

FINAL PROJECT REPORT

Project Title: Cooperative evaluation of high efficiency orchard systems

PI: Matthew Whiting

Organization: WSU-Prosser

Telephone:50978969260

Email: mdwhiting@wsu.edu

Address: IAREC

Address 2: 24106 N. Bunn Road

City:Prosser

State/Zip: WA 99350

Cooperators: Ron Everts, Denny Hayden, Steve Nunley, Rick Orozco, Octavio Torres, John Douglas

Total Project Funding: \$30,690

Budget History:

Item	Year 1:	Year 2:	Year 3:
Salaries	1240	1290	1342
Benefits	601	626	651
Wages	6000	6250	6500
Benefits	540	565	585
Equipment			
Supplies	500	500	500
Travel	500	500	500
Plot Fees	500	500	500
Miscellaneous			
Total	9,881	10,231	10,578

OBJECTIVES:

1. Establish new research/demonstration orchard at WSU-IAREC Roza farm comprised of 1 cultivar on 6 new size-controlling rootstock genotypes planted at high density to a fruiting wall architecture.
2. Evaluate system precocity, productivity, efficiency, and fruit quality
3. Identify/develop horticultural strategies necessary for successful systems
4. Cooperate with industry in evaluation and maintenance of research/demonstration orchard
5. Summarize and disseminate results in a timely and effective manner

SIGNIFICANT FINDINGS:

Growth

- Tree size (estimated by trunk circumference) exhibited two-fold variability.
- Controller 5 was the most size-controlling rootstock, dwarfing trees to less than half the size of Lovell-rooted trees.
- Krymsk 1 reduced tree size to about 75% of Lovell.
- HBOK 27 (Controller 6) and HBOK 32 (Controller 7) were similar in vigor, about 80% of Lovell.
- Penta was not particularly size-controlling – trees were less than 10% smaller than Lovell
- Vigor of single-leader trees was only slightly less than that of double-leader trees (ca. 10% difference)
- Tree spacing is too close for Lovell and Penta in the double-leader system
- Tree spacing is too far for Controller 5 (could be doubled)

Yield

- Varied by nearly three-fold
- Controller 5 trees were the lowest yielding (ca. 30 lbs/tree)
- Lovell-rooted trees were the highest yielding (ca. 90 lbs/tree)
- Single- and double-leader systems yielded similarly with Controller 5
- Double-leader training increased tree yield on other rootstocks by about 33%

Fruit quality

- Fruit size/weight was greatest on Lovell-rooted trees and least on Controller 5 (ca. 30% smaller)
- Size on other rootstocks/systems was similar
- Fruit firmness was greatest on HBOK 27 consistently over the years
- Fruit soluble solids was unaffected by rootstock

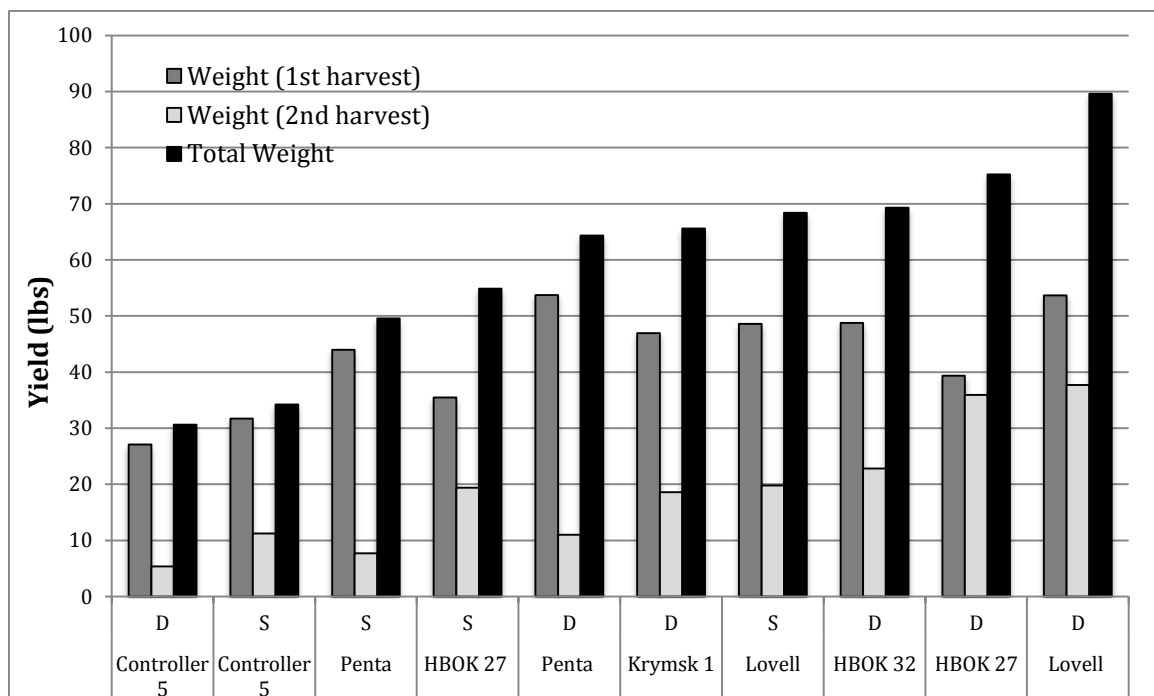
RESULTS & DISCUSSION:

Yield

In 2013, yield per tree varied tremendously with double-leader Lovell trees yielding the most, and single-leader Controller 5 trees the least with ca. 90 and 30 lbs per tree, respectively (Fig. 1). This is largely a consequence of vigor, and, therefore, greater bearing surface on Lovell-rooted trees. However, due to the weak growth of Controller 5 trees, it is possible that one could compensate for

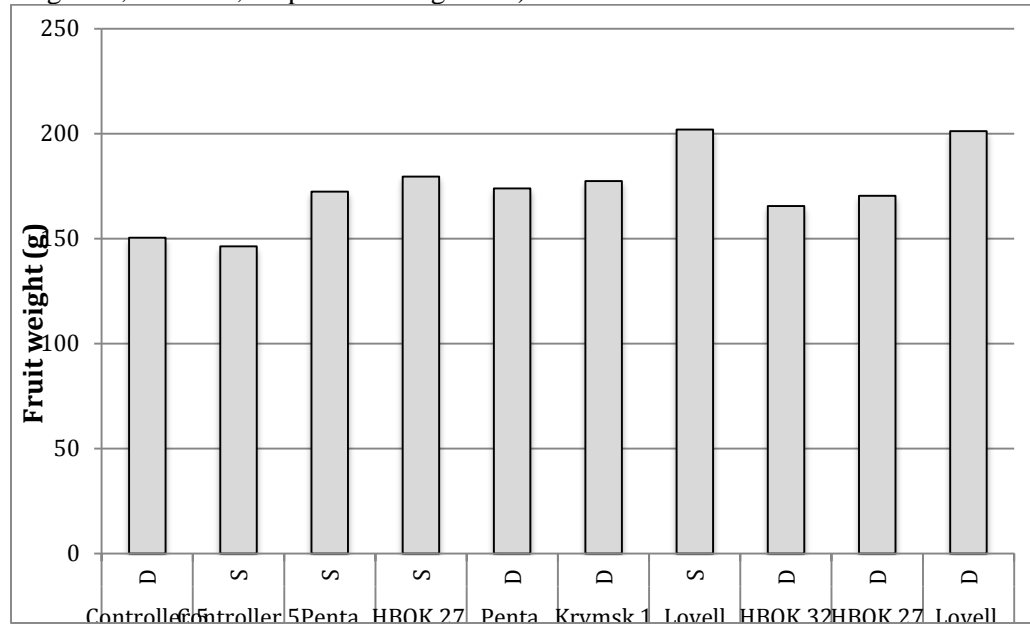
lower per tree yield by simply planting trees at a higher (i.e., three-fold) density. Observations of tree size suggest this would be possible though concerns over fruit quality on Controller 5 remain (see below). Single-leader Penta and HBOK 27 (Controller 6) trees yielded about half of the double-leader Lovell (ca. 52 lbs per tree) whereas the other rootstocks trained to the double-leader system were similarly productive, yielding about 68 lbs per tree. With the exception of Controller 5-rooted trees, the double-leader system out yielded the single-leader system – Penta was +30%, HBOK was +37%, and Lovell was +31%.

Yields in 2013 were significantly greater than in previous years suggesting that trees are still filling their space. Double-leader Lovell yielded 90 lbs in 2013 vs. ca 50 lbs in 2012, and double-leader HBOK 27 yielded ca. 75 lbs in 2013 vs. 45 lbs in 2012, for example. Alternatively, hand-thinning fruit may not have been sufficiently aggressive and this contributed to the higher yields (mean fruit weight in 2013 was about 20% lower than in 2012).



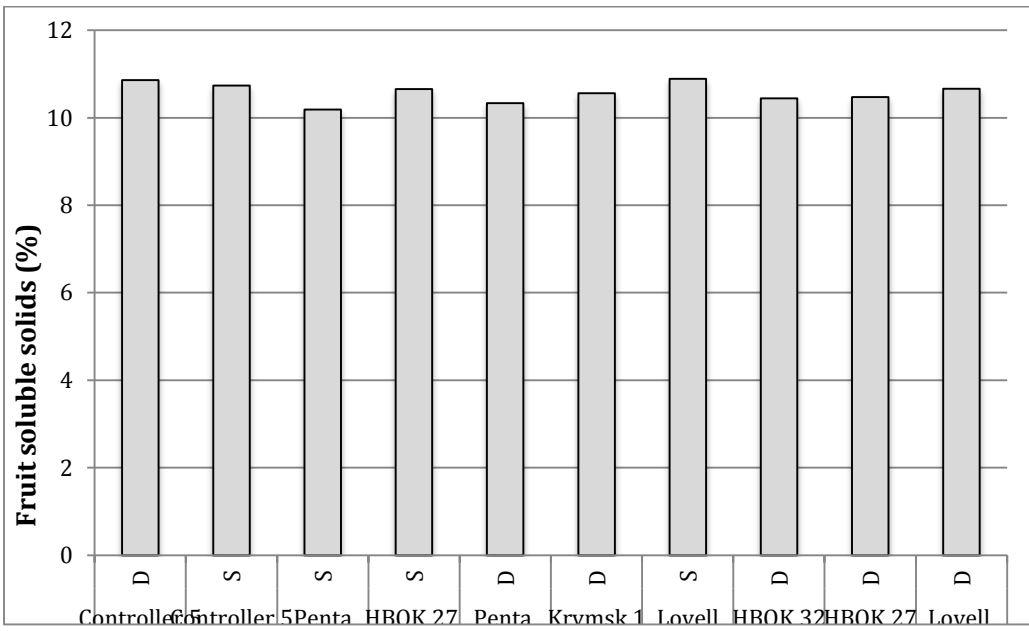
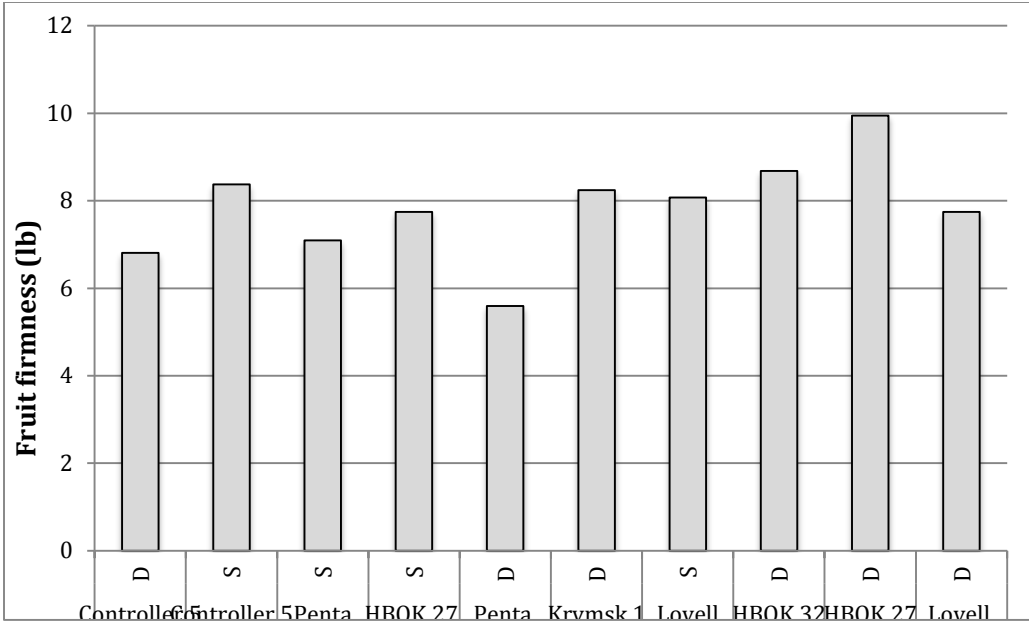
Fruit quality

Fruit weight varied from a low of 146 g to a high of 202 g for Controller 5 single-leader and Lovell single-leader, respectively. This represents about a 20% decrease in fruit weight compared to 2012 which may be due to insufficient thinning (yields were about 50% higher in 2013). Fruit from Controller 5 have been consistently smaller than from other rootstocks. It isn't clear whether this is a direct rootstock effect, or one that may be overcome with modified horticultural management (i.e., irrigation, nutrition, crop load management).



Fruit firmness was slightly lower than in 2012, reflecting the later harvest timing. Firmness of 6 – 8 lbs is recommended harvest timing for picking for local markets according to most guides, but slightly too soft for long or medium distance shipping. Firmness ranged from a low of 5.6 on Penta to a high of 9.9 lbs on HBOK 27 double-leader trees. Fruit firmness from HBOK 27-rooted trees has been consistently higher than other rootstocks – from the first fruiting season to 2013. This appears to be a direct effect of rootstock on firmness since fruit maturity appears to be unaffected.

Fruit soluble solids (i.e., sweetness) did not vary much among rootstocks, ranging from a low on Penta of about 10.2% to a high on Lovell of about 10.9%. This is consistent with previous years – no clear effect of rootstock on soluble solids. Soluble solids in 2013 were down about 15% compared to 2012, again, likely due to high crop load and insufficient thinning.



EXECUTIVE SUMMARY:

In this systems trial we observed that rootstock affected precocity, productivity, and fruit quality. The rootstocks included in this trial were those identified in previous testing to exhibit various degrees of size control compared to the standard, Lovell. The potential to reduce canopy size without inhibiting fruit quality is compelling. Lovell was the most vigorous and productive rootstock in the current trial but it also consistently yielded the highest quality fruit. Controller 5 was the least vigorous and productive rootstock that also consistently yielded the lowest quality fruit. The question of whether sufficient yields can be achieved on one of the size-controlling rootstocks is not completely answered from this trial. It is likely that trees on Controller 5 could be planted at much higher densities and that yield would improve though concerns about fruit quality remain. The most interesting rootstock is HBOK 27 (Controller 6), that controls vigor by about 20% compared to Lovell, is very productive and yields good quality fruit with exceptionally high firmness. Most importantly, trees on HBOK 27 could reasonably be trained to a planar system such as the double-leader utilized in this trial whereas Lovell-rooted trees are too vigorous for this system. The ability to adopt mechanization for thinning and pruning, and platforms for management in planar systems will become increasingly important.