

Evaluation of Potential New, Size Controlling Rootstocks for European Pears

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ABSTRACT

The Multi-state Research Project, NC140, "Improving Economic and Environmental Sustainability in Tree-Fruit Production through changes in Rootstock Use", was established in the late 1980's. The first multi-state pear trial was established in 1987 and subsequent ones in 2004-2006. Three trials were planted in California in April 2005: Bartlett in Mendocino (loam) and Sacramento (clay) Counties and Golden Russet Bosc in Mendocino County (loam). Trial design in California is the standard NC-140 configuration of randomized complete block (RCB) with 10 single tree replicates. Rootstocks being tested in California include 708-36 (UK), BM2000 (Australia), Fox11 (Italy), Horner 4, OHxF69 and OHxF87 (Oregon), Pyro 2-33 and Pyrodwarf (Germany), and Winter Nelis as a standard (Sacramento County only). Survival rate was poorest for Pyro 2-33 and Fox11 in Mendocino County and for BM2000 and Fox11 in Sacramento County. Trees are larger in Sacramento County, in-row spacing closer in Mendocino (1.6m vs. 3m). OHxF69. Horner 4 is the largest tree in both Mendocino and Sacramento Counties; 708-36 is the smallest in Sacramento County. Horner-4 and OHxF69 had significantly more flower clusters in Mendocino County but OHxF87 yielded the most in both locations. Survival, growth, and yield data will again be collected in 2009.

INTRODUCTION

There are very few commercially viable size controlling rootstocks for pears. Quince rootstock is widely used in Europe, but has only been successfully used as a rootstock for Comice in the U.S. The Old Home x Farmingdale (Brooks®) series offers several potential options that have only recently been explored. The two OHxF selections most offered by major wholesale nurseries are 97 and 87 (333 is generally sold to homeowners). 97 is a large tree (though more precocious than *P. betulaefolia*), similar to Winter Nelis. 87 is a smaller tree, but has been shown to produce small fruit in some locations. Data from California, and more recently Washington, has suggested that a very promising OHxF selection appears to be 69, which has yet to become widely commercially available (Elkins and DeJong, 2002, Elkins et al., 2008).

The NC140 Regional Rootstock Research Project (www.NC140.org) is a federally-supported, multi-state project for perennial fruit and nut crops. The goal is to disseminate information generated from trials throughout the U.S. Each participating state establishes and evaluates similar ("uniform") trials using the same rootstocks and similar plot design so that regional differences can be determined. Progress and results are shared at an annual 2-day meeting and via the NC140 website. Each state submits an annual report which is distributed at the meeting. State reports are then compiled into a national report for USDA. California has long participated in NC140 for apples and peaches and began participating actively in pears in 2006.

In coordination with Oregon, Washington, and New York, three new NC140 trials were established in California in spring 2005, two in Talmage, Mendocino County (Bartlett and Golden Russet Bosc, 5' x 10' spacing), and one in Courtland (9' x 15' spacing). Trees were grown by Fowler Nurseries, Inc. in Newcastle. These trials are currently the **only replicated** rootstock trials in California and the Talmage Bartlett trial is the only one planted in 2005 that includes OHxF69. The information they provide will be invaluable for decisions, particularly for new, high density planting systems (the Talmage trial is planted at 871 trees per acre and is on very fertile soil).

Objectives in 2007 and 2008 included:

- 1) Evaluate potential precocious, size-controlling rootstocks for pear orchards in California.
- 2) Evaluate rootstocks for size, vigor, growth habit on various soils, productivity, compatibility with major varieties, susceptibility to diseases and pests, propensity to sucker, etc.
- 3) Select the best potential candidates for future increased propagation and industry use.

MATERIALS AND METHODS

Three trials were planted in northern California in April 2005. Design was Randomized Complete Block, with 10 single tree replicates per rootstock. Trials were also established in the Northwest in 2005 and 2006. Rootstock and cultivar selections varied by site, depending on availability and investigator preference (Table 1).

Data collection and calculation at each site from 2005-2008 varied slightly, but included trunk cross sectional area (TCSA), tree height, number of flower clusters, number of fruit, yield, yield efficiency, number of root suckers, and % survival.

RESULTS AND 2009 PLANS

2005 Bartlett Pear Rootstock Planting

- 1) North Coast - Talmage, Mendocino County, Cole loam (Tables 2-3)

No trees died in 2008. Flowering increased nearly tenfold but fruiting only 74% compared to 2007. Tree yield was taken for the first time and yield efficiency will be calculated after trunk cross-section is measured in December 2008. There were no differences in fruit size and fruit was generally small (less than 200 grams). OHxF87 had the most fruit and Fox 11 and OHxF69 the least. Horner 4 and OHxF87 yielded the most, and BM2000 and OHxF69 the least. A severe freeze during bloom and late/early fruiting may have affected ultimate yield.

- 2) Sacramento Delta - Courtland, Yolo County; Sacramento Basin clay soil (Table 4)

One tree, a Winter Nelis, died in 2008. Trunk cross-section increased 160% and number of fruit 264% compared to 2007. Cross-section was largest for Horner-4, smallest for 708-36. Yields averaged 32% more than in Mendocino County but fruit were 32% smaller. OHxF87 yielded the

most and 708-36, BM2000, Horner-4 and Winter Nelis the least. There were no differences in fruit size and fruit size was small (less than 150 grams).

2005 Golden Russet Bosc Pear Rootstock Planting

1) North Coast-Talmage, Mendocino County; Pinole-Yokayo-Redvine sandy loam (Tables 5-6)

No trees died in 2008. There were no significant differences in number of flower clusters, number of fruit ($p=.08$), tree yield or suckers, however, OHxF87 had numerically greater yield and BM2000 had no fruit. Trunk cross-section and height will be measured in December 2008. A severe freeze April 20-21 may have affected final fruiting.

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LITERATURE CITED

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Table 1: Locations and included rootstocks, NC140 pear rootstock trials, Oregon and Washington, 2005 and 2006 plantings.

Rootstock	Origin	2005 MCAREC ¹ Anjou	2005 Cashmere Anjou	2005 Tonasket Bosc	2005 Yakima Bartlett	2006 MCAREC Anjou	2006 Cashmere Anjou	2006 Tonasket Bosc	2006 Yakima Bartlett
28-119	France	x							
Pyriam	France								
(OH-11)						x	x	x	x
P-2532	France					x	x	x	x
Bet 2291	China					x	x	x	x
BM 2000	Australia	x	x	x	x				
BU-2	Germany	x	x						
BU-3	Germany		x						
Fox 11	Italy	x	x		x	x	x	x	
	Hood								
Horner 4	River, OR	x	x	x	x	x	x	x	x
OHxF 69	Oregon								x
OHxF 87	Oregon	x	x	x	x	x	x	x	x
Pyro 2-33	Germany	x		x					
Pyrodwarf	Germany	x	x	x	x				

¹ Mid-Columbia Agricultural Research and Extension Center, Hood River, Oregon

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

	Flower Clusters 4/16/07 (no./tree)	No. Fruit	TCSA 2/14/08 (cm ²)	Tree Height 2/14/08 (cm)	Root Suckers 10/03/07 (no./tree)	Tree Survival 10/03/07 (%/10 trees)
ROOTSTOCK¹						
708-36	5.6 ab	8.5 a	7.6 c	182.6 b	0.0 ab	90
BM 2000	1.1 b	1.6 b	6.3 c	197.9 ab	0.1 ab	100
Horner-4	6.9 a	6.6 ab	13.1 a	225.0 a	0.0 b	100
Fox 11	3.6 ab	5.5 ab	6.2 c	181.3 b	0.4 a	80
OHxF 69	7.4 a	6.2 ab	11.2 ab	194.1 b	0.1 ab	100
OHxF 87	6.1 ab	8.1 a	8.9 bc	189.0 b	0.0 b	100
Pyrodwarf	5.9 ab	6.0 ab	7.7 bc	181.2 b	0.0 ab	90
Pyro 2-33	2.1 ab	3.5 ab	6.6 c	174.9 b	0.0 b	70
ANOVA²						
Rootstock	**	**	***	***	*	
Block	NS	NS	NS	*	NS	

¹ Within columns, rootstock treatment means significantly different (Tukey HSD test, P≤0.05).

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

Table 3: Effects of 2005 NC-140 rootstock planting on tree circumference, flower clusters, number of fruit, root suckers, and tree survival among 3-year-old Bartlett pear trees, Talmage, California, 2008.

	Flower Clusters 4/8/08 (no./tree)	No. Fruit 8/22/08	Fruit Size 8/22/08 (g/fruit)	Yield 8/22/08 (kg/tree)	TCSA 12/10/08 (cm ²)	Yield Efficiency (kg/cm ²)	Tree Height 12/10/08 (cm)	Root Suckers 4/8/08 (no./tree)	Tree Survival 12/10/08 (%/10 trees)
ROOTSTOCK¹									
708-36	48.7 ab	8.3 ab	168	1.40 abc	12.6 bc	0.14 b	224 b	0.0	90
BM 2000	29.9 b	8.1 ab	109	0.98 c	9.9 c	0.09 b	260 b	0.1	10
Horner-4	76.5 a	12.3 ab	194	3.11 a	18.9 a	0.16 ab	298 a	0.0	100
Fox 11	24.0 b	6.5 b	197	1.28 bc	10.6 bc	0.12 b	243 b	0.0	80
OHxF 69	78.2 a	6.7 b	192	1.61 c	14.5 b	0.09 b	230 b	0.1	100
OHxF 87	54.0 ab	17.6 a	172	3.03 ab	11.6 bc	0.26 a	230 b	0.0	100
Pyrodwarf	39.9 ab	11.6 ab	175	2.02 abc	11.4 bc	0.18 ab	221 b	0.0	90
Pyro 2-33	27.3 b	7.9 ab	189	1.48 abc	10.5 bc	0.12 ab	219 b	0.0	70
ANOVA²									
Rootstock	***	*	NS	**	***	***	***	NS	
Block	*	*	*	*	NS	*	NS	NS	

¹ Within columns, rootstock treatment means significantly different (Tukey 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 4: NC-140 rootstock effects on tree growth, suckering, and harvest of 3-year-old Bartlett pear trees, Courtland, California, 2008.

	Flower Clusters (no./tree)	No. Fruit 7/24/08	Fruit Size 7/24/08 (g/fruit)	Yield 7/24/08 (kg/tree)	TCSA 11/7/08 (cm ²)	Yield Efficiency (fruit/cm ²)	Tree Height 11/7/08 (cm)	Root Suckers 11/7/08 (no./tree)	Tree Survival 11/7/08 (%/10 trees)
ROOTSTOCK¹									
708-36	36.3	16.7 ab	107	1.79 b	14.0 b	1.20 ab	235.9 c	0.14	70
BM 2000	10.9	10.7 b	123	1.32 b	22.5 ab	0.48 b	312.8 ab	1.86	70
Horner-4	12.8	9.6 b	145	1.38 b	26.4 a	0.36 b	346.0 a	0.44	90
Fox 11	24.1	28.9 ab	131	3.80 ab	23.6 ab	1.22 ab	287.3 abc	0.88	80
OHxF 87	26.6	36.0 a	145	5.23 a	21.3 ab	1.69 a	274.3 bc	0.00	90
Pyrodwarf	26.2	25.0 ab	147	3.68 ab	17.9 ab	1.39 ab	261.0 bc	1.25	80
Pyro 2-33	16.0	18.5 ab	163	3.01 ab	18.2 ab	1.02 ab	269.0 bc	0.70	100
W. Nelis	11.3	12.2 b	123	1.51 b	17.8 ab	0.69 ab	256.3 bc	1.33	90
ANOVA²									
Rootstock	NS	**	NS	***	**	**	***	NS	
Block	NS	*	NS	*	**	NS	**	NS	

¹ Within columns, rootstock treatment means significantly different (Tukey 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: 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, Talmage, California, 2007.

	Flower Clusters 4/16/07 (no./tree)	No. Fruit	TCSA 2/14/08 (cm ²)	Tree Height 2/14/08 (cm)	Root Suckers 10/03/07 (no./tree)	Tree Survival 10/03/07 (%/10 trees)
ROOTSTOCK¹						
708-36	0.1	0.0	6.6	182.9	0.1	80
BM 2000	0.3	0.6	5.0	176.0	0.0	70
Horner-4	0.1	0.1	8.1	191.5	0.0	100
Fox 11	0.2	0.7	5.5	179.5	0.0	60
OHxF 87	0.5	1.5	7.9	181.3	0.0	80
Pyrodwarf	0.0	0.0	6.8	186.5	0.0	90
Pyro 2-33	0.1	0.1	4.9	170.2	0.0	80
ANOVA²						
Rootstock	NS	NS	NS	NS	NS	
Block	NS	NS	NS	*	NS	

¹ Within columns, rootstock treatment means significantly different (Tukey 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 6: Effects of 2005 NC-140 rootstock planting on tree circumference, height, flower clusters, number of fruit, root suckers, and tree survival among 3-year-old Bosc pear trees, Talmage, California, 2008.

	Flower Clusters 4/8/08 (no./tree)	No. Fruit 9/5/08	Fruit Size 9/5/08 (g/fruit)	Tree Yield 9/5/08 (kg/tree)	TCSA 12/10/08 (cm ²)	Yield Efficiency (kg/cm ²)	Tree Height 12/10/08 (cm)	Root Suckers 4/8/08 (no./tree)	Tree Survival (%/10 trees)
ROOTSTOCK¹									
708-36	13.1	5.5	177	1.11	10.2	0.09	255	0.1	80
BM 2000	1.1	0.0	0	0.00	8.3	0.00	260	0.0	70
Horner-4	8.1	4.8	163	1.11	13.6	0.06	279	0.0	100
Fox 11	32.3	13.2	150	3.94	8.3	0.14	256	0.0	60
OHxF 87	16.8	10.1	194	2.61	11.5	0.14	228	0.0	80
Pyrodwarf	6.1	2.8	211	0.88	11.1	0.06	244	0.0	90
Pyro 2-33	7.0	0.5	185	0.25	8.5	0.01	237	0.0	80
ANOVA²									
Rootstock	NS	NS	NS	NS	NS	NS	NS	NS	
Block	NS	NS	NS	NS	*	NS	**	NS	

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

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