex. J. Agric. Res., 26: 415-22.

El-Hammady, A.M.; M. Abou-Rawash; A. Abou-Aziz; N. Abd El-Hamid and E. Abd El-Moneim (1995). Impact of irrigation with salinized water on growth and mineral content of some citrus rootstock seedlings. Annals Agric. Sci. Ain Shams Univ. Cairo, 40 (1): 327-341.

Freed, R.P.; S.P. Eisensmith; S. Goelz; D. Reicozky; W.W. Small and P. Woberg (1986) MSTAT. A software program for design, management and analysis of agronomic research experiments. Dept. Crop and Soil Sci. Michigan State Univ., USA

Hassan, E.M.M. and A.M Galal (1986). Salt tolerance among some citrus rootstocks. Proc. 1st Hort. Sci. Tanta Univ., September, (Vol. 11, 407-416).

Jackson, M.L. (1958). Soil Chemical Analysis. Prentic-Hall Inc. Englewood Cliffs. N.J., U.S.A.

Moussa, A.M., B.H. Abou-Lila and M. Hussen (1985). Biochemical changes in Lupine plants under the influence of salinity types. Bull. Egypt. Soc Physiol. Sci., 5: 181-194.

Parkinson, J.A. and S.E. Allen (1995) A uew oxidation procedure suitable for the determination of nitrogen and mineral nutrients in biological material. Commun. Soil Science and Plant Analysis. 6: 1-11.

Snedecor, G.W. and W.G. Cochran (1979). Statistical Methods 7th

Ed, the Iowa State Univ. Press, Iowa, U.S.A., p. 593.

Stevens, R.M. and G. Harvey (1995). Effect of water longing, rootstock and salinity on NaCl and K concentrations of the leaf and root, and shoot growth of sultana grapevines. Australian J. of Agric. Res. 46 (3): 541-551. Hort. Abst. 66: 2077.

Stevens, R.M.; G. Harvey and G. Davies (1996). Separating the effects of foliar and root salt uptake on growth and mineral composition of four grapevine cultivars on their own roots and on (Ramsey) rootstock. J. Amer. Soc. Hort. Sci. 121 (3): 569-575.

Tennant, D. (1975). A test of modified line intersect method of estimating root length. J. Ecol. 63: 995-1001.

Yamdagni, R.; S.S Dahikya and U.P. Ahlawat (1988). Mineral composition of leaves of some pomegranate cultivars. Haryana, Agric. Univ. J. of Res. 18 (1): 50-52.

Zarad, S.S.; A.M. Saleh and Y.A. Hossny (1996). Studies on salt tolerance of nabk plants. Fourth Arabic Conf. for Hort. Crops, El-Minia, Egypt. 46, 11: 605-616.

تأثير ملوحة ماء الرى على محتوى العناصر لشتلات بعض أصناف الرمان

د. كاميليا ابراهيم أحمد أمين[1]،د. حسين محمد على راغب[2] ، د.حسن عبد القوى عبد الجليل[1] ، السيد/ ياسر شحاته على[1]

١- قسم البساتين ، ٢- قسم الأراضى - كلية الزراعة - جامعة أسيوط

أجريت هذه التجربة خلال مواسم النمو ١٩٩٦/١٩٩٧ ، ١٩٩٧/١٩٩٨ بالصوبة الخشبية فى مزرعة الفاكهة بكلية الزراعة جامعة أسيوط وذلك بغرض دراسة تأثير الرى بتركيزات مختلفة من ملوحة مياه الرى على محتوى العناصر لشتلات أربعة أصناف من الرمان هى (منفلوطى - ناب الجمل - منتخب - وردى) عمر (سنة / سنتين) رويت بأربعة مستويات من الأملاح هى (صفر (كنترول) ، ٢٠٠٠ ، ٤٠٠٠ ، ٦٠٠٠ جزء فى المليون) من المخلوط الملحى المكون من كلوريد صوديوم وكلوريد كالسيوم بنسبة ١:١ . وقد شملت الدراسة تأثير كل من التركيزات السابقة لملوحة مياه الرى على المحتوى المعدنى للأوراق والجذور من العناصر الغذائية مثل (النيتروجين - الفوسفور - البوتاسيوم - الكالسيوم - الصوديوم) . ولقد صممت تجربة عاملية بطريقة القطاعات العشوائية واحتوت كل معاملة على ثلاث مكررات واحتوت كل مكررة على ثلاث نباتات .

وكانت أهم النتائج المتحصل عليها هى :

١ - لا توجد فروق معنوية بين تركيز عنصر النيتروجين فى كل من أوراق وجذور شتلات الرمان المروية بالماء المالح مقارن بأوراق وجذور شتلات الكنترول خلال موسمى الدراسة .

٢ - لا توجد فروق معنوية لتركيز عنصر الفوسفور فى جذور الشتلات المروية بالماء المالح وجذور شتلات الكنترول .

٣ - لا توجد فروق معنوية واضحة بين تركيز عنصر البوتاسيوم فى كل من أوراق وجذور الشتلات المروية بالتركيزات المختلفة من الملوحة مقارنة بتركيز عنصر البوتاسيوم فى أجزاء شتلات الكنترول باستثناء جذور الشتلات .

٤ - زيادة ملوحة ماء الرى حتى ٤٠٠٠ جزء فى المليون لا تؤثر معنويا على تركيز عنصر الكالسيوم فى الأوراق للشتلات المروية ولكن ارتفاع مستوى الأملاح فى ماء الرى الى ٦٠٠٠ جزء فى المليون يزيد معنويا تركيز الكالسيوم فى الأوراق .

٥ - لاتوجد فروق معنوية بين تركيز عنصر الكالسيوم فى جذور شتلات الرمان المروية بتركيزات ملوحة مختلفة وجذور شتلات الكنترول .

٦ - يزداد تركيز عنصر الصوديوم فى أوراق الشتلات المعاملة زيادة معنوية مع زيادة تركيز الملح فى ماء الرى مقارنة بالكنترول وكانت أعلى قيمة عند المعاملة ٦٠٠٠ جزء فى المليون فى حالة الشتلات الكبيرة عمر سنتين وعموما لا توجد فروق معنوية بين الأصناف .

٧ - لا توجد فروق معنوية بين تركيز عنصر الصوديوم فى جذور الشتلات الصغيرة (عمر سنة) مقارنة بجذور الكنترول أما تركيز عنصر الصوديوم فى جذور الشتلات الكبيرة (عمر سنتين) يتناسب طرديا مع زيادة ملوحة ماء الرى وعموما لا توجد فروق معنوية بين محتوى جذور الأصناف المختلفة عمر سنتين فى محتواها من عنصر الصوديوم .