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

G. McGranahan, R. Snyder, D. Ramos, and H. Forde

ABSTRACT

During the 1989 growing season we evaluated 269 seedlings, 7 selections, 81 introductions and 14 cultivars for 23 traits associated with walnut phenology, yield and nut quality. The data has been compiled in a computer data base and is available to farm advisors and growers on request. Summaries of the performance of selected cultivars and French introductions are provided in this report. Brief descriptions of selections advancing towards release are also summarized. In addition, we have compiled and presented information on cultivar, selection, and rootstock evaluation statewide to allow us 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.)

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; dichogomy; 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'.
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: Cultivar performance at U.C. Davis (Tables 1 & 2) was relatively good this year. The improvement from last year was expressed by increased tree vigor, estimated yield, and kernel color. The improvement is attributed to favorable conditions during bloom and nut development. Water stress due to drought conditions continues to impact the U.C. walnut collections.

'Chandler' and 'Howard' shell strength continues to improve. It must be noted that the increase in shell mass has correspondingly created a relative decrease in the percent kernel.

Cultivars from the old U.C. "Variety" and "Selection" blocks have been established in a permanent cultivar collection at "Wolfskill Experimental Orchards". This collection was dedicated to Mr. William Stuke at a ceremony on March 22, 1989 and will be referred to as the "Stuke Collection" from now on.

Selections: Brief descriptions of currently evaluated U.C. selections are provided (Table 3). Seven selections are under evaluation at U.C. Davis or in county based field plots. Another twelve selections are being maintained for specific or unusual traits in the "Stuke Collection" at Wolfskill Experimental Orchards. Other selections, popular with growers in specific areas but not anticipated to be released, are also maintained but not evaluated.

U.C. 67-11 and U.C. 67-13 are closest to release and may be propagated so sufficient material will be available to growers. We continue to be concerned about the frequency of pistillate flower abscission in 67-13 (see Catlin and McGranahan Walnut Res. Reports, 1989).

Seedlings: The Serr/Forde seedlings have been discarded, delegated to a permanent collection or advanced to selection status with the exception of five that continue to be evaluated as potential pollinizers for 'Chandler', 'Howard' and 'Hartley'.

The 1986 and 1987 controlled crosses (designed to produce late leafing, protogynous pollinizers for 'Chandler', 'Howard' and 'Hartley') have continued in the evaluation process as planned. Seventy of the seventy-five 1986 seedlings have been selected and transplanted into a seedling block and will be evaluated for the 23 traits listed in the procedure section beginning in Spring 1990. The 1987 seedlings received the first leafing date evaluation and based on this data 110 of the 189 individuals will be transplanted for complete evaluation beginning in Spring 1991.

Introductions: Eighty-one introductions from China, France, India, Korea, Pakistan, Poland and USA regions are being evaluated as potential selections, rootstock or germplasm resources. Seven of the fifteen French I. regia clones were immediately designated as advanced selections due to the extensive evaluations conducted by E. Germain in France. Evaluations at U.C. Davis (Tables 4 & 5) show these French selections to be mid to late leafing. Several French
individuals demonstrate exceptional precocity with eight producing pistillate flowers in the second year after grafting and one of this group producing catkins. The Chinese J. regia clones leaf out before or with 'Payne' and two exhibited extreme precocity with pistillate and staminate bloom produced by graft wood buds in two propagation sites. The same clones have produced pistillate flowers and catkins in the second and third year after grafting, are 100% laterally fruitfulness and are very vigorous (first year shoots grew 10 to 15 feet). Additionally, the second and third year yields were rated high with high percent kernel (ranging from 52.4 to 69.7%) and large kernels (ranging from 9.1 to 11.8 gms), but shell strength and kernel color continue to be poor. The Polish clones are early leafing with moderate to poor walnut blight ratings. The rootstock introductions are either being maintained as germplasm, developed for field evaluation or have been established in field rootstock trials (Table 7).

**Field Trial Summaries:** Rootstock, cultivar and selection trials have been established by U.C. Cooperative Extension Farm Advisors in 9 counties (Tables 6 & 7). 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>
<thead>
<tr>
<th>Cultivars/Selections (Cross)</th>
<th>Leafing Date</th>
<th>Leafing DAP</th>
<th>Pollen Shedding 1st Peak</th>
<th>Pollen Shedding Last Peak</th>
<th>Pistillate Bloom 1st Peak</th>
<th>Pistillate Bloom Last Peak</th>
<th>Fruitful Laterals</th>
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*a"DAP" denotes "days after Payne".
*bCatkin abundance: 1 = no catkins, 9 = extremely dense catkin production
*cYield estimate: 1 = no walnuts, 9 = extremely high yield
*dBlight score: 1 = no sign of infection, 9 = extremely severe infection
Table 2. CULTIVAR AND SELECTION EVALUATIONS AT U. C. DAVIS (FALL 1989)

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<th>Cultivar</th>
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<th>Shell b Seal</th>
<th>Shell b Thickness (mm)</th>
<th>Weight-10 Sound Nuts</th>
<th>% Kernel 1989 avg.</th>
<th>Kernel Color Light</th>
<th>Kernel Shrive10 Random Nuts (%)</th>
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a "DAP" denotes "days after Payne".
b Shell Seal: percent with open seal under slight pressure.
c Shell Strength: 1 = strong, 4 = very weak.
d Kernel Fill: 3 = well, 7 = poor.
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 overall good rating in 1989. Harvests 2 weeks after Payne. Potential pollenizer for Vina. 67-11 an offspring of Serr continues to be evaluated for "pistillate flower drop" (PFA). (For 1989, UC 67-11 PFA ranged from 3 to 7% compared to 25% for Serr in the same orchard). Released under test agreement for field evaluations (standard and hedgerow plantings) in Butte, Merced, Stanislaus, Sutter, Tehama, Tulare and Yolo Counties.

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 1988 at U.C. Davis. Near homogomous 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 as a pollenizer for 'Chico'. UC 67-13 an offspring of Serr continues to be evaluated for "pistillate flower drop" (PFA) (in 1988, 67-13 PFA ranged from 68 to 96% compared to Serr PFA ranging from 82 to 83%; and in 1989, 67-13 PFA ranged from 23 to 26% compared to Serr PFA ranging from 34 to 35% in the same orchard). Released under test agreement in Butte, Kern, Merced, San Benito, Stanislaus, Tulare and Yolo Counties.

68-104
Leafs out 2 to 9 days before Hartley. Laterally fruitful (85%). Yields are average to excellent. Nut size is small, yet "percent kernel" is high. Kernel quality is variable. Harvests one week after Payne. Appears to yield in shaded areas of tree. Released under test agreement (standard and hedgerow plantings) in Butte, Merced, Stanislaus, Tulare 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 Merced, 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 Merced, 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 Stanislaus and Yolo Counties.

78-189  Leafs out from 1 day before to 7 days after Hartley. Protogynous, nearly homogamous. Potential pollenizer for Chandler, Howard and Hartley. Laterally fruitful (75%). Yield is average. Nut size is small. Kernel quality is excellent with average "percent kernel" ratings. Advanced to selection status in 1988. Released under test agreement in Stanislaus and Yolo Counties.
### TABLE 4. FRENCH INTRODUCTION EVALUATIONS AT U.C. DAVIS (SPRING 1989)

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<th>Cultivars/Selections (Cross)</th>
<th>Leafing Date</th>
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<th>Pollen Shedding 1st Peak</th>
<th>Last Peak</th>
<th>Last Abundance</th>
<th>Pistillate Bloom 1st Peak</th>
<th>Last Peak</th>
<th>Fruitful Laterals</th>
<th>Yield&lt;sup&gt;c&lt;/sup&gt;</th>
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<td>25</td>
<td>4/10</td>
<td>4/18</td>
<td>5/11</td>
<td>6</td>
<td>4/18</td>
<td>5/3</td>
<td>5/14</td>
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<tr>
<td><strong>French Introductions</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Verdot, RA 118 (---)</td>
<td>4/12</td>
<td>25</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>4/22</td>
<td>5/1</td>
<td>5/8</td>
<td>40</td>
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<tr>
<td>Solezé, RA 137 (---)</td>
<td>4/7</td>
<td>20</td>
<td>4/14</td>
<td>---</td>
<td>4/5</td>
<td>2</td>
<td>4/16</td>
<td>4/21</td>
<td>4/26</td>
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<td>Ronde de Montignac, RA 38-2 (---)</td>
<td>4/25</td>
<td>38</td>
<td>5/9</td>
<td>5/14</td>
<td>5/21</td>
<td>3</td>
<td>5/3</td>
<td>5/12</td>
<td>5/19</td>
<td>20</td>
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<tr>
<td>Meylannaïse, RA 1019 (---)</td>
<td>4/8</td>
<td>21</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>4/12</td>
<td>4/18</td>
<td>4/23</td>
<td>50</td>
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<tr>
<td>Chase D9, RA 494 (---)</td>
<td>3/26</td>
<td>8</td>
<td>4/6</td>
<td>4/10</td>
<td>4/13</td>
<td>4</td>
<td>4/9</td>
<td>4/12</td>
<td>4/19</td>
<td>30</td>
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<tr>
<td>**F. purpurea, RA 1088 (---)</td>
<td>3/26</td>
<td>8</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>4/8</td>
<td>4/11</td>
<td>4/18</td>
<td>40</td>
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<tr>
<td>J. cordiformis x J. regia, CR 1-1</td>
<td>4/1</td>
<td>14</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>---</td>
<td>1</td>
<td>---</td>
<td>--</td>
</tr>
<tr>
<td>J. nigra, NG 23 (---)</td>
<td>4/17</td>
<td>30</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>---</td>
<td>1</td>
<td>---</td>
<td>--</td>
</tr>
<tr>
<td>J. major, NG 209 (---)</td>
<td>4/2</td>
<td>15</td>
<td>4/28</td>
<td>5/2</td>
<td>5/5</td>
<td>3</td>
<td>4/30</td>
<td>5/7</td>
<td>5/15</td>
<td>20</td>
</tr>
<tr>
<td>J. hindsi, HD 6-15 (---)</td>
<td>3/31</td>
<td>13</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>---</td>
<td>1</td>
<td>---</td>
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<td><strong>French Selections</strong></td>
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<td></td>
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<tr>
<td>H 91-10 (Franquette x Payne)</td>
<td>3/30</td>
<td>12</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>4/7</td>
<td>4/13</td>
<td>4/19</td>
<td>90</td>
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<tr>
<td>H 91-37 (Franquette x Payne)</td>
<td>4/4</td>
<td>17</td>
<td>4/27</td>
<td>---</td>
<td>4/29</td>
<td>2</td>
<td>4/9</td>
<td>4/20</td>
<td>5/1</td>
<td>70</td>
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<tr>
<td>H 94-11 (Franquette x Lara)</td>
<td>4/9</td>
<td>22</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>4/17</td>
<td>4/28</td>
<td>5/4</td>
<td>50</td>
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<tr>
<td>H 94-12 (Franquette x Lara)</td>
<td>4/11</td>
<td>24</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>4/19</td>
<td>4/26</td>
<td>5/6</td>
<td>40</td>
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<tr>
<td>H 92-53 (Franquette x Ashley)</td>
<td>4/7</td>
<td>20</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>4/18</td>
<td>4/26</td>
<td>5/2</td>
<td>50</td>
</tr>
<tr>
<td>H 93-9 (Franquette x Pedro)</td>
<td>4/15</td>
<td>28</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>4/29</td>
<td>5/5</td>
<td>5/11</td>
<td>40</td>
</tr>
<tr>
<td>H 97-13 (Solèze x Lara)</td>
<td>4/8</td>
<td>21</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>4/13</td>
<td>4/22</td>
<td>5/2</td>
<td>60</td>
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</tbody>
</table>

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

<sup>b</sup>Catkin abundance: 1 = no catkins, 9 = extremely dense catkin production

<sup>c</sup>Yield estimate: 1 = no walnuts, 9 = extremely high yield

<sup>d</sup>Blight score: 1 = no sign of infection, 9 = extremely severe infection
Table 5. FRENCH INTRODUCTION EVALUATIONS AT U.C. DAVIS (FALL 1989)

<table>
<thead>
<tr>
<th>Cultivar/Selections</th>
<th>Harvest Date</th>
<th>DAP</th>
<th>Shell Seal</th>
<th>Shell Strength</th>
<th>Shell Thickness (mm)</th>
<th>Weight - 10 Sound Nuts (gms)</th>
<th>In-Shell Kernel (gms)</th>
<th>% Kernel Fill</th>
<th>Kernel Color - 10 Random Nuts (%)</th>
<th>Kernel Shrivel - 10 Random Nuts (%)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soleze, RA 137</td>
<td>9/23</td>
<td>8</td>
<td>1</td>
<td>1.6</td>
<td>138.7</td>
<td>61.8</td>
<td>44.6</td>
<td>6</td>
<td>100</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Bonde de Montignac, RA 38-2</td>
<td>9/28</td>
<td>13</td>
<td>3</td>
<td>2.1</td>
<td>122.0</td>
<td>60.3</td>
<td>49.4</td>
<td>4</td>
<td>100</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Meylanaise, RA 1019</td>
<td>9/24</td>
<td>9</td>
<td>5</td>
<td>1.5</td>
<td>115.1</td>
<td>46.1</td>
<td>40.1</td>
<td>6</td>
<td>100</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Chase D9, RA 494</td>
<td>9/20</td>
<td>5</td>
<td>2</td>
<td>1.6</td>
<td>155.3</td>
<td>78.7</td>
<td>50.7</td>
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<td>70</td>
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<td>10</td>
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<tr>
<td>Sibisel-39, RA 948</td>
<td>9/22</td>
<td>7</td>
<td>1</td>
<td>1.5</td>
<td>199.2</td>
<td>87.8</td>
<td>44.1</td>
<td>4</td>
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<tr>
<td>Geisenheim -139, RA 399-1</td>
<td>9/21</td>
<td>6</td>
<td>1</td>
<td>1.9</td>
<td>164.4</td>
<td>66.0</td>
<td>40.1</td>
<td>6</td>
<td>100</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>J. purpurea, RA 1088</td>
<td>9/18</td>
<td>3</td>
<td>1</td>
<td>1.8</td>
<td>114.0</td>
<td>56.2</td>
<td>49.3</td>
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<td>RED</td>
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<tr>
<td>J. cordiformis x J. regia, CR 1-1</td>
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<td></td>
<td></td>
<td>J. cordiformis x J. regia, CR 1-1</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Lara, RA 480</td>
<td>9/20</td>
<td>5</td>
<td>30</td>
<td>2.2</td>
<td>180.9</td>
<td>84.5</td>
<td>46.7</td>
<td>5</td>
<td>90</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>J. nigra, NG 23</td>
<td>9/20</td>
<td>5</td>
<td>2</td>
<td>1.5</td>
<td>136.5</td>
<td>65.4</td>
<td>47.9</td>
<td>5</td>
<td>80</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>J. major, NG 209</td>
<td>9/20</td>
<td>5</td>
<td>2</td>
<td>1.5</td>
<td>169.6</td>
<td>82.0</td>
<td>48.3</td>
<td>5</td>
<td>90</td>
<td>10</td>
<td>20</td>
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<tr>
<td>J. hindtii, HD 6-15</td>
<td>9/20</td>
<td>5</td>
<td>2</td>
<td>1.5</td>
<td>136.5</td>
<td>65.4</td>
<td>47.9</td>
<td>5</td>
<td>80</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

- **DAP** denotes "days after Payne".
- **Shell Seal**: percent with open seal under slight pressure.
- **Shell Strength**: 1 = strong, 4 = very weak.
- **Kernel Fill**: 3 = well, 7 = poor.
TABLE 6. 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: 13 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 76-121, UC 77-12, UC 78-1, UC 78-57 and UC 78-82) were planted at standard spacing.
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:
Established:
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: 1987
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: Daniel M. Irving
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 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 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 pollinator 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.
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 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:
TABLE 7. 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, Paradox 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. Whitmer and D. Van Steenwyk
Location: Paso Robles, California
Established: Rootstock - 1986 (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 rootstocks (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 tree 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 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: