COMPARISON OF HORNER 4, OHXF 87, AND OHXF 97 ROOTSTOCKS UNDER VARYING GROWING CONDITIONS AND CULTURAL PRACTICES IN LAKE COUNTY, CALIFORNIA

(2021-2022 Progress Report)

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ABSTRACT

The Multi-State Research Project NC-140, "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 OHxF[1] 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 - -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 seven growing seasons (2016 - 2022) across all four trial sites, Horner 4 trees were significantly larger based on TCSA and height, had significantly more and larger fruit, and higher yields than OHxF rootstocks. OHxF 87 trees were smallest and had the least and smallest fruit, and lowest yields. Tree growth, productivity, fruit maturity data will continue in 2023 and mid-day stem water potential monitored.

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. All Regional projects must be re-authorized every five years; the NC-140 2017-2022 continuing 5-year proposal accepted by the North Central Regional Association (NCRA) of State Agricultural Experiment Station Directors is available on the NC-140 website. 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. Rootstock and cultivar selections for the existing 2005 NC-140 pear plantings are shown in Table 1. 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 OHxF[1] 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 - -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.

[1]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; Landlow 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 - 2022): 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 – 2022; *variable by orchard)*: Total number of fruit per tree were counted and weighed and average grams/fruit calculated. Yield efficiency was calculated.

Fruit quality (2021 – 2022): Two fruit 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). Juice was obtained from the combined fruit sample and soluble solids (°Brix) 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 - 2022 RESULTS (Tables 2-23)

Tree survival, growth, and vigor (Tables 2-16)*:* Cumulatively across all four orchards through 2022*,* there was a trend (p = .08) toward lower OHxF 87 survival (Horner 4 and OHxF 97 85%, OHxF 87 74%). Horner 4 trees were largest, followed by OHxF 97, then OHxF 87 (33.0 > 27.8 > 19.4 cm^2 TCSA; 320 > 260 > 210 cm tall). While Horner 4 and OHxF97 trees grew at equal rates in 2021, Horner 4 growth rate trended higher in 2022 (26.6% vs 25.3% TCSA increase, with OHxF 87 trailing (19.3%). There were no differences in number of root suckers.

Cumulative 2016 - 2022 results for each location:

D&S (Horner 4 and OHxF 97 only): Horner 4 survival rate was significantly lower than for OHxF 97 (83 vs 100%, p =.04). Horner 4 trees were shorter than OHxF 97 trees (200 vs 186 cm tall, p = .06) and grew more slowly (533 vs 709% TCSA cm^2 increase

from baseline, p = .03). There were very few root suckers.

Henderson: Horner 4 survival rate was significantly higher (88%, p =.01) than OHxF 97 (56%) and trended higher than OHxF 87 (60%) (p = .02). Horner 4 trees were significantly largest (17.0 > OHxF 97 11.4 = OHxF 87 7.6 cm^2 TCSA; 269 > OHxF 87 165 = OHxF 97 130 cm tall). There were no overall differences in growth rate, however Horner 4 growth rate trended greater in 2021 and 2022 (p = .07). There were very few or no root suckers (OHxF 97).

Lone Pine: There were no survival differences. Horner 4 and OHxF 97 TCSAs were very significantly larger than OHxF 87 in 2022 (51.8 = 42.8 > 30.4 cm^2 TCSA, p < .001) though Horner 4 trees were very significantly taller than either OHxF 97 or 87 (399 > 308 >252 cm, respectively, p <.001). There were no growth rate differences. There was a trend toward more Horner 4 root suckers (6.8 > 9/8 and 3/3/tree for OHxF 97 and 87, respectively, p =.08).

Neck: Survival was 100%. Horner 4 trees were very significantly largest (40.6 cm^2 TCSA, 350 cm tall (p<.001) while OHxF rootstock tree sizes were equal (26.1, 246; 20.1, 212). Horner 4 growth rate was very significantly greater than OHxF 97 and OHxF 87 (1032 > 246 = 653 % TCSA increase, p<.001) There were no differences in root suckers.

Tree productivity: (Tables 2 – 16). Cumulatively across all four trial sites in 2021-2022, Horner 4 had significantly more (75 > 64 = 41 fruit/tree, p = .01) and larger (161 > 131 > 112 gm/fruit, p < .001) fruit than OHxF 97 and 87, and subsequently significantly higher yield per tree (11.7 kg > 9.2 > 5.0 kg/tree, p < .001). There were no yield efficiency differences.

Cumulative 2016 - 2022 results for each location:

D&S (Horner 4 and OHxF 97 only): In contrast to the other trial sites, OHxF97 bore very significantly more fruit (37 vs 15/tree) and higher overall yield (6.1 vs 2.2 kg/tree) and yield efficiency (.23 vs.08 kg/cm^2) (p < .001 for all variables). There were no fruit size differences (156 v 152 gm).

Henderson: Horner 4 fruit number trended higher (24 vs 11 (97) and 8 (87), p = .07). There were no differences in fruit size, though higher fruit numbers resulted in a trend toward higher yield (4.0 vs 1.8 for 97 and 1.3 87 kg/tree (p = .08)). There were no yield efficiency differences.

Lone Pine: There were significant differences among rootstocks. OHxF 97 (95) had significantly more fruit than OHxF 87 (15), and numerically more than Horner 4 (78) (p = .04). Horner 4 fruit size (178 gm) trended larger versus OHxF 97 (144 gm) and was significantly larger versus OHxF 87 (141 gm) (p = .03). OHxF 97 yield (14.2 kg/tree)

trended higher than Horner 4 (12.6 kg) and was significantly higher than OHxF 87 (3.9); $p = .02$). Yield efficiency trended higher for Horner 4 (.31 kg/cm^2 TCSA) and OHxF97 (.24), and lowest for OHxF87 (.14) ($p = .07$).

Neck: Horner 4 had very significantly more and larger fruit than OHxF 97 and 87 (158 > 93 = 65, $p = .001$; 149 > 122 = 112 gm, $p < .001$), translating into very significantly higher yield (24.2 > 12.0 = 7.7 kg/tree, $p < .001$). Horner 4 also had significantly higher yield efficiency than OHxF rootstocks (.58 >.46 =.37 kg/tree, $p < .001$).

Fruit quality (Tables 17-23). Averaging all four orchards in 2021-2022, Horner 4 (10.8 kg force and OHxF 97 (11.0) fruit firmness trended lower than OHxF 87 (11.5)($p = .06$), perhaps correlating with their respective vigor and suggesting earlier maturity. There were no differences in soluble solids.

2021-2022 DISCUSSION AND 2023 PLANS

2021 and 2022 were very hot years, challenging tree growth and productivity. After seven growing seasons, cumulatively across all four trial sites, Horner 4 trees were largest with no differences in growth rate. Horner 4 trees had significantly more and larger fruit and highest yield, followed by OHxF 97, with no yield efficiency differences. OHxF 87 trees were least vigorous and bore least. For individual sites, Horner 4 trees were the largest (TCSA and/or height) in three of four orchards (Henderson, Lone Pine, Neck), and have grown to equal size as OHxF 97 trees in the fourth (D&S). OHxF 87 trees were consistently smallest. Horner 4 trees bore more fruit in two trials (Henderson and Neck) and larger fruit in two (Lone Pine and Neck). This combination resulted in statistically or numerically higher yields in three of the four trials, with yield efficiency equal to OHxF97 despite its larger size. OHxF 97 has performed best in the D&S trial (no OHxF 87 comparison). OHxF 87 trees were least vigorous and bore least. Horner 4 fruit firmness and soluble solids trended lower, suggesting earlier maturity. Tree growth and productivity, fruit maturity, and MSWP measurements will continue in 2023 (Year 8).

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Table 2: Average cumulative effect of rootstock on number and size of fruit, tree yield and growth, root suckers, and tree survival of 1st to 7th leaf 'Bartlett' pear trees, D&S, Henderson, Lone Pine, and Neck Orchards combined, Kelseyville, Lake County, California, 2016-2022.

Treatment[1]	Crop Load (fruit no/tree)	Fruit Size[3] (gm)	Yield (kg/tree)	Yield (ton/ac)	Cumulative Yield Efficiency[6] (kg/cm^2)	2022 TCSA (cm^2)	TCSA Increase (%)	2022 Tree Height (cm)	Root Suckers[7] (no/tree)	Tree Survival (%)
Horner 4[4]	75 a	161 a	11.7 a	7.4 a	0.29	33.0 a	750	320 a	1.5	85
OHxF 87[5]	41 b	126 c	5.0 b	3.3 b	0.24	19.4 c	755	210 c	1.1	74
OHxF 97[4]	64 b	143 b	9.2 b	5.4 ab	0.30	27.8 b	706	260 b	0.9	85
ANOVA (*P* -value) [2]										
Treatment	** (0.01)	*** (<0.001)	*** (<0.001)	*** (0.001)	NS (0.20)	*** (<0.001)	NS (0.77)	*** (<0.001)	NS (0.69)	NS (0.12)
Block	* (0.03)	NS (0.20)	** (0.01)	** (0.01)	NS (0.13)	NS (0.16)	NS (0.25)	NS (0.69)	NS (0.84)	NS (0.90)
Treatment x Block	** (0.004)	NS (0.76)	*** (0.001)	*** (0.001)	* (0.003)	NS (0.57)	NS (0.78)	NS (0.66)	NS (0.99)	NS (0.43)

[1] Within columns, 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.

[3] Average fruit size 2021 and 2022.

[4] Average of 4 plots.

[5] Average of 3 plots.

[6] Based on cumulative yield (2021-22) and final TCSA (2022).

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

Table 3: Effect of rootstock on number and size of fruit, tree yield and growth, root suckers, and tree survival of 7-year-old (8th leaf) 'Bartlett' pear trees, D&S, Henderson, Lone Pine, and Neck Orchards combined, Kelseyville, Lake County, California, 2022.

Treatment[1]	Crop Load (fruit no/tree) 8/8-24/2022	Fruit Size (gm) 8/8-24/2022	Yield (kg/tree) 8/8-24/2022	Yield (ton/acre) 8/8-24/2022	Yield Efficiency (kg/tree) 2022	Dormant TCSA (cm^2) 11/17-29/2022	TCSA[3] Increase (%) 2021-2022	Tree Height (cm) 11/17-29/2022	Root Suckers (no/tree) 11/17-29/2022	Tree Survival (%) 11/17-29/2022
Horner 4[4]	38 a	162 a	5.6 a	2.9 a	0.19	33.0 a	26.6 a	320 a	1.1	85
OHxF 87[5]	19 b	119 b	2.0 b	1.1 b	0.15	19.4 c	19.3 b	210 c	0.8	74
OHxF 97[4]	33 a	147 a	4.8 a	2.0 b	0.20	27.8 b	25.3 ab	260 b	0.7	85
ANOVA (*P* -value) [2]										
Treatment	** (0.002)	*** (<0.001)	*** (<0.001)	*** (<0.001)	NS (0.07)	*** (<0.001)	* (0.02)	*** (<0.001)	NS (0.76)	NS (0.12)
Block	* (0.05)	NS (0.91)	* (0.03)	* (0.03)	NS (0.06)	NS (0.16)	NS (0.21)	NS (0.69)	NS (0.78)	NS (0.90)
Treatment x Block	** (0.004)	NS (0.83)	** (0.003)	*** (0.001)	** (0.003)	NS (0.57)	NS (0.17)	NS (0.66)	NS (0.99)	NS (0.43)

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$).
[2] *, **,** Indicates significance at $P \leq 0.05$, 0.01, and 0.0011 respectively. NS indicates not significant.
[3] Survival data normalized using SQRT (survival+1) for *P* -values.
[4] Average of 4 plots.
[5] Average of 3 plots.

Table 4: Effect of rootstock on number and size of fruit, tree yield and growth, root suckers, and tree survival of 7-year-old (8th leaf) 'Bartlett' pear trees, D&S, Henderson, Lone Pine, and Neck Orchards combined, Kelseyville, Lake County, California, 2021.

Treatment[1]	Crop Load (fruit no/tree) 8/10-18/2021	Size (gm) 8/10-18/2021	Yield (kg/tree) 8/10-18/2021	Yield (ton/acre) 8/10-18/2021	Yield Efficiency (kg/tree) 2021	Dormant TCSA (cm^2) 3/9-10/2022	TCSA[3] Increase (%) 2020-2021	Tree Height (cm) 3/22-29/2022	Root Suckers (no/tree) 3/9/2022	Survival[6] (%) 3/9/2022
Horner 4[4]	31 a	135 a	4.2 a	2.4 a	0.14	25.7 a	19.6 a	245 a	0.5 ab	86 ab
OHxF 87[5]	18 b	112 b	1.9 b	1.0 b	0.11	16.0 b	11.6 b	176 c	0.6 a	74 b
OHxF 97[4]	23 ab	131 a	3.0 ab	1.4 b	0.12	21.9 a	19.2 a	213 b	0.4 b	87 a
ANOVA (*P* -value) [2]										
Treatment	** (0.01)	** (0.002)	*** (0.001)	*** (<0.001)	NS (0.19)	*** (<0.001)	*** (<0.001)	*** (<0.001)	* (0.05)	* (0.05)
Block	NS (0.41)	NS (0.52)	NS (0.14)	NS (0.17)	NS (0.55)	NS (0.15)	* (0.02)	NS (0.06)	NS (0.67)	NS (0.77)
Treatment x Block	* (0.02)	NS (0.47)	** (0.01)	* (0.02)	* (0.03)	NS (0.67)	* (0.03)	NS (0.56)	NS (0.95)	NS (0.38)

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$).
[2] *, **,** Indicates significance at $P \leq 0.05$, 0.01, and 0.0011 respectively. NS indicates not significant.
[3] Survival data normalized using SQRT (survival+1) for *P* -values.
[4] Average of 4 plots.
[5] Average of 3 plots.
[6] Survival revised 12/8/2022

Table 5: Average cumulative effect of rootstock on number and size of fruit, tree yield and growth, root suckers and tree survival of 1st to 7th leaf 'Bartlett' pear trees, D&S Orchard, Kelseyville, Lake County, California, 2016-2022.

Treatment[1]	Crop Load (fruit no/tree)	Average Fruit Size[3] (gm)	Yield (kg/tree)	Yield (ton/ac)	Average Cumulative Yield Efficiency[5] (kg/cm2)	2022 TCSA (cm^2)	TCSA Increase from Baseline (%)	2022 Tree Height (cm)	Root Suckers[6] (no/tree)	Tree Survival (%)
Horner 4	15 b	152	2.2 b	0.7 b	0.08 b	23.8	533	263	0.2	83
OHxF 97	37 a	156	6.1 a	2.0 a	0.23 a	26.4	709	261	0.2	100
ANOVA (*P* -value) [2]										
Treatment	*** (<0.001)	NS (0.63)	*** (<0.001)	*** (<0.001)	*** (<0.001)	NS (0.63)	* (0.03)	NS (0.82)	NS (0.88)	* (0.04)
Block	** (0.01)	NS (0.83)	* (0.02)	* (0.02)	NS (0.08)	NS (0.36)	NS (0.53)	NS (0.31)	NS (0.30)	NS (0.56)
Treatment x Block	NS (0.64)	~[4]	NS (0.57)	NS (0.57)	NS (0.32)	NS (0.33)	NS (0.38)	NS (0.24)	NS (0.69)	NS (0.52)

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

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

[3] Average fruit size 2021 and 2022.

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

[5] Based on cumulative yield (2021-22) and final TCSA (2022).

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

Table 6: Effect of rootstock on number and size of fruit, tree yield and growth, root suckers, and tree survival of 7-year-old (8th leaf) 'Bartlett' pear trees, D&S Orchard, Kelseyville, Lake County, California, 2022.

Treatment[1]	Crop Load (fruit no/tree) 8/8/2022	Size (g.) 8/8/2022	Yield (kg/tree) 8/8/2022	Yield (ton/acre) 8/8/2022	Dormant TCSA (cm^2) 11/29/2022	Yield Efficiency (kg/cm^2) 2022	TCSA Increase (%) 2021-2022	Tree Height (cm) 11/29/2022	Root Suckers[3] (no./tree) 11/29/2022	Tree Survival (%) 11/29/2022
Horner 4	8.4 b	172	1.4 b	0.5 b	23.8	0.05 b	22.2	263	0.1	82 b
OHxF 97	26.7 a	168	4.6 a	1.5 a	26.4	0.17 a	21.2	261	0.2	100 a
ANOVA (*P* -value) [2]										
Treatment	*** (<0.001)	NS (0.74)	*** (<0.001)	*** (<0.001)	NS (0.22)	*** (<0.001)	NS (0.79)	NS (0.82)	NS (0.66)	* (0.04)
Block	** (0.01)	NS (0.28)	** (0.01)	** (0.01)	NS (0.36)	NS (0.06)	NS (0.32)	NS (0.31)	NS (0.32)	NS (0.56)
Treatment x Block	NS (0.90)	~ [4]	NS (0.84)	NS (0.83)	NS (0.33)	NS (0.71)	NS (0.87)	NS (0.24)	NS (0.67)	NS (0.52)

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$.

[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 interactions

Harvest date: 8/8/2022

Table 7: Effect of rootstock on number and size of fruit, tree yield and growth, root suckers, and tree survival of 6-year-old (7th leaf) 'Bartlett' pear trees, D&S Orchard, Kelseyville, Lake County, California, 2021.

Treatment[1]	Crop Load (fruit no/tree) 8/10/2021	Size (gm) 8/10/2021	Yield (kg/tree) 8/10/2021	Yield (ton/acre) 8/10/2021	Dormant TCSA (cm^2) 3/9/2022	Yield Efficiency (kg/cm^2) 2021	TCSA Increase (%) 2020-2021	Tree Height (cm) 3/22/2022	Root Suckers[3] (no/tree) 3/9/2022	Tree Survival (%) 3/9/2022
Horner 4	6.0 b	133	0.8 b	0.3 b	19.4	0.03 b	23.1	186	0.1	82 b
OHxF 97	10.6 a	143	1.5 a	0.5 a	22.0	0.07 a	21.8	200	0.0	100 a
ANOVA (*P* -value) [2]										
Treatment	*** (0.001)	NS (0.38)	*** (0.001)	*** (0.001)	NS (0.15)	*** (<0.001)	NS (0.72)	NS (0.06)	NS (0.26)	* (0.04)
Block	* (0.02)	NS (0.27)	NS (0.06)	NS (0.06)	NS (0.34)	NS (0.13)	NS (0.10)	NS (0.84)	NS (0.46)	NS (0.56)
Treatment x Block	** (0.01)	~ [4]	* (0.03)	* (0.03)	NS (0.28)	** (0.01)	NS (0.22)	NS (0.12)	NS (0.33)	NS (0.52)

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$.

[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 interactions

Harvest date: 8/10/2021

Table 8: Average cumulative effect of rootstock on number and size of fruit, tree yield and growth, root suckers and tree survival of 1st to 7th leaf 'Bartlett' pear trees, Henderson Orchard, Kelseyville, Lake County, California, 2016-2022.

Treatment[1]	Crop Load (fruit no/tree)	Fruit Size[3] (gm)	Yield (kg/tree)	Yield (ton/ac)	Cumulative Yield Efficiency[5] (kg/cm^2)	2022 TCSA (cm^2)	TCSA Increase (%)	2022 Tree Height (cm)	Root Suckers[6] (no/tree)	Tree Survival (%)
Horner 4	24	169	4.0	2.6	0.18	17.0 a	261	269 a	0.1	88 a
OHxF 87	8	165	1.3	0.9	0.11	7.6 b	221	165 b	0.1	60 ab
OHxF 97	11	160	1.9	1.3	0.13	11.5 b	262	209 b	0.0	56 b
ANOVA (*P* -value) [2]										
Treatment	NS (0.07)	NS (0.85)	NS (0.08)	NS (0.09)	NS (0.40)	*** (<0.001)	NS (0.67)	*** (<0.001)	NS (0.61)	* (0.02)
Block	NS (0.63)	NS (0.44)	NS (0.71)	NS (0.72)	NS (0.76)	NS (0.81)	NS (0.92)	NS (0.65)	NS (0.57)	* (0.01)
Treatment x Block	NS (0.52)	~[4]	NS (0.63)	NS (0.63)	NS (0.58)	NS (0.27)	NS (0.16)	NS (0.37)	NS (0.82)	NS (0.63)

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

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

[3] Average fruit size 2021 and 2022.

[4] Not enough trees with fruit for interactions.

[5] Based on cumulative yield (2021-22) and final TCSA (2022).

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

Table 9: Effect of rootstock on number and size of fruit, tree yield and growth, root suckers, and tree survival of 7-year-old (8th leaf) 'Bartlett' pear trees, Henderson Orchard, Kelseyville, Lake County, California, 2022.

Treatment[1]	Fruit No. (per tree) 8/10/2022	Size (g.) 8/10/2022	Yield (kg/tree) 8/10/2022	Yield (ton/acre) 8/10/2022	Dormant TCSA (cm^2) 11/17/2022	Yield Efficiency (kg/cm^2) 2022	TCSA Increase (%) 11/17/2022	Tree Height (cm) 11/17/2022	Root Suckers (no./tree) 11/17/2022	Tree Survival (%) 11/17/2022
Horner 4	12	180	2.2	1.4	17.0 a	0.10	20.0	269 a	0.1	88 a
OHxF 87	4	161	0.7	0.4	7.6 b	0.05	12.6	165 b	0.1	60 ab
OHxF 97	7	184	1.3	0.9	11.4 b	0.09	23.5	209 b	0.0	56 b
ANOVA (*P* -value) [2]										
Treatment	NS (0.07)	NS (0.41)	NS (0.08)	NS (0.08)	*** (<0.001)	NS (0.24)	NS (0.07)	*** (<0.001)	NS (0.61)	* (0.02)
Block	NS (0.78)	NS (0.27)	NS (0.81)	NS (0.81)	NS (0.82)	NS (0.81)	* (0.02)	NS (0.65)	NS (0.57)	** (0.01)
Treatment x Block	NS (0.49)	~ [3]	NS (0.53)	NS (0.53)	NS (0.27)	NS (0.47)	NS (0.18)	NS (0.37)	NS (0.82)	NS (0.63)

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$), fruit no. and yield by (Fisher's LSD, $P \leq 0.05$).

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

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

Harvest date - 8/10/2022

Table 10: Effect of rootstock on number and size of fruit, tree yield and growth, root suckers, and tree survival of 6-year-old (7th leaf) 'Bartlett' pear trees, Henderson Orchard, Kelseyville, Lake County, California, 2021.

Treatment[1]	Fruit No. (per tree) 8/17/2021	Size (g.) 8/17/2021	Yield (kg/tree) 8/17/2021	Yield (ton/acre) 8/17/2021	Dormant TCSA (cm^2) 3/10/2022	TCSA Increase (%) 2020-2021	Tree Height (cm) 3/22/2022	Root Suckers (no./tree) 3/10/2022	Tree Survival (%) 3/10/2022
Horner 4	11 a	152	1.7 a	1.1 a	13.9 a	15.2	192 a	0.0	92 a
OHxF 87	4 b	172	0.6 b	0.4 b	6.9 b	8.5	115 b	0.0	60 b
OHxF 97	4 b	135	0.6 b	0.4 b	8.8 b	10.3	130 b	0.0	64 b
ANOVA (*P* -value) [2]									
Treatment	* (0.03)	NS (0.27)	* (0.04)	* (0.04)	*** (<0.001)	NS (0.07)	*** (<0.001)	~	** (0.01)
Block	NS (0.34)	NS (0.28)	NS (0.45)	NS (0.45)	NS (0.20)	NS (0.17)	NS (0.78)	~	** (0.002)
Treatment x Block	NS (0.46)	~ [3]	NS (0.68)	NS (0.68)	NS (0.23)	NS (0.33)	NS (0.26)	~	NS (0.88)

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$), fruit no. and yield by (Fisher's LSD, $P \leq 0.05$).

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

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

Harvest date - 8/17/2021

Table 11: Average cumulative effect of rootstock on number and size of fruit, tree yield and growth, root suckers and tree survival of 1st to 7th leaf 'Bartlett' pear trees, Lone Pine Orchard, Kelseyville, Lake County, California, 2016-2022.

Treatment[1]	Crop Load (fruit/tree)	Fruit Size[3] (g)	Yield (kg/tree)	Yield (ton/ac)	Cumulative Yield Efficiency[4] (kg/cm^2)	2022 TCSA (cm^2)	TCSA Increase (%)	2022 Tree Height (cm)	Root Suckers (no/tree)	Tree Survival (%)
Horner 4	78 ab	178 a	12.6 ab	8.4 ab	0.24	51.8 a	1174	399 a	6.8	72
OHxF 87	31 b	141 b	3.9 b	2.6 b	0.14	30.4 b	1225	252 c	3.7	63
OHxF 97	95 a	144 ab	14.2 a	9.5 a	0.31	42.8 a	1069	308 b	3.3	83
ANOVA (*P* -value) [2]										
Treatment	* (0.04)	* (0.03)	* (0.02)	* (0.02)	NS (0.07)	*** (<0.001)	NS (0.59)	*** (<0.001)	NS (0.08)	NS (0.28)
Block	NS (055)	NS (0.29)	NS (0.42)	NS (0.42)	NS (0.43)	* (0.02)	* (0.02)	NS (0.34)	NS (0.64)	NS (0.09)
Treatment x Block	** (0.01)	NS (0.49)	* (0.02)	* (0.02)	*** (<0.001)	NS (0.49)	NS (0.10)	NS (0.07)	NS (0.54)	* (0.05)

[1] Within columns, 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.

[3] Average fruit size 2021 and 2022.

[4] Based on cumulative yield (2021-22) and final TCSA (2022).

Table 12: Effect of rootstock on number and size of fruit, tree yield and growth, root suckers, and tree survival of 7-year-old (8th leaf) 'Bartlett' pear trees, Lone Pine orchard, Kelseyville, Lake County, California, 2022.

Treatment[1]	Crop Load (fruit/tree) 8/24/2022	Size (gm) 8/24/2022	Yield (kg/tree) 8/24/2022	Yield (ton/acre) 8/24/2022	TCSA (cm^2) 11/29/2022	Yield Efficiency (kg/cm^2) 2022	TCSA Increase (%) 2020-2021	Tree Height (cm) 11/29/2022	Root Suckers[3] (no/tree) 11/29/2022	Tree Survival (%) 11/29/2022
Horner 4	17 ab	190 a	8.7 a	2.9 a	51.8 a	0.17	24.4	399 a	5.2	72
OHxF 87	15 b	160 ab	2.0 b	0.7 b	30.4 b	0.07	20.1	252 c	2.6	63
OHxF 97	20 a	148 b	8.4 a	2.8 a	42.8 a	0.18	29.2	308 b	2.5	83
ANOVA (*P* -value) [2]										
Treatment	* (0.04)	* (0.03)	* (0.02)	* (0.02)	*** (<0.001)	NS (0.11)	NS (0.29)	*** (<0.001)	NS (0.09)	NS (0.28)
Block	NS (0.30)	NS (0.48)	NS (0.20)	NS (0.20)	* (0.02)	NS (0.16)	NS (0.48)	NS (0.34)	NS (0.76)	NS (0.09)
Treatment x Block	* (0.02)	NS (0.32)	* (0.02)	* (0.02)	NS (0.49)	*** (0.001)	NS (0.53)	NS (0.07)	NS (0.64)	NS (0.05)

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

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

Harvest Date: 8/24/2022

Table 13: Effect of rootstock on number and size of fruit, tree yield and growth, root suckers, and tree survival of 6-year-old (7th leaf) 'Bartlett' pear trees, Lone Pine orchard, Kelseyville, Lake County, California, 2021.

Treatment[1]	Crop Load (fruit/tree) 8/18/2021	Size (gm) 8/18/2021	Yield (kg/tree) 8/18/2021	Yield (ton/acre) 8/18/2021	Dormant TCSA (cm^2) 3/9/2022	Yield Efficiency (kg/cm^2)	TCSA Increase (%) 2020-2021	Tree Height (cm) 3/22/2022	Root Suckers[3] (no/tree) 3/9/2022	Tree Survival (%) 3/22/2022
Horner 4	27	143	3.9 ab	1.3 ab	41.7 a	0.09 ab	21.1	358 a	1.6	72
OHxF 87	15	125	1.8 b	0.6 b	25.2 b	0.07 b	14.6	302 b	1.1	63
OHxF 97	39	146	5.8 a	1.9 a	33.7 ab	0.16 a	17.9	229 ab	0.7	83
ANOVA (*P* -value) [2]										
Treatment	NS (0.19)	NS (0.11)	* (0.03)	* (0.03)	*** (<0.001)	* (0.03)	NS (0.31)	*** (0.001)	NS (0.30)	NS (0.28)
Block	NS (0.94)	NS (0.13)	NS (0.70)	NS (0.70)	NS (0.10)	NS (0.89)	** (0.01)	NS (0.25)	NS (0.23)	NS (0.09)
Treatment x Block	* (0.05)	~ [4]	NS (0.09)	NS (0.09)	NS (0.57)	** (0.01)	NS (0.44)	NS (0.13)	NS (0.38)	NS (0.05)

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

[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 trees with fruit for interaction.

Harvest Date: 8/18/2021

Table 14: Average cumulative effect of rootstock on number and size of fruit, tree yield and growth, root suckers and tree survival of 1st to 7th leaf 'Bartlett' pear trees, Neck Orchard, Kelseyville, Lake County, California, 2016-2022.

Treatment[1]	Crop Load (fruit/tree)	Average Fruit Size[3] (gm)	Yield (kg/tree)	Yield (ton/acre)	Cumulative Yield Efficiency[4] (kg/cm^2)	2022 TCSA (cm^2)	TCSA Increase (%)	2022 Tree Height (cm)	Root Suckers[5] (no/tree)	Tree Survival (%)
Horner 4	158 a	149 a	24.2 a	15.4 a	0.58 a	40.6 a	1032 a	350 a	0.1	100
OHxF 87	65 b	112 b	7.7 b	4.9 b	0.37 b	20.1 b	813 b	212 b	0.2	100
OHxF 97	93 b	122 b	12.0 b	7.7 b	0.46 b	26.1 b	653 b	246 b	0.3	100
ANOVA (*P* -value) [2]										
Treatment	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	NS (0.41)	~
Block	* (0.03)	** (0.01)	** (0.004)	** (0.004)	* (0.03)	** (0.01)	** (0.002)	* (0.05)	NS (0.11)	~
Treatment x Block	*** (<0.001)	* (0.02)	*** (<0.001)	*** (<0.001)	*** (<0.001)	** (0.01)	** (0.01)	*** (<0.001)	NS (0.83)	~

[1] Within columns, 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.

[3] Average fruit size 2021 and 2022.

[4] Based on cumulative yield (2021-22) and final TCSA (2022).

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

Table 15: Effect of rootstock on number and size of fruit, tree yield and growth, root suckers, and tree survival of 7-year-old (8th leaf) 'Bartlett' pear trees, Neck orchard, Kelseyville, Lake County, California, 2022.

Treatment[1]	Fruit No. (per tree) 8/12/2022	fruit Size (gm) 8/12/2022	Yield (kg/tree) 8/12/2022	Yield (ton/acre) 8/12/2022	Dormant TCSA (cm^2) 12/29/2022	TCSA Increase (%) 2021-2022	Yield Efficiency (kg/cm^2) 2022	Tree Height (cm) 12/29/2022	Root Suckers[3] (no/tree) 12/29/2022	Tree Survival (%) 12/29/2022
Horner 4	87 a	173 a	15.0 a	9.6 a	40.6 a	36.4 a	0.36 a	350 a	0.00	100
OHxF 87	36 c	131 b	5.0 b	3.2 b	20.2 b	33.0 b	0.24 b	212 c	0.12	100
OHxF 97	57 b	136 b	8.1 b	5.2 b	26.1 b	27.6 ab	0.31 ab	246 b	0.16	100
ANOVA (*P* -value) [2]										
Treatment	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	** (0.01)	*** (<0.001)	*** (<0.001)	NS (0.13)	~
Block	*** (<0.001)	* (0.03)	*** (<0.001)	*** (<0.001)	** (0.003)	NS (0.28)	*** (<0.001)	** (0.01)	NS (0.22)	~
Treatment x Block	*** (<0.001)	** (0.01)	*** (<0.001)	*** (<0.001)	** (0.01)	* (0.05)	*** (<0.001)	*** (<0.001)	NS (0.88)	~

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$), n=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: 8/12/2022

Table 16: Effect of rootstock on number and size of fruit, tree yield and growth, root suckers, and tree survival of 6-year-old (7th leaf) 'Bartlett' pear trees, Neck orchard, Kelseyville, Lake County, California, 2021.

Treatment[1]	Crop Load (fruit/tree) 8/11/2021	Fruit Size (gm) 8/11/2021	Yield (kg/tree) 8/11/2021	Yield (ton/acre) 8/11/2021	Dormant TCSA (cm^2) 3/9/2022	TCSA Increase (%) 2020-2021	Yield Efficiency (kg/cm^2) 2021	Tree Height (cm) 3/29/2022	Root Suckers[3] (no/tree) 3/9/2022	Tree Survival (%) 3/9/2022
Horner 4	72 a	125 a	9.1 a	5.8 a	30.0 a	19.8 a	0.29 a	255 a	0.12	100
OHxF 87	29 b	93 c	2.7 b	1.7 b	16.3 b	12.6 b	0.16 b	174 b	0.12	100
OHxF 97	36 b	108 b	3.9 b	2.5 b	20.5 b	23.2 a	0.19 b	200 b	0.12	100
ANOVA (*P* -value) [2]										
Treatment	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (0.001)	*** (<0.001)	*** (<0.001)	NS (1.00)	~
Block	NS (0.39)	** (0.01)	** (0.01)	** (0.01)	* (0.02)	NS (0.95)	NS (0.52)	*** (<0.001)	NS (0.40)	~
Treatment x Block	*** (<0.001)	NS (0.06)	*** (<0.001)	*** (<0.001)	*** (0.001)	NS (0.19)	*** (<0.001)	*** (<0.001)	NS (0.29)	~

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$), n=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: 8/11/2021

Table 17: Average cumulative effect of rootstock on fruit firmness and soluble solids of 7th and 8th leaf 'Bartlett' pear trees, D&S, Henderson, Lone Pine, and Neck Orchards, Kelseyville, Lake County, California, 2021-2022.

Treatment[1]	Firmness (kg force)	Soluble Solids (°Brix)
Horner 4[3]	10.8	13.1
OHxF 87[4]	11.5	13.4
OHxF 97[3]	11.0	13.6
ANOVA (*P* -value) [2]		
Treatment	NS (0.06)	NS (0.36)
Block	NS (0.60)	NS (0.86)
Treatment x Block	NS (0.92)	NS (0.99)

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

[2] NS indicates not significant.

[3] Average of 4 plots.

[4] Average of 3 plots.

Table 18: Effect of rootstock on fruit firmness and soluble solids of 7-year-old (8th leaf) 'Bartlett' pear trees, D&S Orchard, Kelseyville, Lake County, California, 2022.

Treatment[1]	Firmness (kg force) 8/9/2022	Soluble Solids (°Brix) 8/9/2022
Horner 4	11.0	12.9
OHxF 97	10.4	14.0
ANOVA (*P* -value) [2]		
Treatment	NS (0.41)	NS (0.14)
Block	NS (0.68)	NS (0.32)

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

[2] NS indicates not significant.

Harvested 8/8/22; tested 8/9/22.

Table 19: Effect of rootstock on fruit firmness and soluble solids of 6-year-old (7th leaf) 'Bartlett' pear trees, D&S Orchard, Kelseyville, Lake County, California, 2021.

Treatment[1]	Firmness (kg force) 8/11/2021	Soluble Solids (°Brix) 8/11/2021
Horner 4	10.7	14.0
OHxF 97	11.0	14.3
ANOVA (*P* -value) [2]		
Treatment	NS (0.70)	NS (0.65)
Block	NS (0.61)	NS (0.99)

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

[2] NS indicates not significant.

Harvested 8/10/21; tested 8/11/21.

Table 20: Effect of rootstock on fruit firmness and soluble solids of 7-year-old (8th leaf) 'Bartlett' pear trees, Henderson Orchard, Kelseyville, Lake County, California, 2022.

Treatment[1]	Firmness (kg force) 8/15/2022	Soluble Solids (°Brix) 8/15/2022
Horner 4	10.0	12.0 b
OHxF 87	10.6	12.4 a
OHxF 97	11.1	12.3 ab
ANOVA (*P* -value) [2]		
Treatment	NS (0.15)	* (0.05)
Block	NS (0.16)	NS (0.19)

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

[2] NS indicates not significant.

Harvested 8/10/22; tested 8/15/22.

Table 21: Effect of rootstock planting on fruit firmness and soluble solids of 6-year-old (7th leaf) 'Bartlett' pear trees, Henderson Orchard, Kelseyville, Lake County, California, 2021.

Treatment[1]	Firmness (kg force) 8/18-24/2021	Soluble Solids (°Brix) 8/18-24/2021
Horner 4	11.8	13.5
OHxF 87	11.3	13.4
OHxF 97	11.4	13.1
ANOVA (*P* -value) [2]		
Treatment	NS (0.73)	NS (0.66)
Block	NS (0.59)	NS (0.71)

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

[2] NS indicates not significant.

Harvested 8/17/21; tested 8/18-24/21.

Table 22: Effect of rootstock on fruit firmness and soluble solids of 7-year-old (8th leaf) 'Bartlett' pear trees, Lone Pine Orchard, Kelseyville, Lake County, California, 2022.

Treatment[1]	Firmness (kg force) 8/31/2022	Soluble Solids (°Brix) 8/31/2022
Horner 4	9.0	12.2
OHxF 87	10.0	11.9
OHxF 97	9.1	12.4
ANOVA (*P* -value) [2]		
Treatment	NS (0.06)	NS (0.85)
Block	NS (0.25)	NS (0.63)

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

[2] NS indicates not significant.

Harvested 8/24/22; tested 8/31/22.

Table 23: Effect of rootstock on fruit firmness and soluble solids of 6-year-old (7th leaf) 'Bartlett' pear trees, Lone Pine Orchard, Kelseyville, Lake County, California, 2021.

Treatment[1]	Firmness (kg force) 8/24-25/2021	Soluble Solids (°Brix) 8/24-25/2021
Horner 4	13.1	12.4
OHxF 87	12.8	12.4
OHxF 97	12.4	13.2
ANOVA (*P* -value) [2]		
Treatment	NS (0.53)	NS (0.28)
Block	NS (0.60)	NS (0.31)

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

[2] NS indicates not significant.

Harvested 8/18/21; tested 8/24-25/21.

Table 24: Effect of pear rootstock on fruit firmness and soluble solids of 7-year-old (8th leaf) 'Bartlett' pear trees, Neck Orchard, Kelseyville, Lake County, California, 2022.

Treatment[1]	Firmness (kg force) 8/15/2022	Soluble Solids (°Brix) 8/15/2022
Horner 4	9.9	12.3 b
OHxF 87	10.5	13.5 a
OHxF 97	10.5	13.5 a
ANOVA (*P* -value) [2]		
Treatment	NS (0.71)	* (0.03)
Block	NS (0.49)	NS (0.14)

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

[2] NS indicates not significant.

Harvested 8/12/22; tested 8/15/22.

Table 25: Effect of pear rootstock on fruit firmness and soluble solids of 6-year-old (7th leaf) 'Bartlett' pear trees, Neck Orchard, Kelseyville, Lake County, California, 2021.

Treatment[1]	Firmness (kg force) 8/12/2021	Soluble Solids (°Brix) 8/12/2021
Horner 4	11.6	15.0
OHxF 87	13.2	16.3
OHxF 97	12.7	15.6
ANOVA (*P* -value) [2]		
Treatment	NS (0.13)	NS (0.16)
Block	NS (0.65)	NS (1.00)

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

[2] NS indicates not significant.

Harvested 8/11/21; tested 8/12/21.