EVALUATION OF NEW USDA ADVANCED FIRE BLIGHT-RESISTANT PEAR SELECTIONS (2013-2016 FINAL REPORT)

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ABSTRACT

'Bartlett' accounted for 81% of California production and 76% of pear acreage in 2013, being used for both fresh and processing (USDA-NASS 2014). All other cultivars comprised 19% of production and 24% of acreage, with 'Bosc' the majority (NASS 2014). Growers and marketing organizations see promise in growing new cultivars for specific markets and customers, and industry is thus supportive of trialing new selections (Boyd 2013). Five new USDA numbered fire blight-resistant selections and one newly-released named cultivar on OHxF 87 rootstock were planted May 2, 2013 in a replicated trial on deep Russian loam soil along the Russian River in Hopland, Mendocino County, California: US 71655-014 ('Gem'[1]), US 69426-038, US 84907-069, US 84907-078, US 84907-166, with 'Bartlett' as the control. Trees were headed to 30 inches with no further pruning except removing growth below the first wire to avoid herbicide damage. After four years, similarly to other trial sites (CA, OR, WA, WVa, possibly MI), US 84907-166 yielded dramatically more than other selections, including Bartlett, which had half the yield and unsurprisingly, larger fruit. 'Gem' was removed in fall 2014 after being found to be infected with the apple stem pitting virus, the cause of pear vein yellows. The remaining selections, most which yielded poorly, subsequently tested positive for ASPV/PVY and are scheduled to be removed in early 2017, with future replanting possible.

INTRODUCTION

The number of commercially-available pear cultivars is very few relative to apples (Karst 2013, Schrack 2007). California primarily markets six specific cultivars: 'Bartlett', 'Bosc', 'Buerre Prococe Morettini' (aka 'Sunsprite', 'Comice', 'Forelle', and 'Seckel'. There are also a number of red skinned cultivars grouped as "Red Pears" for marketing purposes, among them, Hailey Red[TM] Bartlett, 'Red Sensation Bartlett', and 'Red Clapp's Favorite' (aka 'Starkrimson', 'Super Red') (CPAB 2015). Bartlett accounted for 81% of California production and 76% of the acreage in 2013 being used for both fresh and processing (USDA-NASS 2014). All other cultivars comprised 19% of production and 24% of acreage, with Bosc the majority (NASS 2014). Also in contrast to apple, none of the seven cultivars or cultivar "categories" is recently developed or released, despite the availability of multiple possibilities, including the USDA fire blight-resistant cultivars 'Sunrise' and 'Blakes Pride'

(Bell 2014), fully russeted Bartlett sport 'Cinnamon' from Fowler Nurseries, and fire blight resistant Ag Canada releases AC™ Harrow Sweet and Harovin Sundown.

These, as well as others, have been favorably received in consumer taste tests (Elkins 2006 and 2005, Elkins et al 2008). 'Sunrise' and 'Cinnamon' in particular continue to perform well in local trials (Ingels 2014).

Despite the slow pace of industry acceptance, some growers and marketing organizations see promise in growing new cultivars for specific markets and customers, and industry is thus supportive of trialing new selections (Boyd 2013). In this context, five new numbered fire blight-resistant selections and one newly-released named cultivar were planted in a replicated trial on deep Russian loam soil along the Russian River in Hopland, Mendocino County, California. Fire blight resistance was derived from 'Seckel' and eating quality from 'Bartlett' and others. The trial succeeded a previous similar one of five fire blight-resistant USDA selections planted in Scotts Valley (Lakeport), Lake County in 1995, from which 'Blakes Pride' (OHUS 66131-021) and 'Sunrise' (OHUS 66170-047) emerged as potential commercially-acceptable cultivars and are being sold at selected nurseries, primarily on the East Coast.

PROCEDURES

Five numbered selections and one newly-released named cultivar on OHxF 87 rootstock were planted in a replicated randomized complete block design trial (4 single tree replicates) in a newly planted high density 'Bartlett' pear orchard in Hopland, Mendocino County, California. Soil was a deep Russian loam. Selections included US 71655-014 ('Gem'), US 69426-038 (038), US 84907-069 (069), US 84907-078 (078), US 84907-166 (166), and 'Bartlett' as the control (Figure 1). Trees were planted May 2, 2013 north to south down a portion of the west edge row adjacent to mature 'Bosc' trees and headed to 30'. No other formal pruning was done except removal of all growth below the first wire to avoid damage by herbicides. After planting minimal pruning consisted only of removing crossing, broken, or poorly placed branches. Data collected in 2014-2016 included number of fruit spurs and lateral branches (feathers) (2014 only), and flower clusters, fruit number and size, yield, fruit firmness and soluble solids, trunk cross sectional area (TCSA), and tree height. Fruit set and yield efficiency were calculated.

2013-2016 RESULTS AND DISCUSSION (Tables 1- 4)

Tree survival and growth: Trees grew moderately well and there were no losses until 'Gem' was discovered to be infected with pear vein yellows (PVY) virus at all locations and removed from the Hopland location in

November 2014. Bartlett trees were largest (TCSA) and 069 trees smallest, though there were no significant height differences.

Flowering and fruiting: Fruit was harvested from late July to early August depending on year. Similar to other trial sites (CA, OR, WA, WVa, possibly MI), 166 was by far the most precocious, with the most flower clusters and fruit, and highest fruit set and yield efficiency. 069 was the least precocious, with nearly no fruit by the end of 2016. 038 and 078 also yielded very little. Bartlett had the second highest yield (a little more than half of 166) and also the largest fruit, though 166 fruit was statistically as large despite much having nearly double Bartlett's yield. 038 had the smallest fruit.

Fruit maturity: Fruit was harvested prior to Bartlett timing in 2015, with all selections more mature than Bartlett. There were no differences in firmness among selections in 2015 but 078 soluble solids were highest (13°B) In 2016, neither 069 or 078 had sufficient fruit to harvest. 038 had the firmest fruit, with no difference between 166 and Bartlett, which had the highest yields. There were no differences in soluble solids in 2016.

Pear vein yellows: 'Gem' was removed in November 2014 after being found to be infected with the apple stem pitting virus, the cause of pear vein yellows. The remaining selections subsequently tested positive for ASPV/PVY in July 2016 and are scheduled to be removed in early 2017, with replanting possible in the future (C. Dardick, pers. communication). Despite current virus status, 'Gem' is being propagated for eventual commercial sales in Hood River, Oregon.

In conclusion, all the above-discussed USDA cultivar selections appear to mature earlier than Bartlett (although 166 matured close to Bartlett in 2016). Based on 2013-2016 data, US 84907-166 appears to be a precocious selection which is worth pursuing if larger fruit size can be attained. The other selections appear unlikely to provide benefits over Bartlett other than potential fire blight resistance.

ACKNOWLEDGEMENTS

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Table 1: Effect of cultivar selection on number and size of fruit, tree yield and growth, yield efficiency and root suckers of the 4th leaf, minimally- pruned pear trees on OHxF 87 roostock, Hopland, Mendocino County, California, 2013-2016.

	Average Fruit No. (per tree)	Average Fruit Size[3] (g)	Average Yield (kg/tree)	2016 Cultivar TCSA (cm²)	Average Yield Efficiency[4] (kg/cm²)	2016 Rootstock TCSA (cm²)	Average Rootstock Yield Efficiency[4] (kg/cm²)	2016 Tree Height (cm)	No. Root Suckers (per tree)
Cultivar Selection[1]									
US 69426-038	3.0 b	72 c	0.26 bc	19.3 ab	0.01 b	25.3 ab	0.01 b	242	0.0
US 84907-069	<0.1 b	174 a	<0.01 c	7.5 b	0.02 b	18.6 b	0.01 b	198	0.0
US 84907-078	3.7 b	106 bc	0.39 bc	15.8 ab	0.03 b	30.7 ab	0.01 b	215	0.0
US 84907-166	29.7 a	117 abc	3.22 a	11.7 ab	0.29 a	19.4 ab	0.18 a	191	0.0
Bartlett	12.0 b	163 ab	1.71 b	23.2 a	0.07 b	43.7 a	0.04 b	258	0.0
ANOVA[2]									
Cultivar selection (*P* -value)	** (0.004)	* (0.03)	** (0.004)	NS (0.19)	** (0.001)	NS (0.17)	** (0.003)	NS (0.40)	~
Block (*P* -value)	NS (0.42)	NS (0.12)	NS (0.38)	NS (0.11)	NS (0.47)	NS (0.16)	NS (0.48)	* (0.02)	~

[1] Within columns, cultivar treatment means significantly different (Duncan Multiple Range test, *P* ≤0.05).

[2] *, ** Indicates significance at *P* ≤ 0.05 and 0.01 respectively. NS indicates not significant.

[3] Average fruit size based on fruiting years -2014-2016.

[4] Based on cumulative yield (2014-16) and final TCSA (2016).

Table 2: Effect of cultivar selection on fruit number and size, tree yield and growth, trunk, yield efficiency and root suckers of 4th leaf, minmally-pruned pear trees on OHxF 87 rootstock, Hopland, Mendocino County, California, 2016.

	Fruit No.[3] (per tree)	Fruit Size[3] (g)	Yield3 (kg/tree)	Cultivar TCSA[4] (cm^2)	Cultivar Yield Efficiency (kg/cm^2)	Tree Height[4] (cm)	Root Suckers[4] (per tree)
Cultivar selection[1]							
US 69426-038	2.0 ab	59 b	0.14 ab	19.3 ab	0.01 b	242	0.0
US 84907-069	0.0 b	~	0.02 b	7.5 b	0.00 b	198	0.0
US 84907-078	0.0 b	~	0.00 b	15.8 ab	0.00 b	215	0.0
US 84907-166	6.7 a	167 a	1.07 a	11.7 ab	0.09 a	191	0.0
Bartlett	3.7 ab	208 a	0.75 ab	23.2 a	0.03 b	258	0.0
ANOVA[2]							
Cultivar selection (*P* -value)	* (0.05)	* (0.04)	NC (0.08)	NS (0.19)	** (0.01)	NS (0.40)	~
Block (*P* -value)	NS (0.62)	NS (0.31)	NS (0.58)	NS (0.11)	NS (0.36)	* (0.02)	~

[1] Within columns, cultivar treatment means significantly different (Duncan Multiple Range test, $P \leq 0.05$).

[2] *, ** Indicates significance at $P \leq 0.05$, and 0.01 respectively. NS indicates not significant.

[3] Sampled 7/28 & 8/8/16. Bartletts harvested at commercial harvest, 8/8/16. One-Way ANOVA (Duncan Multiple Range test, P<0.05) due to insufficient data.

[4] Measured 11/18/16.

Table 3: Effect of cultivar selection on number of clusters, fruit number and size, fruit set, yield and trunk cross-sectional area (TCSA) on 3rd leaf, minimally-pruned pear trees on OHxF 87 rootstock, Hopland, Mendocino County, California, 2015.

	Cluster No.[3]	Fruit No.[4]	Fruit Set[4]	Fruit Size[4]	Yield[4]	TCSA[5]	Yield Efficiency
	(per tree)	(per tree)	(%/100 clusters)	(g)	(kg/tree)	(cm^2)	(kg/cm^2)
CULTIVAR SELECTIONS[1]							
US 69426-038	6.0 ab	1.0 b	10.0	121 ab	0.12 b	10.8 ab	0.02 b
US 84907-069	2.7 b	0.3 b	4.2	201 a	0.07 b	4.6 b	0.02 b
US 84907-078	6.3 ab	3.7 b	85.4	92 b	0.39 b	8.9 ab	0.07 b
US 84907-166	21.0 a	18.7 a	94.9	103 b	1.93 a	6.9 ab	0.29 a
Bartlett	10.0 ab	8.3 b	91.9	119 ab	1.00 ab	13.4 a	0.08 b
ANOVA[2]							
Cultivar Selection (*P* -value)	NS (0.06)	*** (0.001)	NS (0.21)	NS (0.09)	** (0.002)	NS (0.17)	** (0.003)
Block (*P* -value)	NS (0.38)	NS (0.26)	NS (0.74)	NS (0.41)	NS (0.15)	NS (0.26)	NS (0.37)

[1] Within columns, cultivar treatment means significantly different (Tukey HSD test, $P \leq 0.05$, $P \leq 0.1$ for fruit size, Duncan MRT, P<0.05 for brix and tcsa).

[2] **, *** Indicates significance at $P \leq 0.01$, and 0.001 respectively. NS indicates not significant.

[3] Sampled 3/24/15.

[4] Sampled 7/9/15. Fruit picked prior to commercial harvest, estimate 7/20/15.

[5] Measured 10/7/15

Cultivar Selection[1]	Firmness (kg force)		Soluble Solids (° Brix)	
	2015[4]	2016[5]	2015[4]	2016[5]
US 69426-038	6.7 b	10.1 a	12.6 ab	12.5
US 84907-069	7.1 b	~	11.0 ab	~
US 84907-078	9.7 b	~	13.0 a	~
US 84907-166	7.9 b	6.8 b	10.6 ab	11.6
Bartlett	12.5 a	7.7 b	8.4 b	13.0
ANOVA[2]				
Cultivar Selection (*P* -value)	** (0.004)	** (0.01)	NS (0.11)	NS (0.33)
Block (*P* -value)	NS (0.50)	NS (0.19)	NS (0.10)	NS (0.76)

Table 4: Effect of cultivar selection on firmness and soluble solids of 3rd-4th leaf, minimally-pruned pear trees on OHxF 87 rootstock, Hopland, Mendocino County, California, 2015-2016.

[1] **Within columns, cultivar treatment means significantly different (Tukey HSD test, $P \leq 0.05$ for firmness, Duncan MRT, $P < 0.05$ for brix).**

[2] ** Indicates significance at $P \leq 0.01$. NS indicates not significant.

[4] Harvested 07/09/15, prior to commercial harvest (estimated 7/20/15); measured 10/07/15

[5] Harvested 07/28 and 08/08/16; measured 07/28, 08/10 and 12/16.

BARTLETT

BARSECK

SECKEL

BARTLETT

MICHIGAN-US 437

US 309

BARTLETT

US 84907-069
US 84907-078
US 84907-166

US 56112-146

ROI CHARLES DE WURTEMBURG

OPEN-POLLINATED

US 65062-040

BARTLETT

BARSECK

SECKEL

MICHIGAN-US 437

US446

BARTLETT

DOYENNE DU COMICE

BARTLETT

BARSECK

SECKEL

MICHIGAN-US 437

US 309

BARTLETT

US 56112-146

ROI CHARLES DE WURTEMBURG

OPEN-POLLINATED

US 69426-038

BARTLETT

BARSECK

SECKEL

MICHIGAN-US 437

DAWN

BARTLETT

DOYENNE DU COMICE

Figure 1. Pedigrees of advanced USDA fire blight resistant pear selections, planted in Hopland, Mendocino County, California, 2013.