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Summary of the 2002 Pacific Northwest of USA Pear Rootstock Trials: Performance of 'd'Anjou' and 'Golden Russet Bosc' Pear on Eight *Pyrus* Rootstocks

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Abstract

In 2002, a multi-site pear rootstock trial was established to evaluate 'd'Anjou' and 'Golden Russet Bosc' pear (*Pyrus communis* L.) performance on eight *Pyrus* rootstocks in the Pacific northwestern US states of Oregon and Washington. The plantings were conducted under the multi-state cooperative research project NC-140. Rootstock genotypes tested at all three sites included, Fox 11 (Bologna, Italy), two clonal Old Home × Farmingdale selections (OH×F 87 and OH×F 40; US), 708-36 (East Malling, UK), and Pyrodwarf and Pyro 2-33 (Geisenheim, Germany). In addition, Fox 16 (Bologna, Italy) was evaluated at the two WA sites, and Winter Nelis seedling was evaluated at the OR site. Summarized across all sites, OH×F 87 had the highest yields and yield efficiency (YE) and the largest average fruit size; Fox 11 and 708-36 produced the smallest trees; and Pyrodwarf produced significantly low cumulative yields of smaller fruit, possessed the lowest cumulative YE, and suckered profusely (counted in OR, and visually observed in WA). In general, 'd'Anjou' trees were larger than 'Golden Russet Bosc' for a given rootstock. For the inherently vigorous cultivar 'd'Anjou', 708-36 produced the smallest trees followed by the Fox selections, but none of these genotypes had high YE. Cumulative tree yield and YE were consistently highest for OH×F 87, the latter despite the relatively large tree size for this rootstock and cultivar combination. The lowest yields were observed for Pyrodwarf, Fox 11, Fox 16 (WA site only) and 708-36. For 'Golden Russet Bosc', cumulative tree yield was highest on OH×F 87, intermediate on OH×F 40 and Pyro 2-33, and significantly lower on Fox 11, Fox 16, 708-36, and Pyrodwarf. The rootstock 708-36, however, had similarly high YE as OH×F 87, but exhibited premature leaf reddening which may be indicative of pear decline. Based on the results of these trials, OH×F 87 was the best overall performing rootstock and appears well-suited for moderate-density winter pear plantings.

The Pacific northwestern USA states of Oregon and Washington account for the total US 'd'Anjou' pear crop, and ~85% of the US 'Bosc' pear crop (Kevin Moffitt, personal communication). The US commercial production of 'd'Anjou' is on low-density, mature pear orchards that are characterized by tall, broad, complex tree architectures that have limited capacity for exploiting recent advances in labor-saving, tree-fruit automation technologies (Singh et al., 2010). The complete reliance on ladders for pruning and harvest operations results in significant barriers to profitability (West et al., 2012). In addition, young orchards of 'd'Anjou' are slow to achieve commercially significant yields due to a lack of precocity. Size-controlling rootstocks (*Pyrus* or other genera) for pear are not commercially available in the US (Elkins et al., 2012). While sufficient dwarfing is induced with quince (*Cydonia oblonga* Mill.), sensitivity of quince to sub-freezing

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temperatures has precluded its use in northern regions (Wertheim, 1998; Westwood, 1993). Development of new *Pyrus* rootstocks, however, has been limited by insufficient size control (Brewer and Palmer, 2011). This is in contrast to the present situation for other Rosaceae tree-fruit crops (Lang, 2000; Webster,1995). Consequently, only a small percentage of winter pear acreage has been renovated over the past several decades.

An 'NC-140' evaluation of 'Bartlett', 'd'Anjou', 'Golden Russet Bosc', 'Comice', 'Clapps', 'Harrow Delight' and 'Magness' pear performance on several OH×F clones (40, 217, 333, 339, and 519) and *Pyrus communis*, *Pyrus calleryana*, and *Pyrus betulifolia* seedling rootstocks indicated that, in general, OH×F 40 produced consistently higher yields and yield efficiency (YE) than the other rootstocks tested (Azarenko et al., 2002). Tree size of OH×F 40 was intermediate among the rootstocks studied. Similarly, a commercial pear rootstock trial evaluated OH×F clones (18, 40, 69, 87, 97, 217, 282, and 333) on performance of 'Starkrimson', 'Red d'Anjou' and 'Bosc' and observed higher yields and improved precocity with OH×F 87, irrespective of the scion (Ing, 2002). In that trial, OH×F 40 was only tested with 'Bosc' and yields were fairly high. Based on these earlier evaluations, OH×F 40 and OH×F 87 were advanced to a new trial that included several promising new rootstock selections from international pear rootstock programs not previously tested in the US: Pyrodwarf, Pyro 2-33, Fox 11, Fox 16, and, 708-36. Pyrodwarf reportedly imparted significant dwarfing to 'Bartlett' (comparable to Quince C), induced precocity and cropping of large fruits, and achieved high YE (Jacob, 1998, 2002). Pyro 2-33 was more vigorous than Pyrodwarf, but induced equally good fruit size and productivity of the scion (Jacob, 1998, 2002). Fewer performance data exist for 708-36 (Webster, 1998) and the Fox series rootstocks (Bassi et al., 1996; Wertheim, 1998). The objective of the present study, therefore, was to evaluate the performance of new rootstock clones on winter pear tree size, fruit production, fruit size, yield efficiency and tree survival at locations representative of major winter pear growing districts in the US Pacific Northwest.

Materials and Methods

New pear rootstocks from several *Pyrus* rootstock breeding programs were selected for inclusion in a 10-year rootstock evaluation trial with three sites (two in Washington (WA) and one in Oregon (OR)) and two cultivars ('d'Anjou' (OR and WA) and 'Golden Russet Bosc' (WA)). Rootstock genotypes were from the US (OH×F 87 and OH×F 40; Lombard and Westwood, 1987), UK (708-36; Johnson et al., 2005; Wertheim, 1998), Germany (Pyrodwarf and Pyro 2-33; Jacob, 2002), and Italy (Fox 11 and Fox 16; Bassi et al., 1996). Winter Nelis seedling rootstock was included in one trial site (OR). Seedlings of Winter Nelis were raised from seed of virus-indexed plants maintained at Fowler Nurseries (Newcastle, CA). All other rootstock genotypes were micropropagated by Meadow Lake Nursery (McMinnville, OR), and micropropagated liners were shipped to Fowler Nurseries for scion budding. Trees were grown at Fowler Nurseries for 1-year prior to being shipped in the spring of 2002 to the trial sites.

Two trial sites were planted with 'd'Anjou': 1) Oregon State University's Mid-Columbia Agricultural Research and Extension Center in Hood River, OR (lat. 45.7°N, long. 121.5°W) and 2) Cashmere, WA (private orchard site; lat. 47.3°N, long. 120.3°W). Soil at the OR site was a Van Horn series, fine sandy loam, and at the WA site a Wenatchee silt loam. Trees were headed at a height of 60 cm from the ground in the spring of 2002 and trained to a free-standing modified central leader. Branches were spread using toothpicks and, later, tree-spreaders to achieve approximately 60-75° angles from vertical. An additional site was planted in WA using 'Golden Russet Bosc' as the scion and trained to a free-standing modified central leader:

Tonasket, WA (private grower; lat. 48.5°N, long. 119.3°W). Soil was a Pogue fine sandy loam. At all trial sites, ten single-tree replicates were planted 3.05 × 4.88 m (in row × between row spacing) for a density of 672 trees·ha^{-1} in a randomized-complete-block design. 'Bartlett' trees were inter-planted (~16% acreage) at uniform intervals within rows, but offset in adjacent rows to provide sufficient pollen.

The following data were collected annually at each site: tree survival; trunk circumference (measured on the scion, 20 cm above the graft union and converted to trunk cross-sectional area [TCA]); yield; and, average fruit weight. Yield efficiency (YE) was derived from the cumulative yield divided by final TCA. For OR, fruit set was recorded in each of the first three years of flowering (2005-2007) and expressed as the number of fruit per 50 flower clusters. Two scaffolds per replicate tree were selected at bloom and 50 total flower clusters were tagged; 25 per scaffold beginning at the base of each scaffold and working toward the apex. Fruit produced on those clusters were counted following the 'June' drop period. Suckering was evaluated at the conclusion of the trial as the total number of suckers occupying the rectangular land area devoted to each tree based on tree spacing. All other cultural practices were performed according to industry standards. The duration of the OR trial was 10 years. Both WA trials were terminated following nine years; however, spring frosts eliminated the 2010 crop of 'Golden Russet Bosc', so data are only provided through the first eight years for 'Golden Russet Bosc'.

Due to unequal rootstock genotypes per site and early termination of the WA trials, data were analyzed for the six rootstocks common to all sites following the 2009 season (eighth-leaf) by PROC MIXED (SAS, Cary, NC) to detect rootstock differences among sites for cumulative yield, TCA, YE (cumulative), and average fruit size. Location (site) was considered as a random factor and rootstock as a fixed factor. Binary mortality data were analyzed using exact tests for Likelihood Ratio Chi Square due to sparseness of mortalities. Data from individual sites were analyzed separately using PROC GLM to determine differences among rootstocks within a site. Mean separation was determined by Duncan's Multiple Range test (P<0.05).

Results and Discussion

Comparisons across sites and cultivars. Tree survival was generally high and did not markedly differ among rootstocks across locations (Table 1). After 8 years, tree size was

Table 1. Performance of 'd'Anjou' and 'Golden Russet Bosc' pear on six rootstocks over an 8-year period planted at three locations.

Rootstock	Avg. fruit wt. (g)	Cum. tree yield (kg)	TCA (cm^2)	Cum. yield efficiency (kg·cm^{-2})	Tree survival (%)
708-36	228 b[z]	29.6 c	95.7 b	0.34 c	86
Fox11	236 b	31.7 c	96.6 b	0.34 c	83
OHxF40	236 b	50.6 b	116.5 a	0.44 ab	97
OHxF87	251 a	61.2 a	119.6 a	0.51 a	93
Pyro 2-33	234 b	43.3 b	115.3 a	0.38 bc	88
Pyrodwarf	216 c	28.5 c	118.5 a	0.24 d	93
Pr>F Rootstock	<0.0001	<0.0001	<0.0001	<0.0001	0.4514
Pr>F Site	<0.0001	<0.0001	<0.0001	<0.0001	0.0088
Pr>F Rootstock×Site	0.1424	0.2039	0.0054	0.0257	0.8827

[z] Mean separation within columns by Duncan's Multiple Range test at P = 0.05.
[y] Tree spacing: 3.05 m in-row × 4.88 m between rows (672 trees·ha^{-1}).

significantly influenced by rootstock across all sites (Table 1). Fox 11 and 708-36 were smaller than OH×F 40, OH×F 87, Pyro 2-33 and Pyrodwarf, which produced trees of similar size. Our data do not concur with the previously reported tree size control induced by Pyrodwarf (Jacob, 1998, 2002). Differences in environmental factors and cultivar habit between those trials and ours could have contributed to this disparity. For TCA, there was a significant interaction between rootstock and site (Table 1), likely attributed to the marked differences in response of 'd'Anjou' trees compared to 'Golden Russet Bosc' to given rootstocks. Our model did not account for cultivar effects, which were confounded with location. When only the 'd'Anjou' sites were analyzed, *P*-values for location and the interaction of location and rootstock were 0.13 and 0.32, respectively, indicating consistent performance for this scion cultivar across locations. For a given rootstock, 'd'Anjou' trees were generally larger than 'Golden Russet Bosc' trees (Tables 2-4), but statistical comparisons were not possible due to limited cultivar replication.

Cumulative yield was significantly higher for OH×F 87, intermediate for OH×F 40 and Pyro 2-33, and lowest for Pyrodwarf, Fox 11 and 708-36 (Table 1). OH×F 87 was slightly more precocious and produced consistently higher yields throughout the trial period (Fig 1). These data agree with earlier North American work demonstrating good productivity for a wide range of pear cultivars on OH×F 87 (Denby and Meheriuk, 1987; Kappel and Quamme, 1988).

A significant interaction between rootstock and location was observed for YE similar to that for TCA; although, this might be expected given that YE is derived from TCA. Despite the statistically higher cumulative YE of OH×F 87 and OH×F 40 (Table 1) observed in this study, these values were much lower than those reported for several pear cultivars planted at similar densities (Robinson, 2011; Sugar et al., 1999), and at higher densities (Singh et al., 2010). These differences are likely attributed to the characteristically low productivity of 'd'Anjou' pear in the formative years. This was more pronounced in the dataset reported in Table 1 given that the data were only analyzed through eight years and were disproportionately represented by 'd'Anjou'.Yield efficiencies of rootstocks on 'Golden Russet Bosc' were relatively high (Table 4). Productivity of 'd'Anjou', however, improved markedly in the subsequent years, especially for the OR 'd'Anjou' trial (Fig 1). The fact that YE was poor for rootstocks that restricted tree size (708-36 and Fox 11) obviates their future evaluation in high-density pear trials.

Average fruit size was largest on OH×F 87 and smallest on Pyrodwarf (Table 1). The other rootstocks evaluated had intermediate fruit size. The effect of rootstock on fruit size would also have economic significance which we did not evaluate; nevertheless, fruit of OH×F 87 were one box-size larger than those from other rootstocks (Table 1).

Within site comparisons-'d'Anjou'. In OR, 'd'Anjou' trees on 708-36 and Fox 11 were significantly smaller than trees on Winter Nelis and Pyrodwarf (Table 2). Winter Nelis trees were quite uniform, a feature not often associated with seedling pear rootstocks (Lombard and Westwood, 1987; Westwood et al., 1976). OH×F 87 and OH×F 40 were intermediate in size, and did not significantly differ from the other rootstocks (Table 2). Overall, only limited control of tree size was observed relative to seedling Winter Nelis, with less than 25% difference occurring between trees on the smallest and largest rootstock genotypes after 10 years (Table 2). 'd'Anjou' trees in WA were also smallest on Fox 11 and 708-36, as well as Fox 16 (Table 3). Fox 11 and Fox 16 were identified for their good scion compatibility. Fox 11 possesses a higher tolerance to soil alkalinity than Fox 16 while Fox 16 has low susceptibility to crown gall (*Agrobacterium tumaefaciens*) root disease (Bassi et al., 1996; Wertheim, 1998). Although vigor of Fox 11 and Fox 16 was reportedly higher than BA29C

Table 2. Performance of 'd'Anjou' pear on seven rootstocks over a 10-year period planted in Hood River, Oregon, USA.

Rootstock	Fruit set[z] (%)	Avg. fruit wt. (g)	Cum. tree yield (kg)	TCA (cm^2)	Cum. yield efficiency ($kg \cdot cm^{-2}$)	Suckering (no./tree)	Tree survival (%)
708-36	42.4 a[y]	218 b	196.3 b	131.0 bc	1.51 b	18.6 b	100
Fox11	26.2 b	224 ab	181.2 b	127.4 c	1.54 b	0 c	90
OH×F40	31.3 ab	215 b	220.1 ab	144.9 abc	1.53 b	0 c	100
OH×F87	35.7 ab	238 a	263.1 a	146.1 abc	1.96 a	0 c	100
Pyro 2-33	37.5 ab	223 ab	223.3 ab	152.0 ab	1.59 b	0 c	100
Pyrodwarf	32.4 ab	214 b	170.4 b	156.8 a	1.08 c	33.9 a	100
Winter Nelis	26.4 b	228 ab	219.2 ab	164.8 a	1.37 b	0 c	80
Pr>F	0.0393	0.0137	0.0117	0.0084	<0.0001	<0.0001	0.2197

[z] Fruit set was determined in the first three years of flowering (2005-07). Fruit set was estimated as the number of fruit per flower cluster.
[y] Mean separation within columns by Duncan's Multiple Range test at $P = 0.05$.
[x] Tree spacing: 3.05 m in-row × 4.88 m between rows (672 trees·ha^{-1}).

(Bassi et al., 1996; Wertheim, 1998), greater size control in the Fox series is continuing to be sought (Quartieri et al., 2011). BA29C is considered to lack cold resistance, limiting its use in northwestern US. In the warmer growing region of Medford, Oregon (southern Oregon) BA29C and 708-36 produced equivalent and significantly smaller 'Golden Russet Bosc' trees compared to Fox 11, Pyro2-33, Pyrodwarf, and OH×F 97, all of which produced similarly sized trees (David Sugar, personal communication). Although BA29C is considered vigorous among quince rootstocks (Wertheim., 1998), its size control relative to *Pyrus* rootstocks used in the US would be an improvement. The smaller tree size induced by 708-36, Fox 11 and Fox 16 in our trials, however, was not accompanied by high yields or YE (Tables 2 and 3).

Fruit set of 'd'Anjou' in the first three years of flowering was highest for 708-36 and lowest for Winter Nelis (Table 1). Interestingly, these rootstocks ranked opposite for tree size, supporting the widely established inverse relationship between pear tree vigor and fruit set (Westwood, 1993). Differences in fruit set were not due to greater flower density per tree (data not shown), but rather to a higher fruit-setting efficiency. While these data imply improved precocity, they were not pronounced enough to markedly alter yields in the first years of production

Table 3. Performance of 'd'Anjou' pear on seven rootstocks over a 9-year period planted in Cashmere, Washington, USA.

Rootstock	Avg. fruit wt. (g)	Cum. tree yield (kg)	TCA (cm^2)	Cum. yield efficiency ($kg \cdot cm^{-2}$)	Tree survival (%)
708-36	233 a[z]	91.9 cd	124.2 b	0.67 bc	80
Fox11	249 a	84.2 cd	132.4 b	0.66 bc	100
OHxF40	247 a	197.1 ab	180.1 a	1.09 a	100
OHxF87	258 a	204.5 a	175.4 a	1.14 a	100
Pyro 2-33	247 a	143.7 bc	147.1 ab	0.98 ab	100
Pyrodwarf	188 b	64.7 d	146.4 ab	0.39 c	100
Fox16	246 a	96.7 cd	130.1 b	0.73 b	100
Pr>F	<0.0001	<0.0001	0.0072	<0.0001	0.6778

[z] Mean separation within columns by Duncan's Multiple Range test at $P = 0.05$.
[y] Tree spacing: 3.05 m in-row × 4.88 m between rows (672 trees·ha^{-1}).

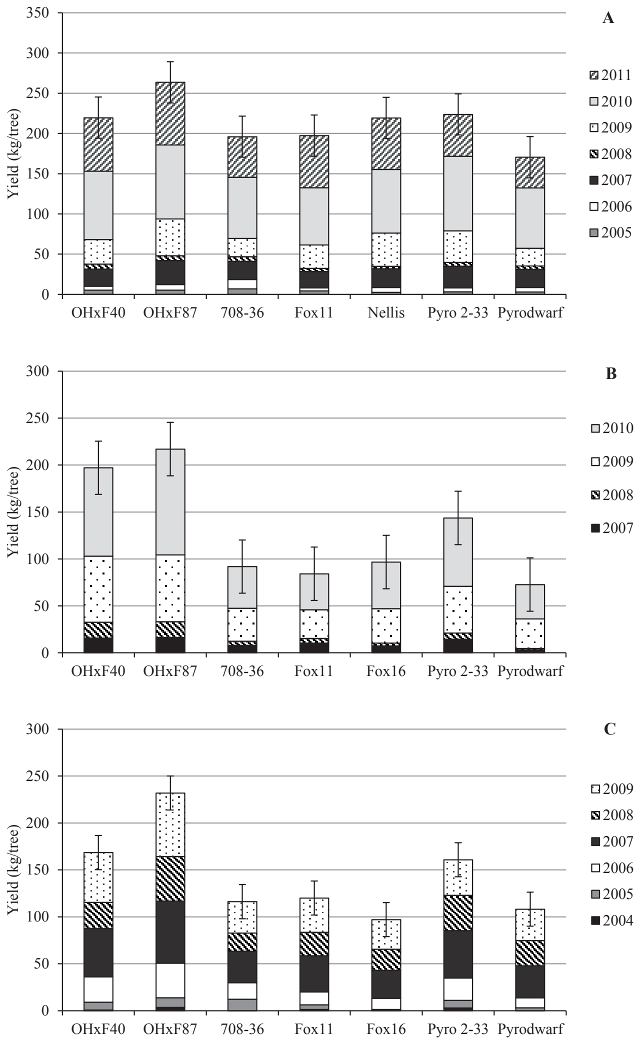

Fig. 1. Annual and cumulative yield of 'd'Anjou' pear trees planted in Oregon (A) and Washington (B), and 'Golden Russet Bosc' pear trees planted in Washington (C) on seven rootstock genotypes per site established in 2002. Bars signify LSD for cumulative yield at *P*= 0.05.

(Fig. 1). Moreover, with the exception of the first two years of fruiting in OR (2006-2007), YE was consistently low for 708-36 (data not shown).

At both 'd'Anjou' sites, cumulative yield was highest for OH×F 87 and lowest for Pyrodwarf, Fox series rootstocks, and 708-36 (Tables 2 and 3). 'd'Anjou' productivity occurred earlier in OR than in WA (Fig. 1) as a result of crop loss sustained following 2006 freeze events in WA. 'd'Anjou' required a considerably long time from planting to produce adequate volumes of fruit (Fig. 1).

Average fruit weight from trees on OH×F 87 was statistically higher (Table 2) or similar to that of other rootstocks (Table 3). In the

US, there is considerable economic incentive for production of fruits larger than 211 g (i.e., 90 fruit per 20 kg box; Kevin Moffitt, personal communication). Pyrodwarf consistently produced smaller fruit despite having significantly lower yields and YE (Tables 2 and 3) compared with all rootstocks evaluated. These data contrast with previous reports of high yields of large fruit for Pyrodwarf (Jacob, 1998, 2002; Webster, 1998). OH×F 40 had relatively small fruit in OR, but not WA. It is unclear as to what to attribute these differences, because most other factors evaluated at each site were similar. Inconsistencies in OH×F 40 fruit size have been documented previously (Azarenko et al., 2002; Wertheim, 1998). Perhaps this rootstock is more sensitive to different soil environments.

Root suckers were only observed for Pyrodwarf, and to a lesser degree with 708-36 (Table 2). Pyrodwarf was observed to sucker profusely in both WA trials, though the response was not measured (Tim Smith, personal observation). These results are corroborated with high suckering of Pyrodwarf in 'Concorde' and 'Taylor's Gold' trials in New York and Nova Scotia (Elkins et al., 2011). Pyrodwarf was categorized as highly suckering in the original evaluation (Jacob, 1998).

Comparisons within sites-'Golden Russet Bosc'. Numerically higher mortality rates were observed for Pyro 2-33, Fox 11, Fox 16 and 708-36 than for other rootstocks, but these differences were not significant (Table 4). It is important to note that the apparent low survivability of 'Golden Russet Bosc' on Pyro 2-33 was based on five single-tree replicates, of which two died. Limited tree numbers were due to plant losses in the nursery. An experimental design comprising 10 single-tree replicates and seven rootstocks (notwithstanding unequal replication) has severe limitations for evaluating binary data (i.e., dead or alive). The remaining replicates of Fox 11, Fox 16 and 708-36 appeared weak (i.e., characterized by poor annual extension growth and premature leaf reddening beginning late summer during the latter years of the trial; Einhorn and Smith, personal observation). These symptoms closely resemble those expressed by rootstocks that exhibit 'more tolerance' to pear decline, but slowly succumb to the disease (Wertheim, 1998). *Pyrus communis* rootstocks (clonal or seedling propagated) are typically tolerant to pear decline (Lombard and Westwood, 1987); however, 708-36 originated from a cross of 'BP1' and 'Old Home' (Webster, 1998), and 'BP' selections have shown decline symptoms attributed to their Asian pear lineage (Kate Evans, personal communication). In addition, 'Golden Russet Bosc' is inherently more precocious than 'd'Anjou' (Fig 1), facilitating earlier detection of decline symptoms.

Table 4. Performance of 'Golden Russet Bosc' pear on seven rootstocks over an 8-year period planted in Tonasket, Washington, USA.

Rootstock	Avg. fruit wt. (g)	Cum. tree yield (kg)	TCA (cm^2)	Cum. yield efficiency ($kg \cdot cm^{-2}$)	Tree survival (%)
708-36	246	116.1 c[z]	61.9 b	1.89 a	78
Fox11	252	113.1 c	73.9 b	1.52 b	67
OHxF40	255	167.9 b	102.1 a	1.71 ab	100
OHxF87	268	221.3 a	116.5 a	1.97 a	90
Pyro 2-33	254	158.9 b	112.9 a	1.41 b	60
Pyrodwarf	241	107.8 c	107.7 a	1.02 c	90
Fox 16	261	96.5 c	70.2 b	1.38 b	70
Pr>F	0.0997	<0.0001	<0.0001	<0.0001	0.2097

[z] Mean separation within columns by Duncan's Multiple Range test at P= 0.05.
[y] Tree spacing: 3.05 m in-row × 4.88 m between rows (672 trees·ha^{-1}).

The situation for the Fox series rootstocks is not likely the result of incompatibility, since these rootstocks were selected from *P. communis* crosses (Bassi et al., 1996). Vegetative growth control associated with Fox was likely influenced by the scion; the inherently weaker growth of 'Golden Russet Bosc' in combination with a colder climate may have resulted in greater freeze injury at that site.

Tree size on 708-36, Fox 11 and Fox 16 was roughly 50% to 60% of OH×F 87 (Table 4). Despite producing small trees, the YE of Fox 11 and Fox 16 was significantly lower than 708-36 and OH×F 87 (Table 4). Johnson et al. (2005) observed good YE for 708-36 in several trials planted in the UK using 'Williams' and 'Conference'. The high YE of 'Golden Russet Bosc' on either 708-36 or OH×F 87, was consistent with early performance data (first five years) from a multi-site 'Bartlett' rootstock trial (Elkins et al., 2011). Our data are also comparable to those reported for 10-year-old 'Bosc' on selected quince rootstocks (Lombard et al., 1984). For 708-36, small tree size disproportionately contributed to high YE (Table 4), while for OH×F 87 high YE was a function of greater yield. Despite highly significant differences in 'Golden Russet Bosc' yield among rootstocks, average fruit size was not significantly influenced by rootstock (Table 4).

In conclusion, OH×F 87 was the most productive rootstock for 'd'Anjou' and 'Golden Russet Bosc', possessing high YE and good fruit size. Relative to the rootstocks evaluated, OH×F 87 did not impart strong tree size control on either cultivar. Given these observations, OH×F 87 is well-suited for moderate density orchards. Robinson (2011) reported a negative relationship between trunk size and density for pear rootstocks, including OH×F 87, implying that control of tree size over a range of tree densities is achievable for pear plantings on semi-dwarfing rootstocks. For 'Bosc', cumulative yield and YE improved with increasing tree density, up to 2,000 trees·ha^{-1}, but these advantages were partially offset by reduced fruit size (Robinson, 2011). While these results were encouraging, future pear rootstock research efforts need to focus on the development of well-adapted rootstocks that induce precocity, dwarfing, and large fruit size of winter pear cultivars.

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