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Growth and Mineral Composition of Twelve Different Kinds of *Citrus* Seedlings used as Rootstocks

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ABSTRACT

Highly significant differences were recorded in growth vigor and in the level of nine nutrient elements, N, P, K, Ca, Mg, Fe, Zn, Mn and Cu, in top and root of 7-month-old seedlings of twelve *Citrus* species, varieties and hybrids. *C. macrophylla*, citrumelo 4475, *C. volkameriana* and sour orange were the most vigorous. They accumulated in their tops and roots the highest content of most of the nutrient elements determined. On the other hand, 'Orlando' tangelo, the citranges: 'Troyer', 'Carrizo' and 'Uvalda', and *C. taiwanica* showed slow growth and poor vigor. The total amount of different nutrient elements in their tops and roots was very low. 'Cleopatra' mandarin and the limes, 'Benzahair' and 'Rangpur' showed moderate vigor. Their total uptake of different nutrients was around the general average for all *Citrus* kinds tested. The limitations in interpreting these data were discussed. Calculated means of nutrient elements, as percentage of total ash, revealed probable nutrient imbalances. Exceptionally high or extremely low levels of one or more element as percent of total ash were detected in all *Citrus* kinds except sour orange. The need for more work, in this direction, is expressed to allow for more critical comparisons.

INTRODUCTION

During the last three decades, leaf analysis has helped to gain considerable information, in fruit-tree nutrition, in a relatively short time. However, a general fallacy in leaf analysis work is to assume that changes in leaf nutrient concentration necessarily reflect similar changes in total nutrient uptake by the plant (2). This fallacy is clearly exposed by the work of Cain (3) with the apple tree. Analyses of the various parts of the citrus tree have been made in several regions (1,4,8). The work of Barnette *et al.* (1) on a 19-year-old grapefruit tree was the most inclusive.

With the onset of a citrus rootstock research program at the University of Tripoli, it was considered beneficial to establish a relationship, if any, between soil — and seedling rootstock — nutrient content. Such relationship may allow for a preliminary com-

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parison between different rootstocks in their uptake and distribution of elements under the existing environment.

The results of a study of growth, uptake and mineral distribution in 7-month-old seedlings of 12 species, varieties and hybrids used as citrus rootstocks are presented in this report.

MATERIALS AND METHODS

The plant material used in this study was started from the seeds of: *C. macrophylla* West.; [*P. trifoliata* (L.) Raf. X *C. paradisi* Macf.] citrumelo 4475; *C. volkameriana* Ten. and Pasq.; *C. aurantium* L. sour orange; *C. aurantifolia* (Christm.) Swing. 'Benzahair' (true) lime; *C. limonia* Osbeck 'Rangpur' lime; *C. reshni* Hort. ex. Tan. 'Cleopatra' mandarin; (*C. paradisi* Macf. X *C. tangerina* Tan.) 'Orlando' tangelo; *C. taiwanica* Tan. & Shim.; and [*P. trifoliata* (L.) Raf. X *C. sinensis* (L.) Osbeck] the citranges 'Carrizo', 'Troyer' and 'Uvalda'.

On 1 May 1972 seeding was done in rows in an outdoor seed-bed at Gudaida Nursery, Ministry of Agriculture and Agrarian Reform, Tripoli. Seed-bed dimensions were 1.5 m × 10 m. Analysis of the upper 30 cm of the seed-bed soil as taken from 5 locations at random showed satisfactory uniformity and the mean values for analysis are shown in Table 1. No fertilizers were added and cultural treatments were uniform for all seedlings. On 1 December 1972 samples of 10 seedlings each representing every species, variety and hybrid were collected, in triplicate, each from a different row. Care was practiced to dig-out the entire seedling without much loss of rootlets. After preliminary cleaning, tops (leaves and stems) were severed from the root systems. Fresh and dry weights for each were recorded. Sample preparation for analysis was done as described by Smith (9).

Table 1 Mechanical and chemical analysis of top soil[1] from seed-bed experimental plot used for seeding citrus varieties and hybrids.

Mechanical analysis:		Electrical conductivity		
(Bouyoucos method)		Mmhos/cm.25C°		0.52
Sand %	85.0	Saturation extract determinations:		
Silt %	7.8	Cations:		
Clay %	7.2	$Ca^{++} + Mg^{++}$	Meq./1.	6.70
Saturation %	29.1	Na^{+}	Meq./1.	0.78
pH of saturated soil	7.8	K^{+}	Meq./1.	0.23
Organic matter %	0.342	Total	Meq./1.	7.71
Organic carbon %	0.199	Anions:		
Total nitrogen %	0.028	CO_3^{--}	Meq./1.	0
Cation – exchange capacity		HCO_3^{-}	Meq./1.	3.00
Meq./100g.	4.0	SO_4^{--}	Meq./1.	1.90
Available P_2O_5 ppm	184.5	Cl^{-}	Meq./1.	3.10
Available K_2O ppm	125.8	Total	Meq./1.	8.00

[1]Each value presented is a mean for 5 soil samples taken at random from the upper 30 cms of soil. Dimensions of seed-bed strip were 1.5 m × 10 m.

The analytical methods used were as follows: total nitrogen by Kjeldahl method (7), phosphorus by molybdenum blue method of Fiske and Subbarow, potassium by flame-photometry, calcium and magnesium by titration with E.D.T.A., iron by O-phenan-

throline method, manganese by the potassium periodate method, copper and zinc by dithizone-carbamate method (5).

The total content of each element in different plant parts, as well as in the whole plant, was calculated from the mean dry weight of tops, roots and whole seedlings multiplied by the mean percent composition of elements in dry weight. The data obtained was again used in estimating the mean percentage of each element in total ash.

RESULTS AND DISCUSSION

The interpretation of the results presented in this report has the following limitations: (1) fast growing species, varieties or hybrids developed larger rootsystems with higher ability to exploit and penetrate the soil, thereby, aggravated the differences obtained; (2) the performance of a budded rootstock may differ from a stock growing on its own roots; (3) as rootstocks become older and their roots penetrate the soil better, the picture may become entirely different; and (4) year-to-year variability in composition should be taken into consideration. With all these limitations in mind, it can still be assumed that element concentrations found within the kinds of seedlings studied may reflect the ability of these plants to acquire nutrients from the soil, in relation to their growth, under the prevailing environment. This assumption sets the basis for comparison between these citrus seedlings under study.

Growth

Fresh and dry weights of tops, roots and whole seedlings, at the end of the 7-month-period, were used as the basis for growth evaluation. These data (Table 2) revealed highly significant differences in growth between the various kinds of the *Citrus* seedlings tested. During that early period of seedling growth, *C. macrophylla*, the most vigorous, had

Table 2 Growth distribution between top and root of 7-month-old seedlings of species varieties and hybrids used as citrus rootstocks.

Citrus seedling	Mean[1] Fresh Weight			Mean[1] dry weight			Top/root ratio (dry wt. basis)
	Top	Root	Whole seedling	Top	Root	Whole seedling	
C. macrophylla	12.77 a[2]	5.55 a	18.32 a	4.45 a	1.69 a	6.14 a	2.63
Citrumelo 4475	6.05 b	4.22 b	10.27 b	2.53 b	1.61 ab	4.14 b	1.57
C. volkameriana	6.67 b	3.44 bc	10.11 b	2.68 b	1.45 abc	4.13 b	1.85
Sour orange	6.45 b	3.22 cd	9.67 b	2.64 b	1.03 bcd	3.68 bc	2.56
Benzahair lime	6.38 b	2.83 cde	9.21 b	2.49 b	1.18 abc	3.67 bc	2.11
Rangpur lime	4.44 c	2.50 de	6.95 c	1.84 c	0.95 bcd	2.79 cd	1.94
Cleopatra mandarin	5.11 c	1.93 f	7.04 c	1.82 c	0.68 de	2.51 de	2.68
Orlando tangelo	2.61 d	2.32 ef	4.93 d	1.10 d	0.86 cde	1.96 de	1.28
Troyer citrange	2.33 d	2.16 ef	4.50 d	1.09 d	0.93 cde	2.02 de	1.17
Carrizo citrange	2.44 d	1.95 f	4.39 d	0.95 d	0.79 cde	1.74 ef	1.20
Uvalda citrange	1.39 e	1.07 g	2.46 e	0.65 d	0.45 e	1.10 f	1.44
C. taiwanica	1.61 e	1.12 g	2.73 e	0.71 d	0.40 e	1.12 f	1.78
General mean	4.85	2.70	7.54	1.91	1.00	2.92	1.85

[1]Means were based on three replicates; each comprised of ten seedlings.

[2]Values followed by same letter, within any one column, are not significantly different at P = 0.01 according to Duncan's Multiple Range Test.

gained in fresh weight 6.45 times that of 'Uvalda' citrange. The same trend holds true when dry weights were compared with the former weighing 4.58 times that of 'Uvalda'. The seedling species, varieties and hybrids which achieved appreciably better-than-average growth for top and root were in descending order: *C. macrophylla*, citrumelo 4475, *C. volkameriana*, sour orange and 'Benzahair' lime. The 'Cleopatra' mandarin and 'Rangpur' lime were shown to be moderately vigorous, with no great differences between them. The fresh and dry weights of tops and roots of 'Orlando' tangelo, the citranges 'Troyer', 'Carrizo' and 'Uvalda' and *C. taiwanica* were far below average indicating poor performance. The highest top/root ratios for the different seedlings were 2.68 for 'Cleopatra' mandarin, 2.63 for *C. macrophylla* and 2.56 for sour orange but the lowest ratios were 1.17 for 'Troyer' and 1.20 for 'Carrizo' citranges.

Composition and Distribution of Nutrient Elements

Data presented in Tables 3 and 4, show statistically significant differences between seedlings of the various *Citrus* kinds tested in the composition and top-root distribution of all the nutrient elements determined. At the time of sampling, other than growth vigor, no visible deficiency or toxicity symptoms were observed.

On dry weight basis, the mean percentages of N, Ca, Mn and total ash were much higher in the tops than in the roots of every *Citrus* kind analyzed (Table 3). On the other hand, Fe was at a much higher level in the roots than in the tops (Table 4). The P, K, Mg, Zn and Cu did not show a definite trend in their distribution between roots and tops. Results of earlier work by Smith *et al.* (8) on mineral composition of leaves and rootlets of bearing 'Valencia' orange trees showed consistently much higher levels of Fe, Zn, Mn and Cu in rootlets than in leaves. The differences between results obtained in this study and those of Smith *et al.* (8) may be due to the use of the whole top and rootsystem in the present work as well as to the previously mentioned limitations.

A critical evaluation of the results presented in Tables 3 and 4 will reveal considerable variability in the percentages of the various elements in tops and roots between the different *Citrus* kinds. For example, *C. macrophylla* top had the highest percentage of Ca and Cu, but the lowest Mg level as compared with other *Citrus* kinds. Citrumelo 4475 seedlings contained the highest level of Mg in their roots but the lowest Mn percentage in their tops. *C. Volkameriana* tops had the lowest Ca and Zn percentages. Sour orange achieved the highest level of P in their tops as well as the highest levels of Ca, Zn and Cu in their roots.

At this stage it was felt that more work was needed along the same line to clarify the patterns of nutrient allocations throughout budded and seedling rootstocks in addition to the changes in selective accumulation processes of the roots as affected by scion tops. In this respect, the review by Emmert (6) on ion-interaction in tissue analysis results is most useful.

Nutrient Uptake

Tables 5 and 6 present the calculated total uptake and distribution of macro- and micro-nutrients between top and root of *Citrus* kinds studied. These tables show that the total amount of individual elements accumulated in the tops of each plant was much higher than that in the roots with the exception of Fe. The roots were able to retain most of the iron absorbed from the soil. Only in *C. taiwanica*, was the amount of Fe translocated to its top higher than that retained by the roots. Among all Citrus kinds, *C. taiwanica* showed the lowest Fe content in both top and root.

Table 3 Macronutrients composition and distribution in 7-month-old seedlings of species, varieties and hybrids used as citrus rootstocks.

	Mean[1] percent in dry weight											
	Ash		N		P		K		Ca		Mg	
Citrus seedling	Top	Root	Top	Root	Top	Root	Top	Root	Top	Root	Top	Root
C. macrophylla	7.44 ab[2]	4.67 cd	1.83 cd	1.33 ef	0.21 ab	0.22 bc	0.57 b	0.59 bc	2.42 a	0.50 cd	0.04 g	0.27 bc
Citrumelo 4475	6.32 bc	3.31 ef	1.66 cd	1.36 e	0.21 ab	0.19 cd	0.43 c	0.39 e	2.07 bcd	0.58 bc	0.17 ef	0.37 a
C. volkameriana	6.33 bc	3.38 ef	1.81 cd	1.35 ef	0.17 ab	0.18 d	0.56 b	0.44 de	1.70 e	0.45 d	0.29 b	0.20 d
Sour orange	7.72 a	6.23 b	1.94 bc	1.40 de	0.25 a	0.22 bc	0.71 a	0.58 bc	2.17 abc	1.38 a	0.19 de	0.19 d
'Benzahair' lime	5.53 c	5.35 c	2.30 ab	1.52 cd	0.25 a	0.27 a	0.22 d	0.59 bc	2.26 ab	0.52 bcd	0.25 bc	0.30 b
'Rangpur' lime	6.13 c	2.96 f	1.66 cd	1.31 ef	0.18 ab	0.18 d	0.51 bc	0.47 de	1.77 de	0.47 cd	0.24 c	0.24 c
'Cleopatra' mandarin	7.59 a	4.50 cd	1.88 cd	1.27 ef	0.21 ab	0.23 b	0.78 a	0.67 ab	2.22 ab	0.59 bc	0.18 de	0.28 bc
'Orlando' tangelo	8.03 a	7.59 a	2.47 a	2.14 a	0.18 ab	0.21 bc	0.51 bc	0.70 a	2.36 ab	0.63 b	0.21 cde	0.35 a
'Carrizo' citrange	7.98 a	4.54 cd	1.68 cd	1.23 f	0.22 ab	0.21 bc	0.47 bc	0.47 de	2.26 ab	0.58 bc	0.14 f	0.29 b
'Troyer' citrange	5.37 c	4.11 de	1.73 cd	1.54 bc	0.13 b	0.14 e	0.70 a	0.50 cd	1.81 de	0.41 d	0.42 a	0.30 b
'Uvalda' citrange	6.22 c	4.04 de	1.54 d	1.35 ef	0.15 b	0.11 f	0.28 d	0.27 f	1.90 cde	0.22 e	0.22 cd	0.19 d
C. taiwanica	6.25 c	3.07 f	1.80 cd	1.67 b	0.19 ab	0.19 cd	0.30 d	0.17 g	2.24 ab	0.28 e	0.22 cd	0.13 e

[1] Means were based on three replicates; each comprised of ten seedlings.

[2] Values followed by same letter, within any one column, are not significantly different at P = 0.01 according to Duncan's Multiple Range Test.

Table 4 Micronutrient composition and distribution in 7-month-old seedlings of species varieties and hybrids used as citrus rootstocks

	Mean ppm in dry weight[1]							
	Fe		Zn		Mn		Cu	
Citrus seedling	Top	Root	Top	Root	Top	Root	Top	Root
C. macrophylla	66 cde[2]	271 de	33.2 bc	30.2 b	14.7 de	8.8 c	10.6 a	7.0 cd
Citrumelo 4475	80 c	214 f	15.0 g	24.7 c	9.0 f	2.7 f	10.3 ab	7.3 bc
C. volkameriana	51 efg	234 ef	10.3 gh	12.0 e	38.3 b	9.7 b	5.8 cd	7.4 bc
Sour orange	61 def	448 b	34.0 b	45.8 a	28.3 c	8.1 c	7.4 bcd	10.7 a
'Benzahair' lime	42 g	298 d	26.5 de	17.0 d	29.3 c	12.7 a	4.5 d	4.9 e
'Rangpur' lime	48 fg	138 g	13.3 gh	9.7 ef	39.7 b	4.6 e	4.5 d	5.2 e
'Cleopatra' mandarin	49 fg	238 ef	22.7 f	25.5 c	27.7 c	8.4 c	7.6 bcd	8.9 b
'Orlando' tangelo	257 a	368 c	29.5 cd	42.0 a	15.0 de	6.9 d	8.3 abc	6.3 cde
'Troyer' citrange	74 cd	247 def	21.7 f	16.0 d	26.3 c	9.7 b	6.4 bcd	5.4 de
'Carrizo' citrange	81 c	237 ef	37.3 b	28.5 bc	12.3 e	2.2 f	7.8 bcd	8.8 b
'Uvalda' citrange	100 b	542 a	16.2 g	25.8 c	52.0 a	8.4 c	4.9 cd	7.5 bc
C. Taiwanica	81 c	98 g	51.5 a	8.0 f	17.0 d	4.1 e	6.4 bcd	3.1 f

[1]Means were based on three replicates; each comprised of ten seedlings.
[2]Values followed by same letter, within any one column, are not significantly different at P = 0.01 according to Duncan's Multiple Range Test.

In general, total uptake of most elements was superior by seedlings of *C. macrophylla*, citrumelo 4475, *C. volkameriana* and sour orange. Seedlings of the former species were the highest in content of all the elements determined except Mn and Mg, the latter showing the least amount compared with the other three. The seedlings of *C. taiwanica* and the citranges were the poorest in total uptake of most elements.

Nutrient element distribution as percentage of the total ash of the entire plant is presented in Table 7. It can be detected that in every *Citrus* kind Ca was the most abundant element comprising 37.48 % of total ash of *C. macrophylla* which scored the highest level obtained, and 20.44 % in 'Orlando' tangelo as the lowest.

In Table 7, the percentage of maximum difference is presented as an indication of the degree of variability in the level of any one element, in ash, among the twelve *Citrus* kinds studied. It is evident that maximum variability occurred in the level of Fe. The ash content of the entire plant of 'Uvalda' citrange was relatively rich in Fe (0.527 %) while 'Cleopatra' mandarin was the poorest (0.147 %). The same comparison can be carried out for other elements. The exceptionally high or extremely low levels of one or more element in total ash as recorded for the *Citrus* kinds tested may raise a question about the nutrient balance in their seedlings.

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Table 5 Total uptake and distribution of macronutrient elements in 7-month-old seedlings of species, varieties and hybrids used as citrus rootstocks.

	Mean content in milligrams[1]																	
	Ash			N			P			K			Ca			Mg		
Citrus seedling	Top	Root	Whole seedling	Top	Root	Whole seedling	Top	Root	Whole seedling	Top	Root	Whole seedling	Top	Root	Whole seedling	Top	Root	Whole seedling
C. macrophylla	231.1[2]	78.9[2]	310.0[2]	81.4[2]	22.5[2]	103.9[2]	9.4[2]	3.6[2]	13.0[2]	25.4[2]	10.0[2]	35.4[2]	107.7[2]	8.5	116.2[2]	1.8	4.6	6.4
Citrumelo 4475	159.9	53.3	213.2	42.0	21.9	63.9	5.3	3.1	8.4	10.9	6.3	17.2	52.4	9.3	61.7	4.3	6.0[2]	10.3
C. volkameriana	169.6	49.0	218.6	48.5	19.6	68.1	4.6	2.6	7.2	15.0	6.4	21.4	45.6	6.5	52.1	7.8[2]	2.9	10.7[2]
Sour orange	203.8	64.2	268.0	51.2	14.4	65.6	6.6	2.2	8.8	18.7	6.0	24.7	57.3	14.2[2]	71.5	5.0	2.0	7.0
'Benzahair' lime	137.7	63.1	200.8	57.3	17.9	75.2	6.2	3.2	9.4	5.5	7.0	12.5	56.3	6.1	62.4	6.2	3.5	9.7
'Rangpur' lime	112.8	28.1	140.9	30.5	12.4	42.9	3.3	1.7	5.0	9.4	4.5	13.9	32.6	4.5	37.1	4.4	2.3	6.7
'Cleopatra' mandarin	138.1	30.6	168.7	34.2	8.6	42.8	3.8	1.6	5.4	14.2	4.6	18.8	40.4	4.0	44.4	3.3	1.9	5.2
'Orlando' tangelo	88.3	65.3	153.6	27.2	18.4	45.6	2.0	1.8	3.8	5.6	6.0	11.6	26.0	5.4	31.4	2.3	3.0	5.3
'Troyer' citrange	58.5	38.2	96.7	18.9	14.3	33.2	1.4	1.3	2.7	7.6	4.7	12.3	19.7	3.8	23.5	4.6	2.8	7.4
'Carrizo' citrange	75.8	35.9	111.7	16.0	9.7	25.7	2.1	1.7	3.8	4.5	3.7	8.2	21.5	4.6	26.1	1.3[3]	2.3	3.6
'Uvalda' citrange	40.4[3]	18.2	58.6	10.0[3]	6.1[3]	16.1[3]	1.0[3]	0.5[3]	1.5[3]	1.8[3]	1.2	3.0	12.4[3]	1.0[3]	13.4[3]	1.4	0.9	2.3
C. taiwanica	44.4	12.3[3]	56.7[3]	12.8	6.7	19.5	1.4	0.7	2.1	2.1	0.7[3]	2.8[3]	15.9	1.1	17.0	1.6	0.5[3]	2.1[3]
General mean	121.7	44.8	166.5	35.8	14.4	50.2	3.9	2.0	5.9	10.1	5.1	15.2	40.7	5.8	46.4	3.7	2.7	6.4
% Maximum difference[4]	472	541	447	714	269	545	840	620	767	1,311	1,328	1,164	769	1,320	767	500	1,100	410

[1]Calculated from values presented in Tables 2 and 3.
[2,3]Designates the highest and the lowest means, respectively, within each column.
[4]% Maximum difference = (highest mean – lowest mean) × 100/lowest mean.

Table 6 Total uptake and distribution of micronutrient elements by 7-month-old seedlings of species varieties and hybrids used as citrus rootstocks.

	Mean content in micrograms[1]											
	Fe			Zn			Mn			Cu		
Citrus seedling	Top	Root	Whole seedling	Top	Root	Whole seedling	Top	Root	Whole seedling	Top	Root	Whole seedling
C. macrophylla	292[2]	459	751[2]	148[2]	51[2]	199[2]	65	15[2]	80	47[2]	12[2]	59[2]
Citrumelo 4475	202	345	547	38	40	88	23	4	27	26	12[2]	38
C. volkameriana	138	339	477	28	17	45	103[2]	14	117[2]	16	11	27
Sour orange	160	461[2]	621	90	47	137	75	8	83	20	11	31
'Benzahair' lime	105	352	456	66	20	86	73	15[2]	88	11	6	17
'Rangpur' lime	88	131	219	25	9	34	73	4	77	8	5	13
'Cleopatra' mandarin	89	159	248	41	17	58	50	6	56	14	6	20
'Orlando' tangele	283	317	600	33	36	69	17	6	23	9	5	14
'Troyer' citrange	81	230	311	24	15	39	29	9	38	7	5	12
'Carrizo' citrange	77	187	264	35	23	58	12[3]	2[3]	14[3]	7	7	14
'Uvalda' citrange	65	244	309	11[3]	12	23[3]	34	4	38	3[3]	3	6[3]
C. taiwanica	57[3]	39[3]	96[3]	37	3[3]	40	12[3]	2[3]	14[3]	5	1[3]	6[3]
General mean	136	272	408	48	24	73	47	7	55	14	7	21
% Maximum difference[4]	412	252	682	1,245	1,600	765	758	650	736	1,467	1,100	883

[1]Calculated from values presented in Tables 2 and 4.

[2,3]Designate the highest and the lowest means, respectively, within each column.

[4]% Maximum difference = (highest mean – lowest mean) × 100/lowest mean.

Table 7 Percentage distribution of nutrient elements in the total ash of 7-month-old seedlings of species varieties and hybrids used as citrus rootstocks.

Citrus seedling	Total ash per plant in mg.	Total ash % of dry wt.	Mean percent of total ash[1]								
			P	K	Ca	Mg	Fe	Zn	Mn	Cu	undetermined
C. macrophylla	310.0[2]	5.05	4.19	11.42	37.48[2]	2.07[3]	0.242	0.064	0.026	0.019[2]	44.49[3]
Citrumelo 4475	213.2	5.15	3.94	8.07	28.94	4.83	0.257	0.041	0.013[3]	0.018	53.89
C. volkameriana	218.6	5.29	3.29	9.79	23.83	4.90	0.218	0.021[3]	0.054	0.012	57.88
Sour orange	268.0	7.28	3.28	9.22	26.68	2.61	0.231	0.051	0.031	0.012	57.88
'Benzahair' lime	200.8	5.47	4.68[2]	6.23	31.08	4.83	0.227	0.043	0.044	0.009[3]	52.86
'Rangpur' lime	140.9	5.05	3.55	9.87	26.33	4.76	0.155	0.024	0.055	0.009[3]	55.25
'Cleopatra' mandarin	168.7	6.72	3.20	11.14	26.32	3.08	0.147[3]	0.034	0.033	0.012	56.03
'Orlando' tangelo	153.6	7.84[2]	2.47[3]	7.55	20.44[3]	3.45	0.391	0.045	0.015	0.009[3]	65.63[2]
'Troyer' citrange	96.7	4.79[3]	2.79	12.72[2]	24.30	7.65[2]	0.322	0.040	0.039	0.012	52.13
'Carrizo' citrange	111.7	6.42	3.40	7.34	23.37	3.22	0.236	0.052	0.013[3]	0.013	62.35
Uvalda citrange	58.6	5.32	2.56	5.12	22.87	3.93	0.527[2]	0.039	0.065[2]	0.010	64.46
C. taiwanica	56.7[3]	5.06	3.70	4.94[3]	29.98	3.70	0.169	0.071[2]	0.025	0.011	57.40
General mean	166.5	5.79	3.42	8.62	26.80	4.09	0.260	0.044	0.034	0.012	56.68
% Maximum difference[4]	447	64	89	157	83	270	259	238	400	111	47

[1] Calculated from values presented in Tables 5 and 6.

[2,3] Designate the highest and the lowest means, respectively, within each column.

[4] % Maximum difference = (highest mean − lowest mean) × 100/lowest mean.

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