

FINAL PROJECT REPORT

YEAR: 3 of 3

Project Title: Evaluation of potential, new pear cultivars for the PNW

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|---|---|
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Budget: **Year 1: \$12,578** **Year 2: \$17,334** **Year 3: \$11,952**

Cooperators: Kate Evans

Other funding sources: None.

Budget 1: Todd Einhorn

Organization Name: OSU-MCAREC

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Contract Administrator: Russell Karow

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| Item | 2015 | 2016 | 2017 |
|----------------------------|--------------|--------------|--------------|
| Salaries ¹ | 2,291 | 4,720 | 2,421 |
| Benefits | 1,535 | 3,162 | 1,629 |
| Wages ² | 0 | 0 | 500 |
| Benefits | 0 | 0 | 50 |
| Equipment | 0 | 0 | 0 |
| Supplies ³ | 500 | 500 | 500 |
| Travel | 0 | 0 | 0 |
| Miscellaneous ⁴ | 1,552 | 1,552 | 1,552 |
| Total | 5,878 | 9,934 | 6,652 |

Footnotes: ¹Salaries are calculated as 5% of technician time (2.5 weeks) in year 1 and 10% of technician time in years 2 and 3 (5 weeks). The increase in salary in year 2 reflects a 3% rate increase. Benefits are calculated using OPE rate of 66%. ²Wages are for part-time employee help harvesting fruit and general maintenance during the season; 80 hours at \$13/hr. Part-time employee benefits are calculated at 10%. ³Supplies are for tree training. ⁴Miscellaneous costs account for MCAREC plot fees at a rate of \$3,103/acre, prorated to 1/2 acre for field on-site field trials.

Budget 2: Tom Auvil

Organization Name: WTFRC

Telephone: 509-665-8271

Contract Administrator: Kathy Coffey

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| Item | 2015 | 2016 | 2017 |
|----------------------------------|-------------|-------------|-------------|
| Salaries | 3,000 | 3,500 | 2,000 |
| Benefits | 1,200 | 1,400 | 800 |
| Wages | 0 | 0 | 0 |
| Benefits | 0 | 0 | 0 |
| Equipment | 0 | 0 | 0 |
| Supplies | 1,000 | 1,000 | 1,000 |
| Travel¹ | 500 | 500 | 500 |
| Miscellaneous² | 1,000 | 1,000 | 1,000 |
| Total | 6,700 | 7,400 | 5,300 |

Footnotes: ¹Ten trips to Wapato/Dryden from mid-August through mid-Oct. ²RCA cold storage room charges.

Objectives:

1. To test five new scion selections from the USDA-ARS pear breeding program in small-scale plantings in WA and OR.
2. To test two new pear cultivars from Prevar, Australia, in medium-scale plantings in WA and OR.

Significant Findings:

Objective 1

- Objective 1 was discontinued after year 2; hence, data were not collected in 2017. The budget was reduced accordingly. This decision followed Dr. Richard Bell's (USDA-ARS) communication that all selections had tested positive for viruses. Consequently, information gleaned from these trial evaluations may not appropriately represent tree growth, productivity or fruit quality attributes of these genotypes in a 'virus-free' condition.
- Notable results from the first two years (3rd leaf and 4th leaf production) of observations pertained only to one selection, 84907-166, which flowered profusely, had similar yields as Bartlett and produced attractive fruit with high percentages of red blush.
- We continued to observe 84907-166 in 2017. Trees to produced ~150 fruit per tree (2017 was the 5th leaf). At this level of cropping, thinning would be required. Over-cropping resulted in small fruit (158 g); however, our previous data show fruit weight between 200-270 g at the appropriate crop load. Dr. Richard Bell submitted material to the Clean Plant Network to undergo therapy to produce virus free material.

Objective 2

- Tree growth in Hood River continued to be strong in 2017 (4th leaf) despite small tree sizes at planting and poor growth in the establishment year.
- The selection 0118 is an early-maturing genotype, harvested ~2 weeks before 'Bartlett' (Aug 3, 2017). Fruit size, however, continued to be small (~142 g) and did not improve between the first and second pick (~1 week apart). These data were nearly equivalent to 2016 (fruit weight ~135 g; ~150 fruit per box). Fruit were attractive with fairly extensive red blush (nearly 50% of surface area), good sugar concentration (13.9%) but low acidity (0.24 % TA).
- Following 2 months of RA storage, 0118 ripened to dessert quality (FF, 2.9 lb)
- 0131 is a late-harvest selection, ~2 to 3 weeks after 'Bartlett' (approx. 'd'Anjou' timing). 0131 was not nearly as precocious as 0118, producing only a few fruit per tree in 2016 and 2017. Despite low crop load, 2017 fruit were small (150 g; harvested August 31, 2017). In 2016, fruit size was larger (180 g). Ripening was not evaluated given the limited number of fruit harvested.
- Given the lack of fire blight in Australia and the lineage of 0131 and 0118, we field-inoculated both genotypes and compared to 'd'Anjou' (control). Inoculation with 2×10^7 colony forming units/mL suspension of *Erwinia amylovora* at bloom (April 29) resulted in 90% of 0131 and 0118 tree mortality; in comparison, no 'd'Anjou' trees died from inoculations.
- The combination of small fruit size and apparent fire blight sensitivity does not support additional evaluation of these selections in the PNW.

Results:

1. **USDA-ARS cultivars.** Four fire-blight tolerant, summer pear selections were evaluated from Dr. Richard Bell's breeding program: 69426-038 (038), 84907-069 (069), 84907-078 (078) and

84907-166 (166). These were compared to commercial standards ('Bartlett', 'Bosc' and 'd'Anjou'). In addition, 71655-014 ('Gem') was planted in WA. As previously discussed, all accessions tested positive for viruses. 'Gem' is currently undergoing virus therapy at the Clean Plant Network. After notification of virus status, evaluations ceased, with the exception of 166 where we performed limited observations in 2017.

Data are provided from 2015-2017 in tables below. For most selections, tree size was about 2/3rds the size of Anjou trees and similar or slightly smaller than 'Bartlett'. All trees were on OHxF 87. Selection 069 is a weak tree (~50% of 'Bartlett'); though, this should not be confused as beneficial dwarfing since trees appear to be in poor health. In Hood River, we observed a wide range of precocity among the four scions evaluated in the 3rd leaf (2015): 166 >> 038 = 069 > 078. In the fourth leaf, all scions bloomed at Anjou timing, except 166, which bloomed with Bartlett. Although 'Gem' was not included in this trial in Hood River, we have documented its bloom timing over 15 years to occur with 'Bartlett'. Fourth-leaf (2016) fruit set was highest for 078, followed by 069 and 166. Yields of these three selections were similar to 'Bartlett'. Fruit was not hand-thinned in the fourth leaf since crop loads were deemed adequate for tree sizes. Fruit maturity (to determine harvest timing) was monitored by FF weekly beginning mid-July based on preliminary data from 2015 and information from Dr. Richard Bell. Fruit size and quality was variable between sites and genotypes: Fruit size of 038 and 078 was small and unattractive at harvest and 069 had no appreciable distinguishing attributes compared to 'Bartlett'. Additionally, 078 was not precocious in 2015 compared to other selections. The only cultivar that appeared promising was 166 which had large fruit and produced yields similar to 'Bartlett' in OR. In WA, fruit size of 166 was small. In 2017, fruit was smaller than in 2016 but this was attributed to large cropload. Among years, fruit of 166 required different chilling in order to ripen to adequate firmness following a ripening treatment. Two months of RA storage were sufficient to satisfy chilling requirement in 2015 and 2017 (fruit softened to 3.3 lb after 7 d ripening) but not in 2016 (fruit did not soften below 6 lb), despite being harvested at lower pressure in 2016. Flavor profiles (informally evaluated) were quite similar to 'Bartlett' for all four selections.



Photos: An example of fruit from one replication of 166 following 2 months of RA storage (left) and after a 7 day ripening treatment at 68°F (right).

We previously documented 'Gem' storage and ripening behavior: Gem requires 30 days of chill to soften (Einhorn and Wang, 2016 *Journal of the American Pomological Society* 70 (1): 26-35).

2015, 3rd leaf bloom, fruit set, harvest data, and tree size of 4 USDA-ARS advanced selections in Hood River, OR compared to commercial standards.

| Cultivar | Full Bloom (date) | Flower clusters (no. per tree) | Fruit set (fruit per cluster) | Fruit after thinning (no. tree) | Harvest (date) | Fruit weight (g) | Fruit shape (length:width) | Firmness (lbf) | Trunk cross-sectional area (cm ²) |
|-----------|----------------------|-----------------------------------|----------------------------------|------------------------------------|-------------------|---------------------|-------------------------------|-------------------|--|
| 69426-038 | 2-Apr | 33 | 0.46 | 10.2 | 3-Aug | 144.8 | 1.44 | 12.4 | 17.2 |
| 84907-069 | 1-Apr | 35 | 0.11 | 4.6 | 3-Aug | 226.7 | 1.29 | 14.4 | 11.2 |
| 84907-078 | 2-Apr | 8 | 0.55 | n.d. | n.d. | n.d. | n.d. | n.d. | 17.1 |
| 84907-166 | 5-Apr | 91 | 1.43 | 35 | 4-Aug | 192.3 | 1.23 | 17.2 | 15.5 |
| | | | | | 29-Aug | 249.7 | 1.21 | 15.3 | |
| Anjou | 1-Apr | 5 | 0.1 | 0.8 | n.d. | n.d. | n.d. | n.d. | 23.1 |
| Bartlett | 5-Apr | 122 | 0.83 | 40.2 | 3-Aug | 222.4 | 1.29 | 18.9 | 20 |
| Bosc* | n.d. | 0 | n.d. | 0 | n.d. | n.d. | n.d. | n.d. | 2.8 |

n.d., no data

* Bosc trees were planted from small containers in 2015

2016, 4th leaf production for 4 USDA-ARS pear selections compared to standard cultivars at OSU- MCAREC, Hood River, OR.

| Genotype | Tunk size (cm ²) | Flower clusters (no./tree) | Fruits/cluster (%) | Harvest (date) | Yield/tree (no. fruit) | Fruit wt. (g) | SSC (%) | TA (%) | FF (lbs) |
|-----------|---------------------------------|-------------------------------|-----------------------|-------------------|---------------------------|------------------|------------|-----------|-------------|
| 69426-038 | 27.9 | 149 | 19.82 | 21-Jul | 27.4 | 131.36 | 12.6 | 0.3326 | 13.49 |
| 69426-038 | | | | 28-Jul | | 156.54 | 12.3 | 0.3039 | 12.18 |
| 84907-069 | 16.3 | 124.2 | 43.58 | 28-Jul | 37.2 | 215.82 | 11.7 | 0.3166 | 13.36 |
| 84907-069 | | | | 4-Aug | | 241.6 | 11.3 | 0.3125 | 12.94 |
| 84907-078 | 29.6 | 82.8 | 112.24 | 3-Aug | 59.6 | 193.92 | 12.3 | 0.3489 | 11.81 |
| 84907-166 | 25.6 | 115 | 37.86 | 3-Aug | 37.6 | 269.18 | 11 | 0.388 | 14.49 |
| Anjou | 40.8 | 34 | 10.95 | n.a. | 3.5 | | | | |
| Bartlett | 31.2 | 180 | 29.12 | 3-Aug | 44.8 | 275.78 | 12.2 | 0.3751 | 18.42 |
| Bosc | 6.0 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |

2017, 5th leaf production of '166' at OSU MCAREC, Hood River, OR.

| Cultivar | Harvest (date) | Yield/tree (no. fruit) | Fruit wt. (g) | FF (lb) | SSC (%) | TA (%) | Trunk size (cm ²) |
|-----------|-------------------|---------------------------|------------------|------------|------------|-----------|----------------------------------|
| 84907-166 | 9-Aug | 148 | 157.8 | 16.5 | 11.9 | 0.44 | 32.2 |

means based on 5 single-tree replicates.

2. Australian (Prevar) cultivars.

All trees were exceptionally small when planted in 2014. Despite limited growth during the establishment year, trees recovered and, in fact, grew vigorously in 2016 and 2017 in Hood River, OR.

0118 is an early-maturing cultivar, harvesting ~ 2 weeks prior to Bartlett. Fruit size, however, has been quite small (130-140 g), in the range of 'Seckel' or 'Forelle' in both 2016 and 2017. The parentage of both selections is 'Corella', which is closely related to 'Forelle'. Providing an additional week on the tree did not improve fruit size of 0118 in either year. 0131 is a later-maturing cultivar, which harvested ~ between two and three weeks after 'Bartlett (closer to Anjou timing). Fruit size was equivalent to 110 box size in 2016 but markedly smaller in 2017 (131 g), despite low fruit set. Although harvest pressure was ~3 lb higher in 2017 than 2016, fruit growth had ceased between the two harvest dates of Aug 23 and Aug 31. Fire blight infection and sampling to determine harvest maturity severely reduced fruit quantities for 2017 evaluations. SSC and TA levels at harvest were moderate in 2016.

2016, 3rd leaf production for two Prevar, Australian pear selections at OSU- MCAREC, Hood River, OR.

| Genotype | Tunk size (cm ²) | Flower clusters (no./tree) | Fruits/cluster (%) | Harvest (date) | Yield/tree (no. fruit) | Fruit wt. (g) | SSC (%) | TA (%) | FF (lbs) |
|----------|---------------------------------|-------------------------------|-----------------------|-------------------|---------------------------|------------------|------------|-----------|-------------|
| 118 | 16.3 | 4.9 | 154.9 | 21-Jul | 6.3 | 132.0 | 12.4 | 0.31 | 12.9 |
| 118 | | | | 28-Jul | | 134.3 | 12.4 | 0.31 | 10.4 |
| 131 | 14.3 | 7.6 | 98.5 | 18-Aug | 7.4 | 175.1 | 12.8 | 0.46 | 14.9 |
| 131 | | | | 24-Aug | | 180.6 | 12.0 | 0.40 | 13.4 |

Following 2 months of RA cold storage, fruit were assessed for quality and then exposed to a 7-day ripening treatment and evaluated for their ripened quality. 0118 fruits softened to acceptable dessert texture. 0131 fruits did not soften to a soft-buttery texture. 0131 has been characterized as a 'ready-to-eat' European pear. Results in 2017 were similar for 0118 but an insufficient quantity of 0131 precluded quality evaluations in 2017.

2016, 3rd leaf PH quality of Prevar, Australian pear selections at MCAREC, OR.

| Genotype | 2 months RA cold storage | | | + 7 days at room temp. | | |
|---------------|--------------------------|-----------|-------------|------------------------|-----------|-------------|
| | SSC (%) | TA (%) | FF (lbs) | SS (%) | TA (%) | FF (lbs) |
| 118 Harvest 1 | 13.2 | 0.34 | 11.0 | 13.6 | 0.29 | 3.3 |
| 118 Harvest 2 | 13.3 | 0.28 | 9.6 | 13 | 0.25 | 3.1 |
| 131 Harvest 1 | 13.5 | 0.50 | 15.1 | 14 | 0.50 | 6.1 |
| 131 Harvest 2 | 14 | 0.34 | 14.1 | 13.8 | 0.44 | 8.8 |

2017, 4th leaf production of Australian pear selections at OSU-MCAREC, Hood River, OR.

| Scion | Bloom (no. clusters) | Fruit set (no. fruit) | Fruit set (%) | Yield (lb/tree) | Avg. fruit wt. (g) | Fruit diameter (mm) | Fruit height (mm) | SSC (%) | TA (%) | FF (lb) |
|-------|-------------------------|--------------------------|------------------|--------------------|-----------------------|------------------------|----------------------|------------|-----------|------------|
| 118 | 59.76 | 45.65 | 74.6 | 9.4 | 142.4 | 75.68 | 61.68 | 13.7 | 0.28 | 12.62 |
| 131 | 60.3 | 9.1 | 14.7 | | 130.9 | 73.7 | 61.9 | | | 17.01 |

data are means of four multi-tree replicates; fire blight spread from inoculated trees, infecting many 131 trees limiting yield and quality data 0118 trees were harvested on Aug 3 and Aug 9 (data shown for Aug 3), 131 were harvested Aug 23 and Aug 31 (data shown for Aug 31)

Given that 'Corella' is a parent of 0118 and 0131, we were concerned that these selections may be susceptible to fire blight. One L of suspension (2×10^7 colony forming units/mL suspension of *Erwinia amylovora*) was fogged onto trees (both selections plus 'd'Anjou' trees of the same age and location) at daybreak the morning of April 29 (courtesy of Drew Hubbard). All trees were considered to be within 1-2 d of full bloom. The infection risk was moderate according to the Cougarblight model. Inoculation resulted in high infection rates and 90% tree mortality for both 0131 and 0118; in comparison, no 'd'Anjou' trees died from inoculations. 'd'Anjou' had a significantly lower percentage of strikes than either 0131 or 0118 (roughly half). Application of Acitgard reduced the percentage of strikes but did not significantly affect lesion length or tree mortality.

2017 fire blight (*E. amylovora*) inoculation in the field (MCAREC). Trees were at full bloom

| Selection | Treatment | Strikes (no./tree) | stdev | Strikes (%) | stdev | Mortality (no. of trees) |
|-----------|-----------|-----------------------|-------------|----------------|-------------|-----------------------------|
| 131 | utc | 52.4 | a 6.542171 | 0.352434 | a 0.056922 | 4 |
| 131 | actigard | 34.8 | ab 7.120393 | 0.205632 | b 0.017778 | 3 |
| 118 | utc | 40.2 | ab 20.25339 | 0.369294 | a 0.102871 | 5 |
| 118 | actigard | 26.6 | b 9.289779 | 0.26014 | ab 0.085872 | 3 |
| Anjou | utc | 29.2 | b 12.51799 | 0.173878 | b 0.042833 | 0 |



Photos: An example of fruit from one replication of 0118 following 2 months of RA storage (left) and after a 7 day ripening treatment at 68°F (right).

Plant material, Sites and Planting Designs:

1. USDA-ARS cultivars. Five European pear scion selections from USDA-ARS were established in 2013 at two sites in Washington (Wapato, Chuck Peters; and, Wenatchee, Josh Koempel) and one site in Oregon (Hood River, MCAREC) via a 3-year project entitled, ‘Pear scion trials in the Pacific Northwest’ (see Evans et al. 2015 Final Report). At all sites, 5 single-tree replicates were randomized in high-density, modern training systems with ‘d’Anjou’, ‘Bartlett’, and ‘Bosc’ trees as controls. At Wenatchee, trees were planted 3 ft. in-row x 12 ft. between rows (1,210 trees per acre) without a trellis. Trees will be positioned ~70° from the vertical in year 4. At Wapato, trees were spaced 4 ft. in-row x 12 ft. between rows (908 trees per acre); each tree was tipped opposite its neighbor in a narrow V trellis. At MCAREC, spacing is 5 ft. in-row x 12 ft. between rows (726 trees per acre) and trained to a V, similar to Wapato.

2. Australian (Prevar) cultivars. Two bi-colored, Australian cultivars were to be established in medium-scale plantings in WA and OR in 2014. ‘Lanya’ (ANP-0118) was planted at two Washington sites (Dryden, Josh Koempel; and, Wapato, Chuck Peters) and at one site in Oregon (Hood River, MCAREC). Each site had a minimum of ~80 trees. At Dryden, trees were planted in a double-row design spaced 3 ft. x 12 ft. (1,210 trees per acre). At Wapato, trees are trained to a tall spindle and spaced 4 ft. x 12 ft. (908 trees per acre). In Hood River, trees were planted and trained identical to the USDA-ARS selections described above. The second cultivar, ‘Deliza’ (ANP-0131), however, was only established at MCAREC (40 trees) due to a shortage of nursery material. Additional trees were budded and cultured by a nursery collaborator for 2016 delivery (funding provided from the previous grant).

Executive Summary

New cultivars are needed to expand the pear market and excite new consumers. If promising, new cultivars are to be adopted, their performance needs to be evaluated in the PNW. This project evaluated five elite selections of fire blight tolerant European pear from the USDA-ARS pear breeding program and two Australian pear cultivars presently handled by Prevar. Preliminary data and proposed plantings were reported in the 2015 Final Report: Pear scion trials in the Pacific Northwest, led by Dr. Kate Evans.

The USDA-ARS pear selections were tested in small-scale plantings along with commercial standards ('Bartlett', 'GR Bosc' and 'd'Anjou') in WA and OR. The experimental design was a randomized complete block design with five single-tree replicates. The Australian selections were established as medium-scale plantings in WA and OR with roughly 10 trees per replicate in a randomized complete block design with four replicates.

Key findings are presented by objective.

1. USDA-ARS selections:

- We discontinued evaluation of these selections after year 2. This decision followed Dr. Richard Bell's (USDA-ARS) communication that all selections had tested positive for viruses. Consequently, results documented in reports from the first two years of the project may not appropriately represent tree growth, productivity or fruit quality attributes of these genotypes in a 'virus-free' condition.
- Notable results from the first two years (3rd leaf and 4th leaf production) of observations pertained only to one selection, 84907-166, which flowered profusely, had similar yields as Bartlett and produced attractive fruit with a high percentage of red blush.
- Fruit size varied for 84907-166 among years (ranging from 270 to 150 g). Small fruit size was an indirect effect of over-cropping. At the appropriate crop load, fruit weight of 200 to 270 g was achievable.
- An attempt to clean 84907-166 of virus is underway.

2. Australian selections:

- The selection 0118 is an early-maturing genotype, harvested ~2 weeks before 'Bartlett'. Fruit size, however, was small (~130-140 g) in both years and did not improve between the first and second pick (~1 week apart). Fruit were attractive with fairly extensive red blush (nearly 50% of surface area), good sugar concentration (13.9%) but low acidity (0.24 % TA).
- Following 2 months of RA storage, 0118 ripened to dessert quality (FF, 2.9 lb)
- 0131 is a late-harvest selection, ~2 to 3 weeks after 'Bartlett' (approx. 'd'Anjou' timing). 0131 was not nearly as precocious as 0118, producing only a few fruit per tree in 2016 and 2017. Despite low crop load, 2017 fruit were small (150 g; harvested August 31, 2017). In 2016, fruit size was larger (180 g). Ripening was not evaluated given the limited number of fruit harvested.
- Given the lack of fire blight in Australia and the lineage of 0131 and 0118, we field-inoculated both genotypes as well as 'd'Anjou' (control). Inoculation with 2×10^7 colony forming units/mL suspension of *Erwinia amylovora* at bloom resulted in a higher number of strikes (nearly double) for both Australian cultivars compared to 'd'Anjou' and 90% tree mortality; in comparison, no 'd'Anjou' trees died from inoculations.
- The combination of small fruit size and apparent fire blight sensitivity does not support additional evaluation of these selections in the PNW.