

PERFORMANCE OF 'QUEEN' ORANGE TREES ON 15 CITRUS ROOTSTOCKS^{1,2}

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Abstract. Fruit production and quality of 'Queen' orange (*Citrus sinensis* (L.) Osbeck) on 15 citrus rootstocks were studied for 7 years. Highest cumulative fruit yields and pounds solids produced per tree were from trees on Cleopatra mandarin (*C. reticulata* Blanco), Estes rough lemon (*C. limon* (L.) Burm. f.), rough lemon, rough lemon A, and Troyer citrange (*C. sinensis* X *Poncirus trifoliata* (L.) Raf.) rootstocks. Trees on Large Flower trifoliolate orange (*P. trifoliata*) produced fruit with the highest total soluble solids as compared to the fruit with the lowest total soluble solids on rough lemon A.

Sweet orange (*Citrus sinensis* (L.) Osb.) is the most commonly grown citrus cultivar in the world. Constantly changing cultural practices and rootstock-related diseases accentuate the importance of rootstock selection. However, research on citrus rootstocks is time consuming and the results can vary from area to area due to climate, soil, disease, and cultural practices. This report presents information of 'Queen' orange, a midseason sweet orange (3), propagated on 15 rootstocks.

Materials and Methods

Table 1 presents the cultivar and scientific names of the rootstocks used in this experiment. Budwood of an old-line 'Queen' orange was used in propagating the trees. The trees were planted in June, 1965, in deep, well-drained, sandy, acid soil (Astatula fine sand) at Babson Park, Florida, in a randomized block design with 2 replications of 4-tree plots. The tree spacing was 15 x 25 ft. Fruit yields for the years 1972-1976, 1978, and 1981 were recorded and expressed as the average number of boxes of fruit (90-lb.) harvested per tree. Juice content, total soluble solids, and total acids were determined by standard laboratory procedures from random samples of 20 fruit from each plot for the 1972, 1978, and 1981 harvests. In 1981, tree size as expressed by canopy volume was calculated by the formula width² X height/4 (2). All data were subjected to analysis of variance, and the means were separated by Duncan's multiple range test.

Results and Discussion

Table 2 shows the number of trees planted, dead and/or declining trees, and normal appearing trees. The highest losses of young trees were on Ridge Pineapple and sweet orange rootstocks, probably due to *Phytophthora*

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²The experiment was planted under a Cooperative Agreement with Lake Garfield Nurseries Company, Bartow, Florida. Special thanks are due Lake Garfield Nurseries Company for care of the planting and for making yield records possible. Dr. Frank E. Gardner, deceased, formerly Horticulturist, U.S. Department of Agriculture, Agricultural Research Service, Orlando, Florida, was the investigator originally responsible for the planting of this experiment.

Table 1. Cultivar and scientific name of the 15 citrus rootstocks used to test the performance of 'Queen' orange.

Cultivar	Scientific name
Carrizo citrange	<i>Citrus sinensis</i> (L.) Osbeck X <i>Poncirus trifoliata</i> (L.) Raf.
Cleopatra mandarin	<i>C. reticulata</i> Blanco
Estes rough lemon	<i>C. limon</i> (L.) Burm. f.
Large Flower trifoliolate orange	<i>P. trifoliata</i>
Pomeroy trifoliolate orange	<i>P. trifoliata</i>
Ridge Pineapple orange	<i>C. sinensis</i>
Rough lemon	<i>C. limon</i>
Rough lemon A	<i>C. limon</i>
Rubidoux trifoliolate orange	<i>P. trifoliata</i>
Sanguine Grosse Ronde orange	<i>C. sinensis</i>
Sour orange	<i>C. aurantium</i> L.
Sweet orange seedling	<i>C. sinensis</i>
Swingle citrumelo	<i>C. paradisi</i> Macf. X <i>P. trifoliata</i>
Trifoliolate orange	<i>P. trifoliata</i>
Troyer citrange	<i>C. sinensis</i> X <i>P. trifoliata</i>

parasitica Dastur infection. Declining trees were observed on Carrizo citrange, Large Flower trifoliolate, Pomeroy trifoliolate orange, Ridge Pineapple orange, rough lemon A, Rubidoux trifoliolate orange, trifoliolate orange, and Troyer citrange rootstocks. No dead or declining trees were observed on Cleopatra mandarin, sour orange, and Swingle citrumelo rootstocks.

Table 2. Number of trees planted, dead, declining, and normal appearing 'Queen' orange on 15 rootstocks.

Rootstock	No. trees planted	No. trees observed (1981)		
		Dead ^a	Declining ^b	Normal
Carrizo citrange	8		5	3
Cleopatra mandarin	8			8
Estes rough lemon	8	3		5
Large Flower trifoliolate orange	8	1	2	5
Pomeroy trifoliolate orange	8	3	3	2
Ridge Pineapple orange	8	5	1	2
Rough lemon	8	2		6
Rough lemon A	8	2	3	3
Rubidoux trifoliolate orange	8		4	4
Sanguine Grosse Ronde orange	8	1		7
Sour orange	8			8
Sweet orange seedling	8	6		2
Swingle citrumelo	8			8
Trifoliolate orange	8	2	3	3
Troyer citrange	8		1	7

^aMost of these trees were lost in the first 7 years after planting, presumably due to foot rot, *Phytophthora parasitica* Dastur infection.

^bDeclining refers to trees with apparent freeze damage and/or sparse or thin foliage possibly suggesting the syndrome called blight.

Fruit yields for 1972, 1976, and 1981, 7-year cumulative yield, and 1981 canopy volume are presented in Table 3. The highest yielding trees in 1972 were on rough lemon, rough lemon A, and Estes rough lemon rootstocks, and the lowest yield was on Ridge Pineapple orange. In 1981, the highest yielding trees were on Cleopatra mandarin followed by those on rough lemon and Troyer citrange, while trees on Ridge Pineapple orange had the lowest fruit yield. Trees on rough lemon, rough lemon A, Estes rough lemon, Cleopatra mandarin, and Troyer citrange gave the highest cumulative yields (1972-1976, 1978, and 1981). The lowest yield was from trees on sweet orange. The largest

Table 3. Fruit yields in 1972, 1976, and 1981, the 7-year cumulative yield, and 1981 canopy volume of 'Queen' orange on 15 rootstocks.

Rootstock	Fruit yields in average boxes per tree ^z				1981 Canopy volume ft ³
	1972	1976	1981	Cumulative (1972- 1976, 1978, 1981)	
Rough lemon	2.4 ay	3.5 a	3.3 ab	22.7 a	886 a
Rough lemon A	2.2 ab	3.5 a	1.2 h	20.5 ab	419 b
Estes rough lemon	2.2 ab	3.2 abc	2.8 bcde	20.4 ab	547 b
Cleopatra mandarin	1.3 cd	3.3 ab	4.0 a	19.1 abc	611 ab
Troyer citrange	1.2 cd	2.9 abcd	3.3 ab	19.0 abc	600 ab
Sanguine Grosse Ronde orange	1.2 cd	2.8 abcd	2.8 bcde	17.2 bcd	486 b
Sour orange	1.0 cd	2.6 abcd	3.0 bcd	16.2 cde	564 b
Carrizo citrange	1.0 cd	2.4 bcde	2.8 bcde	15.8 cde	613 ab
Swingle citrumelo	1.0 cd	2.8 abcd	2.4 cdef	15.8 cde	437 b
Pomeroy trifoliolate orange	1.6 bc	2.4 bcde	2.2 defg	15.5 cde	465 b
Trifoliolate orange	1.5 bc	2.4 bcde	1.8 fgh	14.8 de	340 b
Rubidoux trifoliolate orange	1.5 bc	2.5 abcde	2.3 def	14.4 de	350 b
Large Flower tri- foliate orange	1.4 cd	2.2 cde	1.7 fgh	13.2 ef	373 b
Ridge Pineapple orange	0.8 d	2.1 de	1.4 gh	13.1 ef	467 b
Sweet orange seedling	1.5 bc	1.5 e	2.0 efgh	10.3 f	381 b

^z90 lb. fruit per box.

^yMeans followed by the same letter are not significantly different at the .05 confidence level.

trees were on rough lemon, followed by Carrizo citrange, Cleopatra mandarin, and Troyer citrange rootstocks.

The fruit quality data, the means of 1972, 1978, and 1981 harvests, and the cumulative average pounds solids per tree for 1972-1976, 1978, and 1981 are presented in Table 4. There were no significant differences in juice content from fruit of trees among the rootstocks. Fruit highest in total soluble solids was produced by trees on Large Flower trifoliolate orange; fruit with the lowest total soluble solids came from trees on rough lemon A. Acids were highest in fruit from trees on Cleopatra mandarin, while all other rootstocks produced fruit lower in total acids. The greatest quantity of cumulative pounds solids per tree was produced by trees on rough lemon, Troyer citrange, Estes rough lemon, rough lemon A, Cleopatra mandarin, and Sanguine Grosse Ronde orange. Trees on Large Flower trifoliolate orange, Ridge Pineapple orange, and sweet orange produced the least pounds solids per tree.

Table 4. Fruit quality (means of 1972, 1978, and 1981) and cumulative solids (pound per tree, means of 1972-1976, 1978, and 1981) of 'Queen' orange on 15 rootstocks.

Rootstock	Total			Cumulative solids lb/tree average
	Juice (%)	Soluble solids (%)	Acids (%)	
Rough lemon	49 az	10.5 ab	0.87 b	104.7 a
Troyer citrange	51 a	11.3 ab	0.91 ab	97.8 ab
Estes rough lemon	48 a	10.8 ab	0.92 ab	94.4 abc
Rough lemon A	49 a	10.4 b	0.87 b	93.1 abcd
Cleopatra mandarin	48 a	10.8 ab	1.01 a	88.2 abcd
Sanguine Grosse Ronde orange	50 a	11.1 ab	0.90 ab	84.9 abcde
Swingle citrumelo	51 a	11.3 ab	0.86 b	82.2 bcde
Sour orange	49 a	11.2 ab	0.91 ab	79.0 bcde
Carrizo citrange	47 a	11.4 ab	0.87 b	75.8 cde
Trifoliolate orange	49 a	11.4 ab	0.85 b	74.3 cde
Pomeroy trifoliolate orange	49 a	10.9 ab	0.86 b	73.8 cde
Rubidoux trifoliolate orange	48 a	11.3 ab	0.87 b	71.7 de
Large Flower trifoliolate orange	48 a	11.6 a	0.91 ab	64.7 ef
Ridge Pineapple orange	49 a	11.1 ab	0.84 b	63.8 ef
Sweet orange seedling	48 a	11.3 ab	0.93 ab	50.2 f

^zMeans followed by the same letter are not significantly different at the .05 confidence level.

The data presented in this paper indicate that smaller trees can be as productive as larger trees. This is in agreement with previous reports concerning tree size and fruit production (1, 2). The lack of losses and/or decline of trees on 3 rootstocks shows the importance of rootstock selection.

The data presented show that Cleopatra mandarin, sour orange, Swingle citrumelo, and Troyer citrange performed well as rootstocks for 'Queen' orange in the Babson Park area. 'Queen' orange is a relatively minor citrus cultivar, but the results may be applicable to other midseason sweet orange cultivars.

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