2016-2025 Final Report

Comparison Of Horner 4, OHXF 87, And OHXF 97 Rootstocks Under Varying Growing Conditions and Cultural Practices In Lake County, California

Clebson Gonçalves, UC Cooperative Extension, Lake and Mendocino Counties

ABSTRACT

The Multi-State Research Project **NC-140**, titled "*Improving Economic and Environmental Sustainability in Tree Fruit Production through Changes in Rootstock Use*", was established in the late 1980s. The first 10-year, 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 was the standard NC-140 configuration of randomized complete block (RCB) with 10 single-tree replicates. Rootstocks included 708-36 (United Kingdom), BM 2000 (Australia), Fox 11 (Italy), Horner 4 (Oregon), OHxF 69 (Oregon, Mendocino Bartlett only), OHxF 87 (Oregon), Pyro-233 and Pyrodwarf (both Germany). 2014 was the tenth season of the 10-year trial and the final year of formal data collection. After ten years (2005 – 2014), Bartlett on the open pollinated OHxF1 selection Horner 4 consistently had the largest fruit (197 grams average), yielded 41% or more than the next highest yielding rootstocks, and had similar yield efficiencies despite being nearly twice as large as other trees. For 'Golden Russet' Bosc, Horner 4 trees were the largest and had the largest fruit in the final year of the trial, but lower yield efficiency than other rootstocks, suggesting it may be better suited to less vigorous Bartlett. There were very few, if any, root suckers. Horner 4 was also the least water stressed rootstock, most likely to attain baseline values of -6 to -8 bars mid-day stem water potential (MSWP), the suggested baseline for fully-watered trees (Shackel 2007). Increasing (positive) MSWP was significantly and positively correlated with fruit size, TCSA, and yield efficiency. Based on positive results, a series of four replicated trials was initiated in 2016 in the Kelseyville (Big Valley) growing area of Lake County, California to compare Horner 4 versus OHxF 87 and OHxF 97 rootstocks on a range of soil types and cultural practices. Three trials were interplanted between rows of mature 'Bartlett' trees and one trial installed in a replant site. After ten growing seasons (2016 - 2025), Combined data from all four trial sites showed that Horner 4 trees had significantly better performance across all parameters measured, including larger plant base diameter (TCSA) and height, significantly more and larger fruit, and higher yields than OHxF87 and HxF97 rootstocks. OHxF 87 trees had the smallest height, the least fruit, and the lowest yields. The results strongly suggest that Horner 4 rootstock may be more suitable for open ground or interplanted conventional or organic pear orchards in Lake County.

INTRODUCTION AND OBJECTIVES

There are very few commercially viable size-controlling rootstocks for pear. Quince rootstock is widely used in Europe interstemmed with Old Home or Beurre Hardy, but is only being employed in the U.S. as a rootstock for Comice due to its incompatibility with other cultivars. The Old Home x Farmingdale (OHxF) (Brooks®)[1] series offers several potential options that are now becoming more widely planted. The two OHxF selections currently most offered by major wholesale nurseries are 97 and 87 (333 is generally sold to homeowners). 97 is a relatively large tree similar to Winter Nelis, though more precocious than *P. betulaefolia*. 87 is smaller but has been shown to produce small fruit in some locations. Data from California, and more recently Washington, has suggested that OHxF 69, which has limited commercial availability, may also be promising, particularly for Bosc, but is difficult to propagate by hardwood cuttings (Elkins and DeJong 2002; Elkins et al. 2008; Elkins and DeJong 2011; Reed 2011; Elkins, Bell and Einhorn 2012).

The North Central Regional Research Project NC-140 (*www.NC140.org*) is a federally (NIFA)-supported, multi-state rootstock project focused on perennial tree fruit crops. The goal of NC-140 is to disseminate information generated from long-term (generally 10 year) trials throughout the U.S. Each participating state (as well as Canada and Mexico) establishes and evaluates similar ("uniform") trials using the same rootstocks and similar plot design so that regional differences can be determined. Researchers share progress and results at the annual meeting and via the NC-140 website. Each state representative submits an annual report which is distributed at the meeting and then compiled into a national report for USDA and posted on the NC-140 website for public use. Data is also shared with growers and nurseries who can then select rootstocks suitable to their location and customer base. California began participating in NC-140 for apples in 1995 and peaches in 2001 and began participating actively in pears in 2005.

In coordination with Oregon, Washington, New York, and Chihuahua, Mexico, three NC- 140 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, Sacramento County (Bartlett, 9' x 15' spacing). Rootstock liners were propagated by Meadow Lake Nursery, McMinnville, Oregon then budded and grown by Fowler Nurseries, Inc., Newcastle, California. The Courtland trial was abandoned after 2009, leaving the two Mendocino County trials in place. The 2005 NC-140 trials were the only **bearing *replicated*** rootstock trials in California. The ultimate objective of these, as with all NC-140 and other rootstock trials, was to select the best potential available candidates for future increased propagation and industry use. The information they have provided has already contributed to future nursery and grower planting decisions, particularly for new, high-density planting systems.

After ten years (2005 – 2014), Bartlett, on the open-pollinated OHxF1 selection Horner 4, consistently had the largest fruit (197 grams average), yielded 41% or more than the next highest yielding rootstocks, and had similar yield efficiencies despite being nearly twice as large as other trees. For 'Golden Russet' Bosc, Horner 4 trees were largest and had the largest fruit in the final year of the trial, but lower yield efficiency than other rootstocks, suggesting it may be better suited to less vigorous Bartlett. There were very few, if any, root suckers. Horner 4 was also the least water-stressed rootstock, most likely to attain baseline values of -6 to -8 bars mid-day stem water potential (MSWP), the suggested baseline for fully-watered trees (Shackel 2007). Increasing (positive) MSWP was significantly and positively correlated with fruit size, TCSA, and yield efficiency.

The male parent of this series has now been shown to be Bartlett (Postman et al. 2013).

Based on positive results from 2005-2014, efforts were made to propagate a greater number of Horner 4 trees to test Horner 4 under varying grower conditions (soil type, nutritional challenges, microclimates), culminating in planting four replicated trials (all Bartlett scion) in the Big Valley (Finley-Kelseyville) growing area of Lake County in spring 2016. Comparison rootstocks were OHxF 97 (all four sites) and OHxF 87 (three sites).

OBJECTIVES

- Early and consistent production.
- Vigor and production on a range of (heavier) soil types.
- Compatibility with organic production (two orchards).
- Usefulness as an interplant to replace the vigorous but non-precocious *P. betulaefolia* (being phased out by nurseries).

PROCEDURES

Trial locations and descriptions: all Bartlett, sprinkler irrigated

1) D&S (conventional; omit 87); 12.5' x 12.5', interplanted; Cole clay loam, Still loam (stratified);
2) Henderson (organic); 12' x 6', interplanted; Cole clay loam;
3) Lone Pine (organic); 12' x 12', open ground, replanted; Cole clay loam;
4) Neck (conventional); 12.5' x 6', interplanted; Still loam, stratified;
5) Land low Variant silty clay loam.

Budded trees from hardwood cuttings were obtained from Sierra Gold Nursery (Yuba City, California) and planted April 4-27, 2016.

Design: Randomized complete block with five blocks consisting of 2-3 treatments x 5 tree plots (10-15 trees/block). Blocking configuration varies with location.

Data Collection

Tree survival, growth, and vigor (2016 - 2025): Percent tree survival was determined. Tree height and cultivar trunk cross-sectional area (TCSA) 10 cm. above the graft union were measured at planting (baseline) and annually thereafter. Root suckers were counted from base of origin annually.

Tree productivity (2019 – 2025; *variable by orchard)*: The total number of fruit per tree was counted and weighed, and the average grams/fruit was calculated. Yield efficiency was calculated.

Fruit quality (2021 – 2025): Two fruits per tree (total 10 fruit per 5 replicate) were collected. Firmness (kg force) was measured on each side of the fruit using a stand firmness tester ("UC" type, 5/16 mm tip). The juice was obtained from the combined fruit sample and soluble solids (°Brix) were measured using a hand refractometer (ATC-1, Atago Co. Ltd., Tokyo, Japan).

Data summarization and analysis

Data was analyzed using ANOVA and means separated using Tukey HSD test, $p \leq 0.05$ (root suckers by Duncans MRT, $p \leq 0.10$) (Statgraphics Centurion XVII, StatPoint Technologies, Warrenton, VA).

2021 - 2025 RESULTS (Tables 1-9)

Tree Productivity, Vigor, Growth, and Survival*:* Cumulatively combined data across all four orchards through 2025 showed that Horner 4 and OHxF 97 performed similarly for crop yield (kg/tree) and yield (ton/ac) (Table 1). However, no difference was observed for crop load (fruit no/tree) for all three rootstocks evaluated in these trials.

On the other hand, the rootstock OHxF 87 had the lowest performance for all three productivity metrics used in this study. Similar results were observed for the dormant trunk cross-sectional area (TCSA), where Horner 4 trees had a TCSA of 54.1 cm, followed by OHxF 97 with 46.5 cm and OHxF 87 with 36.2 cm (Table 1). Horner 4 also proved to be more vigorous, with plants height of 337 cm followed by OHxF 97 (290 cm) and OHxF 87 (240 cm), respectively. The results showed lower survival for OHxF 87 with 45 % of tree survival, followed by OHxF 97 with 65 % and Horner 4 with 73 % (Table 1). There were no differences in number of root suckers.

2025 results for each location:

***D&S Orchard Site (Horner 4 and OHxF 97 only)*:** For this trial site, OHxF97 bore significantly more Crop Load (fruit no/tree) and Fruit Size (g) compared to Horner 4, however, no difference were observed for yield (kg/tree), yield (ton/ac), dormant TCSA, yield efficiency, TCSA Increase, TCSA increase from baseline, tree height, root suckers between rootstocks (Table 2). The results showed lower survival for Horner 4 with 77 % compared to OHxF 97 with 96 %.

Henderson Orchard Site: For this location, Horner 4 had significantly more Crop Load (fruit no/tree) and Fruit Size (g), Yield (kg/tree), Yield (ton/acre), and Yield Efficiency compared to OHxF 97 and OHxF 87 (Table 3). Additionally, Horner 4 presented a better trend higher for vigor, growth, and survival metrics. There were very few or no root suckers.

Lone Pine Orchard Site: For this location, Horner 4 had significantly more Crop Load (fruit no/tree) and Fruit Size (g), Yield (kg/tree), Yield (ton/acre), and Yield Efficiency compared to OHxF 97 and OHxF 87 (Table 3). Also, Horner 4 presented a better trend higher for vigor, and growth metrics. There was no statistical separation for very root suckers and survival.

Neck Orchard Site: Among all four evaluated sites, this site presented the best plant stand, with 100% of the plants surviving. Horner 4 presented significantly more crop load (fruit no/tree), Fruit Size (g), Yield (kg/tree), and Yield (ton/ac) compared to OHxF 97 and OHxF 87 (Table 5). Also, Horner 4 presented better performance for TCSA and trees height (66 cm^2, 345 cm tall (p<.001), followed by OHxF 97 with (34.3 cm^2, 242 cm tall (p<.001), and OHxF 87 with (29.7 cm^2, 168 cm tall (p<.001) (Table 5).

Fruit quality (Tables 7-9). In general, no differences were observed in the fruit firmness and soluble solids values between rootstocks and locations. Except for the Neck Orchard Site, where firmness and soluble solids values were high for OHxF 87.

DISCUSSION AND 2025 PLANS

After ten growing seasons, cumulatively across all four trial sites, Horner 4 rootstock trees showed the best performance (Figure 1). Horner 4 trees had significantly more and larger fruit and highest yield, followed by OHxF 97. OHxF 87 trees were the least vigorous and bore the least. For individual sites, Horner 4 trees presented a better trend higher for all these metrics assessed in three of four orchards (Henderson, Lone Pine, Neck). OHxF 87 trees were consistently the smallest, trees were least vigorous and bore least for all sites. The results of ten-year studies (2016 - 2025) strongly suggest that Horner 4 rootstock may be more suitable for open ground or interplanted conventional or organic pear orchards in Lake County.

ACKNOWLEDGEMENTS

We thank: grower cooperators Dan Goff (G Bar G Orchards), David Mostin (Mostin Orchards), Greg Panella (Henderson Orchards), and David Weiss (Quercus Ranch) for contributing land, capital, labor, and advice to ensure success; UC field and lab staff Carolyn Shaffer, Wilfredo Bello, Taylor Delbar, and Lynn Fraser for collecting data; Sierra Gold Nursery (Cliff Beumel (now with Agromillora California), Chuck Fleck, Reid Robinson), and Scully Packing and Mt. Konocti Growers for tree and fruit cold storage care. We thank California Pear Advisory Board and Pear Pest Management Research Fund for partial funding. Finally, I thank Rachel Elkins for the mentoring provided.

REFERENCES

Elkins, R. 2018, 2019. Comparison of Horner 4, OHxf 87 and OHxF 97 rootstocks under varying growing conditions and cultural practices in Lake County, California. *California Pear Research Report*, https://www.calpear.com/research/.

Elkins, R. 2016, 2017, 2018, 2019. Improving economic and environmental sustainability in California pear production through changes in rootstock use: the NC-140 Regional Rootstock Project. *California Pear Research Report*, https://www.calpear.com/research/.

Elkins, R., R. Bell and T. Einhorn. 2012. Needs assessment for future U.S. pear rootstock research directions based on the current state of pear production and rootstock research. *J. of the American Pomological Society* 66(3):153-163.

Elkins, R et al. 2011. Evaluation of potential rootstocks to improve pear tree precocity and productivity. *Acta Hort* 909:183-194.

Elkins, R. and T.M. DeJong. 2011. Performance of 'Golden Russet® Bosc' on five training systems and nine rootstocks. *Acta Hort* 903:689-694.

Elkins, R. and T.M. DeJong. 2002. Effect of training system and rootstock on growth and productivity of 'Golden Russet® Bosc' pear trees. *Acta Hort* 596:603-608.

Elkins, R., K. Klonsky, R. DeMoura and T.M. DeJong. 2008. Economic Evaluation of

High Density versus Standard Orchard Configurations; Case Study Using Performance Data for 'Golden Russet Bosc' Pears. *Acta Hort* 800:739-746.
Shackel, K. 2007. Water relations. Ch.14, Pear Production and Handling Manual. E. Mitcham and R. Elkins, Technical Editors. University of California Agriculture and Natural Resources Publ. 3483. University of California, Oakland. p. 97-100.
USDA-NASS. rev. 2014. California pears, 1920-2012. California Historic Commodity Data. USDA National Agricultural Statistics Service, California Field Office, 2 pp.
USDA-Soil Conservation Service. 1989. Soil Survey of Lake County, California.

Table 1: Combined effects of 2016 pear rootstock planting on fruit number and size, yield, trunk cross-sectional area (TCSA), yield efficiency, tree height, root suckers, and survival of 10-year-old (11th leaf) "Bartlett" pear trees, at D&S, Henderson, Lone Pine, and Neck[5] Orchards, Kelseyville, Lake County, California, 2025.

Treatment[1]	Fruit No. (per tree)	Size (g)	Yield (kg/tree)	Yield (ton/acre)	Dormant TCSA (cm^2) 2025	Yield Efficiency (kg/cm^2) 2025	TCSA[3] Increase from baseline (%)	Tree Height (cm)	Root Suckers (no./tree)	Survival (%)
Horner 4[3]	122	190 a	24.8 a	9.5 a	54.1 a	0.34	1218	337 a	2.3	73 a
OHxF 87[4]	60	138 b	9.1 b	3.3 b	36.2 b	0.21	1456	240 c	2.9	45 b
OHxF 97[3]	112	150 b	17.0 ab	5.8 a	46.5 ab	0.30	1248	290 b	1.9	65 a
ANOVA (*P*-value)[2]										
Treatment	NS (0.10)	*** (<0.001)	* (0.03)	** (0.003)	* (0.03)	NS (0.08)	NS (0.48)	*** (<0.001)	NS (0.65)	** (0.01)
Block	NS (0.31)	NS (0.11)	NS (0.26)	NS (0.16)	NS (0.63)	NS (0.30)	NS (0.43)	NS (0.19)	NS (0.59)	NS (0.77)
Treatment x Block	NS (0.75)	NS (0.72)	NS (0.81)	NS (0.60)	NS (0.85)	NS (0.77)	NS (0.95)	NS (0.53)	NS (0.75)	NS (0.76)

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$). Viable trees at dormant measurement: Horner-4 = 78, OHxF 87 = 49, OHxF 97 n = 76

[2] *, **, *** Indicates significance at $P \leq 0.05$, 0.01, and 0.0011 respectively. NS indicates not significant.

[3] 4 plots

[4] 3 plots

[5] Grower pruned prior to harvest.

Table 2: Effects of 2016 pear rootstock planting on fruit number and size, yield, trunk cross-sectional area (TCSA), yield efficiency, tree height, rootsuckers, and survival of 9-year-old (10th leaf) "Bartlett" pear trees, at D&S Orchard, Kelseyville, Lake County, California, 2025.

	Fruit No.	Size	Yield	Yield	Dormant TCSA	Yield Efficiency	TCSA Increase	TCSA Increase from baseline	Tree Height	Root Suckers[3]	Survival
	(per tree)	(g.)	(kg/tree)	(ton/acre)	(cm^2)	(kg/cm^2)	(%)	(%)	(cm)	(no./tree)	(%)
Treatment[1]	8/6/2025	8/6/2025	8/6/2025	8/6/2025	11/5/2025	2025	2024-2025	2016-2025	11/5/2025	11/5/2025	11/5/2025
Horner 4	46 b	157 a	7.3	2.4	40.2	0.18	10.4	1079	300	0.9	77 b
OHxF 97	69 a	116 b	8.2	2.7	40.9	0.19	13.6	1118	283	1.2	96 a
ANOVA (*P*-value)[2]											
Treatment	** (0.005)	*** (<0.001)	NS (0.49)	NS (0.49)	NS (0.28)	NS (0.37)	NS (0.28)	NS (0.74)	NS (0.19)	NS (0.36)	* (0.05)
Block	** (0.01)	* (0.03)	* (0.02)	* (0.02)	NS (0.41)	NS (0.33)	NS (0.20)	NS (0.64)	NS (0.93)	NS (0.57)	NS (0.34)
Treatment x Block	NS (0.33)	* (0.04)	NS (0.36)	NS (0.36)	NS (0.47)	NS (0.42)	NS (0.77)	NS (0.31)	NS (0.25)	NS (0.26)	NS (0.14)

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$. Viable trees at 2025 dormant measurement: Horner 4 - 17, OHxF 97 - 24

[2] *, **, *** Indicates significance at $P \leq 0.05$, 0.01, and 0.001 respectively. NS indicates not significant.

[3] Root sucker data normalized, SQRT (root suckers+1.0) for *P*-values.

[4] Not enough Horner 4 trees with fruit for size interactions

Harvest date: 8/6/2025

Table 3: Effect of 2016 pear rootstock planting on fruit number and size, yield, trunk cross-sectional area (TCSA), yield efficiency, tree height, rootsuckers, and survival of 9-year-old (10th leaf) "Bartlett" pear trees, at Henderson Orchard, Kelseyville, Lake County, California, 2025.

Treatment[1]	Fruit No. (per tree) 8/14/2025	Size (g./fruit) 8/14/2025	Yield (kg/tree) 8/14/2025	Yield (ton/acre) 8/14/2025	Dormant TCSA (cm^2) 11/5/2025	Yield Efficiency (kg/cm^2) 2025	TCSA Increase (%) 2024 to 2025	TCSA Increase from baseline (%) 11/5/2025	Tree Height (cm) 11/5/2025	Root Suckers (no./tree) 11/5/2025	Survival (%) 2016-2025
Horner 4	43 a	203 a	8.9 a	5.9 a	33.6 a	0.25 a	24.6	626	321 a	0.3	88 a
OHxF 87	16 b	153 b	3.0 b	2.0 b	17.9 b	0.11 b	24.1	654	211 b	0.2	36 b
OHxF 97	14 b	153 b	2.2 b	1.5 b	23.6 ab	0.09 b	16.9	647	203 b	0.0	32 b
ANOVA (*P*-value) [2]											
Treatment	** (0.01)	*** (<0.001)	** (0.01)	** (0.01)	** (0.003)	** (0.004)	NS (0.53)	NS (0.97)	*** (<0.001)	NS (0.53)	*** (<0.001)
Block	NS (0.28)	NS (0.40)	NS (0.22)	NS (0.22)	NS (0.69)	NS (0.48)	NS (0.66)	NS (0.98)	NS (0.29)	NS (0.52)	NS (0.68)
Treatment x Block	~[3]	~[3]	~[3]	~[3]	~[3]	~[3]	~[3]	~[3]	~[3]	~[3]	~[3]

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$).
[2] **, *** Indicate significance at $P \leq 0.01$ and 0.001 respectively. NS indicates not significant.
[3] Not enough OHxF 87 & 97 trees with fruit for interactions
[4] Not enough viable trees for interactions.
Harvest date - 8/14/2025
Viable trees at 2025 dormant measurements; Horner 4 - 22, OHxF 87 - 11, OHxF 97 - 9.

Table 4: Effect of 2016 pear rootstock planting on fruit number and size, yield, trunk cross-sectional area (TCSA), yield efficiency, tree height, root suckers, and survival of 9-year-old (10th leaf) "Bartlett" pear trees, at Lone Pine Orchard, Kelseyville, Lake County, California, 2025.

Treatment[1]	Fruit No. (per tree) 8/21/2025	Fruit Size (g.) 8/21/2025	Yield (kg/tree) 8/21/2025	Yield (ton/ac.) 8/21/2025	TCSA (cm^2) 11/5/2025	Yield Efficiency (kg/cm^2) 2025	TCSA Increase (%) 2024-2025	TCSA % Increase from baseline 2016-2025	Tree Height (cm) 11/5/2025	Root Suckers[3] (no./tree) 11/5/2025	Survival (%) 11/5/2025
Horner 4	348 a	209 a	73.4 a	24.5 a	101.8 a	0.73 a	25.1	2592 a	404.8 a	7.1	55
OHxF 87	89 c	151 b	13.2 c	4.4 c	50.3 b	0.27 c	24.4	2180 ab	260.8 c	6.7	55
OHxF 97	225 b	169 b	38.6 b	12.9 b	66.8 b	0.55 b	20.7	1762 b	339.3 b	5.1	67
ANOVA (*P*-value)[2]			***								
Treatment	*** (<0.001)	*** (<0.001)	(<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	NS (0.78)	**(0.01)	*** (<0.001)	NS (0.54)	NS (0.61)
Block	NS (0.17)	* (0.03)	NS (0.07)	NS (0.07)	* (0.03)	NS (0.41)	NS (0.17)	**(0.01)	NS (0.13)	* (0.02)	NS (0.09)
Treatment x Block	** (0.002)	NS (0.82)	** (0.01)	** (0.01)	* (0.05)	NS (0.15)	NS (0.14)	* (0.03)	NS (0.58)	** (0.01)	NS (0.33)

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$). Viable trees at 2025 dormant measurement: Horner 4 - 14, OHxF 87 -13, OHxF 97 -18.
[2] *, **, *** Indicates significance at $P \leq 0.05$, 0.01, and 0.001 respectively. NS indicates not significant.
[3] Root sucker data normalized, SQRT (root suckers+1.0) for *P* values.
Harvest Date: 8/21/2025

Table 5: Effect of 2016 pear rootstock planting on fruit number and size, yield, trunk cross-sectional area (TCSA), yield efficiency, tree height, rootsuckers, and survival of 9-year-old (10th leaf) "Bartlett" pear trees, Neck Orchard, Kelseyville, Lake County, California, 2025.

	Fruit No.	Size	Yield	Yield	Dormant TCSA	Yield Efficiency	TCSA Increase	TCSA % Increase	Tree Height	Root Suckers[3]	Survival
	(per tree)	(g.)	(kg/tree)	(ton/acre)	(cm^2)	(kg/cm^2)	(%)	from baseline	(cm)	(no./tree)	(%)
Treatment[1]	8/11/2025	8/11/2025	8/11/2025	8/11/2025	11/5/2025	2025	2024-2025	2016-2025	11/5/2025	11/5/2025	11/5/2025
Horner 4	140 a	199 a	27.5 a	17.6 a	66.0 a	0.42 a	9.3 b	1749 a	345 a	0.9 b	100
OHxF 87	23 c	142 c	3.2 c	2.0 c	29.7 c	0.09 c	12.4 ab	1242 b	168 c	1.4 a	100
OHxF 97	74 b	174 b	13.4 b	8.5 b	44.3 b	0.28 b	14.1 a	1173 b	242 b	0.3 b	100
ANOVA (*P*-value)[2]											
Treatment	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	* (0.03)	*** (<0.001)	*** (<0.001)	* (0.03)	~
Block	** (0.003)	NS (0.12)	** (0.002)	** (0.002)	*** (0.001)	NS (0.14)	* (0.02)	*** (<0.001)	*** (0.001)	NS (0.18)	~
Treatment x Block	*** (<0.001)	** (0.01)	*** (<0.001)	*** (<0.001)	* (0.02)	*** (0.001)	* (0.04)	** (0.01)	** (0.01)	* (0.05)	~

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$), n=25. Viable trees at 2025 dormant measurement: Horner 4 - 25, OHxF 87 - 25, OHxF 97 - 25.
[2] *, **, *** Indicates significance at $P \leq 0.05$, 0.01, and 0.001 respectively. NS indicates not significant.
[3] Root sucker data normalized, SQRT (root suckers+1.0) for *P*-values.
Harvest Date:
8/11/2025

Table 6: Effect of 2016 pear rootstock planting on fruit firmness and soluble solids of 10-year-old (11th leaf) "Bartlett" pear trees, at D&S Orchard, Kelseyville, California, 2025.

Treatment[1]	Firmness (kg of force) 8/18/2025	Soluble Solids (degrees °Brix) 8/18/2025
Horner 4	9.4	13.8
OHxF 97	9.8	12.5
ANOVA (*P*-value) [2]		
Treatment	NS (0.21)	NS (0.20)
Block	NS (0.20)	NS (0.66)

[1] Within columns, treatment means significantly different (Tukey HSD, P≤0.05.
[2] NS indicates not significant.
Harvest Date: 8/6/25 Lab Testing Date: 8/18/25

Table 7: Effect of 2016 pear rootstock planting on fruit firmness and soluble solids of 10-year-old (11th leaf) "Bartlett" pear trees, at Henderson Orchard, Kelseyville, Lake County, California, 2025.

Treatment[1]	Firmness (kg of force) 8/18/2025	Soluble Solids (degrees °Brix) 8/18/2025
Horner 4	8.5	12.3
OHxF 87	9.1	13.2
OHxF 97	8.3	13.2
ANOVA (*P*-value) [2]		
Treatment	NS (0.07)	NS (0.24)
Block	* (0.03)	NS (0.40)

[1] Within columns, treatment means significantly different (Tukey HSD, P≤0.05.
[2] NS indicates not significant.
Harvest Date: 8/14/25 Lab Testing Date: 8/18/25

Table 8: Effect of 2016 pear rootstock planting on fruit firmness and soluble solids of 10-year-old (11th leaf) "Bartlett" pear trees, at Lone Pine Orchard, Kelseyville, Lake County, California, 2025.

Treatment[1]	Firmness (kg of force) 8/25/2025	Soluble Solids (degrees °Brix) 8/25/2025
Horner 4	8.0 b	12.8
OHxF 87	10.0 a	13.5
OHxF 97	9.0 ab	13.1
ANOVA (*P*-value) [2]		
Treatment	* (0.04)	NS (0.18)
Block	NS (0.50)	NS (0.61)

[1] Within columns, treatment means significantly different (Tukey HSD, P≤0.05).
[2] NS indicates not significant.
Harvest Date: 8/21/25 Lab Testing Date: 8/25/25

Table 9: Effect of 2016 pear rootstock planting on fruit firmness and soluble solids of 10-year-old (11th leaf) "Bartlett" pear trees, Neck Orchard, Kelseyville, California, 2025.

	Firmness (kg of force)	Soluble Solids (degrees °Brix)
Treatment[1]	8/18/2025	8/18/2025
Horner 4	7.4 b	12.8 b
OHxF 87	9.6 a	14.0 a
OHxF 97	7.8 b	13.6 a
ANOVA (*P*-value) [2]		
Treatment	* (0.02)	*** (<0.001)
Block	NS (0.26)	** (0.05)

[1] Within columns, treatment means significantly different (Tukey HSD, P<0.05.
[2] NS indicates not significant.
Harvest Date: 8/11/25 Lab Testing Date: 8/18/25

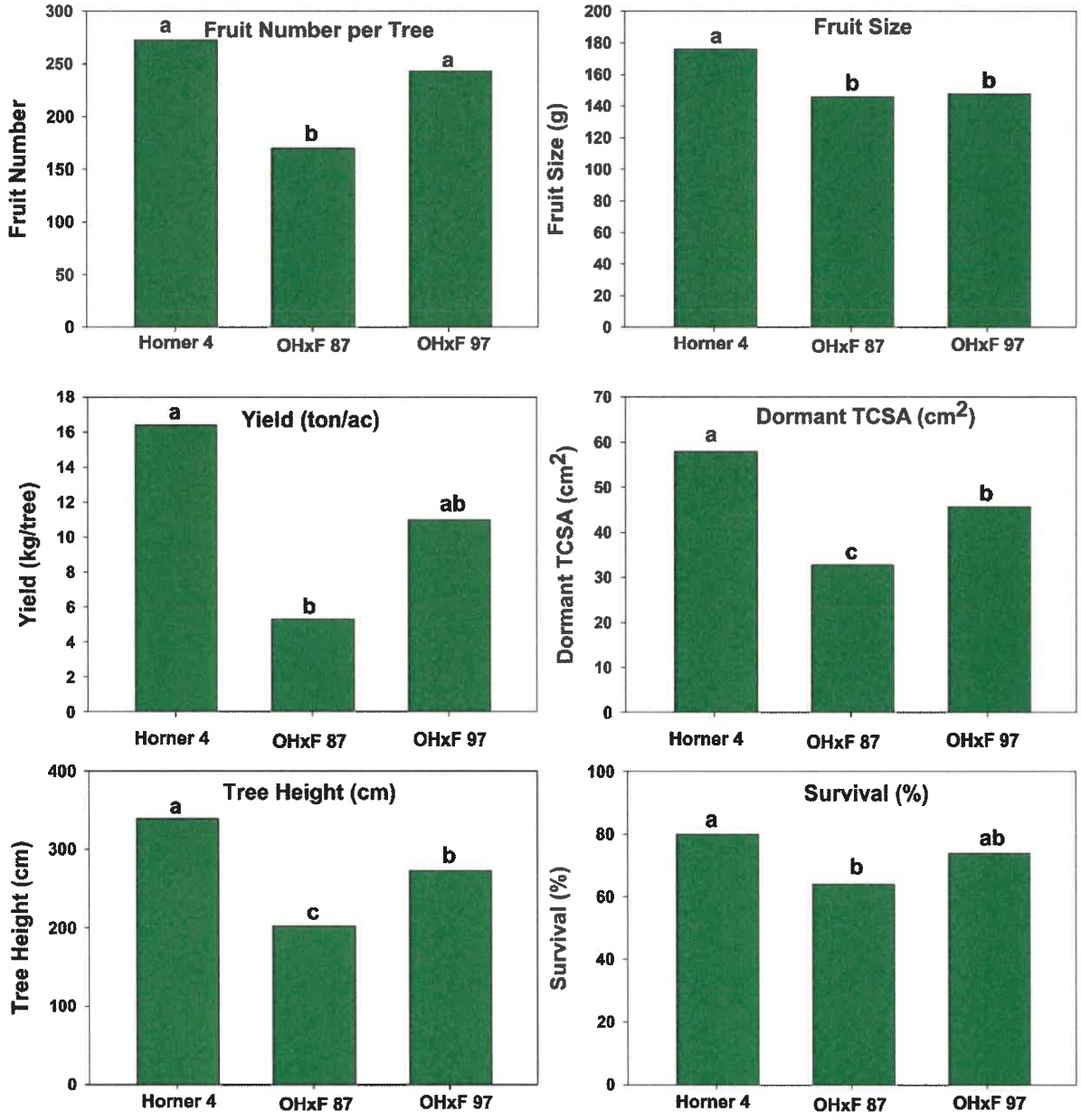

Figure 1: Cumulative effects of 2016 pear rootstock planting on fruit number and size, yield, trunk cross-sectional area (TCSA), tree height, and survival of 6 to 10-year-old (7th to 11th leaf) "Bartlett" pear trees, at D&S, Henderson, Lone Pine, and Neck (dormant only) Orchards, Kelseyville, Lake County, California, 2021-2025.