

# Nucellar Lines of Citrus

## tree size, yield, and fruit characters of old and young lines of ten citrus varieties compared

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**Nucellar-seedling lines** of citrus showed substantially greater tree size and yields in nearly every case, when compared with old-line trees in a study at Riverside.

Nucellar lines arise from seedlings from asexually produced embryos, and are usually vigorous and initially free of certain diseases.

The Riverside experiment provides tree and fruit data on small numbers of mature trees of old lines and nucellar young lines of 10 citrus varieties. Within each variety the old line and young line trees tested were of equal age from budding.

### Tree Size, Fruit Yield

Young-line trees showed greater trunk cross-section areas in every comparison. Excepting the Ruvel, the excess in trunk area of young lines over old lines ranged from 37% in the Lisbon lemon to 112% in the Mediterranean Sweet. In the Ruvel the excess was only 7%.

Yields of the young lines were substantially better than those of old lines in all but one of the comparisons. Thus for the Valencia the average annual yield per tree over the four-year period was 162 pounds for the old line and 246 pounds for the young line. For the Washington Navel it was 176 pounds to 234 pounds, and for the Satsuma mandarin it was 80 pounds to 130 pounds. Excepting the Lisbon lemon, the increase in yield among young lines ranged from 33% to 102%. There is often more tendency to alternate bearing in the young lines than in the old, so that in some seasons the former show no better yields than the latter.

Yield records over a longer period are available for some of the varieties listed in the table on this page, and these substantiate the data shown there. For the Valencia, the 11-year average annual yield per tree has been 118 pounds for the old line and 174 pounds for the young line; for the Washington Navel, it has been 109 pounds and 164 pounds. For the Eureka lemon, the 12-year average

has been 225 pounds for the old line and 377 pounds for the young line.

The Lisbon lemon is the only variety in which the young line has failed to out-yield the old line. For the three years represented in the table, the average yield of the young line was 17% less than that of the old line. However, the average over 12 seasons has been 324 pounds per tree for the old line and 301 pounds, or 93% as much, for the young line. In most varieties the greater young-line yields seem to depend largely on greater tree size, but with this vigorous Lisbon the increase in young-line tree size has so far been accompanied by a reduced proportional fruit set.

### Fruit Size

Average fruit size in old and young lines of any one variety over the two- to four-year period is rather similar. The over-all average packing-house size was the same in the old and young lines of

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Tree and Fruit Characters in Old Lines and Nucellar Young Lines of Ten Citrus Varieties.

Variety <sup>a</sup>	Line	No. of Trees	Average Trunk Cross-Section Area <sup>b</sup>		No. of Years	Average Yield Per Year		Average Number of Fruit per Packed Box	Average Number of Seeds per Fruit <sup>c</sup>
			1951 (sq. in.)	% Excess in Young Line		Lbs. per Tree	% Excess in Young Line		
Eureka	Old	2	66		3	225		300	9.5
Lemon	Young	2	102	55	3	396	76	300	7.5
Lisbon	Old	2	67		3	319		300	6.6
Lemon	Young	2	92	37	3	265	-17	300	5.7
Marsh	Old	1	33		3	172		100	4.6
Grapefruit	Young	1	60	82	3	276	60	100	3.0
Satsuma	Old	3	13		4	80		392	..
Mandarin	Young	4	18	38	4	130	63	392	..
Mediterranean	Old	1	33		2	142		288	5.6
Sweet Orange	Young	1	70	112	2	253	78	220	4.1
Paper Rind	Old	2	32		2	161		288	15.9
Orange	Young	2	54	69	2	326	102	288	11.9
Ruby	Old	2	33		4	187		288	9.8
Orange	Young	2	49	48	4	302	61	288	10.7
Ruvel	Old	2	61		4	105		220	..
Orange	Young	2	65	7	4	194	85	220	..
Valencia	Old	2	40		4	162		220	4.5
Orange	Young	3	78	95	4	246	52	200	4.2
Washington	Old	2	40		4	176		200	..
Navel Orange	Young	4	55	38	4	234	33	200	..

<sup>a</sup> Rootstocks were: Cunningham citrange for the Satsuma, sweet orange for the lemons and for one young-line Ruby, and sour orange for all others.

<sup>b</sup> Calculated from circumference, measured 3" above bud union.

<sup>c</sup> Averages for seed counts are for three years except for Ruby, two years. Forty fruits per tree used in 1951; 20 fruits in the other years.

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eight varieties. In two varieties there was some difference. In one of these, the Valencia, the average was one size larger in the young line than in the old, but this has not been true in every year. In the Mediterranean Sweet orange, fruit size in the young line was clearly larger in the two years covered in the table. In 1952—not shown in the table—fruit size was practically identical in the two lines of this variety, but this occurred with a light crop on the old-line tree and a heavy crop on the young line.

The yearly data for the 10 varieties show that fruit size in a young line sometimes averages larger than in the old line when yields are similar, and is usually at least equal when yields are moderately larger. In a few instances extremely heavy crops have reduced fruit size. Thus in 1950 the average yield of the old-line Paper Rind orange was 181 pounds per tree, and that of the young line, 417 pounds. The respective average packing-house sizes were 288 and 344. Since the size of the sample used to determine fruit size was often small, final conclusions about fruit size in nucellar lines must depend upon future data. However, the data on the Valencia and Satsuma, based on the entire crop in most years, suggest that large differences in size between old lines and high-yielding young lines derived from them should not be expected.

### Fruit Shape

Fruit shape has—with one exception—been practically identical in the two lines of each variety. The young line of the Mediterranean Sweet orange has consistently produced fruit of more elongated shape, which may represent a genetic variation.

### Seeds

Seed counts were taken in the seven varieties that produce seed regularly. In two of these—the Mediterranean Sweet and the Marsh—fruit of the nucellar lines had fewer seeds than that of the old lines for the three consecutive seasons 1949–1951. Fruit of the nucellar Eureka, Lisbon, and Paper Rind showed lower seed counts than fruit of the old lines in two out of three years. The two remaining varieties, Ruby and Valencia, did not show convincing differences in seed numbers.

### Juice

The young lines were slightly higher in juice in six varieties, essentially the same in the four others, and thus not markedly lower in any variety.

Soluble solids were nearly equal in most comparisons but distinctly higher in the young-line Satsuma, perhaps because this young line ripens earlier than its old line. In the Satsuma variety the four-year average was 11.9% solids in the old line and 13.2% in the young line. In each of the four years, the young line averaged at least 0.9% higher than the parent. Two other young lines, the Valencia and the Ruvel, averaged 0.6% higher than their old lines for four- and three-year periods, respectively, but an increase was not found in every year. In the remaining varieties there was even less average difference between lines.

The percentages of acid were similar in most of the comparisons between old lines and young lines. In two varieties there was some indication of a consistent difference between lines. In the Paper Rind orange, the average acid percentage, for a two-year period, was 0.91 in the old

line and 0.76 in the young line. In the Marsh grapefruit, the three-year average was 1.63% acid in the old line and 1.48% in the young line. Acidity may decrease earlier or faster in the young line. If so, it may be of advantage, since grapefruit in some areas of California is high in acid.

The ratios of soluble solids to acid in the two lines of a variety were in most cases nearly equal, and in a few cases—Washington Navel, Paper Rind, and Satsuma—slightly higher in the young line. In the averages for all seasons, the ratio was not appreciably lower in any young line as compared with its related old line.

### Other Fruit Characters

Size of navel structure is another fruit character that is affected by nucellar embryony. Some years ago, fruit of the

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ness of pedicels or cap stems. The cap stems of sprayed clusters were attached more firmly to the berry than those of corresponding unsprayed clusters. A preliminary experiment indicated that growth regulator decreased the amount of berry shatter.

Growers wanting to experiment with growth-regulator application to Thompson Seedless, should reduce the crop of vines as they would for girdling. Fruit of over-cropped vines will not respond to the compound. Spraying should be done immediately after the shatter of berries following flowering since delay in spraying lessens the beneficial effect on size of berry.

Before treating a large block of any variety of grape, growers should spray a few vines with several concentrations the first year—say 5, 10, or 15 ppm.

### Other Seedless Varieties

Black Corinth vines sprayed at full bloom usually developed berries with hard seeds, which would make the fruit

worthless for production of currants. When spraying was delayed for about one week, large berries of acceptable fruit containing no hard seeds developed.

Foliage was only slightly injured by the compound at 10 or 20 ppm, but some shoots on vines sprayed with compound at 40 ppm were killed. The growth regulator at 30 or 40 ppm killed or injured many clusters.

Experiments were performed with other seedless varieties. Clusters of Black Monukka, White Corinth, and Sultana were dipped into solutions of growth regulator. Size of berry was increased. No data were obtained on optimum concentrations to use for spraying.

There is no evidence that any benefits will be obtained with seeded varieties as a result of treatment with a growth regulator.

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*The following Farm Advisors co-operated in the trials—C. H. Beeman, Stanislaus; C. V. Carlson, Merced; B. S. Gould, Madera; R. A. Break, Fresno; F. L. Jensen, Tulare; and A. N. Kasimatis, Kern.*

*The above progress report is based on Research Project No. 1421.*

**Data at Time of Sampling for Black Corinth Grapes from Vines Sprayed with the Diethanolamine Salt of 4-Chlorophenoxyacetic Acid. Full Bloom was on May 17.**

Treatment, concentration of growth regulator (ppm)	Time of treatment	Weight per berry (gm.)	Estimated % berries containing hard seeds	Degree Bailing	Acid %
0 (not girdled)	May 17	0.18	0	19.7	1.48
10 (not girdled)	May 17	0.57	2	18.4	1.29
20 (not girdled)	May 17	0.60	85	21.4	1.25
10 (not girdled)	May 26	0.44	0	13.6	1.54
20 (not girdled)	May 26	0.41	0	19.2	1.52
0 (girdled)	May 17	0.37	0	16.8	1.43