

CALIFORNIA 2007 ANNUAL REPORT OF NC-140 COOPERATIVE REGIONAL PROJECT

PROJECT: NC-140, California

COOPERATING AGENCIES AND PRINCIPAL LEADERS:

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Objective 1. ROOTSTOCK – ENVIRONMENT INTERACTIONS

PROGRESS OF THE WORK AND PRINCIPAL -ACCOMPLISHMENTS

2001 Red Top Peach Rootstock Planting

Trees removed in January 2007

2002 Redhaven Peach Rootstock Planting

Trees removed in January 2007

1999 Fuji Apple Rootstock Planting

Data are no longer being collected from this trial.

2003 Golden Delicious Apple Rootstock Planting

In order to maximize fireblight pressure in this block, we have not cut out shoot strikes. Every tree has had some strikes for the past 3 years. As a result many trees have died, particularly those on standard rootstocks. More than half the trees on M26 and M9 (including both T337 and Pajam 2 clones) have died (Table 1). Five more (4 on M9, 1 on M26) succumbed in 2007. In addition, six trees on experimental rootstocks died in 2007. Two of these were on B9, an extremely weak tree under California conditions. The trees probably didn't die from fireblight, but just grew weaker and weaker every year. The remaining B9 trees will succumb soon. Of the other four trees that died in 2007, two broke off below the graft union. One was on CG 5935 and broke under a heavy fruit load. The other was quite a large tree on CG 4210 and broke during heavy winds in October. Both trees were healthy looking before they broke. A third tree broke right at the graft union. It was on PiAu 51-11 and also appeared healthy before it snapped under a heavy crop load. The final tree that died in 2007 was on JM 2 and it collapsed suddenly mid season, typical of what happens to the M9 and M26 trees when they die from fireblight. Thus, the experimental rootstocks have generally survived fireblight quite well, especially the CG series stocks.

There is a great deal of variability in tree size in this trial. B9 and J-TE-G are very small and weak and barely surviving. At the other extreme are some very vigorous trees (JM 2, PiAu 51-4, PiAu 56-83) that are clearly not dwarfing and too large for this planting. In between are

many rootstocks that are dwarfing or semidwarfing and continue to show promise as productive and disease resistant trees.

Table 1. 2003 NC-140 Golden Delicious apple rootstock planting at the Kearney Ag Center – 2007 tree survival, yield, fruit weight and trunk circumference measurements.

| Rootstock | # Planted | # Died in 2005 | # Died in 2006 | # Died in 2007 | 2007 Yield (kg/tree) | 2007 Fruit Weight (g) | 10/07 Trunk Circumference (cm) |
|-----------------------------|-----------|----------------|----------------|----------------|----------------------|-----------------------|--------------------------------|
| B.9 | 8 | 0 | 2 | 2 | 0.1 e | 113 e | 7.4 g |
| Bud.62-396 | 8 | 0 | 1 | 0 | 1.5 e | 156 de | 13.4 fg |
| CG.3041 | 8 | 0 | 0 | 0 | 1.8 de | 152 de | 17.9 e-g |
| CG.4210 | 7 | 0 | 0 | 1 | 7.1 b-d | 180 a-d | 30.7 cd |
| CG.5179 | 8 | 0 | 0 | 0 | 5.2 b-c | 175 b-c | 18.9 e-g |
| CG.5935 | 8 | 0 | 0 | 1 | 3.8 c-e | 167 c-e | 22.7 d-f |
| G.16 | 18 | 0 | 0 | 0 | 7.9 bc | 176 b-c | 23.1 d-f |
| JM.1 | 7 | 0 | 0 | 0 | 2.8 c-e | 194 a-c | 24.4 c-e |
| JM.2 | 7 | 0 | 0 | 1 | 14.0 ab | 219 ab | 39.7 a |
| JM.4 | 8 | 0 | 0 | 0 | 7.4 ab | 182 a-d | 32.4 b-d |
| JM.5 | 5 | 0 | 0 | 0 | 17.8 a | 192 a-d | 37.7 a-c |
| JM.7 | 7 | 0 | 0 | 0 | 5.3 b-c | 200 a-c | 24.6 c-e |
| JM.8 | 7 | 0 | 0 | 0 | 3.8 c-e | 184 a-d | 23.6 c-e |
| JM.10 | 4 | 0 | 0 | 0 | 6.5 b-e | 201 a-c | 34.8 a-c |
| J-TE-G | 7 | 1 | 0 | 0 | 1.4 e | 162 c-e | 9.3 g |
| J-TE-H | 8 | 0 | 0 | 0 | 3.1 c-e | 174 b-e | 20.4 d-f |
| M.26 | 18 | 11 | 1 | 0 | 4.5 b-e | 172 b-e | 23.4 c-f |
| M.9Pajam2 | 8 | 1 | 3 | 0 | 3.8 c-e | 180 a-e | 19.8 d-g |
| M.9T337 | 18 | 4 | 3 | 4 | 4.3 c-e | 179 b-e | 16.3 e-g |
| PiAu 36-2 | 3 | 0 | 0 | 0 | 7.1 b-e | 228 ab | 34.3 a-d |
| PiAu 51-11 | 8 | 0 | 1 | 1 | 2.8 c-e | 158 de | 23.3 d-f |
| PiAu 51-4 | 7 | 0 | 0 | 0 | 17.8 a | 213 ab | 39.6 a |
| PiAu 56-83 | 8 | 0 | 3 | 0 | 15.6 a | 232 a | 38.7 ab |
| G Smith/M26 (Pollenizer) | 20 | 3 | 3 | 1 | - | - | - |
| Total | 215 | 20 | 17 | 11 | | | |

Related Rootstock Work

The peach rootstock breeding program includes a large number of selections from a wide array of crosses. In 2001, several of these with O’Henry peach grafted on top looked to be extremely promising. The trees ranged in size from very dwarfing to semi dwarfing and all had excellent fruit size. More than 20 of these have been identified and were planted in a large replicated trials in 2003, 2004 and 2005. Several are going out in grower trials in 2007 and 2008.

WORK PLANNED FOR NEXT YEAR: Data collection and rootstock evaluation will continue in 2008 following guidelines established by the NC-140 Technical Committee.

2005 Bartlett Pear Rootstock Planting

1) North Coast - Talmage, Mendocino County; Cole loam (Tables 2-4)

As of 2007, survival rate has been good for most stocks. Exceptions are Fox 11 (2 dead) and Pyro 2-33 (3 dead). These were all small trees at planting ($\leq 1/2$ ") and all died in 2005 or 2006. One 708-36 (1/2") and one Pyrodwarf (1/2") also died in 2006. 2006 was a very late, wet year (51 inches of rain in Ukiah Valley), which likely affected survival of weaker trees, both due to excessively wet soil and heavy summer annual weed growth, e.g. pigweed.

Horner 4 and OHF69 have the largest circumference; Horner 4 is significantly taller than others. OHF69, Horner 4, OHF87, Pyrodwarf and 708-36 had the most flower clusters and 708-36 and OHxF 87 the most fruit and highest yield efficiency. Fox 11 was the only rootstock with notable root suckers.

2) Sacramento Delta - Courtland, Yolo County; Sacramento Basin clay soil (Table 5)

As of December 2006, survival rate was greatest for Pyro 2-33 and Winter Nelis and lowest for BM2000 and 708-36 (3 dead for each). BM2000 had the most suckers. Trunk cross sectional area was 62% and height 39% greater than in Talmage, perhaps due to both prolonged wet weather in 2006 and closer in-row tree spacing in Talmage. There were no significant differences among rootstocks, although Fox 11 was the largest tree at this site versus the smallest in Mendocino County. 708-36 and Fox 11 had the most flower clusters (31 and 17, respectively) and fruit (6/tree) in 2007.

It will be interesting to continue observing differences due to soil type in the two sites.

2005 Golden Russet Bosc Pear Rootstock Planting

1) North Coast - Talmage, Mendocino County; Pinole-Yokayo-Redvine sandy loam (Tables 6-8)

Overall survival rate is less than for Bartlett although it was planted only one day later (April 21 vs. April 20). 14 trees have died, all in 2005 (12) and 2006 (2). Worst survival is for Fox 11 (4 dead) and BM2000 (3 dead); best is for Horner 4 and Pyrodwarf. There were no significant differences in growth parameters.

WORK PLANNED FOR NEXT YEAR: Data collection and rootstock evaluation will continue in 2008 following guidelines established by the NC-140 Technical Committee.

Other pear rootstock trials

1) North Coast - Lakeport, Lake County, California; Cole clay loam soil

A 13-year study (1993-2002, 2005) comparing nine rootstocks and five training systems was completed in 2005. Tatura trellis combined with OHxF69 rootstock yielded significantly more than the 53 remaining combinations and had the greatest overall gross economic return based on yield and fruit size. The information from this trial is on a separate handout.

Table 2: Effects of 2005 NC-140 rootstock planting on tree survival of less than 12 month old Bartlett pear trees, Talmage, California, 2005.

| Rootstock | No. Died in 2005 | Tree Survival 4/18/06 (%) | No. Trees Remaining |
|-----------|------------------|---------------------------|---------------------|
| 708-36 | 0 | 100 | 10 |
| BM 2000 | 0 | 100 | 10 |
| Horner-4 | 0 | 100 | 10 |
| Fox 11 | 2 | 80 | 8 |
| OHxF 69 | 0 | 100 | 10 |
| OHxF 87 | 0 | 100 | 10 |
| Pyrodwarf | 0 | 100 | 10 |
| Pyro 2-33 | 1 | 90 | 9 |

Table 3: Effects of 2005 NC-140 rootstock planting on tree circumference, height, number of fruit, root suckers and tree survival of 1-year-old Bartlett pear trees, Talmage, California, 2006.

| Rootstock ¹ | Trunk X-Section 4/18/06 (cm ²) | Tree Height 4/18/06 (cm) | Fruit 10/30/06 (no./tree) | Root Suckers 10/30/06 (no./tree) | No. Died in 2006 | Tree Survival 10/30/06 (%) | No. Trees Remaining |
|------------------------|--|--------------------------|---------------------------|----------------------------------|------------------|----------------------------|---------------------|
| 708-36 | 2.5 bc | 122 abc | 0.0 | 0.0 | 1 | 90 | 9 |
| BM 2000 | 2.2 bc | 113 c | 0.0 | 0.1 | 0 | 100 | 10 |
| Horner-4 | 3.9 a | 134 ab | 0.0 | 0.0 | 0 | 100 | 10 |
| Fox 11 | 2.2 bc | 104 c | 0.1 | 0.1 | 0 | 80 | 8 |
| OHxF 69 | 3.5 a | 140 a | 0.0 | 0.1 | 0 | 100 | 10 |
| OHxF 87 | 3.1 ab | 118 bc | 0.0 | 0.1 | 0 | 100 | 10 |
| Pyrodwarf | 2.6 b | 107 c | 0.1 | 0.0 | 1 | 90 | 9 |
| Pyro 2-33 | 1.6 c | 104 c | 0.0 | 0.0 | 2 | 70 | 7 |
| ANOVA ² | | | | | | | |
| Rootstock | *** | *** | NS | NS | | | |
| Block | NS | NS | NS | NS | | | |

¹ Within columns, rootstock treatment means significantly different (Duncan multiple range test, $P \leq 0.05$).

² *, **, *** Indicate significance at $P \leq 0.05$, 0.01, and 0.001 respectively. NS indicates not significant $P > 0.05$.

Table 4: Effects of 2005 NC-140 rootstock planting on tree circumference, height, flower clusters, fruiting, root suckers, and tree survival of 2-year-old Bartlett pear trees, Talmage, California, 2007.

| Rootstock ¹ | Trunk X-section | Tree Height | Flower Clusters | Fruit (no./tree) | Yield | Root Suckers | Tree Survival | |
|------------------------|----------------------------|--------------|--------------------|------------------|--|---------------------|---------------|----------|
| | 2/05/07 (cm ²) | 2/05/07 (cm) | 4/16/07 (no./tree) | | Efficiency (no.fruit/cm ²) | 10/03/07 (no./tree) | 4/18/06 | 10/03/07 |
| | | | | | | | (%/10 trees) | |
| 708-36 | 4.6 b | 147 b | 5.6 ab | 8.5 a | 1.9 a | 0.0 ab | 100 | 90 |
| BM 2000 | 3.6 b | 156 b | 1.1 b | 1.6 b | .05 b | 0.1 ab | 100 | 100 |
| Horner-4 | 7.1 a | 189 a | 6.9 a | 6.6 ab | 0.9 ab | 0.0 b | 100 | 100 |
| Fox 11 | 3.6 b | 134 b | 3.6 ab | 5.5 ab | 1.6 ab | 0.4 a | 80 | 80 |
| OHxF 69 | 6.9 a | 156 b | 7.4 a | 6.2 ab | 0.9 ab | 0.1 ab | 100 | 100 |
| OHxF 87 | 5.4 ab | 145 b | 6.1 ab | 8.1 a | 1.5 ab | 0.0 b | 100 | 100 |
| Pyrodwarf | 4.8 b | 143 b | 5.9 ab | 6.0 ab | 1.2 ab | 0.0 ab | 100 | 90 |
| Pyro 2-33 | 3.5 b | 137 b | 2.1 ab | 3.5 ab | 1.1 ab | 0.0 b | 90 | 70 |

| ANOVA ² | | | | | | |
|--------------------|-----|-----|----|----|----|----|
| Rootstock | *** | *** | ** | ** | * | * |
| Block | NS | * | NS | NS | NS | NS |

¹ Within columns, rootstock treatment means significantly different (Tukeys HSD test, $P \leq 0.05$).

² *, **, *** Indicate significance at $P \leq 0.05$, 0.01, and 0.001 respectively. NS indicates not significant ($P > 0.05$).

Table 5: 2005 NC-140 rootstock effects on tree caliper, tree height, number of suckers, flower clusters and fruiting of 2-year-old Bartlett pear trees, Courtland, California, 2006-2007.

| Rootstock ¹ | Trunk X-Section | Tree Height | Tree Width | Root Suckers | Flower Clusters | Fruit |
|------------------------|----------------------------|--------------|--------------|--------------------|--------------------|--------------------|
| | 12/5/06 (cm ²) | 12/5/06 (cm) | 12/5/06 (cm) | 12/5/06 (no./tree) | 3/15/07 (no./tree) | 7/12/07 (no./tree) |
| 708-36 | 7.0 | 194 | 84.6 | 0.4 | 30.8 a | 5.8 a |
| BM 2000 | 8.1 | 241 | 94.2 | 0.8 | 9.8 b | 1.2 b |
| Horner-4 | 8.9 | 202 | 77.9 | 0.0 | 4.2 b | 1.0 b |
| Fox 11 | 9.2 | 223 | 88.6 | 0.6 | 17.2 ab | 6.4 a |
| OHxF 87 | 7.6 | 211 | 73.2 | 0.0 | 6.2 b | 2.4 b |
| Pyrodwarf | 6.8 | 201 | 70.9 | 0.3 | 10.1 b | 2.4 b |
| 2-33 | 5.9 | 183 | 64.3 | 0.0 | 4.8 b | 0.3 b |
| W. Nelis | 9.3 | 201 | 73.3 | 0.5 | 5.0 b | 1.6 b |

| ANOVA ² | | | | | | |
|--------------------|----|----|----|----|----|----|
| Rootstock | NS | NS | NS | NS | * | ** |
| Block | * | NS | * | NS | NS | NS |

¹ Within columns, rootstock treatment means significantly different (Fisher's LSD test, $P \leq 0.05$).

² *, **, *** Indicate significance at $P \leq 0.05$, 0.01, and 0.001 respectively. NS indicates not significant ($P > 0.05$).

Table 6: Effects of 2005 NC-140 rootstock planting on tree survival of less than 12 month old Bosc pear trees, Ukiah, California, 2005.

| Rootstock | No. Died in 2005 | Tree Survival 4/18/06 (%) | No. Trees Remaining |
|------------------|-------------------------|----------------------------------|----------------------------|
| 708-36 | 2 | 80 | 8 |
| BM 2000 | 3 | 70 | 7 |
| Horner-4 | 0 | 100 | 10 |
| Fox 11 | 3 | 70 | 7 |
| OHxF 69 | 2 | 80 | 8 |
| OHxF 87 | 1 | 90 | 9 |
| Pyrodwarf | 1 | 90 | 9 |
| Pyro 2-33 | 2 | 80 | 8 |

Table 7: Effects of 2005 NC-140 rootstock planting on tree circumference, height, number of fruit, root suckers and tree survival of 1-year-old Bosc pear trees, Talmage, California, 2006.

| Rootstock¹ | Trunk X-Section 4/18/06 (cm²) | Tree Height 4/18/06 (cm) | Fruit 10/30/06 (no./tree) | Root Suckers 10/30/06 (no./tree) | Tree Survival 10/30/06 (%) | No. Died in 2006 | No. Trees Remaining |
|------------------------------|---|---------------------------------|----------------------------------|---|-----------------------------------|-------------------------|----------------------------|
| 708-36 | 2.6 abc | 104 | 0.0 | 0.0 | 80 | 0 | 8 |
| BM 2000 | 1.5 c | 85 | 0.0 | 0.0 | 70 | 0 | 7 |
| Horner-4 | 3.6 a | 95 | 0.0 | 0.2 | 100 | 0 | 10 |
| Fox 11 | 1.7 bc | 90 | 0.0 | 0.0 | 60 | 1 | 6 |
| OHxF 87 | 3.1 ab | 113 | 0.1 | 0.1 | 80 | 0 | 8 |
| Pyrodwarf | 2.6 abc | 99 | 0.0 | 0.0 | 90 | 0 | 9 |
| Pyro 2-33 | 1.2 c | 94 | 0.0 | 0.0 | 80 | 1 | 8 |

ANOVA²

| | | | | |
|-----------|----|----|----|----|
| Rootstock | ** | NS | NS | NS |
| Block | NS | NS | NS | NS |

¹ Within columns, rootstock treatment means significantly different (Duncan multiple range test, $P \leq 0.05$, 0.01, and 0.001

² *, **, *** Indicate significance at $P \leq 0.05$, 0.01, and 0.001 respectively. NS indicates not significant $P > 0.05$.

Table 8: Effects of 2005 NC-140 rootstock planting on tree circumference, height, flower clusters, root suckers, and tree survival of 2-year-old Bosc pear trees, Ukiah, California, 2007.

| Rootstock¹ | Trunk X-Sect. 2/05/07 (cm²) | Tree Height 2/05/07 (cm) | Flower Clusters 4/16/07 (no./tree) | Fruit (no./tree) | Yield Efficiency (no.fruit/cm²) | Root Suckers 10/03/07 (no./tree) | Tree Survival 10/03/07 (%/10 trees) | No. Trees Remaining |
|------------------------------|---|---|---|-----------------------------|---|---|--|--------------------------------|
| 708-36 | 3.8 | 139 | 0.1 | 0.0 | 0.0 | 0.1 | 80 | 8 |
| BM 2000 | 2.7 | 127 | 0.3 | 0.6 | 0.3 | 0.0 | 70 | 7 |
| Horner-4 | 5.0 | 137 | 0.1 | 0.1 | 0.0 | 0.0 | 100 | 10 |
| Fox 11 | 3.4 | 142 | 0.2 | 0.7 | 0.1 | 0.0 | 60 | 6 |
| OHxF 87 | 4.9 | 136 | 0.5 | 1.5 | 0.3 | 0.0 | 80 | 8 |
| Pyrodwarf | 4.5 | 136 | 0.0 | 0.0 | 0.0 | 0.0 | 90 | 9 |
| Pyro 2-33 | 3.0 | 139 | 0.1 | 0.1 | 0.0 | 0.0 | 80 | 8 |
| ANOVA ² | | | | | | | | |
| Rootstock | NS | NS | NS | NS | NS | NS | NS | |
| Block | NS | NS | NS | NS | NS | NS | NS | |

¹ Within columns, rootstock treatment means significantly different (Tukeys HSD test, $P \leq 0.05$).

² *, **, *** Indicate significance at $P \leq 0.05$, 0.01, and 0.001 respectively. NS indicates not significant ($P \leq 0.05$).