Development and Testing of Pedestrian Orchard Concepts

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ABSTRACT

Economic pressures are forcing growers to reevaluate all farming practices. For production practices, labor costs dominate all others. Over the past few years, much has been learned about the relationship between tree height, production potential, and labor cost savings. Both dwarfing and standard rootstocks have been studied, but never within a comparison as part of an overall system.

Furthermore, while we have demonstrated that orchard height can be significantly and successfully reduced, even while using vigorous rootstocks such as Nemaguard, we still do not know if a true pedestrian orchard, i.e. one in which no ladders are at all necessary, is economically feasible over the long-term.

To understand these issues better, we have begun several trials that will explore the relationships between tree from, orchard density and rootstock vigor. Our overall goal will be to maintain tree height at about 7-8' thus establishing a pedestrian orchard. Within those constraints we will investigate how successful and how suitable such a strategy is.

METHODS

Trial 1: "Owen T" Plum

In March 2007 a block of "Owen T" plums growing on the semi-dwarfing rootstock Citation (about 75-80% of the vigor of Nemaguard) were planted at Kearney. Two row spacings/tree height configurations are used: 1) standard 18 foot wide rows in which the trees will be grown to standard height (12-14 feet tall); and 2) 15 foot wide rows in which the tree will be kept at a pedestrian height (7-9 feet tall). Tree conformation within each includes three training systems: 1) 6-leader Hex-V trees, 2) 4-leader Quad-V trees, and 3) 2-leader Kearney V trees planted at 12, 8, and 4 feet apart respectively. This design will allow us to make comparisons between tree height, tree density, and per acre scaffold count, (table1). This orchard continues to grow very well and full tree size is now achieved in all but the wider spacings. Scaffold orientation was performed in

August by limb tying. Yields will be taken in 2009-2012 and we hope to obtain full yields in 2010 – the fourth leaf – in most of the treatments.

Table 1. Per acre tree and scaffold counts for "Owen T" plums on "Citation" rootstock, growing at differing densities and conformations and planted at the Kearney Ag Center in March 2007.

Row Spacing	Tree Form	Trees/acre		Scaffolds/acre	
		15' row	18' row	15' row	18' row
4'	Kearney-V	726	605	1452	1212
8'	Quad-V	363	303	1452	1212
12'	Hex-V	242	202	1452	1212

Trial 2: "Springcrest"/"O'Henry" Height and Rootstock Comparison

In order to derive yield data in 2008, an established block of five year old "Springcrest" and "O'Henry" peaches was differentially topped in the fall of 2007 prior to dormant pruning. One-half of the orchard was topped at 8' and the other at 10'. The shorter trees were topped even lower during dormant pruning – i.e. approximately 7-8' – with the primary purpose of making them into true pedestrian trees. Within each height, there are four rootstocks, Nemaguard, UC Controller 9, Hiawatha, and UC Controller 5 (listed from greatest to lowest vigor).

2008 yield data is presented below in tables 2 & 3 for Springcrest and O'Henry respectively. Nemaguard and Controller 9 consistently had the greatest yields regardless of variety or tree height, and their fruit size was equal to or greater than that of the other rootstocks. Short Springcrest trees had similar fruit size, but lighter crops and lower yields. Short O'Henry trees had greater fruit size and lower yields, a function of crop load.

It is apparent that fruit from Controller 5 trees is generally smaller than that from the other rootstocks. To better understand this condition we performed shoot "mapping" during fruit development of Controller 5 and Nemaguard trees. Preliminary results of this mapping indicate that Controller 5 develops more flowers per shoot and per unit shoot length, and also sets more fruit per flower, (data not presented). This results in a condition that limits fruit growth potential. We plan to explore methods of dealing with this limitation in 2009.

Another problem with this block in 2008 was that there was a fair amount of shading of fruitwood since the trees were not summer pruned in 2007. This caused difficultly in achieving consistent hanger counts from one treatment to the next. The trees were summer pruned in 2008 and so that should not be an issue in 2009.

Table 2. Yield, crop load and fruit size of Springcrest peaches pruned to two heights and growing on four different rootstocks at the Kearney Agricultural Center, 2008. Values are means ± standard errors.

Short (~8')	**Yield (kg/tree)**	**Crop Load (fruit/tree)**	**Size (g/fruit)**
Nemaguard	12.6 ± 0.8	120 ± 9	105 ± 2
Controller 9	12.6 ± 0.4	129 ± 5	98 ± 1
Hiawatha	11.4 ± 0.6	114 ± 5	100 ± 1
Controller 5	11.0 ± 0.5	132 ± 4	83 ±3
All short trees	11.9 ± 0.3	124 ± 3	96 ± 2
Tall (~10')			
Nemaguard	15.1 ± 0.2	152 ± 2	99 ± 4
Controller 9	14.5 ± 0.7	144 ± 8	101 ± 2
Hiawatha	12.4 ± 1.0	126 ± 7	99 ± 2
Controller 5	11.3 ± 0.4	136 ± 6	83 ± 1
Summary	13.3 ± 0.5	140 ± 4	95 ± 2

Table 3. Yield, crop load and fruit size of O'Henry peaches pruned to two heights and growing on four different rootstocks at the Kearney Agricultural Center, 2008. Values are means ± standard errors.

Short (~8')	**Yield (kg/tree)**	**Crop Load (fruit/tree)**	**Size (g/fruit)**
Nemaguard	40.1 ± 2.0	222 ± 15	182 ± 6
Controller 9	32.9 ± 2.9	183 ± 16	180 ± 4
Hiawatha	28.8 ± 2.6	154 ± 15	187 ± 3
Controller 5	23.0 ± 2.5	154 ± 18	151 ± 7
All short trees	31.2 ± 2.0	178 ± 10	175 ± 4
Tall (~10')			
Nemaguard	39.9 ± 2.0	241 ± 20	165 ± 11
Controller 9	39.0 ± 2.5	240 ± 6	163 ± 9
Hiawatha	33.1 ± 0.4	204 ± 13	164 ± 8
Controller 5	33.1 ± 2.5	233 ± 19	143 ± 7
Summary	36.1 ± 1.2	230 ± 8	159 ± 5

Trial 3: Tree Form and Rootstock for Peach and Nectarine

An orchard block is being established at the Kearney Agricultural Center to study the relationship between tree form, rootstock vigor, and season of ripening. The orchard was planted as rootstock on May 28, 2008. Trees are growing very well and will be grafted in January/February 2009 to Zee Fire nectarine and Summer Flame® 32 peach. The treatments are:

Rootstock	Spacing	Density (tree/acre)	Scaffolds per acre	Form
Nemaguard	12'x16'	227	1362	6-leader Hex V - tall
Nemaguard	12'x16'	227	1362	6-leader Hex V
UC Controller 9	12'x16'	227	1362	6-leader Hex V
UC Controller 9	7' x 14'	445	1780	4-leader Quad V
UC Controller 5	7' x 14'	445	1780	4-leader Quad V
UC Controller 5	5' x 14'	622	1244	2-Leader Kearney V

All trees will be kept at a height of 7-8 feet with the exception of treatment #1, which will be allowed to grow to an industry standard of 12-13 feet. Trees are planted in non-replicated demonstration blocks that are four rows wide and 10 trees long.

In the late summer of 2008 we discovered that Controller 5 has promise as an interstem, which when grafted onto Nemaguard rootstock imposes about 25% dwarfing. We will plant approximately 100 trees in early 2009 to study this combination across a range of varieties.