J. Agric. Sci. Mansoura Univ., 27 (7): 4897 - 4907, 2002

EFFECT OF CHLORIDE AND NITRATE SALTS ON GROWTH AND MINERAL COMPOSITION OF AVOCADO AND CITRUS ROOTSTOCKS

Zarad, S.S.*; Nagwa S. Zaied ** and Salwa A. Khafagy **
Botany Dept.* and Hort. Dept., National Research Center, Dokki, Giza, Egypt**

ABSTRACT

This investigation was carried out during two successive years (2000 & 2001) in an orchard for sub-tropical fruits located in Abou-Rwash district, Giza Governorate, Egypt. Two rootstocks of avocado (*Persea americana* Mill.), the salt-tolerant "Hass" and the salt-sensitive "Duke" and two rootstocks of citrus, the salt tolerant "Rangpur" lime (Citrus limonia) and the salt-sensitive "Volkamer" lemon (*Citrus volkameriana*) were grown in a sandy soil and irrigated daily with nutrient solutions containing various chloride concentrations.

Increasing the concentration of chloride resulted in elevated chloride levels in avocado leaves, and toxic symptoms that were more pronounced in the "Duke" than in the "Hass" avocado rootstocks. When leaves of both rootstocks had accumulated similar chloride levels and showed scorching damage, the leaves of "Hass" abscised, while those of "Duke" did not. High chloride reduced the total dry matter yield of the root more than that of the leaves.

Addition of nitrate to the irrigation water reduced chloride accumulation in the leaves and alleviated its adverse effects. High nitrate reduced phosphorus levels and caused chlorosis in young leaves. Citrus rootstocks responded similarly, but leaves of the chloride-sensitive "Volkamer" accumulated more chloride than "Rangpur". Nitrate reduced chloride accumulation and toxic symptoms in the leaves of the two citrus rootstock.

INTRODUCTION

Avocado (*Persea americana* Mill) is a vigorous evergreen tree, which become a commercial crop just a few decades ago. A popular use is as a salad fruit, paste with flavor extracts and skim milk can also be used to make an ice cream and it's oil can be used for cooking and skin care. (Nakasone and Paull, 1998). Avocado and citrus rootstocks are important because they influence disease resistance, tree vigor, productivity, and quality of fruit produced (Chia and Evans, 1985).

Rangpur lime is a vigorous, dependable, disease-resistant (foot rot, gummosis and tristeza) rootstock for the usual citrus cultivars grown in Egypt and producing full sized trees. Rangpur is widely adapted to a range of soil types, and its seedlings are vigorous and fast growing in the nursery. (Davies and Albrigo, 1994). 'Volkamer' lemon is a hybrid which as a rootstock produces large, vigorous trees yielding large quantities of moderate to poor quality fruit. It is tolerant to malsecco and phytophthora under most conditions.

Ben-Ya'acov and Michelson (1995) concluded that rootstock affect tree size to large extent and thereby can also affect the productivity per unit area.

The Mexican avocado is considered the most salt-sensitive and the West Indian is relatively salt-tolerant (Embleton, *et al.*, 1962). Citrus trees are also salt-sensitive (Zekri, 1993b). Large quantities of chloride have been found to accumulate in their leaves and in the juice of fruit from trees irrigated with water containing high chloride concentrations (Syvertsen, *et al.*, 1993). Chloride uptake and its toxicity has been found to reduced by increasing the nitrate concentration of the nutrient solution for other species (Feigin, 1985; Kafkafi, 1984 and Lahav, *et al.*, 1990).

Any rootstock tolerant or resistant to stress or to any combination of stresses should not be considered resistant if it fails to induce high productivity regardless of the presence or absence of stress (Bar, and Kafkafi, 1992).

Whiley and Schaffer (1994) observed that treating container-grow "Hass" trees with 5 and 10 mM Cl in the nutrient solution results in reductions of tree diameter about 15 and 20%, and reduced water consumption by 77 and 63%, respectively, compared to trees receiving no Cl.

Symptoms of salinity injury to avocado vary depending upon the stage of plant development, leaf age and nutrition (Bingham and Fenn, 1967). Salinity injury has been associated with high concentration of Cl and Na in avocado leaves. The most commonly observed responses are leaf curly and tip and marginal leaf burn, eventually resulting in leaf abscission. Embleton, *et al.*, (1961).

Differences in salt tolerance exist among the ecological races of avocado. Mexican cultivars are more Cl-sensitive (Duke) than that Guatemalian "Hass" and West Indian cultivars (Walden) Kadman and Ben-Yaacov 1976. Nitrate accumulation in edible fruits represents a serious threat to human health. The chloride salts markedly reduced plant growth in both rootstocks (avocado and citrus) (Gorton & Cooper, 1945 and Cram, 1973).

The need to devise practical methods for the optimal irrigation of avocado and citrus orchards in arid regions, where chloride concentrations in the water are high, led to study the quantitative relationship between chloride and nitrate and their effects on the growth and mineral contents in young plants of salt-tolerant and salt-sensitive avocado and citrus rootstocks. (Fageria, 1992, and Somani, 1998).

The aim of this study is to find the best rootstocks can be tolerant to salinity stress for each species (cultivar) and for various growth conditions. Also, to study the quantitative relationship between chloride and nitrate and their effect on the growth and mineral content in young plants (avocado and citrus) rootstocks.

MATERIALS AND METHODS

This investigates was carried out during the two successive seasons of 2000 and 2001 in an orchard for sub-tropical fruits located in Abu-Rwash district, Giza Governorate, Egypt.

Two-years-old healthy, and nearly uniform having of 15-17 leaves avocado plants of two rootstocks , 'Hass' (Guatemalan race) relatively salt-tolerant) and Duke (Mexican salt sensitive), the same one year old, healthy, having of 20-25 leaves, seedlings on two different rootstocks, the salt-tolerant "Rangpur" *Citrus limonia* and the salt sensitive 'Volkamer' *Citrus volkameriana*.

The four rootstocks were grown in greenhouse in 8-liter earthern-clay containers filled with a sandy soil. The field capacity of the soil was determined and the plants were irrigated with 40% excess of the water required to reach field capacity, and at a frequency that did not allow more than 25 to 30% water loss by evapotranspiration. The excess of solution drained out of the pot avoiding salt accumulation in the sand.

The plants were placed under a 40% shade net. The minimum temperature during the experimental period ranged between 25 and 30°C. The minimum relative humidity ranged between 40 and 50% and the maximum between 70 and 90%. Treatments were started on the first of April, 2000 and 2001.

The plants were irrigated for five months with nutrient solutions containing 4, 8, or 12 mM chloride. Each chloride concentration was supplemented with 3, 6, or 12 mM nitrate, resulting in a total of nine treatments, besides the control tap receving water only.

To isolate the chloride anion effects, sodium was excluded from the nutrient solutions. The only source of sodium was tap water; which contained 0.8 mM sodium and had an EC. of 0.81 ds/m. The tap water also contained 0.18 mM nitrate and 0.95 mM chloride. The relevant chloride and nitrate concentrations were obtained with chloride and nitrate salts of Mg, Ca, and K, at a charge equivalent ratio of 1 : 5 : 3 respectively.

The chloride content of the tap water was taken into account during preparation of the nutrient solutions.

Each treatment was replicated three times for each rootstocks. The following data were measured after 150 days from planting : Number of leaves and roots – leaves and roots dry weight (mg/plant). For growth evaluation and mineral analysis, each plant was separated into leaves and roots, and dried for 48h at 70°C, weighed, ground and the N, P, Ca, Cl and Na were determined by digestion with sulfuric acid and hydrogen peroxide. N % was determined by the micro-Rjeldahl method, and Na % by flamephotometry. P % was determined colorimetrically with ammonium molybdate after reduction with ascorbic acid. Ca% was determined by atomic absorption spectrophotometry. Chloride was extracted with 0.1N nitric acid and determined using a chloridemeter. (Helrich, 1990; Bremner and Mulvaney, 1982, and Chapman and Pratt, 1961).

Data were statistically analyzed using a random block design according to Mead *et al.* (1993). Mean comparisons were conducted using LSD values at 0.05 significance level.

RESULTS AND DISCUSSION

Effects of Chloride on Avocado Rootstocks :

It is obvious from Tables (1 and 2) that increasing the chloride concentration in the nutrient solution containing 3 mM nitrate resulted in an increase in chloride levels in the leaves of both rootstocks. The chloride levels in the leaves of the salt-tolerant "Hass" plants in most cases was slightly than those in the salt-sensitive "Duke".

Table (1) : Effects of chloride and nitrate concentrations on some growth characteristics of two avocado rootstocks (Hass and Duke) during (2000 and 2001) seasons.

Season	2000				2001			
Growth characteristics	Number of		Dry weight mg/plant		Number of		Dry weight mg/plant	
Treatments Cl : N	Leaves	Roots	Leaves	Roots	Leaves	Roots	Leaves	Roots
Hass control	33.4	46.4	56.8	67.2	35.1	48.5	58.5	68.9
4 3	26.3	31.7	44.6	37.4	27.4	32.7	45.7	38.7
4 6	28.1	37.2	47.6	44.9	28.3	37.6	46.6	46.5
4 12	32.5	46.1	54.0	55.4	33.5	46.8	53.3	54.6
8 3	25.2	28.2	42.5	33.3	26.9	29.4	44.2	34.8
8 6	26.4	31.3	44.1	37.6	25.9	32.3	45.1	39.1
8 12	27.3	35.4	45.9	42.9	27.7	34.5	47.9	43.3
12 3	21.5	27.1	35.5	32.2	22.0	26.7	36.8	31.2
12 6	23.3	30.6	39.6	36.1	21.2	31.4	37.4	37.7
12 12	24.1	32.5	40.6	38.7	23.3	33.8	39.3	39.9
Mean	26.81	34.7	45.1	42.57	27.13	35.42	45.48	41.9
LSD at 0.05	3.2	2.8	3.9	3.4	3.3	2.9	3.8	3.4
Duke Control	31.2	36.7	52.7	66.3	34.6	39.9	74.8	66.3
4 3	24.5	27.4	40.3	32.9	25.85	28.6	55.0	47.6
4 6	25.7	23.3	42.6	38.8	27.4	33.7	59.4	56.1
4 12	30.3	37.5	51.6	44.9	31.3	38.5	68.2	64.6
8 3	21.8	24.8	35.6	28.8	20.5	24.3	44.0	40.8
8 6	23.2	25.5	39.3	30.8	24.7	26.1	52.8	44.2
8 12	25.1	27.8	42.0	32.5	24.1	28.2	52.8	47.6
12 3	19.6	25.4	32.3	30.2	20.2	27.0	44.0	45.9
12 6	20.5	26.3	34.2	31.8	19.4	25.4	41.8	42.5
12 12	18.4	22.6	30.7	26.4	19.5	21.6	41.9	35.7
Mean	24.03	28.92	40.13	36.34	24.75	26.90	48.52	49.13
LSD at 0.05	3.1	2.6	3.7	2.8	3.1	2.5	3.9	3.1

Increasing the chloride level resulted in decreasing the number of leaves and roots which was more pronounced in the "Duke" than in "Hass" plants (Table 1). It is obvious that salinity had a great deleterious effect of leaf number/seedling.The increament in chloride content in the plants was associated with a decrease in leaves dry matter. However, the dry mater yield of "Hass" plants was in all cases higher than that of "Duke".

Table (2) : Effects of chloride and nitrate concentrations on some leaves mineral contents of two avocado rootstocks (Hass and Duke) during (2000 and 2001) seasons.

Season	2000					2001				
Treatment Cl : NO_3 (mM)	N%	P%	Ca%	Na%	Cl%	N%	P%	Ca%	Na%	Cl%
Hass control	2.2	0.18	2.35	0.18	1.65	2.1	0.20	2.41	0.21	1.68
4 3	2.4	0.16	2.26	0.22	1.70	2.3	0.18	2.32	0.24	1.72
4 6	2.6	0.15	2.24	0.24	1.83	2.7	0.17	2.27	0.25	1.79
4 12	2.8	0.15	2.20	0.25	1.86	2.9	0.16	2.23	0.26	1.84
8 3	2.4	0.14	1.93	0.33	1.95	2.5	0.15	2.15	0.29	1.93
8 6	2.6	0.14	1.81	0.35	1.79	2.9	0.14	2.07	0.32	1.97
8 12	2.8	0.13	1.76	0.36	1.65	2.9	0.14	1.92	0.34	1.86
12 3	2.1	0.13	1.65	0.44	2.60	2.6	0.13	1.86	0.38	2.54
12 6	2.4	0.12	1.62	0.46	2.35	2.7	0.12	1.73	0.43	2.38
12 12	2.6	0.12	1.62	0.48	1.22	2.9	0.11	1.66	0.45	2.27
Mean	2.49	0.14	1.94	0.32	1.86	2.4	0.15	2.06	0.31	1.99
LSD at 0.05	N.S	0.04	0.03	0.08	N.S	N.S	0.07	0.03	0.07	N.S
Duke Control	2.1	0.17	1.93	0.15	1.15	1.90	0.19	2.17	0.17	1.19
4 3	1.9	0.15	1.87	0.21	1.22	2.00	0.17	2.05	0.18	1.24
4 6	2.3	0.14	1.81	0.22	1.12	2.10	0.16	1.93	0.19	1.23
4 12	2.4	0.14	1.79	0.24	1.13	2.36	0.15	1.87	0.22	1.18
8 3	2.2	0.13	1.63	0.32	1.39	2.20	0.14	1.74	0.28	1.32
8 6	2.4	0.12	1.52	0.33	1.06	2.40	0.14	1.63	0.31	1.13
8 12	2.3	0.12	1.51	0.33	0.92	2.40	0.13	1.61	0.32	1.12
12 3	2.1	0.12	1.32	0.41	2.34	2.30	0.13	1.54	0.38	2.25
12 6	2.4	0.11	1.27	0.43	1.85	2.50	0.12	1.43	0.42	2.13
12 12	2.6	0.10	1.24	0.45	1.14	2.60	0.11	1.36	0.46	1.96
Mean	2.03	0.13	1.58	0.31	1.33	2.20	0.14	1.73	0.27	1.47
LSD at 0.05	N.S	0.05	0.02	0.08	N.S	N.S	0.06	0.02	0.06	N.S

The dry weight of the root system in both rootstocks was decreased than that of the leaves in rootstocks irrigated with solutions containing 3 mM nitrate, while increasing the chloride conc. from 4 to 12 mM decreased the dry weight of the roots in both rootstocks.

Data presented in Tables (1 and 2) showed that chloride levels in the leaves of "Hass" were higher than in "Duke" and the leaf tissue of "Hass" is more tolerant than that of "Duke" to high level of chloride. The salt-tolerant "Hass" seedlings shed their leaves when the chloride content exceeded a certain level, whereas the salt-sensitive "Duke" did not.

These findings are agreement with the results obtained by (Nakasone, & Paull, 1998; Somani, 1988; and Whiley and Schaffer, 1994) in other species. The enhancement of leaves growth by irrigation water containing 6 mM chloride is probably a result of reduced root growth which lowers root demand for carbohydrates, and thus allows a more abundant supply to the leaves.

Root media in the severe treatment (Cl, 12 : NO_3, 12) having the highest salt ratios and the highest osmotic pressure, this possibly lead to increasing the concentration of specific toxic ions to plant growth. All these factors may lead to reduce the relative roots power of absorbing water as previously recorded by (Ben-Ya'acov & Michelson, 1995; Downton, 1978; Kadman & Ben-Ya'acov, 1976).

Effects of Nitrate on Avocado Rootstocks :

Four-fold increase in nitrate conc. in the irrigation water (from 3 to 12 mM) resulted in an increase from 10 to 20% in the level of N. in the leaves of both rootstocks. Increasing the nitrate concentration in nutrient solution led a decrease in chloride level in the leaves of both rootstocks. Addition of 3 to 12 mM nitrate to the solutions reduced chloride levels in the leaves of "Hass" by 40-60% and in 'Duke" by 35-40% (Table 2).

When the nitrate conc. in solution containing 12 mM, chloride was increased from 3 to 12 mM, and the dry matter weight of leaves and roots were significantly increased. As shown in Table (1) indicated that averages number of new leaves decreased with increasing of total dissolved salts in the irrigation water.

A decrease in P. level was found in the leaves of both rootstocks as a response to increased nitrate conc. in the nutrient solution. The Ca content of "Hass" leaves Table (2) was higher than that of "Duke" in all the treatments with an average of 1.94% and 1.58% in dry matter, respectively in the first season, 2000. The Ca content of leaves was decreased with increasing salinity, whereas, the Na content of leaves increased with increasing salinity level..

The results of this study confirm the observations of these invistigators (Bar & Kafkafi, 1992; Bingham & Fenn, 1967; and Chia & Evans, 1987).

Salinity injuries has been associated with high concentrations of Cl and Na in avocado leaves. (Kadman and Ben-Ya'acov, 1976). The most commonly observed responses are leaf curl and tip and marginal leaf burn, eventually resulting in leaf abscission. (Cram, 1973).

Downton (1978) observed that high conc. of NaCl (20 mM) in the potting medium reduced the number of leaf buds of "Fuerte" scions grafted on to Mexican and Guatemalan race rootstocks. The crop takes up sodium with water and it is concentrated in the leaves as water is lost by transpiration. Toxicity may result if Na accumulates to concentration that exceed the tolerance of the crop (Fageria, 1992).

This is in line with the findings of (Embleton, *et al.*, 1961 & 1962; Kafkafi, 1990 and Lahav, *et al.*, 1990). Such effect was clear in both two seasons, (2000 and 2001).

Effects of Chloride on Citrus Rootstocks :

Irrigation of "Rangpur" and "Volkamer" rootstocks for 150 days with water containing higher concentrations of chloride resulted in increasing chloride contents in the leaves Tables (3 and 4). When irrigated with water containing only 4 mM chloride, which is considered prime irrigation water, the chloride content of "Volkamer" leaves was four-folds higher than that of "Rangpur" rootstock irrigated with the same solution.

Table (3) : Effects of chloride and nitrate concentrations on vegetative growth of two citrus rootstocks (Rangpur and Volkamer) during (2000 and 2001) seasons.

Season	2000				2001			
Growth characteristics	Number of		Dry weight mg/plant		Number of		Dry weight mg/plant	
Treatments Cl : N	Leaves	Roots	Leaves	Roots	Leaves	Roots	Leaves	Roots
Rangpur control	78.5	89.5	241.3	117.1	75.3	86.3	165.0	146.2
4 3	59.7	68.8	135.7	87.1	58.3	69.5	127.6	117.3
4 6	63.1	74.6	138.6	94.7	61.2	75.7	134.2	127.5
4 12	66.3	76.2	137.4	96.5	67.6	77.6	147.4	130.9
8 3	41.3	47.6	82.0	58.7	54.1	53.2	118.8	90.1
8 6	44.1	51.8	87.6	62.7	51.9	55.1	121.0	93.5
8 12	46.2	53.2	91.1	64.1	46.7	58.3	127.6	98.6
12 3	28.7	23.5	55.2	27.4	42.5	49.5	92.4	83.8
12 6	26.4	30.6	50.9	35.4	36.3	46.7	79.2	78.2
12 12	23.0	26.5	44.4	29.4	33.4	49.4	72.6	83.1
Mean	47.7	54.2	106.4	67.3	58.7	65.7	118.5	104.9
LSD at 0.05	3.6	3.9	4.5	3.6	4.1	4.3	4.9	5.7
Volkamer Control	66.3	78.3	151.8	101.4	09.6	79.2	151.8	134.3
4 3	46.1	57.6	101.2	73.5	58.0	59.1	127.6	100.3
4 6	51.5	62.4	107.1	78.7	59.4	61.8	129.8	103.7
4 12	54.2	67.2	108.3	83.7	59.3	65.9	129.5	110.5
8 3	32.2	39.9	63.7	49.6	42.5	38.7	92.5	64.6
8 6	35.7	43.4	70.3	52.8	46.2	42.6	127.3	71.4
8 12	37.8	46.4	72.2	56.2	49.1	45.0	107.8	76.5
12 3	22.4	28.0	42.1	33.3	35.8	27.3	77.0	45.9
12 6	21.0	25.8	39.7	29.3	38.7	26.4	83.6	44.2
12 12	18.5	23.0	33.3	26.7	39.9	24.8	85.8	40.8
Mean	38.57	47.52	78.97	58.52	49.85	47.08	111.27	79.22
LSD at 0.05	2.0	3.5	3.9	3.4	3.6	3.4	4.7	4.8

High concentration of chloride in the water inhibited leaves growth in "Volkamer" more than in "Rangpur". So the number of new roots and leaves were significantly lower in plants irrigated with saline water than that watered with none saline, tap water (control). Moreover, rootstocks received severe salt treatments (chloride 12 : Nitrate 12, produced the least average number of new roots and leaves.

In this concern, Fageria, 1992 and Somani, (1998) pointed that the early formative stages of leaves and roots are governed by cell division and are relatively insensitive to drought and salinity. Otherwise, the adverse effectiveness of salinity may be due to the hormonal imbalance which may decrease promoters and increase inhibitors.

In the chloride-sensitive citrus rootstocks "Volkamer", inhibition leaves and roots growth were apparent even at 8 mm chloride. In contrast. The salt tolerant "Rangpur" showed some growth inhibition only at the higher chloride conc. and slight yellowing only at 12 mM chloride.

The mode of resistance to chloride in citrus differs from that in avocado leaves of "Rangpur" rootstocks accumulated much less chloride than those of "Volkamer" rootstocks irrigated with water containing the same conc. of chloride.

Table (4) : Effects of chloride and nitrate concentrations on leaves mineral contents of two citrus rootstocks (Rangpur and Vokamer) during (2000 and 2001) seasons.

Treatment	Season / Cl : NO_3 (mM)	2000 N%	2000 P%	2000 Ca%	2000 Na%	2000 Cl%	2001 N%	2001 P%	2001 Ca%	2001 Na%	2001 Cl%
Rangpur	control	1.8	0.26	1.16	0.16	0.04	1.9	0.28	1.19	0.18	0.07
4	3	2.25	0.18	0.78	0.21	0.18	2.27	0.21	0.86	0.21	0.17
4	6	2.30	0.17	0.73	0.23	0.15	2.33	0.21	0.82	0.22	0.16
4	12	2.45	0.16	0.68	0.25	0.13	2.53	0.19	0.75	0.24	0.15
8	3	2.53	0.15	0.64	0.32	0.27	2.56	0.16	0.72	0.28	0.29
8	6	2.65	0.14	0.61	0.34	0.26	2.62	0.17	0.68	0.31	0.28
8	12	2.73	0.14	0.59	0.33	0.24	2.75	0.15	0.63	0.35	0.26
12	3	2.91	0.13	0.57	0.45	0.53	2.93	0.14	0.59	0.36	0.38
12	6	2.90	0.13	0.56	0.47	0.48	2.90	0.14	0.56	0.39	0.36
12	12	3.20	0.12	0.55	0.49	0.42	3.40	0.13	0.55	0.42	0.33
	Mean	2.57	0.15	0.68	0.32	0.27	2.61	0.17	0.72	0.29	0.24
LSD at 0.05		0.40	0.06	0.02	0.07	N.S	0.39	0.07	0.04	0.06	N.S
Volkamer	Control	1.56	0.25	0.96	0.14	0.06	1.62	0.27	0.98	0.16	0.09
4	3	2.12	0.18	0.62	0.26	0.78	1.84	0.21	0.86	0.19	0.57
4	6	2.31	0.16	0.60	0.27	0.65	1.87	0.20	0.78	0.22	0.55
4	12	2.47	0.14	0.60	0.29	0.58	1.36	0.18	0.71	0.27	0.51
8	3	2.63	0.15	0.58	0.43	0.74	2.35	0.17	0.66	0.35	0.78
8	6	2.73	0.14	0.56	0.45	0.62	2.51	0.16	0.62	0.39	0.76
8	12	2.75	0.13	0.56	0.48	0.57	2.67	0.15	0.57	0.43	0.72
12	3	2.86	0.12	0.55	0.51	0.86	2.78	0.13	0.53	0.48	0.86
12	6	2.4	0.13	0.55	0.54	0.77	2.91	0.12	0.51	0.52	0.85
12	12	2.98	0.12	0.53	0.56	0.67	2.96	0.11	0.51	0.56	0.82
	Mean	2.52	0.15	0.61	0.39	0.63	2.34	0.17	0.67	0.35	0.65
LSD at 0.05		0.37	0.06	0.02	0.09	N.S	0.31	0.07	0.03	0.08	N.S

Thus, chloride resistance in "Rangpur" may be attributed to both its ability to restrict chloride uptake and transport to the leaves and the ability of its leaf tissue to withstand high chloride concentrations. This explanation was suggested by Gorton & Cooper, 1954; Feigin, 1985; Fageria, 1992, and Davies & Albrigo 1994).

Effects of Nitrate on Citrus Rootstocks :

Addition of 6 or 12 mm nitrate to the irrigation water containing 4, 8 or 12 mM chloride resulted in decreased chloride contents in the leaves of both "Volkamer and Rangpur" rootstocks.

Application of 6 mM nitrate to water containing 12 mM chloride slightly enhanced leaves grow in "Rangpur". However the Cl-induced inhibition of growth of "Volkamer" leaves was strikingly reversed by the addition of 6mM NO_3 to water containing 4, 8 or 12 mM chloride.

A further increase in nitrate concentration had no significant effect on leaves growth. Increasing the nitrate concentration in the water from 3 to 12 mM resulted P. decreased levels in the leaves of both citrus rootstocks.

Addition of nitrate to irrigation water containing high chloride conc. resulted in decreased chloride levels in citrus leaves, and might therefore account for the alleviation of the chloride-induced toxic effects.

Leaves and roots of "Volkamer" displayed severe damage as a response to increased chloride conc. in the water but no damage was detected in "Rangpur" leaves even at 12mM chloride, except for some slight yellowing. This result was true for the two successive years of (2000 & 2001).The rate of calcium translocation to leaves in the salt-tolerant "Rangpur" was higher than in the salt sensitive "Volkamer" rootstock. The obtained results agreed with those of Embleton, *et al.* (1962) in avocado and of Zekri, 1993 a & b) in citrus.

The reduction in leaf nitrogen content may be attributed to the depressing effect of saline water on the activity of the metabolic processes and the bad nitrogen translocation (Fageria, 1992).

In this concern, Syvertsen, *et al.* (1993) reported that the translocation of N and P from the leaves of avocado and citrus trees was in general, adversely affected by soil salinity.

It can be concluded that these avocado rootstocks "Hass" and citrus "Rangpur" are more salt-tolerant at seedling growth stage.

REFERENCES

Bar, Y. and U. Kafkafi (1992). Nitrate-induced iron-eficiency chlorosis in avocado rootstocks and its prevention by chloride. J. Plant Nutr., 15 : 1739-1746.

Ben-Ya'acov, A. and E. Michelson (1995). Avocado rootstocks. Horticultural Review, 17: 381-429.

Bingham, F.T. and L.B. Fenn (1967). Chloride injury to "Hass" avocado trees : a sand culture experiment, Calif. Avocado Soc. Year Book, 50: 99.

Bremmer, J.M. and C.S. Mulvaney (1982). Total nitrogen. In A.L. Page; R.H. Miller, and D.R. Keeney, eds. Methods of soil analysis. 2nd. Ed. Madison, W.I. pp. 595-622.

Chapman, H.D. and P.R. Pratt (1961). Methods of analysis for soils. Plants and waters. University of California. USA. pp. 150 - 179

Chia, C.L. and D.O. Evans (1987). Avocado Commodity Fact Sheet AVO-3 (A) Fruit. Hawaii Cooperative Extension Service. University of Hawaii. 4 pp

Cram, W.J. (1973). Internal factors regulating nitrate and chloride influx in plant cells. J. Exp. Bot., 24 : 328-341.

Davies, F.S. and L.G. Albrigo (1994). Citrus. CAB International.

Downton, W.J.S. (1978). Growth and flowering in salt-stressed avocado trees. Austr. J. Agric. Res., 29 : 523-534.

Embleton, T.W.; W.B. Storey and M.J. Garber (1961). Chloride and avocado rootstock. Calif. Avocado Soc. Yearbook, 45: 110-116.

Embleton, T.W.; W.B. Storey and M.J. Garber (1962). Chlorine and other elements in avocado leaves as influenced by rootstock. Proc. Am. Soc. Hort. Sci., 80 : 230-236.

Fageria, N.K. (1992). Maximizing Crop Yields. Marcel Dekker, New York. 274p.

Feigin, A. (1985). Fertilization management of crops irrigated with saline water. Plant Soil, 89 : 285-299.

Gorton, B.S. and W.C. Cooper (1954). Relation of Ca and K accumulation in citrus as influenced by rootstock and salinity of irrigation water. Proc. Am. Soc. Hort. Sci., 63 : 49-52.

Helrich, K. (1990). Official Methods of Analysis. AOAC 15th Ed., 2 Vols., Washington . USA.

Kadman, A. and A. Ben-Yaacov (1976). Selection of avocado rootstocks for saline conditions. Acta Hort., 57: 189- 197

Kafkafi, U. (1984). Plant nutrition under saline conditions. pp. 319-338. In : I. Shainberg and J. Shalhevet (Eds.) Soil Salinity Under Irrigation. Ecological Studies Number 51. Springer-Verlag. Berlin, Germany.

Lahav, E.; Y. Bar and D. Kalmar (1990). Effect of nitrogen fertilization on the annual variations in nutrients in avocado leaves. Commn. Soil Sci. Plant Anal., 21 : 1353-1365.

Mead, R.; R.N. Curnow; A.M. Hasted (1993). Statistical Methods in Agriculture and Experimental Biology 2nd. Ed. Chapman and Hall. London.

Nakasone, H.Y. and R.E. Paull (1998). Tropical Fruits. CAB International.

Somani, L.L. (1998). Crop Production with Saline Water. Agro Botanica. India.

Syvertsen, J.P.; M.L. Smith and B.J. Boman (1993). Tree growth, mineral nutrition and nutrient leaching losses from soil of salinized citrus. Agric. Ecosyst. Environ., 45 : 319-334.

Whiley, A.W. and B. Schaffer (1994). Avocado. In : Schaffer, B. and Andersen, Peter, C. (Eds.). Handbook of Environmental Physiology of Fruit Crops. Vol. II. CRC. Press Florida. pp. 3-35.

Zekri, M. (1993a). Seedling emergence, growth and mineral concentration of three citrus rootstocks under salt stress. J. Plant Nutr., 16 : 1553-68.

Zekri, M. (1993b). Salinity and calcium effects on emergence, growth and mineral composition and seedlings of eight citrus rootstocks. J. Hort. Sci., 68 (1) 53-62.

J. Agric. Sci. Mansoura Univ., 27 (7), July, 2002

تأثير أملاح الكلوريد والنترات على النمو والتركيب المعدنى لبعض أصول لأفوكادو والموالح

صلاح سعد زرد*، نجوى سلمى زايد**، سلوى أنور خفاجى**
قسم النبات*، قسم البساتين** المركز القومى للبحوث - الدقى - جيزة - مصر

أجريت هذه الدراسة على أصول بعض أنواع الموالح والأفوكادو خلال موسمين متعاقبين (٢٠٠٠-٢٠٠١) فى مزرعة للفاكهة المدارية بأبى رواش محافظة الجيزة – مصر.

تمت زراعة أصلين من الأفوكادو – صنف مقاوم للملوحة (هاس)، وصنف آخر حساس (ديوك) وكذلك زراعة أصلين من الموالح أحداهما يتحمل الملوحة (رنجبور) وآخر حساس للملوحة (فولكا ماريانا)، حيث تمت الزراعة فى تربة رملية تم ريها بمحاليل مغذية بتركيزات مختلفة لمحاليل أملاح الكلوريد والنترات بالإضافة الى الكنترول. ويمكن تلخيص أهم النتائج كما يلى :

- نتج عن زيادة تركيزات الكلوريد تناقص فى نمو كل من المجموع الجذرى وعدد الأوراق الحديثة لكلا الأصلين كما كان أثر السمية والضرر أكثر وضوحاً على الصنف (ديوك) عن الصنف (هاس).
- التأثير العالى للكلوريد أدى لانخفاض نسبة المادة الجافة فى جذور كلا الصنفين بدرجة أعلى عنه فى الأوراق.
- أضافة النترات الى مياه الرى خفضت من نسبة تراكم الكلوريد فى الأوراق كما تناقصت تأثيراته المعاكسة. وكان لأثر إضافة النترات بالتركيز الأعلى دور فى تقليل نسبة الفوسفور فى الأوراق كما تسببت فى شحوب الأوراق الحديثة.
- أصول الموالح المستخدمة كان لها استجابة مشابهة كما فى الأفوكادو فى حين كان تراكم الكلوريد فى الأوراق فى الصنف (فولكاماريانا) كان أكثر من الصنف الآخر (ديوك).
- إضافة النترات خفضت من تراكم الكلوريد وأعراض السمية فى أوراق صنفى الموالح.