FINAL PROJECT REPORT

Project Title: Cooperative evaluation of high efficiency orchard systems

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Cooperators: Denny Hayden, Rick Orozco, Steve Nunley, Ron Everts

Other funding sources: None

Budget History:
Organization Name: WSU **Contract Administrator: Marl Lou Bricker**
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Item	2008	2009	2010
Salaries			
Benefits			
Wages	3,000	3,000	5,000
Benefits	498	498	830
Equipment			
Supplies	3,500		500
Travel	500	500	500
Miscellaneous	2,000		
Total	9,498	3,998	6,830

OBJECTIVES:

1. establish new research/demonstration orchard at WSU-IAREC Roza farm comprised of 1cultivar 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:

- the PI met with cooperators to select a cultivar (Zee Lady), experimental design, and rootstock needs
- we received permission from UC-Davis to include HBOK rootstocks
- rootstocks were grafted in fall, 2007 at Fowler Nursery
- bud take was poor on Krymsk®1 (28% survival) and HBOK 32 (40% survival) rootstocks
- trees were planted at WSU-Roza experimental farm in spring, 2009
- the single-plane trellis system with 3 wires was established in 2009
- irrigation system of under-tree microsprinklers was installed, 2009
- tree training systems were established in consult with Hayden, Orozco, and Nunley
- tree survival was excellent, irrespective of rootstock or system

METHODS

1. establish new research/demonstration orchard

At the WSU-Roza experimental farm, we will establish a new research and demonstration orchard. We have commitment from Fowler nursery to produce the following scion/rootstock combinations:

i. Zee Lady/Lovell (control)
ii. Zee Lady/Penta (Empyrean®2)
iii. Zee Lady/K146-43 (Controller 5)
iv. Zee Lady/VVA-1 (Krymsk®1)
v. Zee Lady/HBOK27
vi. Zee Lady/HBOK28

Lovell will be included as a control. Penta is a rootstock developed in Italy that reduces scion vigor by about 30% compared to Lovell. K146-43 is a rootstock developed in California that confers significant size control, 5th leaf trees in Prosser were less than 25% the size of Lovell. VVA-1 is a Russian-developed rootstock that reduces scion vigor to about 40% Lovell. It is reported that the HBOK rootstocks restrict vigor by about 40 to 60% of Lovell.

Each scion/rootstock combination will be trained to two different architectures, a spindle vertical fruiting wall system and a two-leader angled fruiting wall system. Tree training will be accomplished in cooperation with industry leaders, utilizing their expertise. This will assure the systems are commercially relevant. Within each system (i.e., single vs. double leader), each of the six rootstocks, will planted in a randomized block design comprised of 6 replications of 5 trees each. Standard commercial practices will be followed with respect to pest control, thinning, irrigation, etc.

All trees will be trained to a vertical fruiting wall and planted at 10 feet between rows with within-row spacing varied with rootstock vigor between 4 and 8 feetwww.

2. evaluate system vigor, precocity, productivity, efficiency, and fruit quality

Each year we will collect pertinent data on the growth, productivity, and fruit quality. In the establishment years we will collect trunk diameter data twice yearly and mean annual growth increment. As trees bear fruit, we will collect yield and quality (fruit size, weight, soluble solids, firmness) data. In addition, rudimentary labor efficiency data will be collected (e.g., time required to thin and harvest).

3. identify/develop horticultural strategies necessary for successful systems

Every year we will meet as a group during the dormant season to assess progress and discuss suitability of tree density and how to adjust pruning/training practices to match.

4. cooperate with industry in evaluation and maintenance of research/demonstration orchard

This entire program will be cooperative with industry, from the design and establishment of the research orchard to annually reviewing the pruning/training requirements. Elements of the collaboration are outlined throughout this section.

5. summarize and disseminate results in a timely and effective manner We will make a high priority of this research program to disseminate research results through the most appropriate means. Potential outlets include the Good Fruit Grower, Fruit Grower News, Western Fruit Grower, web-based delivery on the Stone Fruit Physiology website, and publications in peer-reviewed scientific journals. In addition the project P.I. will make presentations to industry at appropriate meetings. The overall goal is to get information into the hands of industry decision makers.

RESULTS & DISCUSSION

We requested from Fowler nursery 75 trees of each combination. The nursery grafted 95 rootstock liners of each genotype with Zee Lady in fall of 2007. Final tree counts for each combination are outlined in Table 1.

Table 1. Tree counts for each rootstock.

Rootstock	Tree count
Lovell	89
Controller 5™ (K146-43)	92
Penta™ (Empyrean 2)	83
Krymsk®1 (VVA-1)	27
HBOK 27 (94-94-27)	86
HBOK 32 (94-94-32)	38

We were limited in planting material for Krymsk®1 and HBOK 32-rooted trees. The PI and cooperators met and decided to plant a full complement of rootstocks to the double leader system and plant any remaining trees (i.e., not the full replicated set) to the single leader system. The cause of low graft survival with Krymsk®1 and HBOK is unknown but may limit the adoption of these rootstocks. The plot map is attached.

In 2009, trees were planted at the Roza experimental farm and the trellis and irrigation systems were installed. Survival was very good, with only a few trees dying in the first season. Growth data are being collected currently (e.g., trunk cross-sectional area, shoot length) and will be presented in late March, 2010 at a plot tour.

To establish double-leader trees, two side branches were selected at planting for the right angle, other laterals were removed to focus growth into the remaining limbs (see photos below). Limbs were loosely taped to bamboo poles to establish the desired angle (different for rootstocks, based upon the within-row spacing). For single-leader trees, a single limb was selected and the others were removed. The remaining leader was taped to a single upright bamboo pole. For both systems, the bamboo poles were taped to the first wire (ca. 4 ft) to establish the desired angle for growth.

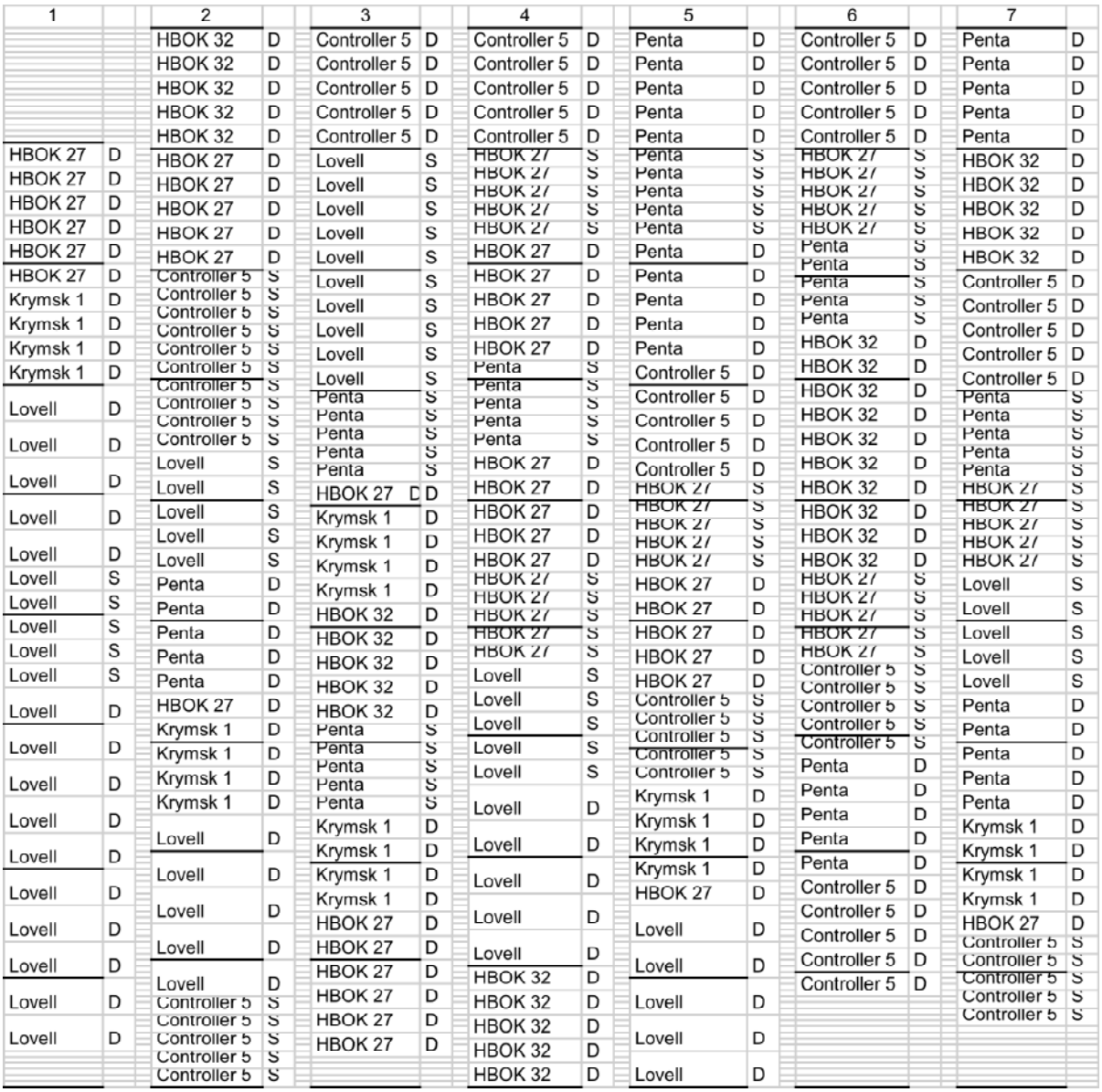
Figure 1. Double-leader system in the dormant season after the first year.

Growth in 2010 was very good with many systems filling the between-tree space. The focus in 2010 was to promote vigorous growth and maximize light interception by filling the space. All fruit were manually thinned in June to optimize vegetative growth. No summer pruning was imposed.

There are training/management challenges in this orchard already. Trees on the vigorous rootstock Lovell will be difficult to maintain at even the lowest density in this system. Growth was excessive in the second year with many lengthy shoots growing into the drive-row. Conversely, trees on the dwarfing Controller 5 rootstock will need to be pushed to maintain vigor and fill the space. This was particularly true for those trained to the double-leader architecture. The trees on Controller 5 had many fruit (that were thinned) – while we did not record fruit number in this second season, it was apparent that this rootstock is very precocious.

Figure 2. Single leader system with Controller 5™, the most size-controlling rootstock.

Figure 3. Strong vegetative growth in the second year (2010).



1		2		3		4		5		6		7	
		HBOK 32	D	Controller 5	D	Controller 5	D	Penta	D	Controller 5	D	Penta	D
		HBOK 32	D	Controller 5	D	Controller 5	D	Penta	D	Controller 5	D	Penta	D
		HBOK 32	D	Controller 5	D	Controller 5	D	Penta	D	Controller 5	D	Penta	D
		HBOK 32	D	Controller 5	D	Controller 5	D	Penta	D	Controller 5	D	Penta	D
		HBOK 32	D	Controller 5	D	Controller 5	D	Penta	D	Controller 5	D	Penta	D
HBOK 27	D	HBOK 27	D	Lovell	S	HBOK 27	S	Penta	S	HBOK 27	S	HBOK 32	D
HBOK 27	D	HBOK 27	D	Lovell	S	HBOK 27	S	Penta	S	HBOK 27	S	HBOK 32	D
HBOK 27	D	HBOK 27	D	Lovell	S	HBOK 27	S	Penta	S	HBOK 27	S	HBOK 32	D
HBOK 27	D	HBOK 27	D	Lovell	S	HBOK 27	S	Penta	S	HBOK 27	S	HBOK 32	D
HBOK 27	D	HBOK 27	D	Lovell	S	HBOK 27	D	Penta	D	Penta	S	HBOK 32	D
HBOK 27	D	Controller 5	S	Lovell	S	HBOK 27	D	Penta	D	Penta	S	Controller 5	D
Krymsk 1	D	Controller 5	S	Lovell	S	HBOK 27	D	Penta	D	Penta	S	Controller 5	D
Krymsk 1	D	Controller 5	S	Lovell	S	HBOK 27	D	Penta	D	Penta	S	Controller 5	D
Krymsk 1	D	Controller 5	S	Lovell	S	HBOK 27	D	Penta	D	HBOK 32	D	Controller 5	D
Krymsk 1	D	Controller 5	S	Lovell	S	Penta	S	Controller 5	D	HBOK 32	D	Controller 5	D
		Controller 5	S	Penta	S	Penta	S	Controller 5	D	HBOK 32	D	Penta	S
Lovell	D	Controller 5	S	Penta	S	Penta	S	Controller 5	D	HBOK 32	D	Penta	S
		Controller 5	S	Penta	S	Penta	S	Controller 5	D	HBOK 32	D	Penta	S
Lovell	D	Lovell	S	Penta	S	HBOK 27	D	Controller 5	D	HBOK 32	D	Penta	S
		Lovell	S	HBOK 27	D	HBOK 27	D	HBOK 27	S	HBOK 32	D	HBOK 27	S
Lovell	D	Lovell	S	Krymsk 1	D	HBOK 27	D	HBOK 27	S	HBOK 32	D	HBOK 27	S
		Lovell	S	Krymsk 1	D	HBOK 27	D	HBOK 27	S	HBOK 32	D	HBOK 27	S
Lovell	D	Lovell	S	Krymsk 1	D	HBOK 27	D	HBOK 27	S	HBOK 32	D	HBOK 27	S
Lovell	S	Penta	D	Krymsk 1	D	HBOK 27	S	HBOK 27	D	HBOK 32	D	Lovell	S
Lovell	S	Penta	D	HBOK 32	D	HBOK 27	S	HBOK 27	D	HBOK 27	S	Lovell	S
Lovell	S	Penta	D	HBOK 32	D	HBOK 27	S	HBOK 27	D	HBOK 27	S	Lovell	S
Lovell	S	Penta	D	HBOK 32	D	HBOK 27	S	HBOK 27	D	HBOK 27	S	Lovell	S
		HBOK 27	D	HBOK 32	D	Lovell	S	HBOK 27	D	Controller 5	S	Lovell	S
Lovell	D	Krymsk 1	D	Penta	S	Lovell	S	Controller 5	S	Controller 5	S	Penta	D
		Krymsk 1	D	Penta	S	Lovell	S	Controller 5	S	Controller 5	S	Penta	D
Lovell	D	Krymsk 1	D	Penta	S	Lovell	S	Controller 5	S	Controller 5	S	Penta	D
Lovell	D	Krymsk 1	D	Penta	S	Lovell	S	Controller 5	S	Penta	D	Penta	D
		Lovell	D	Krymsk 1	D	Lovell	D	Krymsk 1	D	Penta	D	Penta	D
Lovell	D			Krymsk 1	D			Krymsk 1	D	Penta	D	Krymsk 1	D
		Lovell	D	Krymsk 1	D	Lovell	D	Krymsk 1	D	Penta	D	Krymsk 1	D
Lovell	D			Krymsk 1	D			Krymsk 1	D	Controller 5	D	Krymsk 1	D
		Lovell	D	Krymsk 1	D	Lovell	D	HBOK 27	D	Controller 5	D	HBOK 27	D
Lovell	D			HBOK 27	D			Lovell	D	Controller 5	D	Controller 5	S
		Lovell	D	HBOK 27	D	Lovell	D			Controller 5	D	Controller 5	S
Lovell	D	Controller 5	S	HBOK 27	D	HBOK 32	D	Lovell	D			Controller 5	S
		Controller 5	S	HBOK 27	D	HBOK 32	D					Controller 5	S
Lovell	D	Controller 5	S	HBOK 27	D	HBOK 32	D	Lovell	D				
		Controller 5	S			HBOK 32	D						
		Controller 5	S										

Figure 4. Plot map for peach systems trial planted at the WSU-Roza farm. D = double leader, S = single leader

Executive summary:

In collaboration with industry, a new research/demonstration orchard was designed and planted in 2009 at the WSU-Roza experimental farm north of Prosser. The overall goal of this project is to develop guidelines and recommendations for creating high efficiency orchards using size-controlling rootstocks and novel management strategies. The orchard has Zee Lady scion on 6 different rootstocks which have varying degrees of size-control. Trees were trained to single- and double-leader architecture and trellised to develop fruiting walls. By the end of this project trees had completed their second year of growth, with many filling the within-row space. Overall tree survival was high, irrespective of rootstock or training system. This block will become the testing ground for how to develop high efficiency planar architectures in peach.