EVALUATION OF 3-CITRUS VARIETIES BUDDED ON 5-CITRUS ROOTSTOCKS GROWN ON SLIGHTLY SALINE ALKALINE SOIL AT SAKHA, KAFR EL-SHEIKH GOVERNORATE (I) Vegetative growth, root density and distribution and some organic substances

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Abstract

This investigation was carried out in 1997 and 1998 seasons on 2 and 3-years 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 the superiority of *C.volkameriana* and Rangpur lime as better rootstocks than sour orange for Valencia, Washington Navel oranges and Balady mandarin as scion varieties. The trees on these rootstocks are characterized by: Vigorous vegetative growth for the three scion varieties as indexed by growth rate, volume index, trunk cross sectional area and leaf area. Also, larger root system density with better horizontal and vertical fibrous root distribution than those on sour orange and other rootstocks. Moreover, trees on these rootstocks had higher leaf concentrations of proline, protein and total phenolic compounds but had lower carbohydrates while, leaf chlorophyll were not affected.

Generally, the five tested rootstocks could be descendingly arranged due to their effects on vegetative growth and root density and distribution 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.

INTRODUCTION

The problem of rootstock selection has become complicated because many factors other than its resistance to gummossis, Treisteza and all virus diseases should be considered in the choice of a rootstock in a given area. Major factors confirms these

choice such as, resistance to all diseases, tolerance to drought, cold, adaptability to soil salinity, alkalinity, poor drainage and various types of nutrient deficiencies and consistently producing abundant crops of good fruit quality.

Thus, each citrus cultivar should be fitted to a particular stock to perform best under specific conditions and purposes (Reuther, 1973). Moreover, the differences among rootstocks in their response to different environmental stress are considerably varied in a given area (Monteverde *et al.*, 1990). Besides, it is a fact that citrus rootstock may invigorate or dwarf the scion variety, productivity longevity of the scion varieties (Minessy, 1965; Gallasch and Dalton, 1989; Ferguson *et.al.*, 1990; Fallahi, 1992 and Fallahi *et al.*, 1992). In turn, the scion, which has the same effects on the root system, must receive a considerable attention to find a reasonable explanation for the differences among the tested rootstocks under specific conditions.

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 the most widely used rootstock in Egypt for its susceptibility to citrus Tristeza disease. 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 evaluate and compare the vegetative growth, root density and distribution and some organic substances of three scion varieties (WO, VO and BM) on four citrus rootstocks (VM, TC, RL and CM) with (SO) grown on slightly saline alkaline soil at Sakha, Kafr El-Sheikh Governorate 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 Governorate in 1997 and 1998 seasons. The tested rootstocks were: Sour orange (*C. aurantium*), Volkamer lemon (*C. volkamer-*

iana), 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. 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 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	11.6	5.21	22.86	0.4	0	5.72	14.8	19.6
SAR	Average nutrients mg/kg soil					Total carbonate %		Texture grade	
	N		P		K				
7.9	24		8.1		540	3.1		Clayey	

Vegetative growth parameters: Growth rate was calculated by estimating the initial and final plant height from the soil surface to the end of the growing point at the beginning and end of each season. Volume index was calculated as indicated by Turrel (1946) after width measuring on Nov. of each seasons. Trunk cross sectional area (TCSA cm^2) was also calculated by estimating trunk diameter (cm) 10 cm above the soil surface. Leaf area was measured according to Singh and Snyder (1984). Also, in late of Nov. 1998 samples of 3-year-old trees represented each section variety on each of the tested rootstocks was gently removed, then all vegetative growth parameters were measured.

Root system measurements: Fibrous roots density was determined in soil samples taken with a hand operated well-drilling type soil auger with a cup of 10 cm in diameter to make a hole of 10 cm in diameter and 30 cm depth. soil samples were taken in Nov. 1997 at 30 and 60 cm away from plant trunk in the four directions at 0-30

and 30-60 cm depth. Fibrous roots were cleaned and their total number and fresh weight were determined, then the average root weight per hole was calculated as gm/ hole according to Cahoon *et al.* (1959). Also, in late of Nov. 1998 root system fresh and dry weight, longest vertical root (cm) and longest horizontal root (cm) were measured on the removal trees.

Chemical determination of some organic substances: In mid August of both seasons1997and 1998, 20 mature mid shoot leaves per tree were sampled. Leaf samples were washed three times with tap water, and then washed again with distilled water. Leaf chlorophyll a, b was estimating according to Moran and Porath (1980) method and then total chlorophyll was calculated. Total carbohydrate content was determined as percent on dry weight according to Dubois *et al.* (1956). Total protein percentage was estimated depending on leaf nitrogen content (N% x 6.25) due to Pregl (1945). Leaf proline content was determined as (moles/g fresh weight according to Bates *et al.,* (1973). Total phenolic compounds in leaves were determined by using a spectrophotometer according to Sitaramaiah and Pathak (1979) and expressed as mg tanic acid per 100 g dry weight of leaves.

RESULTS AND DISCUSSION

I. Evaluation of vegetative growth: Data concerning WO, VO, and BM scion vegetative growth as affected by 5 citrus rootstocks (Table 2) showed the superiority of VM as the most vigorous rootstock. Trees on it produced the largest tree trunk cross sectional area (TCSA), volume index (VI), growth rate (GR) and leaf area (LA). It is also; clear that VM, as vigorous rootstock was more effective on tree vegetative growth of BM scion variety than that of WO and VO varieties. Similarly, RL rootstock came second in this respect, while CM produced the smallest tree vegetative growth of the three scion varieties. The dwarfing effect was more pronounced on VO variety. As for TC and SO rootstocks, their values came in between due to their effect on tree vegetative growth of the three scion varieties. The differences were significant and true for the two seasons. According to the effect of studied rootstocks on scions vegetative growth, these rootstocks could be descendingly arranged as follow: VM, RL, TC, SO and finally CM.

The vigorous growth of trees on VM and RL rootstocks can be attributed to their larger root system (Table 3), which in turn may uptake adequate amount of water and mineral nutrients via the roots. Anyhow, several literature studies reported that, VM and RL are suitable citrus rootstocks for most citrus scion varieties for their early and vigorous growth, salt and drought tolerance and high productivity (Monteverde *et al.*, 1990; Nieves *et al.*, 199; Fallahi *et al.*, 1992; Martinez *et al.*, 1994; Azab and Hegazy, 1995; Dawood, 1996.

II. Evaluation of root density and distribution:

(a) Root density: Data of Table (3) clear that in 1997 season, trees on VM and RL rootstocks produced the highest fibrous roots fresh weight (g / hole) and numbers (at 30 and 60 cm away from the tree trunk) of the three scion varieties. On the other hand, trees on CM rootstock produced the least fibrous roots fresh weight and number. while, SO is intermediate rootstock like TC for the three scion varieties without significant differences between them in this respect. Also, in 1998 season, trees on VM and RL rootstocks produced the highest fresh and dry weight of all root system as kilograms per tree while, on TC and SO rootstocks were intermediate whereas, CM produced the least fresh and dry weight of root system with the three scion varieties.

(b) Root distribution: Concerning the evaluation carried out on root system distribution of the studied rootstocks (Table 3), the obtained results (1998) indicate the superiority of VM and RL rootstocks for their better and larger rooting area in soil. The highest root system fresh and dry weight, and longest vertical and horizontal roots characterize trees on both rootstocks. On the other hand, CM had the least corresponding values, while TC and SO rootstocks gave intermediate values in this respect. Generally, this evaluation gave a good picture about the ability of root system to spread vertically and horizontally in the soil after 3 years of transplantation in open field, where the soil is slightly alkaline and saline.

Based on the above mentioned root results, the five tested rootstocks could be descendingly arranged due to their root density and distribution as follow: VM, RL, TC, SO and finally CM for the three scion varieties. However, the obtained root results indicate a positive relation between tree height, vegetative growth and depth of root system in soil. These conclusions find support in the results of Mokhtar (1984) and. Saad-

Table 2. Some vegetative growth parameters of the three scion varieties as affected by 5 citrus rootstocks in 1997 and 1998 seasons.

Root-stocks (s)	1997 Season				1998 Season			
	Growth rate* (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (S)	WO	VO	BM	Mean (S)
S.O	34.69	50.52	30.28	38.50	76.06	16.44	60.42	50.97
VM	66.83	28.89	70.98	55.57	38.07	72.47	67.41	59.32
TC	31.77	9.80	29.19	23.59	101.34	35.98	25.39	54.24
RL	33.23	37.21	45.74	38.73	104.35	59.77	67.29	77.14
CM	44.03	11.67	47.09	34.26	43.14	3.33	38.35	28.27
Mean (V)	42.11	27.62	44.66	38.13	72.59	37.60	51.77	53.99
L.S.D.	M.S	M.V		VXS	M.S	M.V		VXS
At 5%	3.18	2.69		3.10	4.22	3.56		3.98
	Volume index** (m^3)							
S.O	0.118	0.044	0.048	0.070	0.549	0.462	0.418	0.476
VM	0.462	0.126	0.254	0.281	0.878	0.864	1.061	0.934
TC	0.100	0.024	0.071	0.065	0.519	0.326	0.357	0.401
RL	0.076	0.085	0.096	0.086	0.826	0.423	0.463	0.571
CM	0.041	0.032	0.031	0.035	0.319	0.297	0.272	0.296
Mean (V)	0.159	0.062	0.100	0.107	0.618	0.474	0.514	0.535
L.S.D.	M.S	M.V		VXS	M.S	M.V		VXS
At 5%	0.028	0.021		0.048	0.038	0.030		0.032
	Trunk cross sectional area* (cm2)							
S.O	1.47	1.17	1.13	1.26	7.07	2.01	5.73	4.94
VM	4.01	3.46	4.79	4.09	21.24	9.62	27.34	19.40
TC	2.27	1.11	2.14	1.84	8.04	2.84	7.07	5.98
RL	1.65	1.86	1.89	1.80	11.95	2.09	7.55	7.20
CM	1.33	1.17	1.37	1.29	4.15	1.13	4.91	3.40
Mean (V)	2.15	1.75	2.26	2.05	10.49	3.54	10.52	8.18
L.S.D.	M.S	M.V		VX.S	M.S	M.V		VXS
At 5%	0.38	0.26		0.31	0.52	0.48		0.39
	Leaf area** (Cm^2)							
S.O	12.72	8.04	6.98	9.24	16.36	15.22	6.89	12.82
VM	15.39	14.77	6.54	12.33	17.65	16.48	7.12	13.75
TC	12.31	11.43	6.96	10.23	15.82	15.09	6.51	12.47
RL	11.20	11.27	6.94	9.80	15.08	15.96	6.94	12.66
CM	10.85	11.08	6.91	9.61	14.21	14.18	6.22	11.54
Mean (V)	12.49	11.32	6.87	10.22	15.82	15.39	6.74	12.65
L.S.D.	M.S	M.V		VX.S	M.S	M.V		VXS
At 5%	0.59	0.46		0.80	0.61	0.43		0.79

*Calculated based on the thesis data.

**1998 season is additional work has been done after collecting the thesis data.

Table 3. Root density and distribution of the three scion varieties as affected by 5 citrus rootstocks in 1997 and 1998 seasons.

Root-stocks (s)	Root density (g/ hole) of 1997 season							
	FW at 30 cm away from the trunk				fW at 60 cm away from the trunk			
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (S)	WO	VO	BM	Mean (S)
S.O	1.280	0.730	0.873	0.961	0.461	0.332	0.370	0.387
VM	1.542	0.941	1.351	1.278	0.892	0.580	0.745	0.739
TC	1.321	0.762	0.883	0.988	0.772	0.320	0.440	0.511
RL	1.433	0.861	0.930	1.075	0.881	0.391	0.551	0.608
CM	0.931	0.390	0.753	0.691	0.451	0.120	0.552	0.374
Mean (V)	1.301	0.737	0.958	0.999	0.691	0.349	0.532	0.524
L.S.D.	M.S	M.V		V x S	M.S	M.V		V x S
At 5%	0.043	0.033		0.081	0.006	0.005		0.011
	Root density (No of fibrous root) of 1997 season							
	At 30 cm away from the trunk				At 60 cm away from the trunk			
S.O	39.33	31.00	34.33	34.89	20.67	14.33	15.33	16.78
VM	61.33	48.33	50.67	53.44	35.33	30.67	27.33	31.11
TC	45.67	32.33	35.33	37.78	27.33	14.33	19.67	20.44
RL	56.33	33.33	42.33	44.00	30.33	15.33	25.67	23.78
CM	34.33	19.67	31.67	28.56	19.67	6.33	21.67	15.89
Mean (V)	47.40	32.93	38.87	39.73	26.67	16.20	21.93	21.60
L.S.D.	M.S	M.V		V x S	M.S	M.V		V x S
At 5%	1.54	1.19		2.67	1.08	0.84		1.87
	Root system density of 1998 season							
	FW (kg) / tree				DW (kg) / tree			
S.O	0.472	0.175	0.600	0.416	0.121	0.046	0.499	0.222
VM	2.500	1.700	4.600	2.933	0.667	0.454	1.182	0.768
TC	0.980	0.175	0.600	0.585	0.276	0.054	0.185	0.172
RL	1.663	0.450	1.100	1.071	0.352	0.117	0.311	0.260
CM	0.400	0.030	0.600	0.343	0.080	0.008	0.154	0.081
Mean (V)	1.203	0.506	1.500	1.070	0.299	0.136	0.466	0.300
L.S.D.	M.S	M.V		V x S	M.S	M.V		V x S
At 5%	0.043	0.033		0.070	0.143	0.111		0.251
	Root system distribution of 1998 season							
	Longest of vertical roots (cm)				Longest of horizontal roots (cm)			
S.O	19.33	15.33	32.33	22.33	24.67	15.67	38.33	26.22
VM	45.67	55.33	52.67	51.22	101.70	47.33	100.70	83.22
TC	57.50	15.67	45.50	39.56	42.67	32.67	60.67	45.33
RL	42.50	24.50	38.67	35.22	72.67	36.00	78.33	62.33
CM	18.17	9.50	14.33	14.00	65.67	7.33	55.67	42.89
Mean (V)	36.63	24.07	36.70	32.47	61.47	27.80	66.73	52.00
L.S.D.	M.S	M.V		V x S	M.S	M.V		V x S
At 5%	1.86	1.45		3.22	2.25	1.75		3.91

Allah *et al.* (1985). On the other hand, the obtained root results disagree with the conclusions of Allurwar and Parihor (1992). Accordingly, the better root system characteristics attained by VM and RL rootstocks with the three scion varieties may be helpful and enable the plant to have better control on water loss and delay the onset of water stress. Such conclusion agrees with the findings of Fallahi *et al.* (1992) and Azab and Higazy (1995).

III. Some organic-substances in scion leaves as affected by different rootstocks:

1. Leaf chlorophyll content: In general, it was obvious that (Table 4) the five tested rootstocks failed to affect the values of chlorophyll in leaves of the three scion varieties. The differences among rootstocks did not reach to the limit of significance in both seasons. In this study, although the amounts of chlorophyll in leaves of the three scion varieties did not vary significantly, it is clear that chlorophyll values in leaves of some scions were always lower on CM rootstock as compared with those on other rootstocks. The obtained chlorophyll results are in general agreement with the finding of Levitt (1980).

2. Leaf total carbohydrates (%): data in Table (4) revealed that leaves of the three scion varieties on VM and RL rootstocks are characterized by lower carbohydrate level. This decreasing in carbohydrate values could be attributed to active vegetative growth. This conclusion is in harmony with the results of vegetative growth characteristic (Table 2). On the other hand, CM rootstock is characterized by a higher level of total carbohydrates in leaves of the three scion varieties. This may be related to carbohydrate accumulation during the less active vegetative growth period. However, trees on SO like TC rootstock recorded intermediate values in this respect. These results came true in both seasons. These conclusions agree with those obtained by Abdel-kader (1989) and are in line with the conclusions of Gallasch and Dalton (1989) and Azab (1995).

3. Leaf total protein content: Data in Table (5) revealed that VM and RL rootstocks had the ability to increase leaves protein content of the three scions, leading to more active vegetative growth than CM rootstock did. However, other rootstocks (SO, TC) seemed to be intermediate in this respect, especially with WO and VO

Table 4. Leaf chlorophyll a, b, (a+b) and total carbohydrates of the three scion varieties as affected by 5 citrus rootstocks in 1997 and 1998* seasons.

Root-stocks (s)	1997 Season				1998 Season*			
	Leaf chlorophyll a (μ g/cm^2)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (S)	WO	VO	BM	Mean (S)
S.O	42.00	35.06	43.79	40.28	41.92	36.12	41.39	39.81
VM	42.80	38.14	42.19	41.04	42.56	38.72	41.68	40.99
TC	42.66	37.49	42.49	40.88	42.81	37.12	42.63	40.85
RL	41.54	36.19	41.87	39.86	41.26	36.59	42.10	39.98
CM	41.05	33.63	38.88	37.85	40.83	34.06	38.36	37.75
Mean (V)	42.01	36.10	41.84	39.98	41.88	36.52	41.23	39.88
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	NS	2.47	5.52		NS	3.12	5.10	
	Leaf chlorophyll b (μ g/cm^2)							
S.O	21.37	14.87	24.12	20.12	20.83	14.51	23.96	19.77
VM	21.97	15.13	19.52	18.87	21.52	15.39	19.83	18.91
TC	22.39	15.70	22.05	20.05	21.79	15.31	21.93	19.68
RL	20.47	12.14	18.40	17.00	19.85	12.67	18.56	17.03
CM	19.77	14.59	16.90	17.09	19.31	14.91	17.12	17.11
Mean (V)	21.19	14.48	20.20	18.63	20.66	14.56	20.28	18.50
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	NS	2.81	6.29		NS	2.35	5.68	
	Leaf chlorophyll a+b (μ g/cm^2)							
S.O	63.37	49.92	67.57	60.29	62.75	50.63	65.35	59.58
VM	64.77	53.27	61.72	59.92	64.08	54.11	61.51	59.90
TC	65.05	53.19	64.53	60.92	64.60	52.43	64.56	60.53
RL	62.01	48.32	60.27	56.87	61.11	49.26	60.66	57.01
CM	60.83	48.22	55.78	54.94	60.11	48.97	55.48	54.86
Mean (V)	63.20	50.58	61.97	58.59	62.54	51.08	61.51	58.38
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	6.49	5.03	11.24		4.37	4.00	8.58	
	Leaf total carbohydrates (%)							
S.O	6.43	7.32	6.70	6.82	6.82	7.56	6.39	6.92
VM	6.28	6.18	5.93	6.13	6.39	6.58	6.13	6.37
TC	6.45	6.40	6.00	6.28	6.39	6.64	6.18	6.40
RL	6.35	6.38	5.95	6.23	6.28	6.07	6.15	6.17
CM	6.58	7.41	7.05	6.92	6.63	7.18	7.03	6.95
Mean (V)	6.42	6.74	6.33	6.49	6.50	6.81	6.38	6.56
L.S.D.	M.S	M.V	VXS		M.S	M.V	VXS	
At 5%	0.23	0.18	0.40		0.21	0.17	0.38	

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

Table 5. Leaf total protein, proline and total phenolic compounds of the three scion varieties as affected by 5 citrus rootstocks in 1997 and 1998* seasons.

Root-stocks (s)	1997 Season				1998 Season*			
	Leaf total protein (%)							
	Variety (V)				Variety (V)			
	WO	VO	BM	Mean (S)	WO	VO	BM	Mean (S)
S.O	15.00	14.59	17.71	15.77	15.69	15.13	15.69	15.50
VM	16.46	15.00	14.38	15.28	16.63	15.50	16.44	16.19
TC	14.38	12.50	17.92	14.93	14.56	14.00	14.88	14.48
RL	16.04	16.25	17.50	16.60	16.19	16.50	16.00	16.23
CM	13.75	8.34	15.00	12.36	14.13	13.74	14.88	14.25
Mean (V)	15.13	13.34	16.50	14.99	15.44	14.97	15.58	15.33
L.S.D.	M.S	M.V		VXS	M.S	M.V		VXS
At 5%	1.27	0.99		2.20	1.32	0.95		2.12
	Leaf proline (μ moles/g)							
S.O	0.265	0.213	0.304	0.261	0.286	0.292	0.301	0.293
VM	0.404	0.284	0.349	0.346	0.386	0.312	0.352	0.350
TC	0.256	0.225	0.338	0.273	0.283	0.340	0.294	0.306
RL	0.315	0.256	0.347	0.306	0.297	0.285	0.268	0.283
CM	0.251	0.202	0.247	0.233	0.266	0.291	0.259	0.272
Mean (V)	0.298	0.236	0.317	0.284	0.304	0.304	0.295	0.301
L.S.D.	M.S	M.V		VXS	M.S	M.V		VXS
At 5%	0.005	0.004		0.009	0.004	0.003		0.011
	Leaf total phenolic compounds (mg/100g)							
S.O	24.85	28.03	34.19	29.02	25.69	28.91	30.16	28.25
VM	28.40	34.85	38.02	33.76	27.83	32.68	33.85	31.45
TC	22.40	28.50	32.70	27.87	23.18	28.66	31.86	27.90
RL	35.97	39.33	44.10	39.80	33.81	36.52	38.12	36.15
CM	20.83	22.42	27.95	23.73	21.73	23.15	22.77	22.55
Mean (V)	26.57	30.63	35.39	30.86	26.45	29.98	31.35	29.26
L.S.D.	M.S	M.V		VXS	M.S	M.V		VXS
At 5%	0.59	0.45		1.02	0.61	0.46		1.13

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

scion varieties in both seasons. Consequently, the best vegetative growth of the three scions on VM and RL rootstocks was associated with higher protein and lower carbohydrate content than those on CM rootstock and other rootstocks. These conclusions agree with those reported by Gallacsh and Dalton (1989); Azab, (1995) and Azab and Hegazy (1995).

Singh *et al.* (1972); Rhoades *et al.*, (1992); Azab (1995) and Azab and Hegazy (1995).

5. Total phenolic compounds: Concerning total phenolic compounds, as shown in Table (5), the highest values in both seasons belonged to leaves of the three scions budded on VM and RL rootstocks, then came on SO and TC rootstocks intermediate. The least values in this respect always belonged to leaves of the same scions budded on CM rootstock. However, the differences among the effect of VM, RL and CM rootstocks were significance. Anyhow, phenolic and related compounds are reported to be present in plant tissues and play an important role in resistance of the plant to different pests and diseases infection (Abd-Allah, 1993). These results are in agreement with those reported by Sitaramaiah and Pathak (1979) and Abd-Allah (1993).

CONCLUSION

It could be concluded that trees on VM and RL rootstocks were the greatest vegetative growth and the largest root system with better vertical and horizontal distribution. Moreover, their leaves contained higher protein, proline and total phinolic compound compared to SO and other rootstocks. Thus, VM and RL may be considered as suitable substitutes for sour orange one in Egypt.

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تقييم ثلاثة أصناف موالح مطعمه على خمسه أصول موالح مختلفة نامية فى ارض طينية خفيفة الملوحه والقلوية فى سخا - بمحافظه كفر الشيخ (ا) النمو الخضرى ،كثافة وتوزيع الجذور وبعض المواد العضوية.

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

أجرى هذا البحث فى موسمى ١٩٩٧ ، ١٩٩٨ على شتلات عمرها ٢-٣ سنة من البرتقال أبو سرة ، الفالنشيا واليوسفى البلدى و التى تم تطعيم كل منها على خمسة أصول مختلفة هى الفولكا ماريانا - ليمون الرانجبور - الترويرسيترنج - النارنج - واليوسفى كيلوباترا ، و التى تم زراعتها فى مزرعة التجارب البحثية لمحطة البحوث الزراعية بسخا - محافظة كفرالشيخ فى سبتمبر عام ١٩٩٥ وذلك بهدف تقييم ومقارنة تاثيرة الأربعة أصول السابقة على النمو الخضرى ، كثافة وتوزيع الجذور وبعض المواد العضوية للأصناف الثلاثة مع أصل النارنج الذى يعتبر أصلا رئيسيا فى مصر.

وقد أوضحت نتائج التقييم الذى أجرى فى هذا البحث أفضليه استخدام الفولكاماريانا وليمون الرانجبور كأصول للأصناف الثلاثة (أبو سرة - الفالنشيا - اليوسفى البلدى) حيث اتصفت الاشجار المطعمة عليهما بما يلى:

١- قوة النمو الخضرى للأصناف الثلاثة ممثلا فى معدل النمو - دليل الحجم - مساحة مقطع الجذع - مساحة الورقة للأصناف الثلاثة المطعمة علي هذين الاصلين.

٢- مجموعها الجذرى تميز بكثافة جذرية كبيرة وتوزيع افقى ورأسى أفضل لجذور الامتصاص فى التربة.

٣- احتواء أوراق الأصناف الثلاثة المطعمة عليها على تركيزات مرتفعه معنويا من كل من البرولين - البروتين والفينولات الكلية وانخفاض محتوياتهما من الكربوهيدرات ولم يتاثر الكلورفيل معنويا.

عموما ومن نتائج التقييم المتحصل عليها فإن الأصول الخمسة موضع الاختبار يمكن ترتيبها تنازليا طبقا لدرجة تأثيرها على النمو الخضرى للأصناف الثلاثة (أبو سرة - الفالنشيا - اليوسفى البلدى) تحت ظروف هذا البحث كما يلى)الفولكاماريانا وليمون الرانجبور) ، (الترويرسترنج ، النارنج) وأخيرا اليوسفى كيلوباترا.وهذا الترتيب كان صحيحا أيضا بالنسبة لكثافة وانتشار الجذور.

وطبقا لذلك: فإنه يمكن اعتبار كلا الأصلين (الفولكاماريانا وليمون الرانجبور) كبدائل مناسبة لأصل النارنج المستخدم حاليا فى مصر.