Title: Analysis of yield potential of Chandler


Questions were raised in 1988 about low and disappointing yields by the Chandler cultivar. These arose from Tulare, Merced, Yolo, Sutter, and Butte Counties. In a Butte county orchard yields from individual trees had been obtained for five years. In 1988 certain individual trees were identified which averaged only 25% of the yield of other ones. Reduced tree yields had not been noticed earlier in this orchard. With a Sutter County orchard, the grower had identified certain trees which were said to have produced no, or very few nuts in 1988. A Yolo County grower was generally dissatisfied with production from his Chandler orchard.

No information about causes of low yielding trees or orchards was available. Thus, we examined several components of the reproductive process that might contribute to differences in amounts of harvested nuts. Earlier work with several other cultivars had indicated that differences in any or all of the following could contribute to reduced yield: level of flower initiation, pistillate flower abscission (PFA), and inadequate pollination. As much as 89% of the individual reproductive organs were lost throughout the progression from flower emergence to nut maturity.

Procedures

Plots were established in one orchard each in Butte, Sutter, and Yolo Counties and in the UCD selection block. The arrangement of sample trees differed somewhat in each plot depending on orchard and tree circumstances. In the Butte and Sutter orchards the previously identified low-yielding ("bad") and normal-yielding ("good") trees appeared to be located at random in the orchard. Four trees of each were selected. In the Butte orchard, Chandler trees (alternating with Howard in each row) for the continuing yield study were on either side of a row of Scharsch Franquette. Some low-yielding trees were in other nearby rows. Trees were 10 years old.

In the Sutter County orchard, six year old Chandler trees were selected so as to have adjacent "good" and "bad" trees in pairs. A row of Scharsch Franquette was about 15 rows to the south. Other Franquette and some Hartley trees were scattered at random in this planting. Their precise location with regard to the sample trees was not determined.

In the Yolo County orchard tree performance was considered about equal and four adjacent sample trees were selected. Trees were midway between pollinator rows. Pollinators were limbs of Scharsch Franquette grafted approximately five years earlier and alternate trees in every tenth row. Chandler trees were nine years old.

At Davis, the same two trees were used which had been monitored earlier for PFA.

Selection of sample limbs, two per tree, and monitoring of flower emergence and nut development was done as for PFA evaluation (Catlin et al., HortScience 22:201-205, 1987). Sample branches were chosen so as to have about 100 or more reproductive spurs. After the early flowering or PFA period additional determination of presence of nuts was made in early June and late July.
Results and Discussion

Monitoring of performance of all spurs on sample limbs allowed determination of degree of fruitfulness (number of spurs that had initiated pistils) and the fate of pistils on individual spurs. Nut yields at harvest, either measured or estimated, were not as had been anticipated from 1988 measurements or accounts. There were no extremely low producing trees in 1989. Thus, results are described from the standpoint of time in the developmental sequence that potentially harvestable nuts were lost.

Reproductive potential and losses attributed to some different causes are given in Table 1. There was potential for producing many nuts since the proportion of growing points that were reproductive ranged from 62 to 89%. The average number of pistils per shoots was slightly greater than two. Any lack of production that might have occurred would not have been due to failure to initiate flowers.

All calculations of losses were done on an individual pistil basis. Only relatively minor losses of pistils occurred during the flower abscission or PFA stage. The "other" category listed in Table 1 during blossoming refers to abscission of one pistil whereas another on the same peduncle continues enlargement. This may be a milder expression of PFA. The size of pistils lost during blossoming is 4 mm or less in diameter. Low levels of PFA throughout are consistent with earlier results for Chandler.

Following the PFA stage, the time at which pollination occurs, pistils remaining rapidly enlarge regardless of whether pollination and fertilization has occurred. Developing nuts may then abscise when from about 8 mm diameter to nearly full size. Such losses are attributed to lack of pollination and/or fertilization. Except for the Butte - "good" trees abscission attributed to the pollination period was the greatest contributor to loss of nuts. Losses after early June to late July ("pollination" and "later" respectively Table 1) were very low.

No yield measurements were made with the Davis or Yolo orchard trees. However, the Yolo grower was less disappointed with production than in earlier years even with a 64% loss of pistils from all causes. Losses of early emerging pistils due to inadequate pollination were about half those of later emerging pistils for three of the four trees. This suggests that there was more overlap with Chandler pollen with these three trees. The Scharsch Franquette pollenizers did not appear to be particularly effective.

In the Sutter County orchard, losses from lack of pollination were higher for trees termed "bad" in 1988. PFA was also slightly higher with these trees. There were no location effects with paired trees for either type of abscission. Nut yields were about 80 lbs dry weight per tree but yield efficiency was slightly lower for the "bad" trees. It should be noted that one of the 1988 - "good" trees had the highest pollination loss in 1989 and the lowest yield efficiency. This result together with the fact that no extremely low yield trees were detected in 1989 strongly suggests the occurrence of year to year effects. No relation could be found for pollination losses with earlier or later emerging pistils. The observation and tagging interval may not have been adequate here to detect such differences. There could have been an overriding effect of tree water status as well. No irrigation water had been supplied as of May 23rd and
It is not known when the first irrigation was applied. There was also a very dense cover crop on the orchard floor that was mowed once.

At the Butte orchard substantial differences existed in losses due to pollination for trees with high and low yield in 1988. In 1989, production ranged from 164 to 205 lbs dry weight per tree for all trees. However, yield efficiency was only slightly lower for the "bad" trees. The rather large difference in abscission seems not to be reflected in yield efficiency. Thus, two sample limbs per tree or their location in the lower portion of the canopy may not have reflected adequately the performance of these large trees. To further confuse this, nuts on the ground on May 26th averaged 296 and 8 per tree for "bad" and "good" trees respectively. These losses would have been reflected in later counts of sample branches. In contrast to the Yolo orchard, earliest emerging pistils incurred greater losses from lack of pollination than later ones. This suggests temporal separation from Chandler pollen and increased effectiveness of Franquette and perhaps Howard pollen.

We can only speculate as to reasons for differences in yield by individual trees in the two years. Flower initiation, PFA, and pollination effectiveness have been shown to vary from year to year but not necessarily in regular alternation. Failure to realize yield differences in 1989 of the same magnitude attributed to 1988 undoubtedly contributes to uncertainty. Nevertheless, nut losses from lack of pollination and fertilization can be substantial. Similar results have been obtained earlier for Serr, Hartley, Howard and Sunland. The lowest total loss for any cultivar in any year was 28%. Perhaps this level or better is what could be expected given better pollination conditions than apparently existed in some cases here.

It also seems clear that individual trees differ in "pollination effects" although the detail of this has not been included here. As noted, individual trees may also differ in this regard from year to year. It does not seem appropriate to indict the Chandler cultivar as a chronic low producer. Improved pollination potential could lead to improved and more stable yields.

Table 1. Pistils or nuts lost, % of total pistils.

<table>
<thead>
<tr>
<th></th>
<th>% Reproductive</th>
<th>Blossoming</th>
<th>Pollination</th>
<th>Later</th>
<th>Total</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>PFA</td>
<td>Other</td>
<td></td>
<td></td>
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<tr>
<td>Yolo</td>
<td>85</td>
<td>6</td>
<td>4</td>
<td>51</td>
<td>3</td>
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<tr>
<td>Davis</td>
<td>62</td>
<td>8</td>
<td>4</td>
<td>38</td>
<td>5</td>
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<td>Butte - Good</td>
<td>75</td>
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</tr>
<tr>
<td>- Bad</td>
<td>73</td>
<td>15</td>
<td>6</td>
<td>38</td>
<td>2</td>
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<tr>
<td>Sutter - Good</td>
<td>89</td>
<td>12</td>
<td>4</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>- Bad</td>
<td>89</td>
<td>21</td>
<td>7</td>
<td>26</td>
<td>10</td>
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