

# Rootstocks Affect Orange Sizes

effect on fruit size should be considered when selecting rootstocks for Washington navels and Valencias

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The size of oranges is influenced by the nature of the rootstocks on which the trees are budded.

The effect of rootstocks on fruit size was determined, over a three-year period, from commercial grading of the Washington navel and Valencia orange varieties of trees growing in an experimental rootstock orchard at the Citrus Experiment Station, in Riverside. Most of the species of rootstocks were represented by several varieties.

The accompanying table presents the effects of 32 different rootstocks on fruit size of Washington navel oranges for the

crops set in 1946, 1947 and 1949, and the effects of 26 different rootstocks on fruit size of Valencia oranges for the crops set in 1946, 1947 and 1948.

A fruit size of 2.44 inches in diameter—252 fruits per packed box—was chosen as the dividing point between medium to large, and small oranges. The data concern those fruit which are size 252 per box or larger.

Seasonal variation in fruit size was striking with the Washington navel. Fruit set in 1946 was small, in 1947, medium, and in 1949, large. The average increase in fruit size of the crop set in 1946 in

comparison with that of 1949 could not be accounted for by the differences in average number of fruits per tree. Some seasonal climatic factors seem to be responsible for these variations.

The largest average production of large navel orange fruit for the three years was produced on the sour orange stocks, with 62% medium to large fruit. The smallest was that on Palestine sweet lime with only 22% in the large size class. Only 44% of the fruits on the average of the sweet stocks were of the large sizes. Fruit on trifoliolate orange stock and on Rough

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Effect of Rootstocks on Size of Washington Navel and Valencia Oranges

Rootstock	Percentage of fruit size 252 per packed box and larger				Total number of fruits per tree				1947 Trees size* (Sq. cm.)
	1946	1947	1949	3-year average	1946	1947	1949	3-year average	
	2	3	4	5	6	7	8	9	10
<b>Washington Navel</b>									
Sweet orange (6 varieties)	26	36	70	44	804	1,114	835	918	297
Sour orange (4 varieties)	48	59	80	62	779	927	789	831	244
Grapefruit (2 varieties)	29	36	71	45	457	845	792	698	262
Mandarin (5 varieties)	19	35	64	39	845	875	841	853	294
Citrange (4 varieties)	32	48	61	47	611	495	550	552	169
Lemon (2 varieties)	14	19	43	25	565	732	434	603	217
Bittersweet (2 varieties)	16	38	61	38	934	1,000	859	931	217
Rough lemon	37	45	71	51	688	901	603	731	218
Siamese shaddock	19	51	70	47	743	778	845	789	210
Sampson tangelo	34	44	66	48	525	749	927	734	319
Trifoliolate orange	43	43	68	51	687	800	612	700	176
Citrus Webberii	12	31	52	32	769	1,045	930	915	253
Palestine sweet lime	12	17	37	22	752	786	368	635	115
Cuban shaddock	—	32	67	49	—	889	704	797	140
<b>Average</b>	<b>26</b>	<b>38</b>	<b>63</b>	<b>43</b>	<b>705</b>	<b>852</b>	<b>721</b>	<b>763</b>	<b>224</b>
<b>Valencia</b>									
	1946	1947	1948		1946	1947	1948		
Sweet orange (5 varieties)	41	29	39	36	1,193	1,058	555	935	419
Sour orange (4 varieties)	35	46	43	41	1,420	963	435	939	338
Grapefruit (3 varieties)	42	43	45	43	967	843	376	729	358
Mandarin (3 varieties)	37	40	44	40	1,262	1,040	359	887	389
Citrange (2 varieties)	44	44	39	42	487	327	236	350	203
Bittersweet (2 varieties)	47	40	40	42	1,107	853	705	888	301
Rough lemon	31	51	48	43	1,265	853	572	897	323
Siamese shaddock	42	54	58	51	1,128	842	298	756	303
Sampson tangelo	53	52	46	50	995	786	392	724	477
Trifoliolate orange	56	78	64	66	1,125	748	453	775	262
Shaddock × St. Michael (Paperrind)	54	42	43	46	1,275	1,123	521	973	347
Citrus Webberii	36	36	41	38	1,210	1,025	751	995	329
Palestine sweet lime	48	36	34	39	1,047	932	636	872	212
<b>Average</b>	<b>44</b>	<b>45</b>	<b>45</b>	<b>44</b>	<b>1,114</b>	<b>876</b>	<b>484</b>	<b>825</b>	<b>328</b>

\* Area cross section of the trunk.



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### ROOTSTOCK

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lemon stock averaged 51% of the larger sizes. The Sampson tangelo stock produced only a slightly higher ratio of large fruit sizes for a 3-year average than the average of all the sweet stocks. Fruit on grapefruit stocks was practically the same size as the fruit on sweet stock and about the same as the average size of the entire orchard.

Considerable variation in fruit size resulted from the use of different varieties of a species as citrus stocks, but this is not shown in detail in the table. Six sweet orange varieties, and four sour orange varieties were used as stocks in the Washington navel experiment. The range of difference during the three years was 11.7% between the varieties of sweet orange stocks and 22.6% between varieties of sour orange stock.

The proportion of large sizes on the variety of sour orange producing the lowest percentage of large fruit was about equal to that on the variety of sweet orange producing the highest percentage of large fruit.

### Valencias

Seasonal fruit-size variation was not as apparent with the Valencias as with the navels. Most of the trees in the experimental orchard produced essentially the same percentages of large fruits in the three years as shown in columns two to five of the table although the average number of fruit per tree—columns six to

nine—varied very markedly from year to year.

The average proportion of large Valencia fruits for the entire 3-year period was smaller on the sweet orange stocks than on all the rootstock species. Since navel oranges were only average size on sweet stock, it can be concluded that this is a general effect and that fruit sizes tend to be small on sweet orange rootstocks.

For the 3-year period, Valencia oranges averaged 41% medium to large sizes on the sour orange stocks in comparison to 36% on the sweet stocks. The percentages of large sized fruits on mandarin, grapefruit, and Rough lemon was essentially the same as the sour stock. The proportion of large-sized fruit for Sampson tangelo stock was slightly larger than these and amounted to 50%. The trifoliolate orange was outstanding in its effect on Valencia fruit size, producing an average of 66% medium-large sized fruit. This was the largest percentage of any rootstock in this trial.

Variations in Valencia fruit size resulted from the use of different varieties of rootstock species. In general such variations were consistent with results obtained with Washington navel orange trees.

### Number and Size of Fruits

The number of fruit produced per tree varied widely in any one year between the different species used as stocks as shown in columns six, seven, and eight of the table. In many instances, within a given species of rootstock, fruit size was inversely correlated with the number of fruits per tree—the greater the number of fruits, the smaller the fruit size.

There were notable exceptions to this. Valencia oranges on trifoliolate orange stock consistently produced large fruit and a large number of fruits per tree in consideration of the size of the trees. This is brought out by comparing columns nine and ten.

The large differences in size between navel fruits produced on certain varieties of sour stocks and on different varieties of sweet stocks could not be explained by

differences in numbers of fruit since the yields in number of fruit were practically equal.

Trees on Sampson tangelo, and on grapefruit stocks were characterized by relatively small numbers of fruit for the size of the trees compared to the average.

Climatic conditions from year to year may affect the numbers of fruit set per tree and in some cases thus directly affect fruit size. Seasonal effects may in such instances be greater than rootstock effects on the size of fruit.

### Size of Tree

Trees on the various rootstocks differed materially in sizes, as measured by the area of the cross section of the trunk six inches above the bud union. A comparison of fruit size and tree sizes suggested that the larger fruit was produced on the smaller trees. Navel orange trees on sour orange stock were only 82% as large as trees on sweet stock, but those on sour root yielded an average of 62% large fruit in comparison with an average of 44% for the trees on sweet stock. Valencia trees on trifoliolate orange stocks were 63% as large as those on sweet stocks, yet they produced 66% large fruit in comparison to 36% on sweet. In contrast, both orange varieties were characterized by large trees on Sampson tangelo stock and yet fruit sizes were larger than average. The crop on this rootstock was always light, however, in consideration of the size of the trees.

Observations on the effects of rootstocks on citrus fruit size are being continued and are being extended to include Marsh grapefruit.

A desirable influence on fruit size is not the only qualification of a good rootstock and other stock effects should be carefully considered in rootstock selection.

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