By Gary S. Bender
Farm Advisor - Subtropical Horticulture
UC Cooperative Extension, San Diego County

High Density Avocado Production:

Could this be the Future for California Growers?

Water prices are going up, market prices for fruit are remaining flat, and San Diego growers are either turning off the water or complaining to me!

To cope with high water prices and maintain productive groves, we have tried varying the timing for fertilizer applications, installing better irrigation systems, leaching the salts on a regular basis and spraying for thrips. Some growers have tried all kinds of "magical" things that are supposed to "inactivate the salts in the water," or help growers use less water, or change the microbiology in the soil -- in other words, a lot of cool-looking expensive devices. But nothing has really boosted our yield per acre so that we can afford to pay those high water bills.

What about tree spacing?

When I first started as a farm advisor, I asked a grove manager, "Why are avocado trees grown on a 20' x 20' spacing?" He replied, "Well, that was the length of the PVC irrigation pipes." This is another way of saying, "You University guys haven't done any spacing trials, so we are going to go with what is easiest." Not quite true. Platt et al. wrote a research paper in 1976 on yield production in a thinned 'Fuerte' grove showing that thinning a crowded grove could actually result in a substantial increase in yield. In their case, crowding occurred after the 14th year and yields remained low during years 15-19. The grove was thinned to 54 trees per acre, then yield per acre recovered to the highest production for the grove in year 22.

Platt was a firm believer in achieving "mature tree size" without excessive crowding. In his research paper he noted, "Planting a greater number of trees per acre requires a positive program of growth control and orchard thinning … the wisdom of extremely close initial tree spacing is sometimes questionable. Yields attained before crowding of non-precocious cultivars occurs are often not sufficient to compensate for the additional cost involved."

University of California (UC) farm advisors and specialists have not completed any spacing trials looking at high density plantings, probably because it's difficult to find a grower willing to chop up a grove into a lot of different spacings with the inherent pruning, fertilizing and irrigation considerations. And, of course, researchers need to have several replications for each spacing trial so we can run the statistics.

For years growers have believed that avocados could be successfully grown just by fertilizing, irrigating through the irrigation system, and leaving pest control to predators and parasites. If we really had to, some growers think, we could spray by helicopter — all we have to do is harvest! This attitude was ingrained in California avocado growers for many years. But now things have to change.

In California, Reuben Hofshi stated the case for why trees should be planted at a higher density:

"To compete in the international market with low avocado prices will require more efficient farming and a significant increase in productivity.

Young trees are vigorous, produce large fruit early, have better canopy to root ratio and reach peak productivity approximately by seven to eight years.

Smaller trees are easier and less expensive to harvest, particularly when size picking is done, and are very amenable to snap harvest.

Spraying for different pests may become a way of life; smaller trees are probably the only ones that could be efficiently sprayed by ground rigs in hilly terrain."

Training avocado trees for high density plantings should begin in the nursery in order to create a strong dominant central leader. Our nurseries normally prune the leader off the 'Hass' trees to create a spreading effect. Trees with a more natural central leader are 'Reed' and 'Lamb Hass'. 'Reed' has a strong natural central leader that allows for more light penetration into the lower canopy, resulting in good fruit set in the lower canopy, so Hofshi tried an ultra high density planting of 'Reed' trees at 7' x 7' with pruning height kept at less than 8'. This was equivalent to 798 trees per acre. For years three through six, this planting yielded 7,050, 28,200, 50,109 and 88,613 pounds per acre. Those were incredibly high yields for avocado! But these were 'Reed,' not 'Hass — and

the marketplace wants 'Hass'. Could anything like this be possible with 'Hass'?

Other countries have been exploring closer spacing of 'Hass' avocado trees with intensive pruning in order to increase yield and some of that information has been filtering back to California. One research team has been planting on steep slopes with shallow soils (similar to San Diego groves) and they have settled on a spacing of 10' x 10'. This allows light management on all sides of each tree and they will not be grown as hedgerows. The proleptic side shoots are cut out and the sylleptic upright shoots are kept to create a pyramid-shaped tree. Water shoots are removed. Their trials will use strong pruning every six to eight years to bring the trees back under control. And they are using uniconazole or paclobutrazol sprays in the spring to slow down the growth. Unfortunately, we are not yet allowed to use these sprays in California.

High density 'Hass' trials in California

I first became aware of two trials on high density plots with 'Hass' in 2011. One grower in Temecula had produced 32,727 pounds per acre in the sixth year. Another grower, in Escondido, produced 24,195 pounds per acre in the fifth year. But both groves had problems.

The Temecula grower called me because they had pruned in the summer after the big harvest and they had very little fruit set in the spring of the following year. Of course a lot of the problem was the inherent on/off cycle in avocados. However, in order to keep these trees in a high density situation without crowding, the grower had pruned in the summer after the harvest, removing most of the fruiting wood for the following spring.

The Escondido grove was not pruned at all. The grove was so incredibly crowded that the irrigator was complaining he couldn't get through the trees to check the sprinklers.

Both growers needed a good plan for maintaining the spacing and the high production of fruit every year.

I proposed to the California Avocado Commission (CAC) at the end of 2011 that we set up a trial in San Diego County with a very simple goal: I wanted to produce the highest yield per acre possible for a 'Hass' and a 'Lamb Hass' grove. The spacing would be 10' x 10' with plenty of pollenizer trees (one 'Zutano' for every eight 'Hass' trees) and plenty of bees.

The trial part of this project would compare two simple pruning methods. The first method would be to prune all sides of each tree and top at 7' to 8' every year after harvest. This method would be somewhat similar to the Chilean idea of keeping the trees in a Christmas-tree-like shape. The second method would be something new. We would prune the southwest side of the trees the first year, the northeast side of the trees in the second year and the top in the third year. The rotation would start over in the fourth year. This second pruning method has several advantages:

- It is easy to teach to grove workers.
- It leaves all of the fruiting wood on two-thirds of each tree every year.
- It keeps trees properly spaced and with a proper height.

We would also record our irrigation use and our labor so we could create a cost analysis at the end of the trial.

CAC liked this idea and they funded the trial, along with new grower education classes, in 2012. The trial was planted on 'Dusa' rootstocks in the late summer of 2012. We have been attempting to train the trees to a single leader and the main part of the pruning trial will start in 2015. All of the trees are growing well and set a heavy crop in the spring of 2014. As our research progresses, we will keep growers informed of our findings.

High density plantings may be one solution to a really serious problem in San Diego County — and for that matter, for all California avocado growers. But growers must continue good farming practices such as a complete leaf analysis each year along with proper irrigation scheduling and pest inspections in order to be successful.