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PERFORMANCE OF SOME CITRUS VARIETIES ON SEVERAL ROOTSTOCKS - INFLUNCE ON LEAF MINERAL CONTENT AND LEAF MINERS INFECTION

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ABSTRACT

This investigation was carried out in 2012 and 2013 seasons on 2 and 3-year-old Washington Navel orange (WO), Valencia orange (VO) and Balady mandarin (BM) budding on five Citrus rootstocks namely; *C. volkameriana* (VM), Troyer citrange (TC). Rangpur lime (RL), Cleopatra mandarin (CM) and sour orange (SO) grown in a private farm at Menofia Governorate, Egypt, where the soil is slightly saline alkaline clayey. The results indicated that Valencia orange, *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 descending 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 impact for nurserymen and citrus growers. It help growers to select the right rootstock for the desired variety in a given area.

INTRODUCTION

Sour orange (*C. aurantium*) is the most common rootstock for Citrus orchards in Egypt and Mediterranean region. Although Sour orange was considered as a satisfactory rootstock for most citrus scion varieties, it had to be replaced in several countries as a result of its susceptibility to Tristeza (Gregoriou and Economides, 1993). Thus using sour orange 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, Cimen *et al.,* (2014) found that sour oranges was the least affected by the induced Fe deficiency and 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 horticulture. 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 FalIhi, *et al.,* 1992). Thus, each citrus cultivar should be fitted to a particular stock to perform best . El-Sayed, (2013) found that Ca leaf content recorded insignificantly difference between rootstocks, but Leaf Mn content was significantly the highest with sour orange 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 the recent years, several studies have been made on some new rootstocks, which have resistance to gummosis and Tristeza and other virus diseases, (Azab and Hegazy, 1995 and Dawood, 1996).

Volkamer lemon is a lemon hybrid . It produced the most vigorous tree growth for the following cultivars as follow : lemon cvs Eureka and Villafranca; (Monteverde *et al*., 1988 and Monteverde, 1989 Hamlin orange , Orlando tangelo trees (Fallahi, *et al.,* 1991); Red blush grapefruit (Fallahi, 1992); Fairchild mandarin (Fallahi *et al.,*1992) and Persian lime(Valbuena, 1996) and (Ibraim., 2000 and 2005)found that N,P,K and Fe the highest significantly influnces with Valencia orange on vollkamer rootstock.

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 in a private farm at Menofia 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 in a private farm at Menofia in 2012 and 2013 seasons. The tested rootstocks were: Sour orange *(C.aurantium* L.*),* Volkamer lemon *(C.volkameriana),* Troyer citrange *(P. trifoliata L.* Raf. *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. 2010 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.ll dS/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 horticulture practices.

Table 1. Some chemical and physical properties 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 August of both season 2012 and 2013, 20 mature mid shoot leaves from non-fruiting shoots of spring cycle 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_20_2 according to the method described by 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 the method described by Jackson and Ulrich (1959). Chloride was determined by silver nitrate methods according to the method described by 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 ppm on dry weight basis.

The percentage of leaf miners infection: The percentage of leaf miner infection was estimated in leaves of the spring flush in each season. The estimation depended on counting the total number of infected and healthy leaves per seedling. All obtained data were statistically analyzed using analysis of variance (ANOVA) and means were compared using the least significant difference (LSD) at level of probability (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) recorded intermediate values of N.

Regarding leaf P content as shown in Table (2), it is clear that 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 , RL and BM rootstocks without significant differences between them in the second season . 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 results concerning leaf NPK content are in line with those reported by Zekri and Hegazy, 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 were detected in leaves of the three scion varieties budded on VM and RL rootstocks, then came TC and SO rootstocks in this respect. On the other hand, the least values of Ca and Mg were constantly recorded in leaves of the three scion varieties budded on CM rootstock in both seasons. Apparently, the higher levels of N, K, Ca 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 by the results of Zekri (1993), Azab and Hegazy (1995), Dawood (1996), and Panahi, *et.al.,* (2014) on citrus rootstocks.

On the contrary, leaf Na values, as shown in Table 3, were lower in leaves of the three scion varieties budded on VM and RL rootstocks than those on the 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); 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.

As for leaf Cl content, the data in Table 3, 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. 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).

Table 2. Leaf mineral content (N, P, K and Ca) of the three scion varieties as affected by five citrus rootstocks in 2012 and 2013 seasons.

Root-stocks (S)	2012 Season				2013 Season			
	N (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (s)	WO	VO	BM	Mean (s)
SO	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.	S	V	VxS		S	V	VxS	
At 5%	0.16	0.13	0.28		0.18	0.12	0.26	
	P (%)							
SO	0.150	0.150	0.97	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.	S	V	VxS		S	V	VxS	
At 5%	0.018	0.014	0.031		0.019	0.013	0.032	
	K (%)							
SO	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.	S	V	VxS		S	V	VxS	
At 5%	0.012	0.09	0.20		0.11	0.08	0.19	

Root-stocks (S)	2012 Season				2013 Season			
	N (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (s)	WO	VO	BM	Mean (s)
	Ca (%)							
SO	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.	S	V	VxS		S	V	VxS	
At 5%	0.49	0.38	0.84		0.18	0.12	0.26	

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Table 3. Leaf mineral content (Mg , Na and Cl) of the three scion varieties as affected by five citrus rootstocks in 2012 and 2013 seasons.

Root-stocks (S)	2012 Season				2013 Season			
	Mg (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (s)	WO	VO	BM	Mean (s)
SO	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	049	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.	S	V	VxS		S	V	VxS	
At 5%	0.08	0.06	0.14		0.09	0.06	0.16	
	Na (%)							
SO	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.	S	V	VxS		S	V	VxS	
At 5%	0.023	0.018	0.040		0.026	0.017	0.044	
	Cl (%)							
SO	0.039	0.043	0.045	0042	0.041	0.036	0.042	0.040
VM	0.036	0.027	0.043	0.035	0.036	0.026	0.034	0.032
TC	0.032	0.033	0.036	0.034	0.033	0.036	0.033	0.034

Root-stocks (S)	2012 Season				2013 Season			
	Mg (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (s)	WO	VO	BM	Mean (s)
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.	S	V	VxS		S	V	VxS	
At 5%	0.0007	0.0006	0.001		0.002	0.003	0.008	

2. Leaf micronutrients:

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 VC leaves on VM and in BM leaves on VM 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 as shown in Table 4, the values were higher in WO leaves on VM, while the highest values of Mn in VO leaves, were recorded on VM 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 are in harmony with conclusions of Gallasch and Dalton (1989); Azab and Hegazy, 1995) and Dawood, (1996), who reported similar findings on Fe, Zn and Mn levels.

Table 4. Leaf micronutrients and chloride content of the three scion varieties as affected by five citrus rootstocks in 2012 and 2013 seasons.

Root-stocks (S)	2012 Season				2013 Season			
	Fe (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (s)	WO	VO	BM	Mean (s)
SO	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.	S	V	VxS		S	V	VxS	
At 5%	0.11	0.86	1.92		1.23	0.81	2.03	
	Zn (ppm)							

Root-stocks (S)	2012 Season				2013 Season			
	Fe (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (s)	WO	VO	BM	Mean (s)
SO	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	3462	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.	S	V	VxS		S	V	VxS	
At 5%	0.83	0.64	1 .43		0.96	0.75	1.69	
	Mn (ppm)							
SO	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.	S	V	VxS		S	V	VxS	
At 5%	1.71	1.33	2.97		1.52	1.26	2.91	

4. Some leaf nutritional balance:

(a) N/K ratio:

It could be concluded that, the most vigorous rootstocks (VM & RL) recorded 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 to this CM rootstock recorded the highest N/K ratio in leaves of the two orange varieties, while; TC rootstock showed similar values in BM leaves. These conclusions go in hand with 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 to be sensitive to salinity and drought stresses This conclusion agrees with the findings of Azab and Hegazy, (1995); and Iriate-Martel (1999).

(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 had 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 the 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 and Hegazy, (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. On the contrary, VM rootstock recorded the least values of Na+ CL. Meanwhile, the total values of Na^+ 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 the current study, the two rootstocks (VM & RL) had a higher ability to reduce Na^+ $C1^-$ 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 apparently revealed that to consider both rootstocks are considered as a good substituent 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 in the second season only. On the other hand, CM rootstock had the highest C/N ratio in leaves of the three scions in both seasons. As for other rootstocks (SO, TC) they reflected 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 related 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 and Hegazy, (1995).

Table 5. Some leaf mineral nutritional balance of the three scion varieties as affected by 5 citrus rootstocks in 2012 and 2013 seasons.

Root-stocks (S)	2012 Season				2013 Season			
	Leaf N/K ratio							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (s)	WO	VO	BM	Mean (s)

Root-stocks (S)	2012 Season				2013 Season			
	Leaf N/K ratio							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (s)	WO	VO	BM	Mean (s)
SO	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.	S	V	VxS		S	V	VxS	
At 5%	0.11	0.08	0.19		0.13	0.09	0.22	
	Leaf K/Na ratio							
SO	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.	S	V	VxS		S	V	VxS	
At 5%	0.34	0.26	0.59		0.28	0.23	0.46	
	Leaf Na^+ Cl value							
SO	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.	S	V	VxS		S	V	VxS	
At 5%	0.007	0.005	0.012		0.008	0.006	0.014	
	Leaf C/N ratio							
SO	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.	S	V	VxS		S	V	VxS	
At 5%	0.08	0.06	0.14		0.09	0.06	0.15	

111. Citrus leafminer infection:

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

On the contrary, the highest 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.

The results as well confirm that an apparent relationship was noticed between a high leaf content of phenolic compounds, K and N/K and infection with leaf miner. These results represent a relationship between high phenolic compounds, K content and N/K ratio in leaves and low infection with leaf miners in the three tested scion varieties. Moreover, the used rootstocks (VM and RL) may play a vital role in reducing the infection of leaf miners but these results disagree with Jacas *et al.,* (2012). Therefore, more studies are needed to confirm these complicated physiological and anatomical interactions in response to leaf miners infection. However, the question is remained without answer, therefore, more studies are needed in this field to clearly distinguish the right factors involved.

Table (6). Some leaf mineral nutritional balance of the three scion varieties as affected by five citrus rootstocks in 2012 and 2013 seasons.

Root-stocks (S)	2012 Season				2013 Season			
	Leaf magnesium (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (s)	WO	VO	BM	Mean (s)
SO	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	23.2
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.	S	V	VXS		S	V	VXS	
At 5%	2.08	1.61	3.60		2.39	1.84	3.86	

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 raise the hope to be as a good substituent to SO rootstock.

The results as well confirm that an apparent relationship was noticed between a high leaf content of phenolic compounds, K and N/K and infection with leaf miner.

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سلوك بعض أصناف الموالح المطعومة على بعض الأحوال - التأثير على المحتوى المعدنى والأصابة بصانعات الأوراق

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أجريت هذه الدراسة على شتلات عمر ٢-٣ سنة من البرتقال أبو سرة، الفالنشيا واليوسفي البلدي والتي تم تطعيمها على خمسة أصول مختلفة هي الفولكا ماريانا – ليمون الرانجبور – الترويرسيترنج – النارنج – واليوسفي كيلوباترا، خلال موسمي ٢٠١٢ - ٢٠١٣ والتي تم ذراعتها في مزرعة خاصة بمحافظة المنوفية. وهذا البحث تم تنفيذه بهدف تقييم ومقارنة تأثير اربعة اصول على المحتوى المعدني بالأوراق والإصابة بصانعات الأنفاق مع أصل النارنج الذي يعتبر أصلا رئيسياً في مصر

أوضحت نتائج التقييم ان اصول الفولكاماريانا وليمون الرانجبور اكثر ملائمة كأصول للأصناف الثلاثة (أبو سرة – الفالنشيا – اليوسفي البلدي) وذلك للأسباب الآتية: مقدرتها على زيادة امتصاص كل من النيتروجين – البوتاسيوم – الكالسيوم – الماغنسيوم – الحديد – الزنك – والمنجنيز ولم يظهر كلا من الفوسفور والمنجنيز اتجاها ثابتاً وكذلك القدرة علي تحمل الملوحة على طريق الخاصية في امتصاص ايونات الصوديوم والكلور من التربة و احتواء أوراق الاصناف المطعمة عليها على نسبة منخفضة من N/K ،C/N ونسبة مرتفعة من K/Na و احتواء أوراق الأصناف المطعمة عليها على اقل اصابة لصانعات الأنفاق.

وبصفة عامة يمكن القول ان افضل الاصول للأصناف الثلاثة (أبو سرة – الفالنشيا – اليوسفي البلدي) تحت ظروف هذا البحث كما يلي الفولكاماريانا -ليمون الرانجبور- الترويرسترنج، النارنج وأخيراً اليوسفي كيلوباترا. وبناء علية فانه يمكن اعتبار كلا الأصلين (الفولكاماريانا وليمون الرانجبور) كبدائل مناسبة لأصل النارنج المستخدم حيث يمكن اعتبار كلا الأصلين من أصول الموالح التي تتحمل الجفاف وملوحة التربة.
,وهذا تقيم تحت الظروف في منطقة الزراعة.