EVALUATION AND DEVELOPMENT OF WALNUT SEEDLINGS, SELECTIONS, CULTIVARS, INTRODUCTIONS AND ROOTSTOCKS


ABSTRACT

Evaluation of 14 cultivars, 8 selections, 86 introductions (domestic and foreign) and 72 seedlings continued during 1990. The introductions and seedlings are progressing in the 5 year evaluation process toward designation as selections or germplasm. Three French and 9 Yugoslavian introductions were added to the U.C.D. collection for initial evaluation. In addition, 105 seedlings developed in 1987 for evaluation as potential Chandler, Howard and Hartley pollenizers have been propagated on paradox rootstock for further evaluation. During 1990, under a joint U.C. and USDA-ARS breeding project (scheduled for three years), 23 crosses were made resulting in 1557 seed which will be developed for evaluation. Evaluation data thru 1990 has been compiled in a computer data base and is available to farm advisors and growers on request. 1990 summaries of the performance of selected cultivars and French introductions are provided in this report. Brief descriptions of selections advancing toward release are summarized including three new selections identified as potential pollenizers for Chandler and Howard. Also included is the current compilation of the statewide cultivar, selection and rootstock field trials being used to develop comparative information.

OBJECTIVE

The general objective of the project is to evaluate and introduce new cultivars and rootstocks which will serve the needs of the walnut industry. The specific objectives are: a) to continue evaluations of seedlings, domestic and foreign introductions, selections and cultivars in our collections; b) to identify pollenizers for 'Chandler', 'Howard', and 'Hartley' by evaluating existing collections and new seedlings resulting from recent controlled crosses; c) to introduce germplasm which will broaden the genetic base available for breeding; and d) to identify rootstocks tolerant of adverse conditions and diseases such as blackline and crown and root rots. (The high density planting and management system report is submitted separately.)

In addition a joint USDA/UC breeding project was initiated. The objective of this project is to enhance walnut germplasm for precocity in pollen production, for protogyny and for a range of harvest dates so that long term goals which include developing cultivars that are adaptable to new production systems can be met.

PROCEDURE

Data is collected annually on the following traits for seedlings, introductions, selections, and cultivars: dates of leafing, first, peak and last pistillate bloom, and harvest; first catkin bearing year; catkin abundance; percent lateral fruitfulness; number of pistillate flowers per inflorescence; dichogamy; precocity; blight incidence; tree vigor; growth habit; estimated yield; shell shape, texture, strength and seal; nut and kernel weight and resulting percent kernel; kernel fill and plumpness; ease of kernel removal; kernel color; type and frequency of kernel shrivel and frequency of kernel...
blanks. Diamond Walnut Growers makes a considerable contribution by providing this program with a commercial crack out evaluation of selected cultivars and selections. A panel reviews the data, observes the kernels and recommends action (save for further evaluation, select or discard) on seedlings, introductions and selections with at least 5 years evaluation. Specific attention is focused on seedlings and selections that shed pollen from peak to last pistillate bloom of 'Chandler', 'Howard' and 'Hartley'.

The USDA/UC breeding project will involve two factorial mating designs to be completed within three years, one aimed at incorporating introduced germplasm into the breeding program (7x5) and the other to generate new cultivars from improved sources (4x5) for a total of 55 different crosses. Parents include: Chinese introduction (85-8), Sinensis #5, French introduction 86-11, PI 18256, Chace D9, Conway Mayette, Franquette, Ronde de Montignac, Soleze, Cascade, Sunland, Chandler, Howard, Vina, UC 67-11, Chico, UC 56-224 and UC 77-12.

Locations and plot designs of cultivar, selection, and rootstock field trials developed by U.C. Cooperative Extension Farm Advisors continue to be solicited to assist the program in developing comparative descriptions of cultivars and selections growing under different conditions.

RESULTS AND CONCLUSIONS

Cultivars: Performance of cultivars in the U.C. Davis collection (Tables 1 and 2) was described as typical with the following exceptions: mid to late leafing cultivars leafed out approximately 4 days earlier than the 5 year average. Cisco and Scharsh Franquette fell 1 and 2 days short respectively of completely overlapping the last half of 'Howard' and 'Chandler' pistillate bloom. Yield for Serr was very poor which corresponds to the 95% pistillate flower abscission observed (Catlin et al., W.R.R.; 1990). Harvests dates reflected the 5 year averages yet the time from packing tissue brown to 80% hull split was elongated for later harvested cultivars. Percent kernel for most cultivars exceeded the 5 year averages. Correspondingly, shell thickness measurements were less than typical. Kernel color for Chandler, Cisco, Howard, Pedro, Serr and Tehama was very good. The crack test conducted by Diamond Growers, Inc. (Table 6) showed mold to be a problem for late harvesting cultivars. (Elevated mold incidence may be attributed to late spring rains and the extended period from packing tissue brown to the harvest dates.)

Selections: Eight U.C. selections are undergoing evaluation at U.C. Davis (Table 3). Two selections, U.C. 68-104 and U.C. 78-189 have been removed from the selection program due to continued poor performance. Both have been assigned to long term maintenance in the "Stuke Collection" at Wolfskill Experimental Orchards. Three Serr/Forde seedlings (U.C. 72-13, U.C. 72-36 and U.C. 77-10) demonstrating potential as pollenizers for Chandler, Howard and Hartley have been elevated to selection status. These new selections will continue to be evaluated at U.C. Davis and in U.C. farm advisor field trials.

U.C. 67-11 which continues to demonstrate good performance in hedgerow configuration as well as good yield and kernel characteristics is entering the U.C. patent process. U.C. 67-13 has been currently removed from patent consideration due to repeated and unacceptably high pistillate flower abscission.
U.C. selections discontinued from current evaluation are maintained in the "Stuke Collection" at Wolfskill Experimental Orchards. These selections are retained for specific or unusual traits, or have been successful in field trial under atypical conditions.

**Seedlings:** Seedlings resulting from controlled crosses designed to produce pollenizers for Chandler, Howard and Hartley and conducted in 1986 and 1987 have advanced in the U.C. evaluation process. The seventy-two 1986 seedlings continue to leaf out from 3 to 35 days after Chandler (earlier leafing as the clones mature is a potential and must be determined during succeeding evaluations). Twenty-two of the '86 seedlings produced pistillate flowers one year after being extensively pruned and transplanted from the original nursery (this may indicate pistillate precocity but must be further evaluated). Staminate precocity (early catkin production) is a primary objective and must be determined. One hundred and five 1987 seedlings were designated (based on leafing dates the same or later than Chandler's) for further evaluation and repopulated on paradox rootstock.

This year 23 crosses were made for the USDA/UC breeding project which resulted in 1557 seed. (Note that in the Serr/Forde breeding program (1948-1978) less than 6000 seedlings were generated over a 30-year period.) The seed have been stratified and the land prepared and fumigated for planting in Spring, 1991. The remaining crosses will be made in 1991 and 1992. Evaluation will begin in 1993.

**Introductions:** Initial evaluation of the 86 introductions received from the U.S.A., Bulgaria, China, France, Hungary, India, Korea, Pakistan, Poland, Romania, Spain and Yugoslavia indicate that 79 will be delegated to the germplasm resources collection. The seven French clones developed by E. Germain and previously designated as advanced selections continue to show promise. The Chinese materials are generally early leafing with related blight problems. Three items 85-8, 85-9 and 85-10 exhibit extreme precocity. Percent kernel is high and the kernel of large, but kernel color is very poor and nuts have shell seal and perforation deficiencies. The Eastern European introduction's leafing dates range from early to late. Blight has been observed on the early to mid leafing clones. The group is not precocious. Percent kernel and kernel size has been rated fair to very good yet kernel color is poor and shell seal and perforation are deficiencies. (Badajoz, the Spanish introduction, is included in this group for description.) The French introductions (Tables 4 and 5) segregate into germplasm resources and advanced selections. Verdot, Soleze, Ronde de Montignec, Meylannaise, Chase D9, Sibisel-39, Geisenheim-139, J. purpurea and Lara are mid to late leafing, not precocious and have limited lateral bud fruitfulness (Chase 9D at 50%, Sibisel at 50%, Geisenheim at 80% and Lara at 90% are exceptions). Nut and kernel quality varies with percent kernel ranging from 38.7 to 56.3, small to medium nut size and kernel color fluctuating from poor to good. The French advanced selections are mid to late leafing and precocious. H94-11 (Franquette x Lara) overlaps the peak to last Chandler pistillate bloom by 5 days (a potential pollenizer). Yields are variable. Harvest dates are late. Nut quality traits are variable percent kernel (42.2 to 57.8), small to medium sized kernels and poor to good kernel color.
Field Trial Summaries: Rootstock, cultivar and selection trials have been established by U.C. Cooperative Extension Farm Advisors in 9 counties (Tables 7 and 8). Some trials are small, designed to evaluate a few specific clones or seed sources; others involve extensive collections of species or selections and cultivars grown under different training systems and/or environments. By compiling the information from these trials we will provide a statewide evaluation of specific items in the future. (Please help us by providing any corrections or missing information.)

(In this report we have provided detailed information in tables that can be used by Farm Advisors and growers. We would appreciate suggestions on potential improvements in the table format for future reports.)
# Table 1. Cultivar and Selection Evaluations at U.C. Davis (Spring 1990)

<table>
<thead>
<tr>
<th>Cultivars/Selections [Cross]</th>
<th>Leaping Date</th>
<th>Leaping DAP&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Leaping sy&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Pollen Shedding 1st Peak</th>
<th>Pollen Shedding Last Abundance&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Pistillate Bloom 1st Peak</th>
<th>Pistillate Bloom Last</th>
<th>Fruitful Laterals</th>
<th>Yield&lt;sup&gt;d&lt;/sup&gt;</th>
<th>Blight&lt;sup&gt;e&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAYNE (____)</td>
<td>3/18</td>
<td>0</td>
<td>0</td>
<td>3/22</td>
<td>4/ 5</td>
<td>3/29</td>
<td>4/ 6</td>
<td>4/15</td>
<td>90</td>
<td>6</td>
</tr>
<tr>
<td>HARTLEY (____)</td>
<td>3/30</td>
<td>12</td>
<td>17</td>
<td>3/29</td>
<td>4/ 5</td>
<td>4/19</td>
<td>6</td>
<td>4/22</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>SCH FRANQUETTE (____)</td>
<td>4/10</td>
<td>23</td>
<td>26</td>
<td>4/ 6</td>
<td>4/15</td>
<td>4/26</td>
<td>7</td>
<td>4/16</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Established</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SERR (PAYNE X PI 159568)</td>
<td>3/19</td>
<td>1</td>
<td>1</td>
<td>3/24</td>
<td>4/ 6</td>
<td>4/ 3</td>
<td>4/10</td>
<td>50</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>ASHLEY (____)</td>
<td>3/17</td>
<td>-1</td>
<td>0</td>
<td>3/23</td>
<td>4/ 6</td>
<td>4/ 3</td>
<td>4/13</td>
<td>90</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>SUNLAND (LOMPOC X PI 159568)</td>
<td>3/20</td>
<td>2</td>
<td>2</td>
<td>4/ 2</td>
<td>4/ 6</td>
<td>4/19</td>
<td>7</td>
<td>4/25</td>
<td>100</td>
<td>8</td>
</tr>
<tr>
<td>TEHAMA (PAYNE X WATERLOO)</td>
<td>3/23</td>
<td>5</td>
<td>10</td>
<td>4/ 7</td>
<td>4/14</td>
<td>2/ 4</td>
<td>4/21</td>
<td>50</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>AMIGO (SHARKEY X MARCHETTI)</td>
<td>3/26</td>
<td>8</td>
<td>12</td>
<td>4/ 3</td>
<td>4/19</td>
<td>4/13</td>
<td>5</td>
<td>4/25</td>
<td>90</td>
<td>8</td>
</tr>
<tr>
<td>PEDRO (PAYNE X C. MAYETTE)</td>
<td>3/27</td>
<td>9</td>
<td>15</td>
<td>4/ 7</td>
<td>4/20</td>
<td>4/20</td>
<td>5</td>
<td>4/14</td>
<td>95</td>
<td>6</td>
</tr>
<tr>
<td>HOWARD (PEDRO X 56-224)</td>
<td>3/29</td>
<td>11</td>
<td>16</td>
<td>3/30</td>
<td>4/ 8</td>
<td>4/19</td>
<td>6</td>
<td>4/10</td>
<td>90</td>
<td>8</td>
</tr>
</tbody>
</table>

---

<sup>a</sup> "DAP" denotes "days after Payne".

<sup>b</sup> Superscripts indicate number of years for average, if 5 years of data not available.

<sup>c</sup> Catkin abundance: 0 - no catkins, 9 - extremely dense catkin production.

<sup>d</sup> Yield estimate: 0 - no walnuts, 9 - extremely high yield.

<sup>e</sup> Blight score: 0 - no sign of infection, 9 - extremely severe infestation.
<table>
<thead>
<tr>
<th>Cultivars/Selections (Cross)</th>
<th>Harvest Date</th>
<th>DAP* avg</th>
<th>Shell% Seal</th>
<th>Shell% Thickness (mm)</th>
<th>In-Shell Kernel Weight (gms)</th>
<th>Average Weight (gms)</th>
<th>Kernel Filled 5 yr. --- Light 1990 avg</th>
<th>Kernel Color (%)</th>
<th>Kernel Shrink (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAYNE (___)</td>
<td>9/15</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1.5</td>
<td>12.18</td>
<td>6.45</td>
<td>52.9</td>
<td>50.2</td>
</tr>
<tr>
<td>HARTLEY (___)</td>
<td>9/29</td>
<td>14</td>
<td>16</td>
<td>2</td>
<td>1.7</td>
<td>11.50</td>
<td>5.53</td>
<td>48.1</td>
<td>45.6</td>
</tr>
<tr>
<td>SCH FRANQUETTE (___)</td>
<td>10/18</td>
<td>33</td>
<td>31</td>
<td>2</td>
<td>1.4</td>
<td>10.21</td>
<td>5.10</td>
<td>51.9</td>
<td>47.8</td>
</tr>
<tr>
<td>PAYNE (PAYNE X PI 159568)</td>
<td>9/14</td>
<td>-1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>15.69</td>
<td>8.98</td>
<td>57.2</td>
<td>57.2</td>
</tr>
<tr>
<td>ASHLEY (___)</td>
<td>9/15</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1.6</td>
<td>12.25</td>
<td>6.35</td>
<td>51.8</td>
<td>49.8</td>
</tr>
<tr>
<td>CHICO (SHARP X MARCHETTI)</td>
<td>9/13</td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>1</td>
<td>11.19</td>
<td>5.39</td>
<td>46.2</td>
<td>46.8</td>
</tr>
<tr>
<td>SINLAND (LOMEC X PI 15695)</td>
<td>9/26</td>
<td>11</td>
<td>13</td>
<td>0</td>
<td>1</td>
<td>19.12</td>
<td>11.39</td>
<td>59.6</td>
<td>57.3</td>
</tr>
<tr>
<td>VINA (PAYNE X SCH FRANQUETTE)</td>
<td>9/14</td>
<td>-1</td>
<td>2</td>
<td>0</td>
<td>1.7</td>
<td>12.73</td>
<td>6.07</td>
<td>47.7</td>
<td>49.3</td>
</tr>
<tr>
<td>TEHAMA (PAYNE X WATERLOO)</td>
<td>9/16</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>1.4</td>
<td>11.63</td>
<td>6.01</td>
<td>51.7</td>
<td>49.8</td>
</tr>
<tr>
<td>ANGIO (SHARP X MARCHETTI)</td>
<td>9/11</td>
<td>-4</td>
<td>-2</td>
<td>0</td>
<td>1.4</td>
<td>11.60</td>
<td>5.94</td>
<td>51.2</td>
<td>51.2</td>
</tr>
<tr>
<td>PEDRO (PAYNE X C. MAYETTE)</td>
<td>9/22</td>
<td>7</td>
<td>6</td>
<td>0</td>
<td>1.6</td>
<td>10.55</td>
<td>5.68</td>
<td>52.0</td>
<td>47.5</td>
</tr>
<tr>
<td>HOWARD (PEDRO X 56-224)</td>
<td>9/14</td>
<td>-1</td>
<td>3</td>
<td>0</td>
<td>1.6</td>
<td>11.07</td>
<td>6.08</td>
<td>51.7</td>
<td>49.2</td>
</tr>
<tr>
<td>CHANDLER (PEDRO X 56-224)</td>
<td>9/29</td>
<td>14</td>
<td>16</td>
<td>0</td>
<td>1.4</td>
<td>12.88</td>
<td>6.63</td>
<td>51.5</td>
<td>49.4</td>
</tr>
<tr>
<td>CISCO (PEDRO X MEYLAN)</td>
<td>10/2</td>
<td>17</td>
<td>19</td>
<td>0</td>
<td>1.7</td>
<td>11.55</td>
<td>5.59</td>
<td>48.4</td>
<td>46.4</td>
</tr>
<tr>
<td>U.C. 67-11 (TIENAMA X SERR)</td>
<td>9/19</td>
<td>4</td>
<td>7</td>
<td>0</td>
<td>2</td>
<td>1.3</td>
<td>14.11</td>
<td>55.4</td>
<td>53.0</td>
</tr>
<tr>
<td>U.C. 67-13 (TIENAMA X SERR)</td>
<td>9/16</td>
<td>1</td>
<td>-1</td>
<td>0</td>
<td>2</td>
<td>1.6</td>
<td>14.04</td>
<td>55.9</td>
<td>54.7</td>
</tr>
<tr>
<td>U.C. 72-13 (59-165 X 53-19)</td>
<td>9/27</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>2</td>
<td>1.2</td>
<td>11.72</td>
<td>58.1</td>
<td>58.1</td>
</tr>
<tr>
<td>U.C. 72-36 (53-39 X CHICO)</td>
<td>9/26</td>
<td>11</td>
<td>11</td>
<td>0</td>
<td>2</td>
<td>1.4</td>
<td>14.71</td>
<td>59.0</td>
<td>59.0</td>
</tr>
<tr>
<td>U.C. 76-80 (CHANDLER X 61-25)</td>
<td>9/19</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td>2</td>
<td>1.4</td>
<td>12.24</td>
<td>52.0</td>
<td>50.1</td>
</tr>
<tr>
<td>U.C. 77-10 (HOWARD X 64-57)</td>
<td>9/10</td>
<td>-5</td>
<td>-5</td>
<td>0</td>
<td>2</td>
<td>1.4</td>
<td>12.37</td>
<td>50.3</td>
<td>50.3</td>
</tr>
<tr>
<td>U.C. 77-12 (HOWARD X 64-57)</td>
<td>9/9</td>
<td>-6</td>
<td>-4</td>
<td>0</td>
<td>2</td>
<td>1.7</td>
<td>12.79</td>
<td>50.4</td>
<td>47.5</td>
</tr>
<tr>
<td>U.C. 78-10 (53-153 X CHANDLER)</td>
<td>10/16</td>
<td>31</td>
<td>25</td>
<td>0</td>
<td>2</td>
<td>1.6</td>
<td>12.71</td>
<td>49.4</td>
<td>46.4</td>
</tr>
</tbody>
</table>

---

* "DAP* denotes "Days after Payne".
* Superscripts indicate number of years for average, if 5 years of data not available.
* Shell Seal: percent with open seal under slight pressure.
* Shell Strength: 1 - strong, 4 - very weak.
* Kernel Fill: 1 - well, 7 - poor.
* Kernel color and shrivel taken on 10 randomly selected nuts; other traits on 10 pound nuts.

Table 2: Cultivar and Selection Harvest Evaluations at U.C. Davis (Fall 1990)
TABLE 3. DESCRIPTION OF U.C. SELECTIONS

67-11

Leafs out 3 to 7 days before Hartley. Laterally fruitful (75%). Yields are very good. Kernel quality is variable with an excellent rating in 1990. Harvests 2 weeks after Payne. Potential pollenizer for Vina. 67-11 an offspring of Serr continues to be evaluated for 'pistillate flower abscission' (PFA). (For 1989, 67-11 PFA was 7% compared to 25% for Serr, and in 1990 it was 20% compared to 95% for Serr in the same orchard (Catlin et al., W.R.R., 1990). Released under test agreement for field evaluations (standard and hedgerow plantings) in Butte, Merced, San Benito, San Joaquin, Sutter, Tehama, Tulare and Yolo Counties. Entered initial stage of U.C. patent process.

67-13

Leafs out 2 to 7 days after Payne. Laterally fruitful (90%). Yields are very good to excellent with the exception of a poor rating in 1998 at U.C. Davis. Near homogamous flowering. Produces large numbers of catkins. Kernel quality has varied from poor to very good (quality was above average for 1989) with consistently high "percent kernel" ratings. Harvests with Payne. Initial good performance in hedgerow plantings and as a pollenizer for 'Chico'. UC 67-13 an offspring of Serr, continues to be evaluated for pistillate flower abscission (PFA). (In 1988 67-13 PFA ranged from 68 to 96% compared to Serr with 82 to 83%, in 1989 67-13 PFA ranged from 23 to 26% compared to Serr's 34 to 35% and in 1990, 67-13 PFA was 55% compared to Serr with 95% [Catlin et al., W.R.R., 1990]). Patent considerations were suspended due to concern over PFA. Released under test agreement in Butte, Kern, Merced, San Benito, Stanislaus, Tulare and Yolo Counties.

72-13

Leafs out 1 day before to 8 days after Hartley. Demonstrated variable lateral bud fruitfulness (5 to 70%). Protandrous and potential pollenizer for 'Chandler', 'Howard' and 'Hartley'. Completely overlapped 'Chandler' pistillate bloom during 2 of 4 years evaluation. Produces adequate number of catkins. Yield has been fair to good. Harvests 5 to 15 days after 'Payne'. Percent kernel has ranged from 50.6 to 58.1. Kernel color has ranged from fair to good. Advanced to selection status in 1990. Further evaluation required to substantiate leafing date, catkin shedding date and abundance yield and kernel quality. Released under test agreement in Yolo County.

72-36

Leafs out 3 to 6 days before 'Hartley'. Laterally fruitful (50%). Protogynous and potential pollenizer for 'Chandler', 'Howard' and Hartley. Overlapped 'Chandler' pistillate bloom during 3 of 4 years evaluated. Adequate catkin production. Yield has been above average. Harvests 3 to 5 days before 'Hartley'. Percent kernel has ranged from 55.9 to 59.0. Kernel color has ranged from poor to excellent. Advanced to selection status in 1990. Further evaluation required to verify leafing date, catkin shedding date and abundance, yield and kernel quality. Released under test agreement in Merced and Yolo counties.
77-10
Leafs out from 4 days before to 5 days after 'Hartley'. Laterally fruitful (75%). Protogynous and potential pollenizer for Chandler, Howard and Hartley. Completely overlapped Chandler pistillate bloom during 2 of 4 years evaluated. Adequate catkin production. Short season crop (leafs 17 days after Payne and harvests with Payne). Yields have been fair to good. Percent kernel has ranged from 47.3 to 50.3. Kernel color has been fair to excellent. Advanced to selection status in 1990. Further evaluation required to substantiate leafing date, catkin shedding date and abundance, yield and kernel quality. Released under test agreement in Merced and Yolo counties.

76-80
Leafs out 6 days before to 1 day after Hartley. Precocious catkin and pistillate flower production. Laterally fruitful (70%). Short season for nut development. Yields are average to very good. Very good kernel quality with average "percent kernel" ratings. Shell seal in question. Released under test agreement in Lake, Merced, San Benito, Stanislaus, and Yolo counties.

77-12
Leafs out from 2 to 6 days after Hartley. Laterally fruitful (85%). Protogynous. Short season for nut development. Yield varies from average to very good. Kernel quality varies from average to excellent with average "percent kernel" ratings. Kernels may have unusual oil composition exhibiting high percent of unsaturated fatty acids. Advanced to selection status in 1988. Released under test agreement in Lake, Merced, San Benito, Stanislaus, and Yolo counties.

78-10
Leafs out 3 days before to 5 days, after Scharsch Franquette. Potential pollenizer for Chandler, Howard and Hartley. Laterally fruitful (95%). Yield varies from average to good. Kernel quality is excellent with average "percent kernel" ratings. Advanced to selection status in 1988. Released under test agreement in Lake, San Benito, Stanislaus and Yolo counties.
## Table 4. French Introduction Evaluations at U.C. Davis (Spring 1990)

<table>
<thead>
<tr>
<th>Cultivars/Selections (Cross)</th>
<th>Leafing</th>
<th>Pollen Shedding</th>
<th>Pistillate Bloom</th>
<th>Fruitful</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Date</td>
<td>DAPb</td>
<td>1st Peak</td>
<td>Last Abundanceb</td>
</tr>
<tr>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAYNE</td>
<td>3/18</td>
<td>0</td>
<td>3/22</td>
<td>3/28</td>
</tr>
<tr>
<td>HARTLEY</td>
<td>3/30</td>
<td>12</td>
<td>3/29</td>
<td>4/5</td>
</tr>
<tr>
<td>SCH FRANQUETTE</td>
<td>4/10</td>
<td>23</td>
<td>4/6</td>
<td>4/15</td>
</tr>
</tbody>
</table>

### French Introductions

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
<th>DAPb</th>
<th>1st Peak</th>
<th>Last Abundanceb</th>
<th>1st Peak</th>
<th>Last</th>
<th>Laterals</th>
<th>Yieldc</th>
<th>Blightd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ronde de Montignac, RA 38-2</td>
<td>4/22</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>4/30</td>
<td>5/4</td>
<td>5/8</td>
</tr>
<tr>
<td>Chase D9, RA 494</td>
<td>3/24</td>
<td>6</td>
<td>4/2</td>
<td>4/4</td>
<td>4/7</td>
<td>5</td>
<td>4/7</td>
<td>4/11</td>
<td>4/18</td>
</tr>
<tr>
<td>J. pupurea, RA 1088</td>
<td>3/23</td>
<td>5</td>
<td>3/30</td>
<td>4/1</td>
<td>4/3</td>
<td>3</td>
<td>4/3</td>
<td>4/4</td>
<td>4/10</td>
</tr>
<tr>
<td>CR 1-1 (J. cordiformis X J. regla)</td>
<td>3/27</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lara, RA 480</td>
<td>3/26</td>
<td>8</td>
<td>4/2</td>
<td>4/6</td>
<td>4/13</td>
<td>4</td>
<td>4/6</td>
<td>4/14</td>
<td>4/23</td>
</tr>
<tr>
<td>J. nigra, NG 23</td>
<td>4/14</td>
<td>27</td>
<td>5/2</td>
<td>5/6</td>
<td>5/9</td>
<td>3</td>
<td>4/27</td>
<td>5/1</td>
<td>5/6</td>
</tr>
<tr>
<td>J. major, NG 209</td>
<td>4/1</td>
<td>14</td>
<td>4/25</td>
<td>5/1</td>
<td>5/9</td>
<td>5</td>
<td>4/12</td>
<td>4/16</td>
<td>4/23</td>
</tr>
</tbody>
</table>

### French Selections

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
<th>DAPb</th>
<th>1st Peak</th>
<th>Last Abundanceb</th>
<th>1st Peak</th>
<th>Last</th>
<th>Laterals</th>
<th>Yieldc</th>
<th>Blightd</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 91-10 (FRANQUETTE X PAYNE)</td>
<td>3/24</td>
<td>6</td>
<td>4/4</td>
<td>4/6</td>
<td>4/7</td>
<td>2</td>
<td>4/10</td>
<td>4/15</td>
<td>4/24</td>
</tr>
<tr>
<td>H 91-37 (FRANQUETTE X PAYNE)</td>
<td>3/29</td>
<td>11</td>
<td>4/4</td>
<td>4/7</td>
<td>4/16</td>
<td>3</td>
<td>4/7</td>
<td>4/15</td>
<td>4/26</td>
</tr>
<tr>
<td>H 94-11 (FRANQUETTE X LARA)</td>
<td>4/10</td>
<td>23</td>
<td>4/16</td>
<td>4/20</td>
<td>5/1</td>
<td>3</td>
<td>4/24</td>
<td>5/1</td>
<td>5/5</td>
</tr>
<tr>
<td>H 92-53 (FRANQUETTE X ASHLEY)</td>
<td>3/29</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>4/12</td>
<td>4/19</td>
<td>4/24</td>
</tr>
<tr>
<td>H 93-9 (FRANQUETTE X PEDRO)</td>
<td>4/13</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>4/23</td>
<td>4/28</td>
<td>5/2</td>
</tr>
<tr>
<td>H 97-13 (SOLEZE X LARA)</td>
<td>3/28</td>
<td>10</td>
<td>4/8</td>
<td>4/10</td>
<td>4/12</td>
<td>2</td>
<td>4/7</td>
<td>4/13</td>
<td>4/22</td>
</tr>
</tbody>
</table>

---

*a "DAP" denotes "days after Payne".
*b Catkin abundance: 0 - no catkins, 9 - extremely dense catkin production.
*c Yield estimate: 0 - no walnuts, 9 - extremely high yield.
*d Blight score: 0 - no sign of infection, 9 - extremely severe infestation.*
<table>
<thead>
<tr>
<th>Cultivars/Selections (Cross)</th>
<th>Harvest Date</th>
<th>Shell Seal</th>
<th>Shell Thickness</th>
<th>Avg. Weight</th>
<th>Kernel Fill</th>
<th>Kernel Color (%)</th>
<th>Kernel Shrivel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAYNE</td>
<td>9/15</td>
<td>0</td>
<td>2</td>
<td>1.5</td>
<td>12.1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>HARTLEY</td>
<td>9/29</td>
<td>14</td>
<td>2</td>
<td>1.7</td>
<td>11.5</td>
<td>5.5</td>
<td>48.0</td>
</tr>
<tr>
<td>SCH FRANQUETTE</td>
<td>10/18</td>
<td>33</td>
<td>2</td>
<td>1.3</td>
<td>10.2</td>
<td>5.3</td>
<td>51.9</td>
</tr>
<tr>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAYNE</td>
<td>9/15</td>
<td>0</td>
<td>2</td>
<td>1.5</td>
<td>12.1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>HARTLEY</td>
<td>9/29</td>
<td>14</td>
<td>2</td>
<td>1.7</td>
<td>11.5</td>
<td>5.5</td>
<td>48.0</td>
</tr>
<tr>
<td>SCH FRANQUETTE</td>
<td>10/18</td>
<td>33</td>
<td>2</td>
<td>1.3</td>
<td>10.2</td>
<td>5.3</td>
<td>51.9</td>
</tr>
<tr>
<td>French Introductions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verdot, RA 118</td>
<td>10/21</td>
<td>36</td>
<td>2</td>
<td>1.2</td>
<td>8.6</td>
<td>4.7</td>
<td>55.2</td>
</tr>
<tr>
<td>Sibisel-39, RA 948</td>
<td>10/7</td>
<td>22</td>
<td>1</td>
<td>1.7</td>
<td>15.6</td>
<td>7.7</td>
<td>49.5</td>
</tr>
<tr>
<td>Geisenheim-139, RA 399-1</td>
<td>9/13</td>
<td>-2</td>
<td>2</td>
<td>1.7</td>
<td>9.8</td>
<td>3.8</td>
<td>38.7</td>
</tr>
<tr>
<td>J. papurea, RA 1088</td>
<td>9/26</td>
<td>11</td>
<td>2</td>
<td>1.7</td>
<td>14.0</td>
<td>7.4</td>
<td>52.9</td>
</tr>
<tr>
<td>CR 1-1 (J. cordiformis X J. regla)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lara, RA 480</td>
<td>9/21</td>
<td>6</td>
<td>1</td>
<td>1.6</td>
<td>15.9</td>
<td>7.8</td>
<td>48.8</td>
</tr>
<tr>
<td>J. nigra, NG 23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J. Major, NG 209</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J. hindsi, HD 6-15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>French Selections</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H 91-10 (FRANQUETTE X PAYNE)</td>
<td>10/15</td>
<td>30</td>
<td>2</td>
<td>1.8</td>
<td>13.5</td>
<td>6.6</td>
<td>49.3</td>
</tr>
<tr>
<td>H 91-37 (FRANQUETTE X PAYNE)</td>
<td>9/23</td>
<td>8</td>
<td>3</td>
<td>1.2</td>
<td>14.0</td>
<td>8.1</td>
<td>57.8</td>
</tr>
<tr>
<td>H 94-11 (FRANQUETTE X LARA)</td>
<td>10/16</td>
<td>31</td>
<td>3</td>
<td>1.2</td>
<td>15.2</td>
<td>8.6</td>
<td>56.6</td>
</tr>
<tr>
<td>H 94-12 (FRANQUETTE X LARA)</td>
<td>10/16</td>
<td>31</td>
<td>1</td>
<td>1.7</td>
<td>15.0</td>
<td>8.1</td>
<td>53.9</td>
</tr>
<tr>
<td>H 92-53 (FRANQUETTE X ASHLEY)</td>
<td>10/9</td>
<td>24</td>
<td>2</td>
<td>1.7</td>
<td>11.7</td>
<td>6.2</td>
<td>52.9</td>
</tr>
<tr>
<td>H 93-9 (FRANQUETTE X PEDRO)</td>
<td>10/7</td>
<td>22</td>
<td>3</td>
<td>1.6</td>
<td>11.2</td>
<td>4.7</td>
<td>42.2</td>
</tr>
<tr>
<td>H 97-13 (SOLEZE X LARA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a"DAP" denotes "days after Payne".
bShell Seal: percent with open seal under slight pressure.
cShell Strength: 1 - strong, 4 - very weak.
dKernel Fill: 3 - well, 7 - poor.
eKernel Color and Shrivel taken on 10 randomly selected nuts, other traits on 10 sound nuts.
Table 6. 1990 UCD Cultivar/Selection Evaluations by Diamond Walnut Growers, Inc.

Diamond Growers Crack Test
Kernel Yield (percent in-shell wt.)

<table>
<thead>
<tr>
<th>Cultivar Selection</th>
<th>% Large Size</th>
<th>RLIa</th>
<th>Light</th>
<th>Light Amber</th>
<th>Amber</th>
<th>Total Edible</th>
<th>Off Grade</th>
<th>Total Yield</th>
<th>Internal Damage (Number)</th>
<th>Harvest Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Shriveln Otherb</td>
<td></td>
</tr>
<tr>
<td>Payne</td>
<td>98</td>
<td>52.2</td>
<td>39</td>
<td>9</td>
<td>1</td>
<td>49</td>
<td>2</td>
<td>51</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Hartley</td>
<td>98</td>
<td>53.2</td>
<td>36</td>
<td>2</td>
<td>0</td>
<td>38</td>
<td>8</td>
<td>46</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>S. Franq.</td>
<td>56</td>
<td>53.6</td>
<td>47</td>
<td>1</td>
<td>0</td>
<td>48</td>
<td>0</td>
<td>48</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Established</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ashley</td>
<td>95</td>
<td>48.8</td>
<td>22</td>
<td>19</td>
<td>2</td>
<td>43</td>
<td>7</td>
<td>50</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chico</td>
<td>84</td>
<td>53.3</td>
<td>30</td>
<td>9</td>
<td>4</td>
<td>43</td>
<td>3</td>
<td>46</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Serr</td>
<td>100</td>
<td>52.2</td>
<td>41</td>
<td>6</td>
<td>2</td>
<td>49</td>
<td>7</td>
<td>56</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Sunland</td>
<td>100</td>
<td>55.4</td>
<td>51</td>
<td>2</td>
<td>3</td>
<td>56</td>
<td>1</td>
<td>57</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Vina</td>
<td>78</td>
<td>51.2</td>
<td>40</td>
<td>3</td>
<td>0</td>
<td>43</td>
<td>2</td>
<td>45</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Tehama</td>
<td>89</td>
<td>53.1</td>
<td>41</td>
<td>3</td>
<td>1</td>
<td>45</td>
<td>5</td>
<td>50</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Amigo</td>
<td>100</td>
<td>48.9</td>
<td>22</td>
<td>12</td>
<td>4</td>
<td>38</td>
<td>11</td>
<td>49</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Pedro</td>
<td>84</td>
<td>53.1</td>
<td>43</td>
<td>3</td>
<td>0</td>
<td>46</td>
<td>1</td>
<td>47</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Howard</td>
<td>94</td>
<td>55.5</td>
<td>45</td>
<td>5</td>
<td>0</td>
<td>50</td>
<td>1</td>
<td>51</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chandler</td>
<td>96</td>
<td>57.2</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>3</td>
<td>53</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Cisco (66-178)</td>
<td>89</td>
<td>54.3</td>
<td>36</td>
<td>6</td>
<td>0</td>
<td>42</td>
<td>3</td>
<td>45</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Selections</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UC 67-11</td>
<td>98</td>
<td>52.1</td>
<td>42</td>
<td>5</td>
<td>2</td>
<td>49</td>
<td>3</td>
<td>52</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>UC 67-13</td>
<td>100</td>
<td>55.6</td>
<td>42</td>
<td>2</td>
<td>1</td>
<td>45</td>
<td>5</td>
<td>50</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>UC 76-80</td>
<td>100</td>
<td>55.1</td>
<td>44</td>
<td>5</td>
<td>0</td>
<td>49</td>
<td>1</td>
<td>50</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

a Relative light intensity
b Other damage: mold, insects and black
TABLE 7. CULTIVAR AND SELECTION FIELD STUDIES

Walnut Cultivar and Selection Performance in High Density Configuration
Principal Investigator: G. Steven Sibbett
Cooperator: L. Bennett
Location: Visalia, California
Established: 1983

Design: 15 cultivars or selections (Ashley, Amigo, Chandler, Chico, Hartley, Howard, Payne, Pedro, Serr, Sunland, Tehama, Vina, UC 76-11, UC 67-13 and UC 68-104) were planted in 9 tree plots (20’ x 10’ spacing, 3 trees per row by 3 rows wide) replicated 3 times.

Evaluations: Bloom characteristics, yield, nut quality and vegetative growth characteristics

Publications: Walnut Research Reports

Walnut Cultivar Performance in High Density Configuration
Principal Investigator: Wilbur O. Reil
Cooperator: C. McNamara
Location: Winters, California
Established: 1984 and 1985

Design: 5 cultivars (Chico, Vina, Chandler, Howard and Amigo) were planted at two spacings (18’ x 9; and 22’ x 11’). Rows oriented east-west.

Evaluations: Yield, nut quality and vegetative growth characteristics.

Publications: Walnut Research Reports

Walnut Cultivar and Selection Performance in High Density Configuration
Principal Investigator: Wilbur O. Reil
Cooperator: J. Fukumoto
Location: Winters, California
Established: 1985

Design: 14 cultivars (Amigo, Ashley, Chandler, Chico, Howard, Payne, Pedro, Sunland, Tehama, Vina, UC 67-11, UC 67-13, UC 68-104 and Cisco [UC-178, established 1987]) were planted at 22’ x 11’ spacing. Ten tree plots are replicated 4 times.

Evaluations: Bloom characteristics, yield, nut quality and vegetative growth characteristics.

Publications: Walnut Research Reports

Walnut Cultivar and Selection Performance
Principal Investigator: Lonnie Hendricks
Cooperator: B. Crane
Location: Merced, California
Established: 1978

Design: 10 cultivars (Chandler, Chico, Howard, Serr, Sunland, Tehama, UC 59-124, UC 60-119, UC 63-396 and UC 64-57) were planted at 28’ x 28’ spacing.

Evaluations: Bloom characteristics, yield and nut quality.

Publications: Walnut Research Reports
Walnut Cultivar and Selection Performance
Principal Investigator: Lonnie C. Hendricks
Cooperator: B. Crane
Location: Merced, California
Established: 1987
Design: 10 cultivars and selections (Chandler, Cisco [UC 66-178], UC 67-11, UC 67-13, UC 68-104, UC 76-39, UC 76-80, UC 76-112, UC 77-12, UC 78-57) were at standard spacing. 1990 UC 72-36 and 77-10 added.
Evaluations: Leafing date, bloom characteristics, yield and nut quality.
Publications: Walnut Research Reports

Selection Performance
Principal Investigator: Lonnie C. Hendricks
Cooperator: G. Schmidt
Location: Merced, California
Established: 1985
Evaluations: Yield, nut quality and vegetative growth characteristics.
Publications:

Cultivar and Selection Performance in Coastal Valley Region
Principal Investigator: William H. Coates
Cooperator: Multiple
Location:
Design: 7 cultivars and selections (Payne, Serr, Howard, Chandler, Pedro, Hartley and UC 64-57) established in standard plantings.
Evaluations: Leafing date, bloom characteristics, blight susceptibility, yield and nut quality.
Publications:

Walnut Cultivar and Selection Performance
Principal Investigator: Kathleen M. Kelley
Cooperator: W. Deardorff
Location: Hickman, California
Established: 1984
Design: 15 cultivars and selections (Amigo, Chandler, Howard, Marchetti, Pedro, Cisco [UC 66-178], UC 67-11, UC 67-13, UC 68-104, UC 76-80, UC 76-98, UC 76-112, UC 77-12, UC 78-10 and UC 78-189) were established in a standard planting.
Evaluations: Leafing date, bloom characteristics, yield, nut quality and vegetative growth characteristics.
Publications:

Cultivar Performance
Principal Investigator: William H. Olson
Cooperator: E. Skinner
Location: Durham, California
Established: 1980 and 1981
Design: 4 cultivars (Chandler, Howard, Cisco [UC 66-178], and Scharsch Franquette) were established in a standard planting. Chandler and Howard trees alternate in the two rows evaluated. Cisco (UC 66-178) and Scharsch Franquette are located in close proximity.
Evaluations: Catkin and pistillate bloom dates, yield and nut quality.
Publications: Walnut Research Reports

Cultivar and Selection Performance
Principal Investigator: William H. Olson
Cooperator: William Stuke
Location: Gridley, California
Established:
Design: 4 cultivars and selections (Cisco [UC 66-178], UC 67-11, UC 67-13, UC 68-104) were established in limited numbers in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom period, yield estimate and relative tree vigor.

Publications:

Cultivar Performance
Principal Investigator: William H. Olson
Cooperator: C.S.U. Chico
Location: Chico, CA
Established: 1987
Design: Cultivar Cisco (UC 66-178) was established as a pollenizer in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative vigor.

Publications:

Cultivar Performance
Principal Investigator: Daniel M. Irvin
Cooperator: C. Dunlap
Location: West Point, California
Established: 1985
Design: Cultivar Cisco (UC 66-178) was established in limited numbers as a pollenizer in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative tree vigor.

Publications:

Cultivar Performance
Principal Investigator: Joseph A. Grant
Cooperator: J. Gotelli
Location: Stockton, California
Established: 1987
Design: Cultivar Cisco (UC 66-178) was established on 10 trees as a pollenizer in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative tree vigor.

Publications:

Selection Evaluation
Principal Investigator: Kathleen M. Kelley
Cooperator: R. Driver
Location: Modesto, California
Established: 1987
Design: 6 selections (UC 59-165, UC 63-378, UC 67-11, UC 67-13, UC 68-104 and UC 75-74) were established in limited numbers in a standard planting.

Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative tree vigor.

Publications:

Selection Performance
Principal Investigator: Janine K. Hasey
Cooperator: J. Conant
Location: East Nicolaus, California
Established: 1984
Design: Selection UC 67-11 was established on 50 trees in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom period, yield estimate and relative tree vigor.

Publications:

Selection Performance
Principal Investigator: G. Steven Sibbett
Cooperator: R. Waite
Location: Bakersfield, California
Established: 1988
Design: Selection UC 67-13 was established on approximately 200 trees in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative tree vigor.

Publications:

Cultivar Performance
Principal Investigator: Joseph W. Osgood
Cooperator: R. Darrow
Location: Vina, California
Established: 1988
Design: Cultivar Cisco (UC 66-178) was established on a limited number of trees as a pollenizer in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimates and relative tree vigor.

Publications:

Selection Performance
Principal Investigator: Joseph W. Osgood
Cooperator: J. Repanich
Location: Corning, California
Established: 1984
Design: Selection UC 67-11 was established on a limited number of trees in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative tree vigor.

Publications:
Cultivar Performance
Principal Investigator: Joseph W. Osgood
Cooperator: W. Sartori
Location: Cottonwood, California
Established: 1984
Design: Cultivar Cisco (UC 66-178) was grafted as a pollenizer in a standard planting
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative tree vigor
Publications:

Cultivar Performance in High Density Configuration
Principal Investigator: G. Steven Sibbett
Cooperator: L. Bennett
Location: Visalia, California
Established: 1987
Design: Cultivar Cisco (UC 66-178) was established on 2 trees as a pollenizer in a 20' x 10' hedgerow planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimates and relative tree vigor.
Publications:

Cultivar and Selection Performance in High Density Configuration
Principal Investigator: Wilbur O. Reil
Cooperator: David Scheuring
Location: Guinda, Yolo County, California
Established: 1989
Design: 10 cultivars (Chandler, Cisco, 67-11, 67-13, 72-13, 76-80, 77-10, 77-12, 78-10, 78-189) were planted 11' x 22'. Four tree plots are replicated three times on two different rootstocks (Northern California Black walnut and Paradox). Observation plantings of four other varieties (76-98, Lara, Ronde Montignac, Meylannaise) are also present. Eight acres of 67-13 are planted by trial. UC 72-36 added in 1990.
Evaluations: Bloom, characteristics, yield, nut quality and vegetative growth characteristics.
Publications:

Cultivar Performance
Principal Investigator: Joseph A. Grant
Cooperator: J. Gotelli
Location: Stockton, California
Established: 1987
Design: Cultivar Cisco (UC 67-178) was established on 10 trees as a pollenizer in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative tree vigor.
Publications:
Selection Evaluation
Principal Investigator: Kathleen M. Kelley
Cooperator: R. Driver
Location: Modesto, California
Established: 1984
Design: 6 selections (UC 59-165, UC 63-378, UC 67-11, UC 67-13, UC 68-104 and UC 75-74) were established in limited numbers in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimates and relative tree vigor.
Publications:

Cultivar and Selection Performance
Principal Investigator: Kathleen M. Kelley
Cooperator: Burchell Nursery
Location: Stanislaus County, California
Established: 1988
Design: Cultivar Cisco (UC 66-178) and selection UC 67-13 were established in limited numbers in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative tree vigor.
Publications:

Selection Performance
Principal Investigator: Janine K. Hasey
Cooperator: J. Conant
Location: East Nicolaus, California
Established: 1984
Design: Leafing date, pistillate and catkin bloom period, yield estimate and relative tree vigor.
Publications:

Selection Performance
Principal Investigator: G. Steven Sibbett
Cooperator: R. Waite
Location: Bakersfield, California
Established: 1988
Design: Selection UC 67-13 was established on approximately 200 trees in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative tree vigor.
Publications:

Cultivar Performance
Principal Investigator: Joseph W. Osgood
Cooperator: R. Darrow
Location: Vina, California
Established: 1988
Design: Cultivar Cisco (UC 66-178) was established on a limited number of trees as a pollinizer in a standard planting.

Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimates and relative tree vigor.

Publications:

Selection Performance
Principal Investigator: Joseph W. Osgood
Cooperator: J. Repanich
Location: Corning, California
Established: 1984
Design: Selection UC 67-11 was established on a limited number of trees in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative tree vigor.
Publications:

Cultivar Performance
Principal Investigator: Joseph W. Osgood
Cooperator: W. Sartori
Location: Cottonwood, California
Established: 1984
Design: Cultivar Cisco (UC 66-178) was grafted as a pollinizer in a standard planting.
Evaluations: Leafing date, pistillate and catkin bloom periods, yield estimate and relative tree vigor.
Publications:

Cultivar and Selection Performance
Principal Investigator: William H. Coates
Cooperator: N. Zanella
Location: Hollister, California
Established: 1990
Design: 1 cultivar and 6 selections (Cisco, UC 67-11, UC 67-13, UC 76-80, UC 77-12, UC 78-10 and UC 78-189) were established in a standard planting.
Evaluations: Leafing date, bloom characteristics, yield, nut quality, and vegetative growth characteristics.
Publications:

Walnut Selection Performance
Principal Investigator: Joseph A. Grant
Cooperator: B. Vink
Location: Tracy, California
Established: 1990
Design: UC 67-11 established in limited numbers for field evaluation.
Evaluations: Leafing date, pistillate and catkin bloom period, yield estimate and relative vigor.
Publications:
### TABLE 8. ROOTSTOCK FIELD STUDIES

#### Walnut Rootstock Performance
Principal Investigator: Lonnie C. Hendricks  
Cooperator: W. Linville  
Location: Gustine, California  
Established: 1986  
Design: 5 rootstocks (J. regia Manregian seedlings, J. regia India seedlings, J. regia Amigo seedlings, J. hindsii Rawlins and Rawlins [Calvert] (Paradox) were planted in 5 tree plots replicated 3 times. Vina was budded onto the rootstocks in 1987 with Vina scions applied to failures in 1988.  
Publications:

#### Walnut Species Rootstock Performance
Principal Investigator: Janine K. Hasey  
Cooperator: J. Conant  
Location: Rio Oso, California  
Established: 1987  
Design: 7 rootstocks (J. californica seedlings, J. major seedlings, J. microcarpa seedlings, J. hindsii seedlings, clonal Paradox and J. ailanthifolia seedlings) grafted to Chandler were planted at a 25' x 25' spacing (except J. ailanthifolia established at a 12.5' x 25' spacing) in a randomized complete block design with 20 replicates.  
Evaluation: Survival, relative tree vigor, yield and nut quality.  
Publications:

#### Walnut Rootstock Performance Under "Dry Land" Management
Principal Investigator: John H. Foott  
Cooperators: M. Whitner and D. Van Steenwyk  
Location: Paso Robles, California  
Established: Rootstock - 1966 (Hartley to be grafted - 1989)  
Design: 5 rootstocks (J. regia Manregian seedlings, J. regia Amigo seedlings, J. regia India seedlings, J. hindsii Rawlins and Rawlins [Calvert] (Paradox) were planted in a completely randomized design with 5 tree plots replicated 5 times.  
Publications:

#### Walnut Rootstock Performance/Tolerance to Armillaria mellea
Principal Investigator: Kathleen M. Kelley  
Cooperator: M. Crow  
Location: Crows Landing, California  
Established: 1986 (grafted to Payne - 1988)  
Design: 4 rootstock (J. regia Manregian seedlings, J. hindsii Rawlins, Rawlins paradox and Pterocarya stenoptera [wingnut] seedlings) were
planted in 4 tree plots replicated 5 times. Payne was grafted to survivors in 1988.

Evaluation: Survival (tolerance to A. mellea) initial rootstock vigor, vigor of Payne grafted trees, yield and nut quality.

Publications:

**Walnut Species Rootstock Performance/Tolerance to A. mellea**
Principal Investigator: Wilbur O. Reil
Cooperator: C. McNamara
Established: 1986
Evaluation: Survival (tolerance to A. mellea), relative tree vigor.
Publications:

**Walnut High Density, Soil Modification and Rootstock Performance**
Principal Investigators: William H. Krueger and John P. Edstrom
Cooperator: Nickel's Estate Soils Laboratory
Location: Colusa County
Established: 1986
Design: 2 rootstocks (J. hindsii Rawlins and Rawlins paradox) grafted to either Chandler or Howard were planted in 5 trees plots replicated 6 times in a completely randomized design. Additionally one half of the plots were "slip plowed".
Evaluation: Relative tree vigor, yield and nut quality.
Publications:

**Walnut Rootstock Performance**
Principal Investigators: Joseph W. Osgood and Father Joseph
Cooperator: Trappist Monastery
Location: Vina, California
Established: 1986
Design: 4 rootstocks (J. regia Eureka, J. regia Manregian, clonal paradox and rooted Chandler) were established.
Publications:

**English Walnut Rootstock Performance**
Principal Investigator: Joseph A. Grant
Cooperator: James Ferrari
Location: Linden, California
Established: 1989
Design: 5 rootstocks (J. regia Manregian seedlings, J. regia Eureka seedlings, J. regia Spain seedlings, J. regia Ronde de Montignac seedlings, and J. regia Carne seedlings) established in a randomized complete block design.
Publications:
Design: 5 rootstocks (J. regia Manregian seedlings, J. regia Eureka seedlings, J. regia Spain seedlings, J. regia Ronde de Montignac seedlings and J. regia Corne seedlings grafted with Chandler were planted in 5 tree plots replicated 3 times.
Evaluation: Relative tree vigor, yield and nut quality.
Publications:

Walnut Rootstock Performance
Principal Investigator: Kathleen M. Kelley
Cooperators: James DeMartini (grower) and David Bonilla (nurseryman)
Location: Modesto, California
Established: 1989
Design: 7 rootstocks (J. regia Manregian seedlings, J. regia Eureka seedlings, J. regia Spain seedling, J. regia Ronde de Montignac seedlings, J. regia Corne seedlings, J. regia Serr seedlings and Paradox seedlings) grafted with Chandler were planted in 5 tree plots replicated 3 times.
Evaluation: Relative tree vigor, yield and nut quality.
Publications: