

## FINAL REPORT

**Project Title:** Field evaluation of new pear rootstocks

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### *Introduction*

The overall objective of this proposal is to identify newly developed rootstocks for commercially important pear cultivars in the Pacific Northwest that will be planted in a COS 2015 orchard. Selected rootstocks must be adaptable to future orchard systems and increase profitability to growers. These rootstocks must be adapted to a fruiting wall, produce early at a sustained high yield, produce large fruit, and be a compact tree that exhibits growth characteristics that are horticulturally beneficial. They must also have resistance to important diseases, pests, and environmental stresses.

COS 2015 trials will include those rootstocks which have reached critical performance targets during the initial evaluation and will be integrated with orchard systems trials located in grower's orchards throughout Oregon and Washington to provide assessment of rootstocks under a wide array of geographic locations and training systems.

For a given rootstock to advance from the initial evaluation to a COS 2015 trial, it must reach or surpass the performance targets outlined below.

- Return at least a 15% rate of return on investment to the grower
- Tree size compatible with COS 2015 objectives that produce early and consistent yield above that of the control rootstock.
- Produce targeted fruit – fruit that generates a return to the grower over and above growing, harvesting, storing, packing, and marketing costs.

Why should pear growers invest in pear rootstock research? The answer is simply economics. The table below is an uncomplicated example showing the net present value (NPV) and the rate of return on investment (ROI) for four pear orchard scenarios. Scenario 1 is the costs to establish and produce the traditional pear orchard in the Mid-Columbia region. This system is planted in a 10' x 16' spacing (272 trees per acre) trained to a central leader system. The yields begin in year 4 and reach full production in year 9 with yields of 3, 6, 12, 24, 32, and 40 bins per acre, respectively. The price per bin is \$150 and results are based on a discount rate of 6 percent.

The bottom-line is that rootstocks can return a higher NPV and ROI to the grower if initial yields and full production can be achieved one-year earlier, prices increase due to larger fruit size, and higher yields obtained over a 20-year period. The marginal increases in NPV is the amount of money, on a per acre basis, a grower can afford to invest towards additional trees, trellising, labor, etc. to obtain the assumed yields and prices. Achieving the goals for less than the

additional NPV's will put money in a grower's pocket. With the combination of all three of these factors pear orchards can be successfully viewed as a COS 2015 system.

Scenario's: Based on a 20-year time horizon. <i>The NPV is based on a per acre basis.</i>	Net Present Value	Rate of Return on Investment
1. Traditional costs to establish and produce pears <sup>1</sup> .	\$ 6,655	7.10%
2. Initial yield and full production achieved one-year earlier in Scenario 1.	\$ 9,501	8.48%
3. Increasing price by \$22 per bin for larger sized fruit in Scenario 2.	\$16,894	11.51%
4. Increasing yield by 50% in all years in Scenario 3.	\$42,337	19.35%

<sup>1</sup>Orchard Economics: Establishing and Producing High-Density Pears in Hood River County.

### ***Progress to Date***

The initial seven-year evaluation of thirteen Horner rootstocks concluded that the Horner series has the potential to provide rootstocks that produce smaller trees with large fruit size, higher precocity and productivity than currently available rootstocks. (Mielke and Sugar, Acta Hort 658, 2004).

Two of these selections, Horner 10 and Horner 51 produced smaller trees than the control. Tree size is represented as Canopy Volume and is expressed as a percent of the OHxF97 control. Based on Canopy Volume measurements, Horner 10 was 69.9% and Horner 51 was 47.9% of the OHxF 97 control, respectively. In addition, the Horner 10 produced 12% greater cumulative yield with larger fruit than the OHxF97 control. Other Horner selections in this trial exhibit the potential for higher yields and larger fruit size and should be considered for further trials. (See tables 1 and 2).

Liners from the first 249 of the Horner selections were established in a 5 ft x 4 ft diamond in double rows, 16 ft between centers of double rows, (1089 trees/acre). The goal was to plant two trees of each selection; however, growth and budding losses reduced some selections to a single tree. Where tree numbers were reduced below two, materials were to be re-propagated for the 2006 planting. In the spring of 2005, 123 additional selections were shipped from Fowler Nursery and established at MCAREC. Trunk diameter measurements were taken soon after planting in both plots. Trunks were measured again in the winter of 2004 and 2005 for the Horner 2004 planting, and winter of 2006 for the Horner 2005 planting. Trees were minimally pruned and trained in a modified central leader system.

### ***Objectives***

#### **Objective 1. Initial screening and evaluation of the Horner rootstock series and evaluate untested rootstocks at OSU-MCAREC**

<b>Phase</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
2004 Horner Planting (249 clones)	Complete third leaf evaluation	Complete fourth leaf evaluation and pre-selection of three to four clones for COS 2015 on-farm evaluations	Complete fifth leaf evaluation and continue to select three to four clones for COS 2015 on-farm evaluations
2005 Horner Planting (123 clones)	Complete second leaf evaluation	Complete third leaf evaluation	Complete fourth leaf evaluation and pre-selection of clones for COS 2015 evaluation
2006 Horner Planting (56 clones)	Plant and first leaf evaluation	Complete second leaf evaluation	Complete third leaf evaluation

P2535,(13 trees) Bet # 2291(5 trees)	Plant and first leaf evaluation	Complete second leaf evaluation	Complete third leaf evaluation
517-9 (35 trees) 708-13 (40 trees) 96FI11 (35 trees) 96FI12 (42 trees) 96FI14 (42trees) 96FI15 (25 trees) Horner4 (45 trees) OH 11 (40trees) OHxF 87 (31 trees) Pyronia (11trees) (Q 29859 (7trees)	Proebsting sends rootstock to nursery to graft and grow out	Plants grafted and grown at nursery	Nursery sends plants to MCAREC to plant

**Objective 2. A comprehensive evaluation of the Horner rootstock series and untested rootstocks to be implement in COS 2015 Trials.**

Phase	2006	2007	2008
H-4, H-10	Send cuttings to Bill Proebsting to propagate liners	Proebsting sends rootstock to nursery to graft and grow out	Plants grafted and grown at nursery. Nursery sends plants to MCAREC to plant in 2009
H-4 (164 trees) OHxF 87 (69 trees)	Plant and first leaf evaluation	Complete second leaf evaluation	Complete third leaf evaluation
H-51	Order from North American Plants (NAP)	NAP sends rootstock to nursery to graft and grow out	Plants grafted and grown at nursery. Nursery sends plants to MCAREC to plant in 2009

**Objective 3. Identification of new rootstocks for future evaluation**

- a) Establish contacts through written and internet correspondence with International breeding programs and university personnel.
- b) Attend the ISHS Xth international Pear Symposium in Lisboa, Portugal to network with the various international breeding programs. Travel to INRA in France and East Malling, UK to seek out new rootstock material.

Methods

Rootstock performance will be judged against a set of “fatal flaws”. These include profuse suckering, tree death from common stresses (e.g. heat or cold), field susceptibility to important diseases (e.g. pear decline), lack of bloom or fruit set, tree structure inconsistent with high density system goals, and insurmountable difficulty in propagation. If a rootstock displays one of these flaws, data collection will be terminated. Performance targets are also outlined in this section.

Cultural practices aimed at establishing trees in two to three seasons will be used. The measurements for determining tree size, yield and key yield components, and fruit size are:

*Tree size*

Trunk cross sectional area (TCSA) provides an index of tree size. Trunk diameter will be

measured at 25 cm above the bud union at time of planting and at the end of each growing season. TCSA will be calculated from trunk diameter.

Canopy volume will be calculated from measurements of tree height, and tree spread parallel and perpendicular to the tree row.

*Yield and yield components*

Yield will be determined by weighing all fruit per replicate at harvest.

Fruit set (fruitlets/blossom cluster) will be determined by counting flower buds and fruitlets (blossom clusters counted during bloom; fruitlets counted after June drop).

Average fruit weight will be determined by dividing yield by fruit number counted at harvest.

Fruit size distribution will be determined with the MCAREC research packing line which provides a frequency distribution based on fruit weight class corresponding to U.S. box sizes or by weighing individual fruit in a random sample of fruit from each replicate.

Parameters such as yield efficiency (yield/unit TCSA) and flower density (flower buds/unit TCSA) will be calculated using the measurements included above.

**Objective 1. Initial screening and evaluation of the Horner rootstock series and evaluate untested rootstocks at OSU-MCAREC**

Trials will provide rapid assessment of new rootstocks and determine which ones should advance to COS 2015 on-farm trials. The 2004 and 2005 Horner series were planted in a 5 ft x 4 ft diamond in double rows, 16 ft between centers of double rows, (1089 trees/acre). The 2004, 2005, and 2006 Horner plantings will be planted with the same spacing to maintain consistency.

- Selections of P2535, Bet # 2291, 517-9, 708-13, 96FI11, 96FI12, 96FI14, 96FI15, Horner 4, OH 11, OHxF 87, Pyronia, and Q29859 will be planted in a 12 ft x 4 ft vertical fruiting wall (907 trees/acre)
- Anjou, Bartlett and Bosc will be used for scions.

Old Home by Farmingdale 87 will be used as a control rootstock. Trees will be trained to a fruiting wall with minimal pruning, and the evaluation period will be five years.

**Objective 2. A comprehensive evaluation of the Horner rootstock series and untested rootstocks to be implemented in COS 2015 Trials.**

This evaluation phase of pear rootstocks will be conducted as relatively small scale trials located at the OSU-MCAREC, Yakima and Wenatchee:

- ten tree replicates per rootstock
- 5 replications per rootstock
- Trees planted in a 12 ft x 4 ft vertical fruiting wall. (907 trees/acre)
- a cultivar that is a good indicator of the characteristics of interest for each growing region, (e.g. Anjou for Hood River, Bartlett for Yakima, Bosc for Wenatchee)

Two standard control rootstocks (Pyro2-33 and OHxF87) will be used.

Trees will be managed to encourage early fruiting and trained to facilitate mechanical assist

harvesting, and the evaluation period will be five years.

Evaluation of each set of rootstocks is scheduled to be completed at the end of the fifth season after planting. At the end of year three, pre-selection of clones expected to advance to COS 2015 plantings will be made and propagation of trees will be initiated.

### **Objective 3. Identification of new rootstocks for future evaluation**

Other rootstock selections will originate from other breeding programs. Reports from the INRA program in France indicate the potential for new material to be available soon. Two new parent selections that are being used for breeding in the French program that look promising are G28-120 and P2532. (Simard and Michelesi, Acta Hort, 658, 2004). An international search will be initiated to identify potential rootstocks for evaluation in future trials. Initially, this search will be conducted using published literature, Internet, and e-mail with assistance from industry and university personnel with established international contacts. These selections will be made in collaboration with the Northwest Pear Rootstock Advisory Committee (see below).

Contacts will be made with the international breeding programs in East Malling UK, Pillnitz Germany, and Angers France to select at least three new clones and begin the process of transferring material to our initial field trials. Liners will be propagated by Bill Proebsting after the material is released from quarantine.

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**Co-PI's:** Clark Seavert, Tom Auvil  
**Project duration:** 2005-2007  
**Current year:** 2005  
Project total (1<sup>st</sup> year): \$24,637  
Current year request: \$29,808

Item	Year 1 (2005)
Salaries <sup>1</sup>	15,239
Benefits (61%)	9,296
Wages	1,200
Benefits (8.2%)	98
Equipment	
Supplies <sup>2</sup>	4,600
Travel	300
Miscellaneous	200
<b>TOTAL</b>	\$30,933 (requested but funded at \$24,637)

<sup>1</sup>0.50 FTE of a technician

<sup>2</sup>Nursery tree orders from Fowler and liners from North American Plants

### Advisory Committee

An advisory committee has been formed with representation from the main pear districts in Washington and Oregon. This committee will meet at multiple times during the year to discuss progress and provide input on future direction of the program. COS 2015 tours in each growing region will provide opportunities to observe pear rootstock trials in other locations.

The effect of Horner rootstocks on trunk cross sectional area, relative tree size (as compared to OhxF97), cumulative fruit number and yield, and average fruit weight.

Rootstock	Trunk <sup>1</sup> Cross Sectional Area <sup>z</sup> (cm <sup>2</sup> )	Tree size <sup>2</sup> (expressed as canopy volume in relation to percent of OHxF97)	Cumulative <sup>2</sup> Fruit (No.)	Cumulative <sup>2</sup> Yield (kg)	Average <sup>2</sup> Fruit Weight (g)
OHxF97	76.8 abc	100.0 a	252.2 abc	61.7 bc	244.6 ab
H-1	76.9 abc	83.6 ab	239.1 abcd	59.0 bcd	246.8 ab
H-3	71.0 bc	72.6 bc	181.5 bcde	41.9 cdef	230.9 bc
H-4	93.3 a	94.5 a	354.0 a	93.2 a	263.3 a
H-6	43.6 de	41.1 fg	39.0 f	8.8 g	225.6 bc
H-9	48.6 de	57.5 cdef	143.5 cdef	32.8 defg	228.6 bc
H-10	58.4 cd	69.9 bcd	297.0 ab	73.4 ab	247.1 ab
H-14	33.5 e	32.9 g	85.3 ef	16.1 fg	188.7 de
H-18	55.4 cde	56.2 cdef	156.5 cdef	35.0 cdefg	223.6 bc
H-19	57.2 cd	50.7 defg	115.5 def	23.8 efg	206.1 cd
H-36	81.6 ab	80.8 ab	186.5 bcde	44.3 cde	237.5 ab
H-51	55.9 cd	47.9 efg	120.2 def	28.7 efg	238.8 ab
H-53	44.2 de	43.8 fg	133.0 cdef	31.8 efg	163.9 e
H-79	61.8 bcd	67.1 bcde	165.5 cde	34.3 defg	207.3 cd
P values	<0.0001	0.0008	0.0001	<0.0001	0.0053

<sup>z</sup>Means within a column followed by the same letter are not significantly different at P=0.05

<sup>1</sup> Mielke, E.A., Sugar, D., Initial Seven Year Evaluation of Thirteen Horner Pear Rootstocks, Proc 1<sup>st</sup> IS Rtstks – Decid.Fruit Acta Hort 658, ISHS 2004, Table 1.

<sup>2</sup>Mielke, E.A. Sugar, D., Initial Seven Year Evaluation of Thirteen Horner Pear Rootstocks, Proc 1<sup>st</sup> IS Rtstks – Decid.Fruit, Acta Hort 658, ISHS 2004, Table 2.

Simard, M.H., Michelesi, J.C., Pear Rootstock Breeding in France, Proc 1<sup>st</sup> IS Rtstks – Decid.Fruit, Acta Hort 658, ISHS 2004