

# Evaluation of *Pyrus* Interspecific Hybrids in Arizona from 2001 – 2004

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## Abstract

*Pyrus calleryana* are widely used in landscapes in regions where they are adapted, however there are many species of *Pyrus* that have not been explored for their potential use in landscapes, particularly in hot, arid climates. The Landscape Plant Development Center in Chanhassen, Minnesota has started a program to develop small statured pear trees for landscape use in different climates. This project in Arizona was initiated in conjunction with the Landscape Plant Development Center with the objective to test second generation hybrid *Pyrus* species for adaptation to the arid climate of the Southwest. Fifty trees were planted in Sierra Vista and 30 trees were planted in Tucson, Arizona, in March 2001. Plant growth, survival, and aesthetic characteristics were observed until fall 2004. Out of thirty trees tested at the Tucson site, one tree from the cross of *Calleryana* 'Chanticleer' x *eleagrifolia* appeared to be well adapted to the climate of the mid-elevation desert based on growth, branch structure and foliage health. *Pyrus* trees performed better in the cooler climate in Sierra Vista compared to Tucson. However, Texas root rot at the site decimated 40 of the 50 trees by the end of the fourth growing season. The aesthetically most pleasing tree at the Sierra Vista site was a cross between *fauriei* x *betulifolia*. This provenance was represented with 17 trees in Sierra Vista, nine of which showed good performance by October 2004. Trees from this provenance seem to be well adapted to the arid climate of the higher elevation desert and appear to have a number of desirable characteristics for urban landscapes.

## Introduction

*Pyrus calleryana* are widely used in landscapes in regions where they are adapted, however there are many species of *Pyrus* that have not been explored for their potential use in landscapes, particularly in hot, arid climates where *Pyrus calleryana* does not thrive. The Landscape Plant Development Center in Chanhassen, Minnesota has started a program to develop small statured pear trees for landscape use in different climates. Breeding efforts are under way to develop new varieties of ornamental pears differing in form, foliage color and texture. These new varieties will add to the palette of small trees that can be used in urban landscapes.

The Landscape Plant Development Center has started a breeding program using the plant collection at the USDA Clonal Repository in Corvallis, Oregon. Interspecies hybrids were produced by crossing ten different species in various combinations and are growing at the Washington State University Research and Extension Center in Puyallup. Subsequent crosses from these plants were produced and the progeny are being tested in different geographic regions to determine if the second generation plants will have superior stress tolerance for use in urban landscapes. Test sites at the University of Arizona are located in Sierra Vista and Tucson.

## Materials and Methods

In March 2001, 80 trees from the *Pyrus* Evaluation Project coordinated by the Landscape Plant Development Center were shipped bare root from Oregon to Tucson, Arizona. Plants were stored at 2°C for three days until planting. Thirty of the trees were planted at the Campus Agriculture Center of the University of Arizona in Tucson, and fifty trees were planted at the Plant Sciences Center of the University of Arizona South in Sierra Vista.

Tucson is located at an elevation of 713 m in Sunset zone 12, the intermediate desert. The climate is characterized by a growing season from mid March to mid November, and an average of 20 nights of frost from November to February. Monthly average high temperatures range from 18°C to 38°C. Of the 30 cm average annual precipitation, more than half occur from July to August, with the remainder during the winter months. The time period since the *Pyrus* evaluation in Tucson started was characterized by a hotter and drier climate than average years.

Sierra Vista is located at an elevation of 1403 m in Sunset zone 10, the high desert area of Arizona and New Mexico. The climate in this area is colder than the Tucson site with 75 to 100 nights of frost. The growing season lasts from early April to early November. Monthly maximum temperatures range from 18°C to 33°C, and minimums range between 0.5 to 18°C. The area receives an average of 38 cm of precipitation annually with a distribution similar to the Tucson area.

Soil and water at both sites have a high pH between 7.8 and 8.0. The field at the Tucson site had previously been in agricultural production and was regularly tilled for weed control. The soil is a sandy loam. Holes were dug with a shovel and plants were spaced at 2.1 m within rows and 4.6 m between rows. The soil at the Sierra Vista site is a sandy loam with 70% sand and a small portion of clay. Before planting, the soil was tilled and amended with compost to improve soil structure and water holding capacity. Plants were spaced 2.1 m between and 2.1 m within rows. Both sites were top dressed with mulch.

Trees were fertilized in June of 2001 with ammonium sulfate and micronutrients at both sites. Mulch was spread around the base of trees, and irrigation was provided with drip emitters. Light pruning to remove suckers at the base and crossing or rubbing branches in the canopy was performed in late winter of 2002 and 2003 at both sites. Plant performance was observed each fall before leaves dropped. General health, growth form, foliage texture and color, thorns, fruit, and fall color were noted.

## Results

### Tucson site

By June 2001 one tree was lost to animals girdling the base, and only 7 trees had healthy, green leaves. All other trees showed various degrees of chlorosis ranging from light to severe, but always starting with the apical growth.

By the end of the second growing season in October 2002 all but five trees suffered from various degrees of defoliation, leaf margin burn, chlorosis, and branch dieback. These trees appeared to have promising adaptability to the challenges of the climate and soil in Tucson.

On February 21, 2003 the five best *Pyrus* based on leaf and branch health, growth, and form were consolidated into one row at the south end of the field. Observations during the growing season of 2003 indicated that the following four trees were developing well. Although some trees lost a few leaves, no leaf burn or chlorosis were observed on the remaining foliage by August 2003.

19990015 P91-21-3 (fauriei x dimorphylla) op  
19990108 P91-26 (fauriei) x (betulifolia) o.p.  
1999091 P93-70 ((Calleryana 'Chanticleer' x eleagrifolia)  
1999092 P93-71 ((Calleryana 'Chanticleer') x (fauriei x betulifolia)

19990108 P91-26 (fauriei x betulifolia) o.p. was transplanted because it is a dwarf form with somewhat pendulous branches. Unfortunately the tree lost all foliage by the end of August 2003, although foliage appeared healthy earlier in summer.

19990015 P91-21-3 (fauriei x dimorphylla) op had less than 10% live foliage by mid October 2004. Tree height was 1.5 m and shoot growth during the growing season was less than 2 cm, although trees had received ample irrigation. Many suckers were produced at the base of the tree.

1999092 P93-71 ((Calleryana 'Chanticleer') x (fauriei x betulifolia) had all of the green foliage still attached with only a few leaves showing leaf edge burn. The many thorny upright branches and heavy suckering contributed to a less attractive form.

1999091 P93-70 (Calleryana 'Chanticleer' x eleagrifolia) was the best tree at the Tucson location after four growing seasons. By mid October 2004 all the foliage was still green and only a small number of leaves were curled or had minimal evidence of leaf edge burn. The tree exhibited an attractive upright growth form and was the tallest among the remaining plants with a height of 2.3 m. Internodes were small and branch tips were very stout. This tree was the only one out of the thirty trees planted in Tucson that shows promise to perform well in the climate of the mid elevation desert.

#### **Sierra Vista site**

Of the 50 *Pyrus* trees planted in Sierra Vista at the Plant Sciences Center of the University of Arizona South, 38 trees were still alive in November 2002. Two of the trees had died soon after transplanting (19990094 P.93-20 (fauriei x betulifolia) x (calleryana x fauriei)), while the other 10 trees succumbed to Texas root rot (*Phymatotrichopsis omnivora*) during the summer of 2002. The disease started at the end of one row and continued to infect trees along the row. By August 2003, the next four trees in the row had died from the disease. Root rot also started to infect trees on the opposite end of the planting and a total of 22 trees were lost to Texas root rot. The fact that trees were planted in amended trenches increased the possibility of further spread of the disease. To prevent complete destruction of the entire study by root rot, five poorly growing trees of provenance 19990015 P.91-21-3 9 (fauriei x dimorphylla) OP were removed by September 2003 and the soil was kept dry.

Provenance 19990098 P.91-16 (fauriei x betulifolia) o.p. was represented with 17 replicates, the greatest number of trees of any provenance in the Sierra Vista evaluation trial. The aesthetically most pleasing tree at this site was from this provenance, showing excellent growth form with well balanced structure, yellow fall color, medium size leaves, and almost no thorns. Unfortunately this tree fell victim to root rot during the summer of 2003 as it was located next to two trees that appeared affected by the disease in late 2002. Phenotypes from this provenance varied from the most aesthetically pleasing, two plants with very low vigor and little growth since transplanting, and the remaining ones growing vigorously. On four of the trees the central leader died back and a new leader developed. Older leaves of eight trees were relatively small, while new growth that developed later in summer had large leaves that resembled apple foliage. By August 2003, a total of 8 trees from this provenance were lost to Texas root rot. The remaining ones performed satisfactory regarding growth and plant health. By October 2004, the nine trees from this provenance were still alive and had attained a height ranging from 1.5 to 2.8 m. Some of the trees had lost their foliage, some retained attractive red colored leaves, while others still retained a full canopy of green leaves by mid October. One of the trees had yellow fall foliage. Most of the trees had an attractive upright growth and well structured branches. On three trees branches that developed during the past two growing seasons had an attractive red color. Four of the trees had small, russet colored fruit that were less than 1 cm in diameter. Trees from this provenance showed the most promising performance in the high elevation desert.

Another vigorous well formed tree was 19990092 P.93-71 (calleryana 'Chanticleer') x (fauriei x betulifolia). The second replicate of this provenance is also a well performing plant, but less exceptional than the previous one and succumbed to root rot in summer of 2003.

Of the three trees from provenance 19990091 P.93-70 ((calleryana 'Chanticleer' eleagrifolia)( one died during summer of 2002 and one during 2003. The remaining specimen was very vigorous in August 2003 and branches were well armed with thorns, however, by October 2004 the plant had died from root rot.

The related provenance 19990092 P.93-71 (calleryana 'Chanticleer') x (fauriei x betulifolia) boasted two very vigorous, well formed specimen; both were lost to root rot in 2003 and 2004.

Vigorous plants with a somewhat coarse branch structure developed from hybrids 19990096 P.91-13 (calleryana x fauriei) x (salicifolia) o.p. Leaf size varied among the five replicates with two plants expressing larger and three plants regular sized leaves. All plants were still healthy in August 2003, and one of them was among the tallest trees in the study with a height of approximately 2.6 m. None of these plants survived by October 2004 due to root rot.

The two representatives of provenance 19990104 P.93-11 (fauriei) x ussuriensis x calleryana) o.p. appeared still healthy in August 2003. On one of the trees branched at 90° angles and leaves had a great resemblance to apple foliage. Both trees succumbed to Texas root rot by October 2004.

Provenance 19990015 P.91-21-3 (fauriei x dimorphylla) OP had 9 replicates in this study, all of which were not thriving after transplanting. Branch dieback, slow growth to a height of 1.0 m to 1.3 m, and poor form were observed among these trees. By August 2003 one tree had died from Texas root rot, three were infected, and the remaining five trees were removed as described above to stop the spread of the disease. Infected trees died during 2004.

All seven hybrids 19990017 P.91-21-5 (fauriei x dimorphylla) OP and three trees of 19990003 P.91-17-3 (fauriei x betulifolia) OP were lost to Texas root rot in summer of 2002 when the disease started to spread.

## Summary

- Out of thirty trees tested at the Tucson site, one tree (1999091 P93-70 (Calleryana 'Chanticleer' x eleagrifolia)) emerged that exhibited an attractive upright growth form, was the tallest among the remaining plants with a height of 2.3 m after four growing seasons, and still had intact green foliage by mid October. This provenance shows potential to perform well under the challenging arid climate and alkaline soil conditions in the mid elevation desert. All other trees showed severe symptoms of chlorosis and leaf edge burn that generally started in early summer and progressed to more severe symptoms by the end of the growing season. Further trials should be conducted to select *Pyrus* varieties that will perform satisfactory under the demanding climate and soil conditions of the arid Southwest.

- *Pyrus* trees performed better at the higher elevation and cooler summers in Sierra Vista compared to Tucson. However, Texas root rot at the site decimated an increasing number of trees as the seasons progressed. From the initial 50 trees in Sierra Vista only 10 remained alive after four growing seasons.

- Provenance 19990098 P.91-16 (fauriei) x (betulifolia) o.p. was represented with 17 replicates, the greatest number of any provenance in the Sierra Vista evaluation trial. The aesthetically most pleasing tree at this site was from this provenance, showing excellent growth form with well balanced structure, yellow fall color, medium size leaves, and almost no thorns. Phenotypes varied, but by October 2004 nine trees from this provenance were still alive although they were surrounded by trees that had died from Texas root rot. Foliage in mid October ranged in color from green, yellow, to red, and some trees had dropped the majority of their foliage already.

Most of the trees had an attractive upright growth and well structured branches. Four of the trees had small, russet colored fruit that were less than 1 cm in diameter. Trees from this provenance seem to be well adapted to the arid climate of the higher elevation desert and appear to have a number of desirable characteristics for urban landscape plants.

**Appendix 1. Complete list of Pyrus hybrids planted in spring 2001 in Tucson.**

1.	Pyrus, 93-2	(calleryana x fauriei) X (nivalis hybrid) O.P.	19990095
2.	Pyrus, 93-2	(calleryana x fauriei) X (nivalis hybrid) O.P.	19990095
3.	Pyrus, 93-2	(calleryana x fauriei) X (nivalis hybrid) O.P.	19990095
4.	Pyrus, 93-70	(calleryana 'Chanticleer' X elaeagrifolia) O.P.	19990091
5.	Pyrus, 93-2	(calleryana x fauriei) X (nivalis hybrid) O.P.	19990095
6.	Pyrus, 93-71	(calleryana 'Chanticleer') X (fauriei x beti)	19990092
7.	Pyrus, 91-26	(fauriei) X (betulifolia), O.P.	19990108
8.	Pyrus, 91-21-3	(fauriei X dimorphylla), O.P.	19990015
9.	Pyrus, 91-21-3	(fauriei X dimorphylla), O.P.	19990015
10.	Pyrus, 93-14	(elaegrifolia) X (fauriei), O.P.	19990099
11.	Pyrus, 93-14	(elaegrifolia) X (fauriei), O.P.	19990099
12.	Pyrus, 93-14	(elaegrifolia) X (fauriei), O.P.	19990099
13.	Pyrus, 93-71	(calleryana 'Chanticleer' X (fauriei x beti), O.P.	19990092
14.	Pyrus, 93-71	(calleryana 'Chanticleer' X (fauriei x beti), O.P.	19990092
15.	Pyrus, 91-21-5	(fauriei x demorphylla). O.P.	19990017
16.	Pyrus, 91-21-5	(fauriei x demorphylla). O.P.	19990017
17.	Pyrus, 91-21-5	(fauriei x demorphylla). O.P.	19990017
18.	Pyrus, 93-71	(calleryana chanticleer) X (fauriei x beti)	19990092
19.	Pyrus, 93-14	(elaegrifolia) X (fauriei), O.P.	19990099
20.	Pyrus, 93-14	(elaegrifolia) X (fauriei), O.P.	19990099
21.	Pyrus, 91-21-3	(fauriei x dimorphylla), O.P.	19990015
22.	Pyrus, 91-21-3	(fauriei x dimorphylla), O.P.	19990015
23.	Pyrus, 91-26	(fauriei x betulifolia), O.P.	19990108
24.	Pyrus, 91-26	(fauriei x betulifolia), O.P.	19990108
25.	Pyrus, 93-71	(calleryana 'Chanticleer' x (fauriei x betu), O.P.	19990092
26.	Pyrus, 93-70	(calleryana 'Chanticleer' x elaeagrifolia), O.P.	19990091
27.	Pyrus, 91-17	(elaegrifolia x amygdaliformis), O.P.	19990106
28.	Pyrus, 91-17	(elaegrifolia x amygdaliformis), O.P.	19990106
29.	Pyrus, 91-17	(elaegrifolia x amygdaliformis), O.P.	19990106
30.	Pyrus, 93-2	(calleryana x fauriei) x (nivalis hybrid), O.P.	19990095

**Appendix 2. Complete list of Pyrus hybrids planted in 2001 in Sierra Vista.**

1	19990017	P.91-21-5	(fauriei x dimorphylla) OP
2	19990017	P.91-21-5	(fauriei x dimorphylla) OP
3	19990017	P.91-21-5	(fauriei x dimorphylla) OP
4	19990017	P.91-21-5	(fauriei x dimorphylla) OP
5	19990017	P.91-21-5	(fauriei x dimorphylla) OP
6	19990017	P.91-21-5	(fauriei x dimorphylla) OP
7	19990017	P.91-21-5	(fauriei x dimorphylla) OP
8	19990003	P.91-17-3	(fauriei x betulifolia) OP
9	19990003	P.91-17-3	(fauriei x betulifolia) OP
10	19990003	P.91-17-3	(fauriei x betulifolia) OP
11	19990098	P.91-16	(fauriei) x (betulifolia) o.p.
12	19990098	P.91-16	(fauriei) x (betulifolia) o.p.
13	19990098	P.91-16	(fauriei) x (betulifolia) o.p.
14	19990015	P.91-21-3	(fauriei x dimorphylla) OP
15	19990015	P.91-21-3	(fauriei x dimorphylla) OP
16	19990015	P.91-21-3	(fauriei x dimorphylla) OP
17	19990015	P.91-21-3	(fauriei x dimorphylla) OP
18	19990096	P.91-13	(calleryana x fauriei) x (salicifolia) o.p.
19	19990096	P.91-13	(calleryana x fauriei) x (salicifolia) o.p.
20	19990096	P.91-13	(calleryana x fauriei) x (salicifolia) o.p.
21	19990096	P.91-13	(calleryana x fauriei) x (salicifolia) o.p.
22	19990096	P.91-13	(calleryana x fauriei) x (salicifolia) o.p.
23	19990015	P.91-21-3	(fauriei x dimorphylla) OP
24	19990015	P.91-21-3	(fauriei x dimorphylla) OP
25	19990015	P.91-21-3	(fauriei x dimorphylla) OP
26	19990015	P.91-21-3	(fauriei x dimorphylla) OP
27	19990015	P.91-21-3	(fauriei x dimorphylla) OP
28	19990098	P.91-16	(fauriei) x (betulifolia) o.p.
29	19990098	P.91-16	(fauriei) x (betulifolia) o.p.
30	19990098	P.91-16	(fauriei) x (betulifolia) o.p.
31	19990098	P.91-16	(fauriei) x (betulifolia) o.p.
32	19990098	P.91-16	(fauriei) x (betulifolia) o.p.
33	19990098	P.91-16	(fauriei) x (betulifolia) o.p.
34	19990098	P.91-16	(fauriei) x (betulifolia) o.p.
35	19990098	P.91-16	(fauriei) x (betulifolia) o.p.

36	19990091	P.93-70	((calleryana 'Chanticleer' x eleagrifolia)(
37	19990098	P.91-16	(fauriei x (betulifolia) o.p.
38	19990104	P.93-11	(fauriei x ussuriensis x calleryana) o.p.
39	19990091	P.93-70	((calleryana 'Chanticleer' x eleagrifolia)(
40	19990092	P.93-71	(calleryana 'Chanticleer') x (fauriei x betulifolia)
41	19990092	P.93-71	(calleryana 'Chanticleer') x (fauriei x betulifolia)
42	19990098	P.91-16	(fauriei x (betulifolia) o.p.
43	19990098	P.91-16	(fauriei x (betulifolia) o.p.
44	19990094	P.93-20	(fauriei x betulifolia) x (calleryana x fauriei)
45	19990098	P.91-16	(fauriei x (betulifolia) o.p.
46	19990098	P.91-16	(fauriei x (betulifolia) o.p.
47	19990104	P.93-11	(fauriei x ussuriensis x calleryana) o.p.
48	19990094	P.93-20	(fauriei x betulifolia) x (calleryana x fauriei)
49	19990091	P.93-70	((calleryana 'Chanticleer' x eleagrifolia)(
50	19990098	P.91-16	(fauriei x (betulifolia) o.p.

## Tucson, Arizona



Normal leaves and leaf with margin burn and chlorosis.



Typical chlorosis observed on many trees planted in Tucson.



Pyrus planted in Tucson in August 2001, 5 months after transplanting.



Best performing tree in Tucson (Pyrus 93-70 (calleryana “Chanticleer” x eleagrifolia 19990091) in October 2004 has good form, full, green foliage and few leaf edge burns (left). New shoot tips are stout (right).

## Sierra Vista, Arizona



Overview of healthy plants in Sierra Vista, August 2003.



One of the good performers.



Fall color at Sierra Vista site (2004).



Fruit in October 2004



Foliage in October 2004



Foliage in October 2004