Keeping Trees Short – Is it Economical?

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The California stone fruit industry has grown tall, large trees for more than a century. Even now it is common to find trees the permanent height of which exceed thirteen feet. Trees of this size were made possible by the abundant supply of relatively inexpensive labor.

As labor became increasingly expensive and somewhat less available, growers began to search for systems that were more efficient. These searches generally led to high density systems like the dual leader palmette (parallel-V), central leader, Tatura trellis, perpendicular V, and quad-V. However, virtually all of these experiments – and the subsequent grower plantings – primarily focused on trees of standard height. High density systems came into production sooner, cost more to establish, and sometimes provided a small reduction in labor – usually as a consequence of tree uniformity – but otherwise performed similarly to standard traditionally spaced orchards.

Other fruit growing areas of the US – primarily Georgia and South Carolina – grow trees that are much shorter, generally less than nine feet tall. These trees are usually wide-spaced, open-center trees that are much easier to prune, thin, and harvest, but which also produce less fruit. While difficult to ascertain with certainty due to the vast differences between the two areas, many experienced observers believe such systems are at least 25% to 50% less productive that the taller California trees.

The question then becomes "why are these shorter trees less productive?" Is it a question of climate, variety, pruning system, light interception, or just simply tree height? Walking into a peach orchard in the southeastern US one is struck by two things: 1) tree height, and 2) empty space between trees. Because these trees are planted at wide (18-20 foot) spacings, and kept low, there is a great deal a wasted space between trees. In California, our trees in open vase orchards take advantage of this additional space by continuing to grow upward and outward beyond the 8-9 feet height limit imposed in the southeast.

In 1997 we began testing the hypothesis that yield is a function of tree volume and orchard light interception, and not primarily related to tree height. To do this we established two leader and four leader trees at either a standard 12-13 feet height, or a reduced 8-9 feet height. Additionally, we tied down the scaffold limbs of the short trees to give a wider, flatter tree. This was done so that at maturity (final tree height) the two different sized trees would have similar two-dimensional planar areas of approximately 65-70 square feet.

In 1999 when trees had reached full size, yields were statistically similar for both tree heights. Hand labor costs to prune, thin, and harvest, were significantly reduced in the shorter trees. Despite our original hypothesis, this was still somewhat surprising. In the 2000 season fruit sets were insufficient to require thinning and yields were also compromised, so it is difficult to draw any conclusions based on those data. However, two things did stand out, 1) pruning costs were again significantly reduced, and 2) we had no trouble maintaining tree height at 8-9 feet.

That said, we will continue this project for at least another two seasons, since the 1999 results certainly fly in the face of conventional wisdom. This project was initially started to test relationships between light, height and yield components with the expectation that smaller trees would give lower yields, but that hopefully any decrease in yield would be offset by decreased labor costs. At this point we have seen similar yields as well as decreased labor costs. Again, this was unexpected and the results may be premature and not applicable to other locations.

However, for those interested in concepts related to tree size, and potential for reducing tree height in specific locations, the following – very general – comments are presented:

Light Interception

The key to any profitable orchard or training system is light interception. When trees are too tall or too shaded, insufficient light filters through the entire canopy to strike the floor of the orchard. When this happens, dieback of lower fruitwood occurs.

In general, tree height can be reduced as long as 1) light interception by the tree is not reduced, and 2) sufficient fruitwood remains on the tree on which to set a full crop. If these conditions are met, it is possible to lower tree height, usually enough to provide for somewhat reduced labor costs. However, care should be taken not to place too much emphasis on reducing labor since fruit is still more valuable than labor.

Managing Vigor

Possibly the greatest challenge in keeping trees short is managing excessive vigor. Care must be taken not to impart too much additional vigor through cultural practices such as fertilization, irrigation, and incorrect pruning. Additional summer pruning events may be necessary, although this has not yet been our experience. In general, it is going to be easier to keep trees short when dealing with weaker varieties, tree species, locations, soils, and rootstocks.

Rootstocks

Dwarfing and semi-dwarfing rootstocks likely provide the best long-term solution to the challenge of reducing tree height and managing vigor. These types of rootstocks have revolutionized the apple industry. However, the use of dwarfing rootstocks will require that other changes in training systems and cultural practices be implemented. In general, trees will have to be planted at an even greater density – likely both down the row and between rows – to best take advantage of the smaller resulting tree sizes. Such changes may also require a change in tractors, sprayers, and other equipment.

All of our work with peach and nectarine has been with Nemagurad rootstock. While it is considered "vigorous," and a suitable semi-dwarfing rootstock is certainly desirable, we have not yet had the problems with excessive vigor that we anticipated. Citation rootstock has worked very well for both plum and apricot. This rootstock reduces tree vigor by about 20-25% and results in a very easily managed tree.

Training Systems and Methods

It is doubtful that the traditional open vase system is suitable for very short trees – for the reasons outlined above about the southeastern US. To reduce the wasted space between trees it will likely be necessary to go to closer tree spacings down the row. At this point – subject to change – 8 to 12 feet seem like sensible figures to consider.

We have been working with trees on an 18' row spacing, but these may also need to be slightly reduced for best performance. Figures in the 14-16 foot row width seem appropriate. What is not known at this time is how important the role of scaffold angle is in suppressing tree vigor. We do know that flat limbs have inherently less vigor than upright limbs, but it remains to be seen if these shorter trees can be successfully grown (if at all) with more upright limbs.

Ripening Uniformity

At this early juncture the short trees seem to have greater ripening uniformity than the taller trees. The may be due to the fact that the light differential from the top to the bottom of the tree is not as great as it is with tall trees. On that same note, it is possible that fruit from the bottom of short trees may be of "higher" quality than those from the bottom of taller trees. This premise will be better tested during the 2001 season.

Nutrition

It would be expected that smaller, more compact trees would have somewhat reduced nutritional needs. It stands to reason that a tree that is 8-9 feet tall would have a reduced fertilizer demand than one that is 3-4 feet taller. Overfertilization, especially with nitrogen, would need to be avoided to prevent problems associated with excess vigor and shading.

Summer Pruning

There is no doubt that without dwarfing rootstocks summer pruning will be required in these short-tree systems. The question are 1) how much, and 2) will it be substantially more than that which is now required in open vase systems? In our trial at Kearney the trees have needed little summer pruning. We are exceptional careful to manage vigor and do not overirrigate or overfertilize. The fact that the trees are grafted and the scaffolds tied flatter than normal also are likely reasons for this vigor suppression. On a positive note, since trees are short therefore it is more possible to do an entire summer pruning of the tree without needing to work with a ladder. Additionally, the judicious use of mechaincal topping to shear off watersprouts at the top of the tree may end up being an important part of the overall summer pruning and vigor management system.

Labor
Since all cultural practices are performed without a ladder, labor savings are possible. A repeated mantra is that ladders add approximately 30% to the cost of any labor operations. We have not been able to find a reference for this statement, but some of our findings suggest that eliminating ladders may save as much as 40% depending on the labor procedure in question.

Yields
As mentioned above, this is a sticking point. We anticipated that short trees would also provide "short" crops. In the one solid year of data that we have this was not the case. It is still premature to consider otherwise, however. Until tested more fully, the question might be better put "Just what sort of crop reduction can be expected with short trees that fully intercept orchard light?"