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EFFICIENCY OF SOME CITRUS ROOTSTOCKS UNDER CALCAREOUS SOILS CONDITION

[51]

Sayed[1], R.A.; S.K.M. Abd El-Naby[2] and S.E. Salem[1]

ABSTRACT

The effect of various levels of soil calcium carbonate content representing some newly reclaimed areas in Egypt on the performance of vegetative growth and leaves content of chlorophyll as well as mineral composition of sour orange; Rangpur lime and Volkamer lemon rootstock seedlings was evaluated during two seasons 2001 and 2002. The results indicated that Volkamer lemon produced similar rate of the increase in seedling and shoot growth and leaves number as compared with other rootstocks in the first season. But, in the second season it was almost in an intermediate order. On the other side, Volkamer lemon had the bigger values of leaf, shoot and root dry weight and its leaves contained remarkable chlorophyll "a and b" content, highest value of N, P, K, Fe, Zn and Mn and low values of Ca and Mg as compared with other studied rootstocks. $CaCO_3$ level in the soil gave similar rate (with few exceptions to the sandy soil) in seedling height, shoots and leaves number. While, dry weights of leaf, shoot and root of rootstocks increased as $CaCO_3$ level increased which was more prominent with 29.4% $CaCO_3$ level. In addition, leaves of seedling grown under sandy soil contained more chlorophyll "a, b". Moreover, rootstocks seedling uptake of Fe, Zn and Mn was decreased as $CaCO_3$ level increased in the soil, while its uptake of K, Ca and Mg was increased in the two seasons. In addition, the uptake of N was increased significantly in the second season only. It is worth mentioning, that planting of Volkamer lemon rootstock under calcareous soil at 29.4% $CaCO_3$ level conditions proved to be superior to the other rootstocks in its growth and leaf nutrient content.

Key words: Citrus rootstocks, Growth, Leaf mineral, Chlorophyll, Calcareous soil.

INTRODUCTION

Every citrus growers must make a concerted effort to fit the rootstock to a specific scion variety, the planting layout of his grove, the predominant soil type, climate and disease environments. The wrong rootstock for a given soil type can mean the difference between success and failure of a grove operation, although any citrus variety can be used as a rootstock, some are better suited to specific conditions than are other (**Lawrence and Bridges, 1974**). Such, high carbonate

1- Horticultural Res. Inst. Agric. Res. Center, Giza, Egypt
2- Pomology Dept., National Res. Center, Dokki, Giza, Egypt.

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soils are a typical soils of arid desert regions "newly reclaimed regions" and are a serious limiting factor for citrus growth because they limit the availability of several micronutrient. **(Castle and Manthey, 1998).** Furthermore, new citrus rootstocks can be used instead of the local sour orange rootstock such as, Volkamer lemon and Rangpur lime which have resistance to diseases, nematodes and foot rot and adaptation to certain soil conditions **(Davies and Albrigo, 1994).**

This investigation aimed to examine the performance of growth and nutritional status of some citrus rootstocks grown on different calcium carbonate levels of soil.

MATERIAL AND METHODS

Plant materials

One year old seedlings of sour orange (*Citrus aurantium linn.*); Rangpur lime (*Citrus limonia Osbeck*) and Volkamer lemon (*Citrus Volkameriana Ten.*) were chosen for the present work throught the 2001 and 2002 seasons.

Uniform and healthy seedlings were transplanted at the beginning of March 2001 on two different calcareous soil types in the greenhouse of the Horticulture Research Institute at Giza. Calcareous soils were collected from El-Noubaria region(Behiera Governate) and Burg El-Arab region (Alex. Governate) representing of some newly reclaimed areas in Egypt. In addition, sandy soil was got from khatatba area (Minufiya Governate) as control .However, three soils had different calcium carbonate levels were experimented as follows 0.45% for sandy soil, 19.6% for El-Noubaria and 29.4% for Burg El-Arab. The mechanical and chemical analysis as well as hydrophysical analysis of soils were determined as shown in Table (1). The seedlings were transplanted in black polyethylene bags which were filled with the three different types of soil with 5kg/ bag and arranged in a complete randomized blocks design.Thus, the experiment co - sisted of 3 soil types x 3 rootstocks kind in three replicates. Each replicate was represented by 10 bags (5 bags/ season).

All seedlings were irrigated with tap water periodically in sufficient quantities to ensure normal growth pattern and they had received ammonium nitrate (NH4NO3) at 0.4 gm./L. every two weeks as a fertilizer solution.

Physico-chemical analysis

1- The initial seedling height and leaves number of the seedlings at transplanting date (March 2001) and March 2002 were recorded as well as growth rate measurements including "final seedling height, shoots number and leaves number per seedling at the end of the two seasons (November 2001 and 2002) were recorded. Then, growth rate was calculated as a percentage

$$\frac{\text{Average final measure} - \text{Average initial measure}}{\text{Average initial measure}} \times 100$$

2- At the end of every season, the experimented seedlings (5 seedling / replicate/ season) were carefully harvested from the bags, washed with tap water followed by distilled water several times and they were divided to vegetative top and root system. then they were dried until a constant weight and their dry weight were recorded.

Table 1. Analytical data of the studied soils.

Soil	Mechanical analysis					Hydrophysical analysis				Chemical analysis						
	Sand		Silt 20-2μ %	Clay <2μ %	Soil texture	*Water holding capacity%	* Field capacity %	*Wilting point %	*Available water %	PH 1:2.5	EC dsm^{-1}	OM %	CEC (mole kg^{-1})	$CaCO_3$ %	Available nutrient (ppm)		
	Coarse >200μ %	Fine 200-20μ %													N	P	K
Khatatba	94.0	3.8	0.8	1.4	Sandy	18.6	5.42	0.86	4.56	7.86	7.5	0.06	2.85	0.45	19	6	40
El-Nouberia	63.3	8.0	10.8	17.9	Sandy loam	26.6	13.6	3.9	9.7	7.96	7.0	0.21	11.38	1.96	43	12	86
Burg El-Arab[ΔΔ]	17.2	13.0	38.8	31.0	Clay loam	33.7	21.9	8.1	13.8	8.20	4.0	0.32	18.91	29.40	51	21	115

* On weight basis

[ΔΔ] Burg El-Arab soil was planted with some green crops before collected it for use in this trial, therefore organic matter and nutrients were high in level.

3- The mineral content of leaf samples (the third up to the fifth leaves from the seedling top in November) were determined in the dry matter as follows: Nitrogen was determined by the micro-kjeldahl method (**Chapman and Pratt, 1978**). Analysis of other elements (phosphorus, potassium, calcium, magnesium, iron, zinc and manganese) were conducted as mentioned by (**Carter, 1993**). After wet-digestion of leaf samples with H_2SO_4-H_2O_2 digest (**Cottenie, 1980**) using atomic absorption.

4- Three mature fresh leaves /replicate were taken in November from the middle of spring shoots and they were cleaned from the dust; washed with distilled water and extracted by 85% aceton, then cholorphyll "a & b" contents were determined as mg./gm. using **Wettslein method (1957).**

Statistical analysis

All data of the present investigation were tabulated and statistically analysed according to **Snedecor and Cochran (1982).** Means were compared using Duncan's multiple range test **(Duncan,** 1955) at the 5% level of probability.

RESULTS AND DISCUSSION

1-Vegetative growth parameters

The results obtained from those parameters are summarized in Tables (2 & 3). Volkamer lemon produced the largest rate of increase in seedling height during the first season, but sour orange gave the greatest rate of increase in seedling height during the second one. On the other hand, there were no significant differences between all rootstocks kind in the rate of increase in shoots and leaves number in the first season. While, Rangpur lime produced the highest rates in this respect in the second season. The relativfe difference in growth features is assumed to be due to species characteristics. In this connection, **Aso (1974) and Montaser (1975)** found that sour orange grow well under high calcareous soils, while, Volkamer lemon was preferable due to it produced vigour orange trees **(Eid, *et al* 2000 a)**, also surpassed all other rootstocks in plant height under two different soil types. **(Abou Rawash, *et al* 1995).**

Concerning $CaCO_3$ level in the soil, there were no significant differences among all soil types in the rate of increase in seedling height and leaves number, except leaves no. in the first season which increased as $CaCO_3$ level increased. On the other hand, sandy soil gave the least rate of increase in shoots number, while the presence of $CaCO_3$ in the soil increased shoots number per seedling. Those facts were hold in the two seasons. Similar results were reported by **El-Gazzar, *et al* (1979); Rokba (1985) and Assal, *et al* (1994).**

Concerning the interaction between soil type and rootstock kind, irrigular behaviour was found among various rootstocks and Ca CO_3 levels of soil.

Volkamer lemon had the greatest leaf, shoot and root dry weights throughout the two studied seasons. A similar trend was found throughout the work of **Montaser (1975); El-Shazly (1976) and Assal, *et al* (1994).**

Regarding $CaCO_3$ level of soil, an increase in leaf, shoot and root dry weights were recorded as $CaCO_3$ level of

Table 2. Rate of increase* in seedling height, shoots number/seedling,leaves number/seedling ,leaves,shoots and roots dry weight and leaf chlorophyll a&b contents of some citrus rootstocks seedlings as affected by different calcareous soils in the first season (2001).

$CaCO_3$ level / Rootstock	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean
	Seedling height				shoots number/seedlig				Leaves number/seedlig				Leaves dry weight %			
Volkamer lemon	1.856 bc	2.796 a	1.366 bc	2.006 A	0.890 b	2.133 ab	1.893 ab	1.638 A	3.26 bc	4.49 ab	6.52 a	4.758 A	45.9 b	61.23 a	63.95 a	57.030 A
Rangpur lime	1.273 c	1.200 c	0.833 c	1.102 B	1.143 b	2.216 ab	2.986 a	2.115 A	4.60 ab	5.46 ab	6.24 a	5.433 A	9.70 c	45.58 b	47.46 b	34.250 C
Sour orange	2.330 a	1.533 bc	1.583 bc	1.925AB	1.186 b	1.370 b	1.996 ab	1.517 A	2.21 c	4.20 ab	5.38 ab	3.932 A	44.64 b	41.08 b	47.28 b	44.335 B
Mean	1.820	1.843	1.261		1.073	1.906	2.292		3.356	4.716	6.046		33.413	49.299	52.903	
	A	A	A		B	AB	A		B	B	A		B	A	A	
	Shoots dry weight %				Roots dry weight %				Leaf chlorophyll "a" mg. / gm.				Leaf chlorophyll "b" mg./gm.			
Volkamer lemon	58.64 bc	62.71 b	70.61 a	63.98 A	69.26 bc	73.72 b	79.27 a	74.087A	2.189 bc	2.103 c	1.650 de	1.980 B	0.640 ab	0.650 ab	0.533 bc	0.608 AB
Rangpur lime	58.09 bc	55.01 c	57.82 bc	56.97 B	62.53 d	61.11 d	66.31 cd	63.321B	1.395 f	1.522 e	1.356 f	1.424 C	0.681 ab	0.516 bc	0.400 c	0.532 B
Sour orange	55.11 c	55.7 c	58.57 bc	56.49B	60.66 d	60.45 d	61.79 d	60.968C	2.647 a	2.300 b	1.746 d	2.231 A	0.797 a	0.740 ab	0.572 bc	0.703 A
Mean	57.281	57.809	62.334		64.157	65.096	69.126		2.077	1.975	1.584		0.706	0.635	0.501	
	B	B	A		B	B	A		A	B	C		A	A	B	

Means with the same letters are not significantly different at 5 % level

$$\text{*Rate of increase} = \frac{\text{final figure in Nov.- initial figure in Mar.}}{\text{initial figure in Mar.}} \times 100$$

Table 3. Rate of increase* in seedling height, shoots number/seedling, leaves number/seedling, leaves, shoots and roots dry weight and leaf chlorophyll a&b contents of some citrus rootstocks seedlings as affected by different calcareous soils in the second season (2002)

$CaCO_3$ level / Rootstock	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean
	Seedling height				**shoots number/seedlig**				**Leaves number/seedlig**				**Leaves dry weight %**			
Volkamer lemon	1.706 b	2.180 ab	1.313 b	1.733 B	0.893 a	1.533 b	1.780 b	1.402 B	5.496 bc	3.110 c	5.266 bc	4.624 B	51.023 bc	59.636 a	59.886 a	56.849 A
Rangpur lime	2.073 ab	1.633 b	1.426 b	1.711 B	1.800 b	3.733 b	3.323 a	2.952 A	6.256 ab	8.466 a	7.710 ab	7.477 A	11.616 d	47.866 c	54.656 b	38.047 C
Sour orange	3.303 a	3.250 a	1.953 ab	2.835 A	1.423 b	1.760 b	1.003 b	1.395 B	8.556 a	3.903 c	7.046 bc	5.502 B	45.706 c	48.116 c	61.060 bc	48.294 B
Mean	2.361 **A**	2.354 **A**	1.564 **A**		1.372 **B**	2.342 **A**	2.035 **A**		6.770 **A**	5.160 **A**	5.674 **A**		36.116 **C**	51.873 **B**	55.201 **A**	
	Shoots dry weight %				**Roots dry weight %**				**Leaf chlorophyll "a" mg. / gm.**				**Leaf chlorophyll "b" mg./gm.**			
Volkamer lemon	61.080 b	65.713 a	68.950 a	65.247A	69.02 b	79.11 a	78.73 a	75.624A	2.121 b	1.885 bc	1.825 c	1.944 A	0.667 b	0.528 de	0.431 f	0.542 B
Rangpur lime	58.313 bc	56.816 c	61.006 b	58.712 B	57.00 cd	57.54 cd	67.17 bc	60.573B	1.549 de	1.378 e	1.392 e	1.440 B	0.590 cd	0.462 ef	0.416 f	0.489 C
Sour orange	56.050 c	57.500 c	60.573 b	58.041 B	61.24 c	60.97 c	63.26 bc	61.827B	2.402 a	1.977 b	1.727 cd	2.035 A	0.947 a	0.653 bc	0.530 de	0.710 A
Mean	58.481 **B**	60.010 **B**	63.510 **A**		62.423 **B**	65.878 **B**	69.723 **A**		2.024 **A**	1.747 **B**	1.648 **B**		0.735 **A**	0.548 **B**	0.459 **C**	

Means with the same letters are not significantly different at 5 % level

$$\text{*Rate of increase} = \frac{\text{final figure in Nov.- initial figure in Mar.}}{\text{initial figure in Mar.}} \times 100$$

soil increased, which were more significant under 29.4% $CaCO_3$ throughout the two seasons. On the contrary, **Montaser (1975) and Assal, *et al* (1994)** found that dry weight of vegetative growth and root system decreased by increasing calcium carbonate level.

Regarding the interaction between the two studied variables, Volkamer lemon seedlings grown in soil which contained $CaCO_3$ gave the greatest dry weight of leaves, shoots and roots in the two seasons compared with other rootstocks and soils.

Leaves of sour orange seedlings contained more chlorophyll "a &b" during the two seasons, while Volkamer lemon leaves was on the par in chlorophyll "b" in the first season and chlorophyll "a" in the second season.

Concerning $CaCO_3$ level of soil, leaf chlorophyll "a &b" contents decreased as $CaCO_3$ level in the soil increased. This was hold in the two seasons. This is in agreement with **El-Gazzar, *et al* (1977); Shaked, *et al* (1988) and Sagee, *et al* (1993)** who indicated that under calcareous soil conditions, severe chlorosis developed in the leaves of rootstocks.

Concerning the interaction, Rangpur lime seedlings leaves grown under different soil types almost contained the least value of chlorophyll "a&b" in the two seasons compared with other rootstocks and soils.

2-Leaf macro-nutrients content

The results in Tables (4 & 5) indicated that sour orange had the lowest value of N, P and K while Volkamer lemon followed with Rangpur lime showed the highest value. This was significant during the two season except P value in the first season where the differences among the rootstocks were insignificant. In contrast, sour orange leaf had greater Ca and Mg contents compared with the other rootstocks. This was hold in the two seasons. Citrus rootstocks varied in their uptake of nutrients, since some rootstocks (Volkamer) can absorb more macronutrients.**[Abou-Rawash, *et al* (1995); Shawky, *et al* (1980) and Eid, *et al* (2000b)].** These results are in harmony with those reported by **Montaser (1975); El-Gazzar, *et al* (1977) and Assal, *et al* (1994).**

Concerning the effect of calcium carbonate levels, there were no significant differences in N and P leaf contents of rootstock seedlings grown on all soils during the two studied seasons except N leaf in the second season where N leaf increased as calcium carbonate level increased in the soil. This fact was related to K, Ca and Mg contents of all rootstocks throught the two seasons. These results are confirmed by those of **Chandra and Yamdagni (1985) and Assal, *et al* (1994).**

Concerning the interaction effect, sour orange leaves contained the least values of N and K under all soil types. While, there were no significant differences in P content between all rootstocks grown on such soil. Incontrast, Volkamer lemon grown on sandy soil produced leaves contained the least values of Ca & Mg compared with other rootstocks or other soils during the two seasons.

3- leaf micro-nutrients content

The Fe, Zn and Mn values in Tables (4 & 5) reveal that Volkamer lemon leaf contained more Fe, Zn and Mn followed by Rangpur lime then sour orange. This

Table 4. Leaf mineral content of some citrus rootstock seedlings as affected by different calcareous soils in the first season (2001)

$CaCO_3$ level / Rootstock	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean
	N%				P%				K%				Ca%			
Volkamer lemon	2.56 a	2.60 a	2.43 a	2.531 A	0.156 a	0.150 a	0.152 a	0.152 A	0.999 b	0.690 d	1.480 a	1.056 A	1.7 f	2.0 e	2.4 b	2.03 C
Rangpur lime	2.28 ab	2.40 ab	2.60 a	2.426 A	0.154 a	0.154 a	0.158 a	0.155 A	0.704 d	0.941 cb	1.438 a	1.027 A	2.3 bc	2.1 de	2.2 cd	2.20 B
Sour orange	1.80 c	2.16 bc	2.28 bc	2.080 B	0.146 a	0.150 a	0.140 a	0.145 A	0.417 f	0.463 f	0.417 f	0.432 B	2.0 e	2.3 bc	5.1 a	3.13 A
Mean	2.213	2.386	2.437		0.152	0.151	0.150		0.706	0.698	1.111		2.000	2.133	3.233	
	A	A	A		A	A	A		B	B	A		C	B	A	
	Mg%				Fe (ppm)				Zn (ppm)				Mn (ppm)			
Volkamer lemon	0.198 d	0.244 b	0.220 c	0.220 B	115 a	35 cd	62 b	70.86 A	75 b	20 c	85 ab	60.00 A		82.5 b	5.0 f	69.16 A
Rangpur lime	0.211 cd	0.210 cd	0.215 c	0.212 B	120 a	25 de	15 ef	53.33 B	94 a	21 c	18 c	44.33 B	87.5 b	67.5 c	22.5 e	59.16 B
Sour orange	0.212 cd	0.210 cd	0.301 a	0.241 A	10 f	112 a	42 c	54.66 B	12 c	77 b	17 c	25.33 C	52.5 d	57.5 cd	52.5 d	54.16 B
Mean	0.207	0.221	0.245		81.667	57.333	39.889		60.333	39.333	40.000		86.667	69.167	26.667	
	C	B	A		A	B	C		A	B	C		A	B	C	

Means with the same letters are not significantly different at 5 % level

Table 5. Leaf mineral content of some citrus rootstock seedlings as affected by different calcareous soils in the second season (2002)

$CaCO_3$ level / Rootstock	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean	0.45%	19.6%	29.4%	Mean
	N%				P%				K%				Ca%			
Volkamer lemon	2.48 a	2.51 a	2.32 b	2.436 A	0.150 a	0.140 ab	0.147 a	0.145 A	1.010 b	0.750 c	1.540 a	1.100 A	1.80 c	2.20 d	2.50 b	2.16 C
Rangpur lime	2.21 cd	2.31 bc	2.54 a	2.354 B	0.149 a	0.147 a	0.150 a	0.148 A	0.800 c	0.952 b	1.501 a	1.084 A	2.48 b	2.25 cd	2.40 bc	2.37 B
Sour orange	1.70 f	2.05 e	2.20 d	1.983 C	0.133 b	0.140 ab	0.130 b	0.134 B	0.523 d	0.541 d	0.520 d	0.526 B	2.20 d	2.45 b	3.55 a	2.73 A
Mean	2.130 C	2.290 B	2.354 A		0.144 A	0.142 A	0.142 A		0.777 B	0.747 B	1.187 A		2.160 C	2.300 B	2.816 A	
	Mg%				Fe (ppm)				Zn (ppm)				Mn (ppm)			
Volkamer lemon	0.190 e	0.232 b	0.210 c	0.210 B	110 a	32 d	50 c	64.16 A	70 b	12 d	74 b	52.00 A	105.5 a	70.0 c	14.0 h	63.16 A
Rangpur lime	0.204 cd	0.200 d	0.208 cd	0.204 C	118 a	20 e	12 ef	50.00 B	80 a	18 c	12 d	36.66 B	79.0 b	60.0 d	26.0 g	55.00 B
Sour orange	0.200 d	0.200 d	0.290 a	0.230 A	10 f	100 b	30 d	46.66 B	10 d	70 b	12 d	30.66 C	45.0 f	53.5 e	46.0 f	48.16 C
Mean	0.198 C	0.210 B	0.236 A		79.333 B	50.833 B	30.667 C		53.333 A	33.333 B	32.667 B		76.500 A	61.167 B	28.667 C	

Means with the same letters are not significantly different at 5% level

was hold in the two seasons. However, Volkamer lemon is the least susceptible rootstock in calcareous soils as shown by Sagee, *et al* (1994). This is in accordance with those recorded by **El-Gazzar, *et al* (1979); Assal, *et al* (1994); Azab (1998) and Castle and Manthey** (1998).

Regarding calcium carbonate level of soils, the results showed that Fe, Zn and Mn concentrations of the studied citrus rootstocks leaves decreased as $CaCO_3$ level of the soil increased, except Zn leaf conc. under 19.6 and 29.4% $CaCO_3$ soils where there were no significant differences were recorded. These results are in line with those obtained by **El-Gazzar, *et al* (1979); Rokba (1985) and Assal, *et al*** (1994).

With respect to the interaction effect, sour orange leaves of seedlings grown in sandy soil contained the lowest Fe value as on the par was Fe value in Rangpur lime leaves of seedlings grown in 29.4% $CaCO_3$ soil, but Volkamer lemon leaves of seedlings grown in 29.4% $CaCO_3$ soil contained the lowest Mn value. While, the least Zn value was varied between the studied rootstocks and $CaCO_3$ soil levels. Those were hold in the two seasons. The correlation between soil type and leaf mineral composition varied according to rootstocks and their ability to cope with lime conditions (**Rokba, 1985**).

In general, all rootstocks leaves under all soil types in the second season appeared either decrease in N, P, Mg, Fe, Zn and Mn contents (except Mn in 29.4% $CaCO_3$ soil) or increase in K and Ca contents (except Ca of sour orange leaves or Ca in 29.4% $CaCO_3$ soil) compared with the first season.

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كفاءة بعض أصول الموالح تحت ظروف التربة الجيرية

[٥١]

رمضان أبو سريع سيد[١] - سعيد كامل محمد عبد النبى[٢] - سلامة عيد سالم[١]

١- معهد بحوث البساتين - مركز البحوث الزراعية-الجيزة - مصر

٢- قسم الفاكهة - المركز القومى للبحوث - الدقى-الجيزة - مصر

أجريت التجربة خلال أعوام ٢٠٠١-٢٠٠٢ لتقييم تأثير مستويات مختلفة من كربونات الكالسيوم بالتربة ممثلة لبعض الأراضى المستصلحة الجديدة على كفاءة النمو الخضرى ومحتوى الأوراق من الكلورفيل والعناصر المعدنية لشتلات ثلاثة أصول جذرية للموالح هى النارنج والليمون الرانجبور والفولكا ماريانا.

أظهرت النتائج أن أصل الفولكا ماريانا أعطى معدل زيادة فى إرتفاع الشتلة وعدد الفروع والأوراق مشابه لإصول النارنج والليمون رانجبور فى الموسم الأول لكنه فى الموسم الثانى كان فى المرتبة المتوسطة بين الأصليين الآخرين.

من ناحية أخرى فإن أصل الفولكاماريانا أعطى أكبر وزن جاف لكل من الأوراق والفروع والجذور كما أن أوراقه كانت تحتوى كلورفيل أ- ب بدرجة جيدة ، وأيضا تحتوى أعلى قيم من عناصر النيتروجين والفوسفور والبوتاسيوم والحديد والمنجنيز بينما تحتوى قيم منخفضة من الكالسيوم والمغنسيوم مقارنة بالأصليين المذكورين.

كما اتضح أن نمو شتلات الأصول المختلفة تحت مستويات كربونات الكالسيوم المختلفة بالتربة كان فى معدل مشابه مع استثناء محدود فى حالة نموها بالتربة الرملية بخصوص إرتفاع الشتلات، عدد الفروع والأوراق الناتجة بينما الوزن الجاف لكل من الأوراق ، الفروع والجذور قد زاد كلما ذادت نسبة كربونات الكالسيوم بالتربة والتى كانت أكثر وضوحاً تحت مستوى ٢٩,٤% "كا ك أ" . بالإضافة إلى أن أوراق الشتلات النامية تحت أحوال التربة الرملية كانت تحتوى كلورفيل أ - ب أكثر.

بجانب ذلك فإن امتصاص شتلات الأصول لكل من الحديد، الزنك والمنجنيز قد نقص بزيادة نسبة كربونات الكالسيوم بالتربة بينما امتصاصها للبوتاسيوم والكالسيوم والمغنسيوم قد زاد خلال موسمى الدراسة فى حين امتصاص النيتروجين زاد خلال الموسم الثانى فقط.

وعلى هذا فإن يمكن زراعة أصل الفولكاماريانا تحت ظروف التربة الجيرية (٢٩,٤% كربونات كالسيوم) لتفوقه على باقى الأصول تحت الدراسة فى النمو ومحتوى الأوراق المعدنى.

تحكيم: أ.د محمد أبو رواش على بدر أ.د محمد رضا بركات