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EVALUATION OF 3-CITRUS VARIETIES BUDDED ON 5-CITRUS ROOTSTOCKS GROWN ON SLIGHTLY SALINE ALKALINE SOIL AT SAKHA, KAFR EL-SHEIKH GOVERNORATE.

(II) Leaf mineral content, some Leaf nutritional balance and leaf miners infection.

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Abstract

This investigation was carried out in 1997 and 1998 seasons on 2 and 3-year old Washington Navel orange, Valencia orange and Balady mandarin budlings on five Citrus rootstocks namely; C.volkameriana, Troyer citrange, Rangpur lime, Cleopatra mandarin and sour orange grown at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt where the soil is slightly saline alkaline clayey soil.

The evaluation results indicated that Valencia, Washington Navel oranges and Balady mandarin as scion varieties on C'.volkaneriana and Rangpur lime rootstocks are characterized by: Higher leaf concentrations of N, K, Ca, Mg, Fe, and Zn, lower C N, N/K and higher K Na ratio compared to other rootstocks while, leaf P and Mn showed no consistent trend. Moreover, these rootstocks had higher ability to reduce Na~ and Cl absorption and its accumulation in leaves of the three scion varieties in contrast to the other rootstocks. Also, they had the least values of leaf miners infection. Generally, the five tested rootstocks could be descendingly arranged due to their effects on these characters of the three scion varieties (WO, VO and BM) under this study conditions as follow: (VM & RL), (TC & SO) and finally (CM).

Accordingly, both rootstocks (VM & RL) may be considered as suitable substitutes for sour orange in Egypt. This evaluation could be of great value for nurserymen and citrus growers. It help growers to select the right rootstock for the desired variety in a given area.

INTRODUCTION

Sour orange is the most common rootstock for Citrus orchards in Egypt and Mediterranean region. Although Sour orange was considered a satisfactory rootstock for most Citrus scion varieties, it had to be replaced in several countries as a result of its susceptibility to citrus Tristeza (Gregoriou and Economides, 1993). Thus, using sour orange stocks had made it imperative to search for a new stock for Citrus, which would show resistance to this disease and also giving high yield and good quality of fruit (El-Azab *et al.*, 1978). Although, many citrus varieties are used successfully as rootstocks, the differences in their capacity to uptake the mineral nutrients are well known. Moreover, the differences among rootstocks in their response to different environmental stress are considerably varied in a given area (Monteverde *et al.*, 1990).

The nutritional status is known to be one of the most important factors in citriculture. Different citrus rootstocks have been found to exert a significant influence on the mineral composition of the scion leaves with respect to macro and micronutrients (Saad-Allah *et al.*, 1985; Gallasch and Dalton, 1989; Fallahi, 1992 and Fallhi, *et al.*, 1992). Thus, each citrus cultivar should be fitted to a particular stock to perform best under specific conditions and purposes (Reuther, 1973).

Therefore, the need for more information about some new rootstocks and their behavior under the environmental conditions of Egypt has become necessary to find a potential substitute for sour orange rootstock. However, in recent years, several studies have been made on some new rootstocks, which have resistance to gummossis and Tristeza and other virus diseases, Azab (1995), Azab and Hegazy (1995) and Dawood (1996).

The purpose of this study was to study and compare leaf mineral content, and some leaf nutritional balance of three scion varieties (WN, VO and BM) on four citrus rootstocks (VM, TC, RL and CM) grown on slightly saline alkaline soil at Sakha, Kafr El-Sheikh Governorate with (SO) as a main rootstock for most citrus varieties in Egypt to find a potential substitute for it.

MATERIALS AND METHODS

This experiment was carried out on 2 and 3-years-old seedlings of three scion varieties namely; Washington Navel orange (WO), Valencia orange (VO) and Balady mandarin (BM) budded on five citrus rootstocks grown at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh in 1997 and 1998 seasons. The tested rootstocks were: Sour orange (*C. aurantium*), Volkamer lemon (*C. volkameriana*), Troyer citrange (*P. trifoliata* x *c. sinensis*), Rangpur lime (*C. aurntifolia* x *C. reticulata*) and Cleopatra mandarin (*C. reticulata*).

Field soil and plant: The experimental seedlings were planted at the end of Sep. 1995 at 5 x 5 meters apart in a complete randomized block design with three seedlings plot replicated three times. Thus, the field experiment included 135 seedlings. The planting soil is classified as clayey (60% clay), slightly alkaline (pH = 8.3), slight saline (EC = 4.11ds/m) and the depth of water table was about 120 cm. Other physical and chemical properties of the soil are presented in Table (1). All planted seedlings received the recommended cultivation practices.

Table 1. Some chemical and physical of the experimental soil (0-120 cm).

Soil pH	EC ds/m	Soluble cations (meq/L)				Soluble anions (meq/L)			
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}
8.3	4.11	11.62	5.21	22.86	0.42	0.00	5.72	14.81	19.58
SAR	Average nutrients mg/kg soil					Total carbonate %		Texture grade	
	N	P		K					
7.88	24	8.1		540		3.10		Clay	

Determination of macro and micronutrients: In mid August of both seasonsl997and 1998, 20 mature mid shoot leaves per tree (60 leaves per replicate) were sampled. Leaf samples were washed three times with tap water, then washed again with distilled water, oven dried at 70°C to a constant weight, ground, digested with H_2SO_4 and H_2O_2 according to Evenhuis and Dewaard (1980). The digested solution was used for the determinations of N, P, K, Ca, Mg, Na, Mn, Zn, Cl, and Fe. Nitrogen was determined by micro-kjeldahl Gunning method (Chapman and Pratt, 1978). Phosphorus was determined calorimetrically by the hydroquinone method (Foster, and Cornelia, 1967). Potassium and sodium were determined by flame photometer E.E.L model (Brown and Jackson 1955). Calcium, magnesium and some micronutrients (Mn, ZN, Cl, and Fe) were determined by Perking-Elemer Atomic absorption spectrophotometer model 2380 AL, according to Jackson and Ulrich (1959). Chloride was determined by silver nitrate methods due to Brown and Jackson (1955).

Determination of some leaf nutritional balance: Leaf N/K, K/Na, Na + C were calculated. C/N ratio was calculated by dividing the percentage of carbon in the carbohydrates value determined in the leaves on the percentage of nitrogen in leaves. All macro-elements were expressed as percent of dry weight, while microelements as p.p.m on dry weight basis.

The percentage of leaf miners infection: The percentage of leaf miner infection was estimated in leaves of the spring flush each season. The estimation depended on counting the total number of infected and healthy leaves per seedling.

All obtained data were statistically analyzed using a randomized complete block design according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

I. Leaf nutrient elements as affected by different rootstocks:

(a) Leaf macronutrients: As for leaf N content, data of Table (2) showed that the highest N percentages in leaves of WO and BM were recorded on VM and RL rootstocks. Similarly, the highest values of nitrogen in leaves of VO variety were detected on RL followed by VM and SO rootstocks without significant differences among them in both seasons. On the other hand, the least N values in leaves of the three scion varieties (WO, VO and BM) were detected on CM rootstock, and the differences were significant when compared with the other tested rootstocks. Meanwhile, the leaves of the same scion varieties on other rootstocks (SO and TC) contained intermediate values of N.

Regarding leaf P content, it is clear that no consistent trend could be detected in leaves of the three scion varieties on the five rootstocks. Moreover, the differences were not significant among them in most cases as shown in Table (2). While, SO, TC and RL revealed higher levels of P in leaves of WO, VO and BM scion varieties, respectively, BM leaves contained the highest P. On the other hand, other rootstocks (CM and RL) indicated the least values of leaf P content.

As for leaf K content, in both seasons, it was obvious that the leaves of WO and VO scion varieties contained the highest K values in their leaves when budded on VM and RL rootstocks without significant differences between them. For BM, its leaves contained the highest K level on RL rootstock in both seasons. On the other hand, the three scion varieties contained the least values of K in their leaves on CM rootstock in both seasons. However, the values of K in leaves of three scion varieties were intermediate on TC and SO rootstocks. The obtained herein results concerning leaf NPK content are in line with those reported by Zekri (1993), Azab (1995) and Dawood (1996) on citrus rootstocks.

Concerning leaf Ca and Mg contents (Tables 2 and 3), it was obvious that the highest values of them were detected in leaves of the three scion varie`:ies budded on VM and RL rootstocks without significant differences between them in both seasons, then came TC and SO rootstocks in this respect. On the other hand, the least values of Ca and Mg always recorded in leaves of the three scion varieties budded on CM rootstock in most cases, and in some cases on CM, SO and TC rootstocks without significant differences among them in both season.

Apparently, the higher levels of N, K, C'a and Mg in leaves of the three scion varieties budded on VM and RL rootstocks can be attributed to their vigorous growth, which in turn increases the demand for these macronutrients to encourage building of new vegetative growth. Also, the larger root system and greater number of fibrous roots than the other tested rootstocks (previously determined in the first part of this study). These conclusions find support in the results of Zekri (1993), Azab (1995), Azab and Hegazy (1995) and Dawood (1996) on citrus rootstocks.

Contrary, leaf Na values (Table 3) were significantly lower in leaves of the three scion varieties budded on VM and RL rootstocks than those on other rootstocks. In this connection, the highest values of Na in leaves of the three scion varieties were recorded on CM rootstock. Meanwhile, the other rootstocks (TC and SO) came in-between. These results came true in both seasons. The obtained results are in line with those reported by Nieves *et al.* (1991) and Zekri (1993). In the same line, Alva and Syvertsen (1991); Azab (1995) and Azab and Hegazy (1995) recommended VM and RL as salt tolerant rootstocks for their ability to reduce Na absorption leading to less Na accumulation in leaves.

Table 2. Leaf mineral content (N, P, K and Ca) of the three scion varieties as affected by 5 citrus rootstocks in 1997 and 1998* seasons.

Root-stocks (s)	1997 Season				1998 Season*			
	Leaf nitrogen (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (S)	WO	VO	BM	Mean (S)
S.O	2.40	2.33	2.65	2.46	2.51	2.42	2.52	2.48
VM	3.63	2.40	5.80	2.61	2.66	2.48	2.63	2.58
TC	2.30	2.00	2.40	2.23	2.33	2.24	2.38	2.32
RL	2.57	2.60	2.87	2.68	2.59	2.64	2.56	2.60
CM	2.20	1.85	2.30	2.11	2.26	2.20	2.38	2.28
Mean (V)	2.42	2.24	2.60	2.42	2.47	2.40	2.49	2.42
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.16	0.13	0.28		0.18	0.12	0.26	
	Leaf phosphorous (%)							
S.O	0.150	0.150	0.197	0.166	0.156	0.184	0.178	0.173
VM	0.130	0.151	0.216	0.166	0.138	0.161	0.167	0.155
TC	0.157	0.188	0.156	0.167	0.154	0.181	0.164	0.166
RL	0.119	0.134	0.203	0.147	0.122	0.136	0.192	0.150
CM	0.105	0.134	0.155	0.136	0.111	0.132	0.148	0.130
Mean (V)	0.132	0.151	0.185	0.156	0.136	0.159	0.170	0.155
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.018	0.014	0.031		0.019	0.013	0.032	
	Leaf potassium (%)							
S.O	1.85	1.75	1.75	1.78	1.66	1.72	1.68	1.69
VM	2.33	2.00	1.86	2.06	1.92	1.88	1.86	1.89
TC	1.85	1.53	1.40	1.59	1.62	1.54	1.44	1.53
RL	2.31	2.20	2.17	2.23	1.98	1.86	1.89	1.91
CM	1.44	1.30	1.49	1.41	1.38	1.32	1.45	1.38
Mean (V)	1.96	1.76	1.73	1.81	1.71	1.66	1.66	1.68
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.012	0.09	0.20		0.11	0.08	0.19	
	Leaf calcium (%)							
S.O	3.58	4.55	4.52	4.22	3.12	3.96	3.82	3.63
VM	5.59	6.62	4.93	5.71	4.21	4.91	3.15	4.09
TC	4.84	4.91	4.70	4.82	3.62	3.88	3.26	3.59
RL	5.59	5.90	5.93	5.81	4.31	4.36	4.72	4.46
CM	3.57	4.45	4.46	4.196	3.22	3.56	3.51	3.43
Mean (V)	4.63	5.29	4.91	4.94	3.70	4.13	3.69	3.84
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.49	0.38	0.84		0.52	0.37	0.92	

*Additional work has been done after collecting the thesis data using the same methods.

Table 3. Leaf mineral content (Mg and Na) of the three scion varieties as affected by 5 citrus rootstocks in 1997 and 1998* seasons.

Root-stocks (s)	1997 Season				1998 Season*			
	Leaf magnesium (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (S)	WO	VO	BM	Mean (S)
S.O	0.48	0.48	1.08	0.68	0.46	0.48	0.52	0.49
VM	1.08	1.08	1.08	1.08	0.54	0.53	0.58	0.55
TC	0.44	0.45	1.06	0.65	0.46	0.48	0.51	0.48
RL	1.08	1.06	1.05	1.06	0.49	0.51	0.54	0.51
CM	0.44	0.45	0.45	0.45	0.44	0.46	0.44	0.45
Mean (V)	0.70	0.70	0.94	0.78	0.48	0.49	0.52	0.50
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5	0.08	0.06	0.14		0.09	0.06	0.16	
	Leaf sodium (%)							
S.O	0.185	0.222	0.238	0.215	0.192	0.236	0.218	0.215
VM	0.119	0.197	0.200	0.172	0.121	0.205	0.183	0.170
TC	0.200	0.220	0.243	0.221	0.204	0.231	0.254	0.230
RL	0.127	0.210	0.220	0.186	0.133	0.218	0.194	0.182
CM	0.222	0.260	0.290	0.257	0.235	0.281	0.264	0.260
Mean (V)	0.171	0.222	0.238	0.210	0.177	0.234	0.223	0.211
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5	0.023	0.018	0.040		0.026	0.017	0.044	

*Additional work has been done after collecting the thesis data using the same methods.

2. Leaf micronutrients and Cl: Regarding leaf Fe content, data in Table (4) clarified that Fe levels in leaves of the three scion varieties were always higher on VM and RL rootstocks than the corresponding values in leaves of the same scions on other rootstocks.

Similarly, VM and RL rootstocks proved to have the ability to increase Zn absorption via their roots. This ability varied with the tested scion variety. The highest values of Zn in WO leaves were detected on RL, in VO leaves on VM and in BM leaves on VM and SO rootstocks. On the other hand, the least values of Zn in leaves of the three scion varieties were recorded on CM rootstock in both seasons.

As for leaf Mn content (Table 4) it was noted that no consistent trend could be traced concerning leaf Mn content as affected by different rootstocks in both seasons. The values were higher in WO leaves on VM while, the highest values of Mn in VO leaves, were recorded on VM and SO rootstocks. On the other hand, in BM leaves, the highest values in this respect were recorded on CM rootstock, while the least values were obtained on VM one.

These explanations find support in the conclusions of Gallasch and Dalton (1989); Azab (1995) and Dawood (1996) reported similar findings on Fe, Zn and Mn levels.

Table 4. Leaf micronutrients and chloride content of the three scion varieties as affected by 5 citrus rootstocks in 1997 and 1998* seasons.

Root-stocks (s)	1997 Season				1998 Season*			
	Leaf iron (ppm)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (S)	WO	VO	BM	Mean (S)
S.O	107.5	74.53	47.35	76.46	112.3	82.56	72.14	89.01
VM	122.9	122.7	98.56	114.7	136.8	132.2	110.1	126.4
TC	74.53	84.90	50.81	70.08	79.39	92.96	65.85	79.4
RL	130.6	146.4	69.32	115.4	128.7	143.2	78.73	116.9
CM	56.48	60.79	44.74	54.00	62.80	92.13	56.83	70.59
Mean (V)	98.38	96.49	62.16	86.13	104.0	108.6	76.74	96.45
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.11	0.86	1.92		1.23	0.81	2.03	
	Leaf zinc (ppm)							
S.O	30.53	28.21	38.59	32.44	32.45	29.88	34.12	31.15
VM	33.49	33.63	48.78	38.63	35.63	34.62	37.94	36.06
TC	30.56	28.60	28.50	29.22	31.22	27.29	29.33	29.28
RL	38.77	30.96	35.44	35.06	38.57	32.24	33.15	34.65
CM	25.44	25.26	25.84	25.51	26.32	27.62	25.26	26.40
Mean (V)	31.76	29.33	35.43	32.17	32.84	29.73	31.96	31.51
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.83	0.64	1.43		0.96	0.75	1.69	
	Leaf manganese (ppm)							
S.O	40.49	110.5	130.5	93.81	58.92	102.2	118.3	93.11
VM	100.5	120.5	60.52	93.83	102.6	118.6	98.36	106.5
TC	30.50	60.59	120.5	70.53	44.52	66.18	102.2	70.98
RL	60.48	69.85	110.6	80.29	68.16	76.54	108.3	84.34
CM	70.45	30.53	140.4	80.47	80.14	36.26	128.3	81.57
Mean (V)	60.49	78.38	112.5	83.79	70.86	79.94	111.1	87.30
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	1.71	1.33	2.97		1.52	1.26	2.91	
	Leaf chloride (%)							
S.O	0.039	0.043	0.045	0.042	0.041	0.036	0.042	0.040
VM	0.036	0.027	0.043	0.035	0036	0.026	0.034	0.032
TC	0.032	0.033	0.036	0.034	0033	0.036	0.033	0.034
RL	0.036	0.029	0.038	0.034	0.034	0.026	0.032	0.031
CM	0.031	0.026	0.033	0.030	0.032	0.028	0.029	0.030
Mean (V)	0.035	0.032	0.039	0.035	0.036	0.030	0.036	0.034
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.0007	0.0006	0.001		0.002	0.003	0.008	

* Additional work has been done after collecting the thesis using the same methods.

As for leaf Cl content, the data in Table (4) showed that the leaves of the three scion varieties contained the highest values of Cl on SO rootstock, while, the least values in this respect were recorded on CM rootstock in the first season only. Meanwhile, the percentages of Cl were high in BM leaves when VM was the used rootstock. Concerning the other rootstocks, the three scion varieties contained intermediate values of Cl in their leaves. These results are in agreement with those of Zekri and Parsons (1992).

4. Some leaf nutritional balance:

(a) N/K ratio: It could be concluded that, the most vigorous rootstocks (VM & RL) detected the narrowest N/K ratios (Table 5) in leaves of WO and VO scion varieties, due to higher N and K levels in their leaves. This conclusion is supported by the obtained results on vegetative and root growth. Contrary, CM rootstock recorded the highest N/K ratio in leaves of the two orange varieties, while; TC rootstock estimated similar values in BM leaves. These conclusions find support in the results of Azab (1995) and Azab and Hegazy (1995).

Conclusively, the unbalanced N/K ratio attained by CM rootstock in the present study can make the three scion varieties budded on this rootstock sensitive to salinity and drought stresses. This conclusion agrees with the findings of Ashkenazy (1992) and Azab (1995).

(b) K/Na ratio: Data in Table (5) indicated that VM and RL recorded the highest K/Na ratio in leaves of the three scion varieties as compared with the other tested rootstocks. However, TC and SO recorded intermediate values in this respect. On the other hand, CM rootstock detected the least K/Na ratios in leaves of the three scion varieties. These results came true in both seasons. The high K/Na ratio may be related to high K and low Na uptake of the good scion growth on VM and RL as vigorous rootstocks. The high K/Na ratio can explain the salt tolerance ability of VM and RL rootstocks Clarkson and Ulrich (1991).

Accordingly, under the conditions of this work, VM and RL may be considered as salt tolerant rootstocks, while CM is expected to be sensitive to salinity. Similarly Zekri and Parsons (1992) and Zekri (1993) found that citrus scions are generally salt sensitive and their response to salinity depends on rootstock ability to import Na^+ ions. In the same direction, Alva and Syvertsen (1991) and Azab (1995) reported that, the best growing rootstocks (VM and RL) had the ability to reduce Na+ absorption leading to less Na accumulation in leaves.

(c) Na^+ + Cl^- value: As shown in Table (5) the three scion varieties contained the highest values of Na^++ Cl^- in their leaves when budded on CM rootstock. Contrary VM rootstock recorded the least values of Na^++ CL^-. Meanwhile, the total values of Na^+ + Cl^- were intermediate in leaves when they were budded on RL, TC and SO rootstocks and the differences were significant in both seasons. Conclusively, under conditions of this work, the two rootstocks (VM & RL) had a higher ability to reduce Na^+ + Cl^- accumulation in leaves of the three scion varieties. This conclusion is supported by the conclusion of Zekri and Parsons (1992).

Accordingly, the obtained results concerning VM and RL rootstocks encourage the hope to consider both rootstocks as a good substituents to SO rootstock, especially in saline soil. These conclusions agree with the conclusions of Zekri and Parsons (1992). Thus, the total value of Na^+ + $C1^-$ in citrus leaves may be considered as valuable tool for assessing salinity injury and ranking salinity tolerance (Nieves *et al.*, 1991).

d. C/N ratio: Data in Table (5) showed that, the two rootstocks (VM, RL) detected the least values of C/N ratios in leaves of the three scion varieties. On the other hand, CM rootstock estimated the highest C/N ratio in leaves of the three scions in both seasons. As for other rootstocks (SO, TC) they estimated intermediate C/N ratio in leaves of the three tested scions in both seasons. It could be concluded that, the most vigorous rootstocks (VM, RL) are characterized by narrow C/N ratio and higher protein levels in leaves of all scions budded on them than those budded on CM rootstock. This may relate to a high rate of carbohydrate depletion due to the more active vegetative growth period. These results are in agreement with the conclusions reported by Azab (1995)

111. Citrus leaf miner infection: As shown in Table (6) in both seasons, it seems that the two rootstocks (VM and RL) recorded the least percentages of citrus leaf miners infection in leaves of the three scion varieties. On the contrary, the highest

Table 5. Some leaf mineral nutritional balance of the three scion varieties as affected by 5 citrus rootstocks in 1997 and 1998* seasons.

Root-stocks (s)	1997 Season				1998 Season*			
	Leaf N/K ratio							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (S)	WO	VO	BM	Mean (S)
S.O	1.31	1.33	1.51	1.38	1.51	1.41	1.59	1.50
VM	1.13	1.20	1.51	1.28	1.39	1.32	1.53	1.41
TC	1.25	1.31	1.71	1.42	1.44	1.45	1.65	1.51
RL	1.11	1.18	1.32	1.20	1.31	1.42	1.45	1.39
CM	1.53	1.42	1.54	1.50	1.64	1.67	1.57	1.63
Mean (V)	1.26	1.29	1.52	1.36	1.46	1.45	1.56	1.49
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.11	0.08	0.19		0.13	0.09	0.22	
	Leaf K/Na ratio							
S.O	10.00	7.88	7.35	8.41	8.65	7.29	7.71	7.88
VM	19.58	10.15	9.30	13.01	15.87	9.17	10.16	11.73
TC	9.25	6.95	5.76	7.32	7.94	6.67	5.67	6.76
RL	18.19	10.18	9.86	12.84	14.89	8.53	9.74	11.05
CM	6.49	5.00	5.14	5.54	5.87	4.70	5.49	5.35
Mean (V)	12.70	8.09	7.48	9.42	10.64	7.27	7.75	8.55
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.34	0.26	0.59		0.28	0.23	0.46	
	Leaf Na + Cl value							
S.O	0.224	0.265	0.283	0.257	0.233	0.272	0.260	0.255
VM	0.155	0.224	0.243	0.207	0.157	0.231	0.217	0.202
TC	0.232	0.253	0.279	0.255	0.237	0.267	0.287	0.264
RL	0.163	0.239	0.258	0.220	0.167	0.244	0.224	0.212
CM	0.253	0.286	0.323	0.287	0.267	0.309	0.293	0.290
Mean (V)	0.205	0.253	0.277	0.245	0.213	0.265	0.259	0.245
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.007	0.005	0.012		0.008	0.006	0.014	
	Leaf C/N ratio							
S.O	1.07	1.26	1.01	1.11	1.12	1.31	1.02	1.15
VM	0.95	1.03	1.03	1.00	0.96	1.06	1.04	1.02
TC	0.12	1.28	0.84	1.08	1.13	1.26	1.08	1.16
RL	0.99	0.98	0.86	0.94	1.00	0.99	1.01	1.00
CM	1.20	1.61	1.18	1.33	1.26	1.32	1.28	1.29
Mean (V)	1.07	1.23	0.98	1.09	1.09	1.19	1.09	1.12
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.08	0.06	0.14		0.09	0.06	0.15	

*Additional work has been done after collecting the thesis data using the same methods.

percentages of infection were recorded in leaves of the same scions budded on CM and TC rootstocks. However, SO rootstock showed intermediate values of leaf miners infection in leaves of the three scion varieties. It was noticed that the percentage of leaf miner infection was affected by:

a. Leaf phenolic compounds content: The results as shown in Table (5) (previously determined in the first part of this study) mean a relationship between high phenolic compounds in leaves and low infection with leaf miners infection in the three tested scion varieties. These results find support in the findings of Wutscher (1982).

b. Leaf K content: As shown in (Tables 2&5), there was a close relationship between leaf K content and citrus leaf miners infection. The lower the leaf-K contents the greater the susceptibility to leaf miners infection. This relationship was more pronounced in VM, RL and CM than other tested rootstocks. This may be due to high K level may be relatively increased the fiber content causing protection against leaf miners to force their ways through leaf tissues less rapidly. These conclusions may explain the decreased infection observed in leaves of the three scions budded on VM and RL rootstocks due to their ability to take up more K absorption via the roots than CM rootstock did. The obtained results concerning the role of K in resistance of the plant to insects and diseases find support in the finding of Levitt (1980).

c. Leaf N/K ratio: As shown in Table (5) another relationship was found between leaf N/K ratio and the infection of leaf miner in all tested scion-stock combinations. It is clear that as N/K ratio increased the percentages of leaf miners infection was increased. This relationship means that the balance between N and K in the leaves plays an important role in response to leaf miners infection. The obtained herein results are in general agreement with the conclusions of Levitt (1980) who found that a high nitrogen level in the leaves could make the plant sensitive to moisture stress and easily susceptible to insect and disease infestations. Moreover, Azab (1995) found that VM and RL had significantly higher NPK values in their leaves than CM and other tested rootstocks.

These results mean a relationship between high phenolic compounds, K content and N/K ratio in leaves and low infection with leaf miners in the threetested scion varieties. Moreover, the used rootstock (VM and RL) may play a vital role in reducing the infection of leaf miners but these results disagree with Jacas *et al.* (1997). Therefore, more studies are needed to confirm these complicated physiological and anatomical interactions in response to leaf mmers infection.

However, the question is remained without answer, therefore, more studies are needed in this field to obtain the suitable answer.

Table 5. Some leaf mineral nutritional balance of the three scion varieties as affected by 5 citrus rootstocks in 1997 and 1998* seasons.

Root-stocks (s)	1997 Season				1998 Season*			
	Leaf magnesium (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (S)	WO	VO	BM	Mean (S)
S.O	9.45	5.63	9.09	8.06	18.83	10.66	16.32	15.27
VM	4.99	4.70	8.09	5.92	8.46	8.24	12.62	9.77
TC	10.38	6.36	20.13	12.29	26.18	12.31	31.26	23.25
RL	5.72	2.49	5.54	4.58	10.37	6.63	7.56	8.19
CM	21.83	8.54	11.62	14.00	36.26	14.22	19.56	23.35
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5	2.08	1.61	3.60		2.39	1.84	3.86	

*Additional work has been done after collecting the thesis data using the same methods.

CONCLUSION

It could be concluded that the three scion varieties had higher leaf proline levels (previously determined in the first part of his study), N, K, Mg, Fe, Zn levels and K/Na ratios in addition to lower Cl^{-} + Na^{+} values and C/N ratio when budded on VM and RL rootstocks than the corresponding values detected on So and other rootstocks. Accordingly, VM and RL may be considered as salt tolerant rootstocks and encourage the hope to consider both rootstocks as a good substituents to SO rootstock.

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تقييم ثلاثة أصناف موالح مطعمة على خمسة أصول موالح مختلفة نامية فى أرض طينية خفيفة الملوحة والقلوية فى سخا – بمحافظة كفر الشيخ (٢) المحتوى المعدنى، توازن بعض العناصر بالأوراق، والإصابة بصانعات الأنفاق

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١ *مركز البحوث الزراعية*
٢ *كلية الزراعة بكفر الشيخ – جامعة طنطا*

أجرى هذا البحث فى موسمى ١٩٩٧، ١٩٩٨ على شتلات عمر ٢ – ٣ سنة من البرتقال أبو سرة، الفالنشيا واليوسفى البلدى والتى تم تطعيم كل منها على خمسة أصول مختلفة هى الفولكا ماريانا – ليمون الرانجبور – الترويرسيترنج – النارنج – واليوسفى كيلوباترا، والتى تم زراعتها فى مزرعة التجارب البحثية لمحطة البحوث الزراعية بسخا – محافظة كفر الشيخ فى سبتمبر عام ١٩٩٥ . وهذا البحث تم تنفيذه بهدف تقييم ومقارنة تأثير الأربعة أصول السابقة على المحتوى المعدنى، بعض التوازن الغذائى بالأوراق مع أصل النارنج الذى يعتبر أصلاً رئيسياً فى مصر.

أوضحت نتائج التقييم الذى أجرى فى هذا البحث أفضلية استخدام الفولكاماريانا وليمون الرانجبور كأصول للأصناف الثلاثة (أبو سرة – الفالنشيا – اليوسفى البلدى) وذلك للأسباب الآتية:

١– مقدرتها على زيادة امتصاص كل من النيتروجين – البوتاسيوم – الكالسيوم – الماغنسيوم – الحديد – الزنك – والمنجنيز ولم يظهر كلا من الفوسفور والمنجنيز اتجاها ثابتاً.

٢– مقدرتها المرتفعة على تقليل امتصاص أيونات الصوديوم والكلور من التربة.

٣– احتواء أوراق الأصناف المطعمة عليها على نسبة منخفضة من N/K ، C/N ونسبة مرتفعة من K/Na.

٤– احتواء أوراق الأصناف المطعمة عليها على أقل قيم لصانعات الانفاق.

عموماً وبناء على نتائج التقييم المتحصل عليها فإن الأصول الخمسة موضع الاختيار يمكن ترتيبها تنازلياً طبقاً لدرجة تأثيرها على الصفات المقدرة للأصناف الثلاثة (أبو سرة – الفالنشيا – اليوسفى البلدى) تحت ظروف هذا البحث كما يلى: (الفولكاماريانا وليمون الرانجبور)، (الترويرسترنج، النارنج) وأخيراً اليوسفى كيلوباترا.

وطبقاً لذلك: فإنه يمكن اعتبار كلا الأصلين (الفولكاماريانا وليمون الرانجبور) كبدائل مناسبة لأصل النارنج المستخدم حالياً فى مصر حيث يمكن اعتبار كلا الأصلين من أصول الموالح التى تتحمل الجفاف وملوحة التربة.

هذا التقييم يمكن أن يكون ذو قيمة للمشتغلين بمشاتل الفاكهة ومزارعى الموالح لمساعدتهم فى اختيار الأصل المناسب للصنف المرغوب تطعيمه تحت الظروف البيئية فى منطقة الزراعة.