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

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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 were nearly twice as large as others, with similar yield efficiencies despite being the largest 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 planted 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. After three growing seasons (2016 - 2018), Horner 4 were significantly largest trees (10 cm^2, 232 cm tall), followed by OHxF 97 (8.4 cm^2, 204 cm tall), then OHxF 87 (6.6 cm^2,179 cm tall). Horner 4 trees were also the least stressed in all four trial sites. Tree growth, (potential) flowering and fruiting, and MSWP data will continue in 2019.

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 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 were nearly twice as large as others, with similar yield efficiencies despite being the largest 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 and OHxF 87.

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, each plot consisting of 15 trees (10 in one case) (5 each of 3 (2 in one case) rootstocks) Blocking varies with location.

Data Collection

Tree survival, growth and vigor (2016-2018): Percent surviving trees was determined. Tree height and cultivar trunk cross-sectional area (TCSA) 10 cm. above the graft union were measured. Root suckers were counted. Weekly or bi-weekly mid-day stem water potential (MSWP) was measured from June 13 to September 27 (D&S, Henderson) or June 13 to October 12 (Lone Pine, Neck) using a pressure chamber (PMS Model 610 Pressure Chamber, PMS Instrument Company, Albany, OR) to assess whether and how much water stress might affect vigor, and vise versa. MSWP measurements were interrupted from July 18 until September/October in 2018 due to wildfires.

Data summarization and analysis

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

2017-2018 RESULTS

Tree survival, growth, and vigor (Tables 1-10)*:* Across all four orchards, there was no difference in % survival. Horner 4 was significantly largest (10.0 cm^2 TCSA, 232 cm tall), followed by OHxF 97 (44.5 cm^2, 204 cm tall) then OHxF 87 (38.4 cm^2, 179 cm tall). The height difference between Horner 4 and OHxF 97 more clearly separated in 2018. Results for each locations were:

D&S: Survival rate was 91% for Horner 4 and 100% for OHxF 97. There were no significant differences in tree growth and almost no suckers.

Henderson: There were no survival. Horner 4 trees were significantly largest (7.1 cm^2 TCSA, 187 cm tall), followed by OHxF 97 then OHxF 87 (5.1/153.0 and 4.0/139.2).

Lone Pine: There were no survival differences (averaging one tree lost per treatment). Horner 4 trees were numerically, but not significantly larger than OHxF 97 (15.0 vs. 12.9 cm^2 TCSA); OHxF 87 trees were smallest (9.8 cm^2). Horner 4 trees were significantly taller (272.3 cm) than both OHxF 97 and 87 (232.5 and 209.6 cm). There was a trend (p = .09) toward more root suckers for OHxF 87.

Neck: Survival is 100%. Horner 4 are the largest trees (9.7 cm^2 TCSA, 259.1 cm tall), with both OHxF rootstocks statistically equal in size. There were no rootstock differences.

Mid-day Stem Water Potential (MSWP) (Figures 1-4): MSWP pattern varied across orchards, however MSWP failed to meet baseline (-6 to -8) on any date. There was variability among orchards, however data suggests a trend toward better water status

for Horner 4 as compared to OHxF trees earlier in the summer. While the values obtained from measuring MSWP in 3rd leaf trees cannot be directly compared to those obtained from mature trees, it is interesting to note that the highest (wettest, least stressed) value, -12, does resemble that of mature trees (generally -10 to -12). This value was obtained in three of the four orchards in late June after an irrigation. Wettest value only reach -16 in the fourth orchard, which had uneven water distribution due to the layout of the emitters, according to the cooperator. Measuring MSWP in young trees offers the opportunity to relate vigor and productivity as trees mature.

2017-2018 DISCUSSION AND 2019 PLANS

After three growing seasons, Horner 4 trees were the largest and OHxF 87 smallest. A few fruit (average less than 1 per tree) was observed across all rootstocks in several orchards in 2018 but was not counted in 2018. Horner 4 also generally had better water status than OHxF. While MSWP failed to reach the currently accepted baseline of -6 to -8 (Shackel 2007), which is seldom met in Lake County pear orchards, it did reach -10 to -12 after irrigating, which is commonly observed in mature trees in this growing area.

Tree growth and MSWP measurements will continue in 2019 and flowering and fruiting measurements commence (Year 4).

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Table 1: Average effect of rootstock on trunk cross-sectional area (TCSA), tree height, and survival on 3-year-old (4th leaf) "Bartlett" pear trees, Kelseyville, California, 2018.

Treatment[1]	Dormant TCSA (cm^2) 12/13/2018	TCSA Increase (%) 12/13/2018	Tree Height (cm) 12/13/2018	Survival[3] (%) 12/13/2018
Horner 4[4]	10.0 a	52.4 a	232 a	94
OHxF 87[5]	6.6 c	38.4 b	179 c	92
OHxF 97[4]	8.4 b	44.5 ab	204 b	95
ANOVA (*P*-value) [2]				
Treatment	*** (<0.001)	** (0.01)	*** (<0.001)	NS (0.71)
Block	NS (0.17)	NS (0.85)	NS (0.74)	NS (0.62)
Treatment x Block	NS (0.20)	** (0.01)	** (0.01)	NS (0.65)

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

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

[3] Survival data normalized using SQRT (survival+1).

[4] Average of 4 plots.

[5] Average of 3 plots.

Table 2: Average effect of rootstock planting on trunk cross-sectional area (TCSA), tree height, and survival on 2-year-old (3rd leaf) "Bartlett" pear trees, Kelseyville, California, 2017.

Treatment[1]	Dormant TCSA (cm^2) 12/8/2017	TCSA Increase (%) 12/8/2017	Tree Height (cm) 12/8/2017	Survival[3] (%) 12/8/2017
Horner 4[4]	6.5 a	45.0 b	191 a	96
OHxF 87[5]	4.6 c	60.7 a	154 b	92
OHxF 97[4]	5.7 b	49.3 ab	176 a	96
ANOVA (*P*-value) [2]				
Treatment	*** (<0.001)	* (0.03)	*** (0.001)	NS (0.43)
Block	NS (0.09)	NS (0.11)	NS (0.30)	NS (0.79)
Treatment x Block	NS (0.58)	NS (0.43)	NS (0.38)	NS (0.24)

[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] Survival data normalized using SQRT (survival+1).

[4] Average of 4 plots.

[5] Average of 3 plots.

Table 3: Effect of rootstock planting on trunk cross-sectional area (TCSA), tree height, root suckers, and survival of 3-year-old (4th leaf) "Bartlett" pear trees in four orchards, D&S Orchard, Kelseyville, California, 2018.

Treatment[1]	Dormant TCSA (cm^2) 12/13/2018	TCSA Increase[3] (%) 12/13/2018	Tree Height (cm) 12/13/2018	Root Suckers (no./tree) 12/13/2018	Survival (%) 12/13/2018
Horner 4	8.4	56.1	202.7	0.1	91
OHxF 97	8.4	56.0	214.7	0.0	100
ANOVA (*P* -value) [2]					
Treatment	NS (0.92)	NS (0.98)	NS (0.41)	NS (0.06)	NS (0.16)
Block	NS (0.08)	NS (0.69)	* (0.05)	NS (0.31)	NS (0.64)
Treatment x Block	NS (0.17)	NS (0.12)	* (0.05)	NS (0.07)	NS (0.63)

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

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

[3] 2017 to 2018 increase.

Table 4: Effect of rootstock planting on trunk cross-sectional area (TCSA), tree height, root suckers, and survival of 2-year-old (3rd leaf) "Bartlett" pear trees in four orchards, D&S Orchard, Kelseyville, California, 2017.

Treatment[1]	Dormant TCSA (cm^2) 12/8/2017	TCSA Increase[3] (%) 12/8/2017	Tree Height (cm) 12/8/2017	Root Suckers (no./tree) 12/8/2017	Survival (%) 12/8/2017
Horner 4	5.4	40.1	156	0.0	96
OHxF 97	5.4	49.1	180	0.0	100
ANOVA (*P* -value) [2]					
Treatment	NS (0.78)	NS (0.20)	NS (0.06)	~	NS (0.32)
Block	** (0.002)	NS (0.16)	NS (0.41)	~	NS (0.48)
Treatment x Block	* (0.05)	NS (0.35)	NS (0.35)	~	NS (0.47)

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

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

[3] 2016 to 2017 increase.

Table 5: Effect of rootstock on trunk cross-sectional area (TCSA), tree height, and survival of 3-year-old (4th leaf) "Bartlett" pear trees, Henderson Orchard, Kelseyville, California, 2018.

Treatment[1]	Dormant TCSA (cm^2) 12/13/2018	TCSA Increase[3] (%) 12/13/2018	Tree Height (cm) 12/13/2018	Survival (%) 12/13/2018
Horner 4	7.1 a	24.3	187.0 a	92
OHxF 87	4.0 c	20.0	139.2 b	88
OHxF 97	5.1 b	25.9	153.0 ab	88
ANOVA (*P*-value) [2]				
Treatment	*** (<0.001)	NS (0.64)	** (0.004)	NS (0.87)
Block	NS (0.24)	NS (1.00)	NS (0.59)	NS (0.18)
Treatment x Block	** (0.01)	NS (0.07)	* (0.04)	NS (0.31)

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$, TCSA % increase $P \leq 0.10$).

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

[3] 2017 to 2018 increase.

Table 6: Effect of rootstock planting on trunk cross-sectional area (TCSA), tree height, and survival of 2-year-old (3nd leaf) "Bartlett" pear trees, Henderson Orchard, Kelseyville, California, 2017.

Treatment[1]	Dormant TCSA (cm^2) 12/8/2017	TCSA Increase[3] (%) 12/8/2017	Tree Height (cm) 12/8/2017	Survival (%) 12/8/2017
Horner 4	5.7 a	15.7 b	137.7	96
OHxF 87	3.2 c	28.4 a	114.4	92
OHxF 97	4.1 b	16.0 b	127.2	92
ANOVA (*P*-value) [2]				
Treatment	*** (<0.001)	*** (0.001)	NS (0.08)	NS (0.82)
Block	*** (0.001)	** (0.01)	NS (0.10)	NS (0.73)
Treatment x Block	** (0.01)	NS (0.42)	NS (0.11)	NS (0.08)

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$, TCSA % increase $P \leq 0.10$).

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

[3] 2016 to 2017 increase.

Table 7: Effect of rootstock planting on trunk cross-sectional area (TCSA), tree height, root suckers, and survival of 3-year-old (4th leaf) "Bartlett" pear trees, Lone Pine Orchard, Kelseyville, California, 2018.

Treatment[1]	TCSA (cm^2) 12/13/18	TCSA Increase[3] (%) 12/13/18	Tree Height (cm) 12/13/18	Root Suckers (no./tree) 12/13/18	Survival (%) 12/13/18
Horner 4	15.0 a	61.1	272.3 a	1.0	92
OHxF 87	9.8 b	57.9	209.6 b	1.3	88
OHxF 97	12.9 a	55.5	232.5 b	0.5	92
ANOVA (*P* -value) [2]					
Treatment	*** (<0.001)	NS (0.86)	*** (0.001)	NS (0.09)	NS (0.85)
Block	NS (0.29)	NS (0.25)	NS (0.46)	NS (0.53)	NS (0.47)
Treatment x Block	NS (0.13)	NS (0.08)	NS (0.07)	NS (0.33)	NS (0.11)

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

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

[3] 2017 to 2018 increase.

Table 8: Effect of rootstock planting on trunk cross-sectional area (TCSA), tree height, and survival of 2-year-old (3rd leaf) "Bartlett" pear trees, Lone Pine Orchard, Kelseyville, California, 2017.

Treatment[1]	TCSA (cm^2) 12/8/17	TCSA Increase[3] (%) 12/8/17	Tree Height (cm) 12/8/17	Survival (%) 12/8/17
Horner 4	9.3 a	82.8	242 a	96
OHxF 87	6.3 b	93.3	182 b	88
OHxF 97	8.3 a	96.7	204 b	92
ANOVA (*P* -value) [2]				
Treatment	*** (0.001)	NS (0.54)	*** (0.001)	NS (0.60)
Block	NS (0.54)	NS (0.27)	NS (0.14)	NS (0.73)
Treatment x Block	NS (0.14)	NS (0.75)	NS (0.32)	NS (0.14)

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

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

[3] 2016 to 2017 increase.

Table 9: Effect of rootstock planting on trunk cross-sectional area (TCSA), tree height, and survival of 3-year-old (4th leaf) "Bartlett" pear trees, Neck Orchard, Kelseyville, California, 2018.

Treatment[1]	TCSA (cm^2) 12/13/2018	TCSA Increase[3] (%) 12/13/2018	Tree Height (cm) 12/13/2018	Root Suckers (no./tree) 12/13/2018	Survival (%) 12/13/2018
Horner 4	9.7 a	68.9 ab	259.1 a	0.1	100
OHxF 87	6.2 b	39.7 b	189.2 b	0.0	100
OHxF 97	7.4 b	39.2 b	211.8 b	0.0	100
ANOVA (*P* -value) [2]					
Treatment	*** (<0.001)	*** (<0.001)	*** (<0.001)	NS (0.37)	~
Block	*** (<0.001)	*** (0.001)	*** (<0.001)	NS (0.41)	~
Treatment x Block	** (0.01)	* (0.02)	* (0.04)	NS (0.45)	~

[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] 2017 to 2018 increase.

Table 10: Effect of rootstock planting on trunk cross-sectional area (TCSA), tree height, and survival of 2-year-old (3rd leaf) "Bartlett" pear trees, Neck Orchard, Kelseyville, California, 2017.

Treatment[1]	TCSA (cm^2) 12/8/2017	TCSA Increase[3] (%) 12/8/2017	Tree Height (cm) 12/8/2017	Root Suckers (no./tree) 12/8/2017	Survival (%) 12/8/2017
Horner 4	5.7 a	42.8 b	225 a	0.0	100
OHxF 87	4.4 b	65.6 a	169 c	0.0	100
OHxF 97	5.3 a	37.3 b	193 b	0.0	100
ANOVA (*P* -value) [2]					
Treatment	*** (<0.001)	*** (<0.001)	*** (<0.001)	~	~
Block	NS (0.09)	* (0.04)	*** (<0.001)	~	~
Treatment x Block	NS (0.07)	* (0.04)	NS (0.17)	~	~

[1] Within columns, treatment means significantly different (Tukey HSD, $P \leq 0.05$), n=25.

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

[3] 2016 to 2017 increase.

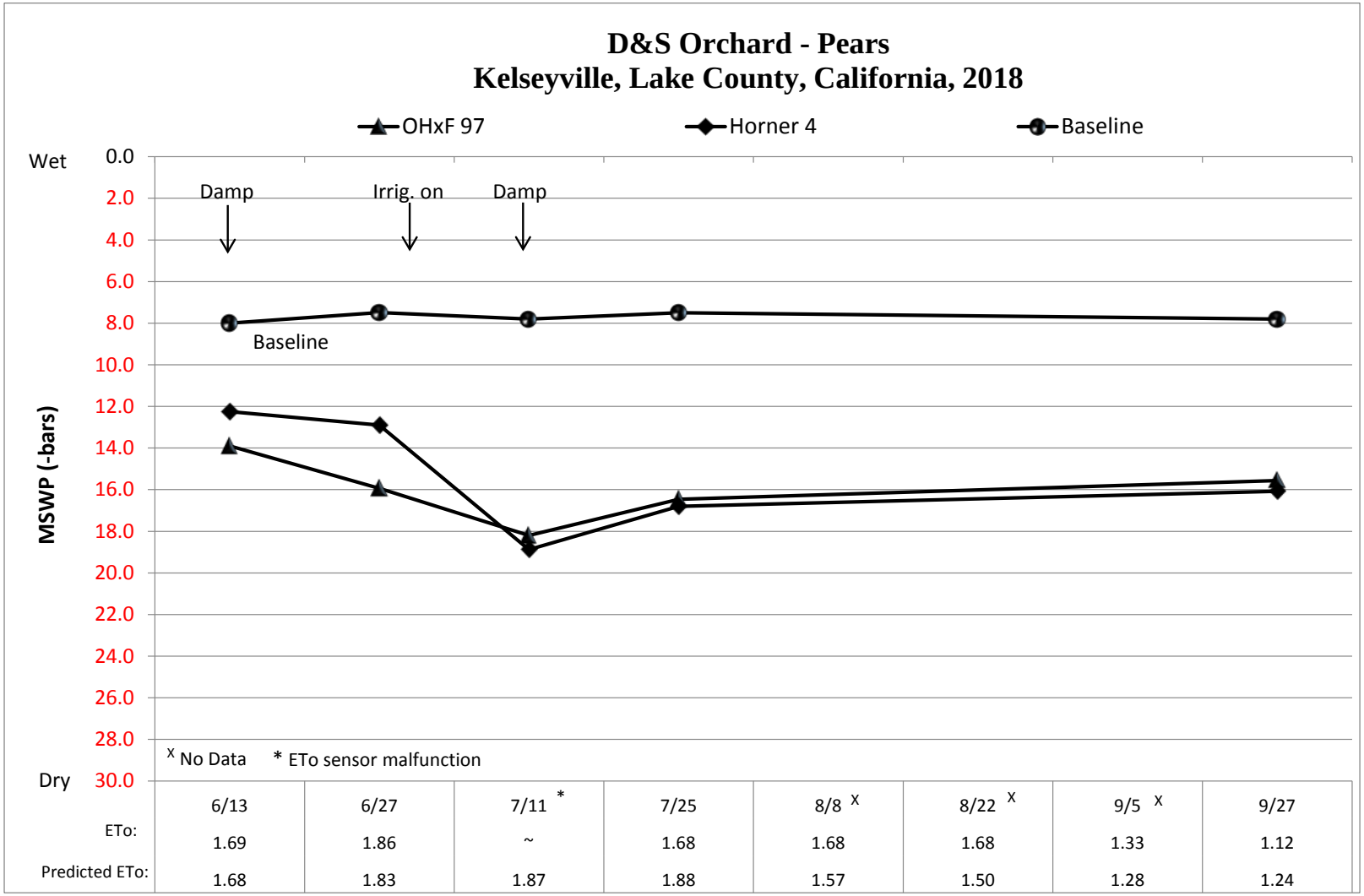
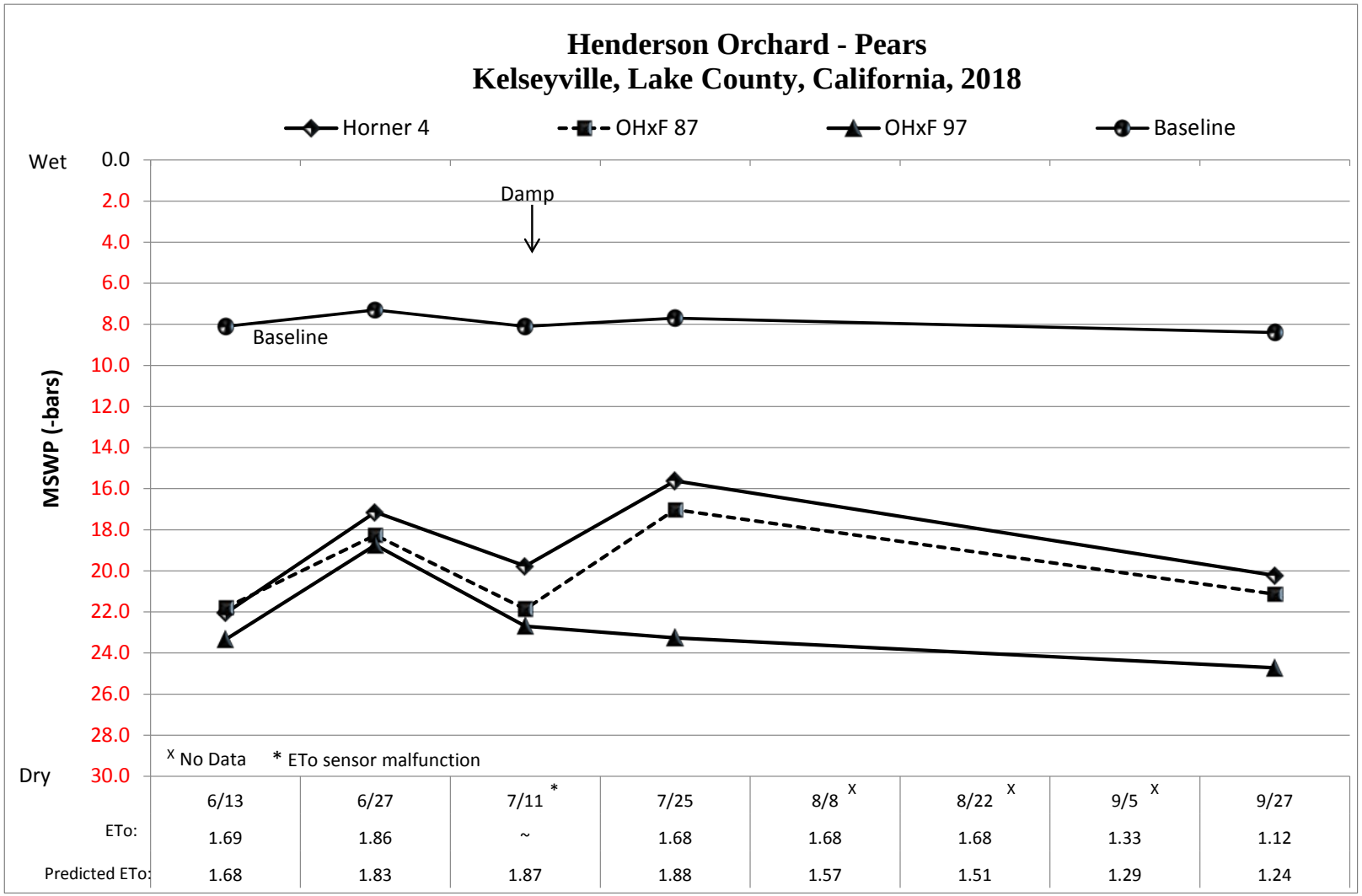
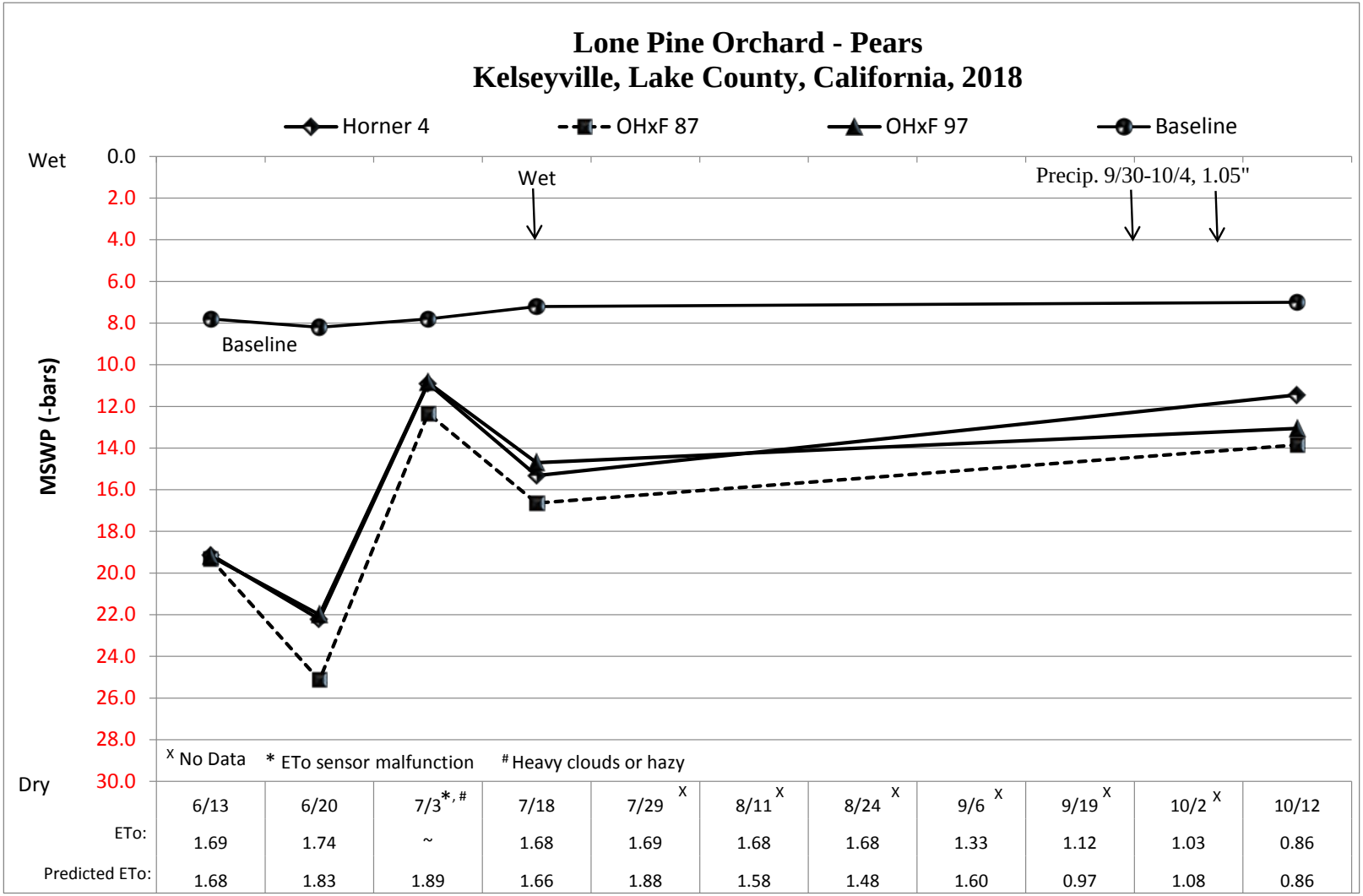


Figure 1: Effect of rootstock on seasonal average mid-day stem water potential (MSWP) of 3rd leaf "Bartlett" pear trees, Kelseyville, Lake County, California, 2018.



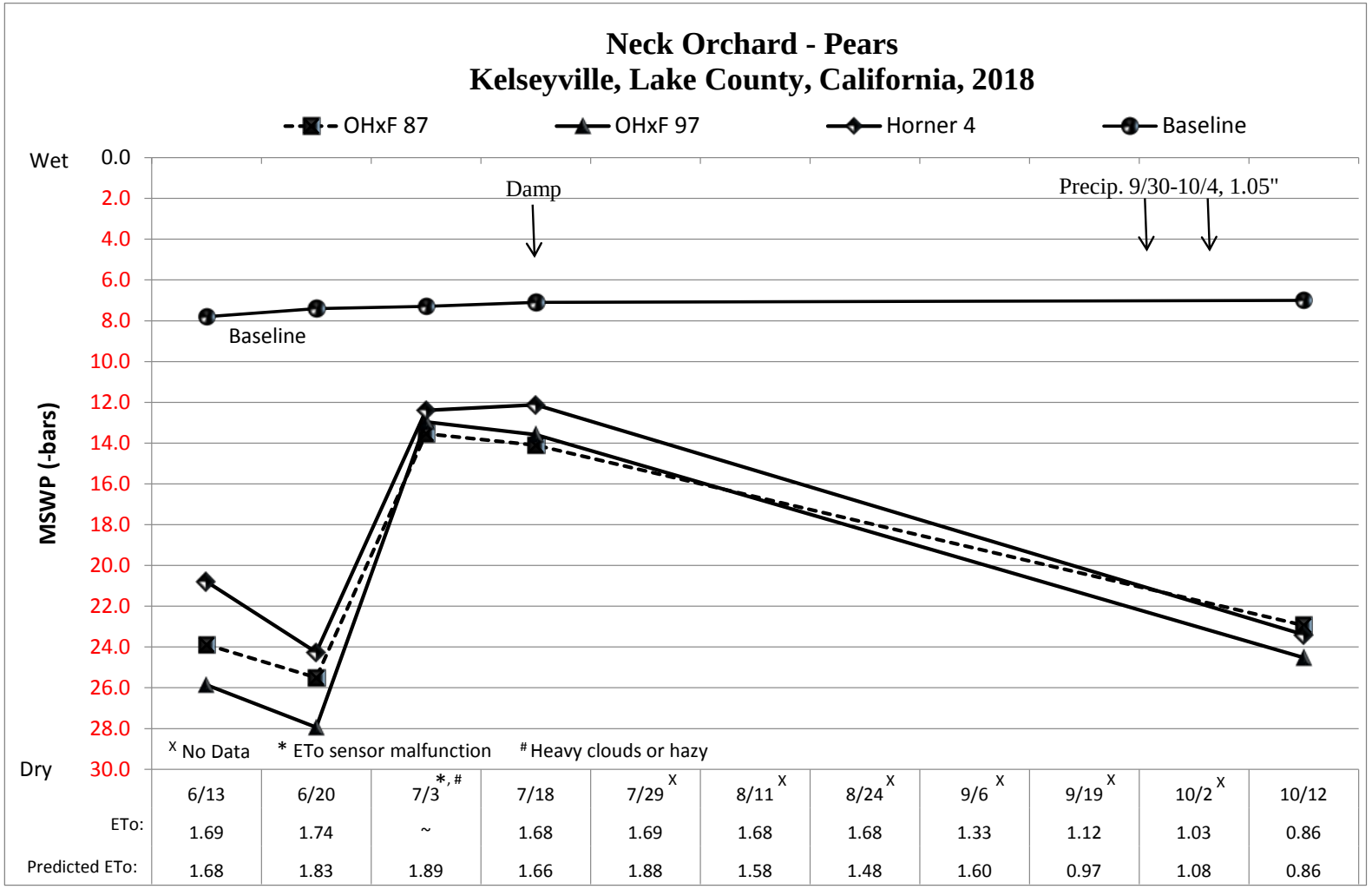
	6/13	6/27	7/11 *	7/25	8/8 X	8/22 X	9/5 X	9/27
ETo:	1.69	1.86	~	1.68	1.68	1.68	1.33	1.12
Predicted ETo:	1.68	1.83	1.87	1.88	1.57	1.51	1.29	1.24

Figure 2: Effect of rootstock on seasonal average mid-day stem water potential (MSWP) of 3rd leaf "Bartlett" pear trees, Kelseyville, Lake County, California, 2018.



	6/13	6/20	7/3*,#	7/18	7/29 X	8/11 X	8/24 X	9/6 X	9/19 X	10/2 X	10/12
ETo:	1.69	1.74	~	1.68	1.69	1.68	1.68	1.33	1.12	1.03	0.86
Predicted ETo:	1.68	1.83	1.89	1.66	1.88	1.58	1.48	1.60	0.97	1.08	0.86

Figure 3: Effect of rootstock on seasonal average mid-day stem water potential (MSWP) of 3rd leaf "Bartlett" pear trees, Kelseyville, Lake County, California, 2018.



	6/13	6/20	7/3 *,#	7/18	7/29 X	8/11 X	8/24 X	9/6 X	9/19 X	10/2 X	10/12
ETo:	1.69	1.74	~	1.68	1.69	1.68	1.68	1.33	1.12	1.03	0.86
Predicted ETo:	1.68	1.83	1.89	1.66	1.88	1.58	1.48	1.60	0.97	1.08	0.86

Figure 4: Effect of rootstock on seasonal average mid-day stem water potential (MSWP) of 3rd leaf "Bartlett" pear trees, Kelseyville, Lake County, California, 2018.