YIELD VARIATIONS AMONG CITRUS NUCELLAR SEEDLING CLONES AT THE FLORIDA STATE BUDWOOD FOUNDATION GROVE

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Abstract. Individual tree production records for selected mature and unscreened juvenile nucellar bud-lines are compared. Among 49 juvenile 'Valencia' orange (Citrus sinensis /L/ Osb.) seedlings 18 years from seed total fruit production ranged from 944 to 2,998 pounds. Yields varied from 3,732 to 6,668 pounds among 32 'Marsh' grapefruit (C. paradisi Macf.) trees 19 years old.

First generation propagations 9 to 13 years budded from nucellar source trees, selected using methods described in 'The Citrus Industry' Vol. 1 (1948), are fruitful, approach old-lines in cropping uniformity, and generally outyielded comparable old-line selections among the varieties tested.

Florida's need for horticulturally sound virus-free citrus budwood is brought into focus in relation to the prevalence of exocortis and tristeza viruses.

Among horticultural crops, selection procedures have been used worldwide to improve yields, quality, and disease resistance with economic advantages to growers. Undoubtedly with citrus, an unorganized but often effective form of selection has been underway since ancient times; and most of the world's presently important commercial varieties were chosen by farmers who liked the fruits and grew them for sale.

In the United States, systematic bud-selection of citrus to obtain improved strains began about 1900 and gained importance largely through the long time studies of A. D. Shamel, who contributed numerous articles related to the subject.

In 1923, following one such study, Shamel (5) concluded: "These results indicate that the number or quantity of fruit produced by citrus trees is a transmissible characteristic capable of perpetuation through bud selection." In South Africa, Marloth, Basson and Bredell (3), in a 15-year study of Valencias on rough lemon and sweet orange rootstocks, found significant differences in tree size and yield between strains of the 'Valencia' orange.

Moreira and Salibe (4), in Brazil, selected nucellar 'Navel' clones for propagation according to whether they ranked low, medium, or high in fruit production. They did not specify the magnitude of yield differences among the individual nucellar trees.

The threefold objective of this paper is to re-emphasize the economic importance of bud selection, to illustrate the magnitude of the differences in fruit production that can occur among individual seedling trees of the 'Valencia' orange and the 'Marsh' grapefruit, and to illustrate the need in Florida to utilize such information within the industry.

Materials and Methods

Florida's Budwood Foundation Grove, planted in 1960, was conceived primarily as a budwood "bank" where indexed bud-lines could be maintained free of viruses. It was also considered advantageous to have a planting where the fruiting potential of the most nearly virus-free trees discovered in the testing program could be observed under uniform care and growing conditions.

By 1956, virus indexing of old-line trees showed that a high percentage of the healthiest appearing trees were carrying xyloporosis and exocortis viruses in symptomless form on their rough lemon and sour orange rootstocks. Presence of these viruses seriously limits the range of rootstocks on which such budwood can be used successfully.

Within the Citrus Budwood Registration Program production of nucellar seedlings by both controlled and open pollination began in 1954. Concurrently, selection of mature seedling trees of commercially important cultivars was underway wherever such trees could be located within the state. By 1978 there were 798 seedlings among the 2,500 total parent tree candidates chosen for virus indexing. Nearly 400 seedling clones were represented at the Budwood Foundation grove where annual horticultural records were made of fruit quality, yields, and for trueness to type. Included among individual seedlings growing on their own rootstocks at the Budwood grove were 49 open-
pollinated nucellar 'Valencias'. Seeds that produced these trees were collected from fruits growing on marked limbs of mature nucellar 'Valencias' selected for fruitfulness and cropping uniformity. Also in this planting were 32 'Marsh' grapefruit nucellars produced by closed-pollination of the 1954 bloom.

The first propagations made at the Foundation grove included 4 old-line and 19 mature nucellar-line 'Valencias'. Also in this older budded group were 2 old-line and 2 mature seedling lines of 'Marsh' grapefruit. Each budline was represented by a minimum of 5 trees, one each on sweet lime, 'Cleopatra' mandarin, rough lemon, sour orange, and Poncirus trifoliata rootstocks. Data from trees on trifoliate orange stocks are not included as most old-line selections of both the 'Valencia' orange and 'Marsh' grapefruit carried exocortis.

The yield data presented herein were secured by a combination of methods coordinated with harvesting procedures to collect the most accurate information practicable. For several years fruit from individually numbered trees was transferred from picking bags to standard boxes then emptied into larger containers. Boxes and part boxes from each tree were recorded. During one harvest season a mechanical weighing device, loaned by the Agricultural Research and Education Center at Lake Alfred, was used with 10-box pallets and the net weight of fruit from each tree calculated. Later, as yields became more substantial, it became necessary to estimate partial pallet boxes, basing the amount of fruit on the proportion of total box depth left unfilled. Finally, when each variety was completely harvested, weight tickets of fruit delivered were compared with the total box count. When discrepancies were 5% or less, no correction factor was applied.

Results and Discussion

The horticultural results presented in this paper deal with fruit production of the 'Valencia' orange and 'Marsh' grapefruit cultivars only. Total yields among the 49 unscreened 'Valencia' nucellars were extremely variable ranging from 944 pounds (10.5 boxes) of fruit to 2,998 pounds (33.3 boxes), (Fig. 1). It is of interest to note

![Fig. 1. Cumulative yield distribution among 49 nucella 'Valencia' seedlings 18 yrs. from seed.](image_url)
that while nearly 25% of the trees deviated less than 10% above or below the general average, a larger group (16 trees) yielded poorly, with the lowest yielding tree 51.7% below the general yield average. Of more practical interest are the 21 trees (43%) which exceed the average yield by as much as 53.4% for the highest yielding bud-line.

Figure 2 illustrates the more stable performance of 'Marsh' grapefruit. With this cultivar 81% of all individual trees showed less than 10% yield deviation from the mean. Only 4 trees (12 1/2%) yielded very poorly, while 2 selections demonstrated a superior yield potential up to 34% above the general average.

The yields recorded in Table 1 for old-line and mature nucellar selections demonstrate greatly improved stability over young nucellar lines. It appears highly significant that propagations from nucellar bud-lines not only produced more fruit for the entire periods reported, but also were more productive than the old-line trees each year throughout the test (unpublished data). These results support the findings of Cameron, Soost and Frost (2) who reported encouraging yield data with respect to the behavior of older nucellar bud-lines. They found that young trees of several of these lines come into bearing as early as do old-lines.

Despite these data it is not the intent of this paper to advocate the abandonment of registered old-lines and suggest exclusive use of high-yielding, fast-growing nucellars. Sound grove planning should consider the total tree (scion and rootstock), the grove space to be allotted each tree, and other factors.

The unsolved problem presently being experienced with rough lemon (C. jambhiri Lush.) rootstock, and the greatly increased incidence of tristeza virus which threatens continued use of sour orange (C. aurantium L.) rootstock, have brought increased demand for trees propagated on rootstocks not thoroughly tested in Florida. When such stocks are to be used with any of the 15 varieties where all old-line trees carry exocortis virus (1), the seedling bud-lines are recommended. In this way the virus information and horticultural data derived from the Citrus Budwood Registration Program can be used to avoid planting unprofitable trees.

Literature Cited


Table 1. Yield comparisons of old line and selected nucellar bud-lines of the Valencia orange and Marsh grapefruit.

<table>
<thead>
<tr>
<th>Clonal type</th>
<th>Cumulative Avg. Yield</th>
<th>% Max. Deviation Above Avg.</th>
<th>% Max. Deviation Below Avg.</th>
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</thead>
<tbody>
<tr>
<td>Nucellar Valencias</td>
<td></td>
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<tr>
<td>13-yrs. old on 4 rootstocks&lt;sup&gt;x&lt;/sup&gt;</td>
<td>35.8</td>
<td>18.7</td>
<td>13.1</td>
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<tr>
<td>Old-line Valencias</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>13-yrs. old on 4 rootstocks&lt;sup&gt;x&lt;/sup&gt;</td>
<td>26.8</td>
<td>37.8</td>
<td>21.7</td>
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<tr>
<td>Nucellar Marsh</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>11-yrs. old on 4 rootstocks&lt;sup&gt;x&lt;/sup&gt;</td>
<td>40.4</td>
<td>22.4</td>
<td>23.1</td>
</tr>
<tr>
<td>Old-line Marsh</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-yrs. old on 4 rootstocks&lt;sup&gt;x&lt;/sup&gt;</td>
<td>31.8</td>
<td>32.8</td>
<td>18.8</td>
</tr>
</tbody>
</table>

<sup>z</sup>Data from 4 old-line Valencia clones 13 trees.
<sup>z</sup>Data from 19 nucellar Valencia clones 65 trees.
<sup>z</sup>Data from 2 old-line Marsh clones 8 trees.
<sup>z</sup>Data from 2 nucellar Marsh clones 8 trees.

<sup>Y</sup>Standard boxes: 90 lbs. oranges; 85 lbs. grapefruit.

<sup>x</sup>Rough lemon, Cleo, Sweet lime, Sour orange.